OPEN ACCESS TO NEXT GENERATION BROADBAND

A thesis presented to the

Queensland University of Technology

In fulfilment of the requirements for the degree of

Doctor of Philosophy

by

Douglas Ross Kelso

B. Eng. (Hons) (University of Queensland)
M. Eng. Sc. (University of Queensland)
Grad. Dip. Media, Comms. & IT Law (Melbourne University)

Creative Industries Faculty

February 2008

Keywords:

ACCC, access, broadband, communications policy, fibre to the home, fibre to the node, Foxtel, next generation broadband, next generation networks, network neutrality, open access, optical fibre, telecommunications, telecommunications policy, Telstra, TransACT.

Abstract

Wireline telecommunications infrastructure in the customer access network or CAN is undergoing a veritable technological and commercial revolution. The paired-copper CAN is being modernised with optical fibre deployed ever closer to customers, culminating soon with fibre-to-the-home networks or some variant thereof. Although bandwidth ceases to be a scarce commodity, the underlying natural monopoly will most likely be strengthened.

National competition policy desires open access to multiple service providers yet commercial pressure calls for closure. This has been the recent experience with the hybrid fibre coaxial networks delivering pay television and Internet access.

This research asks the question: What are the factors that prevent open access to the broadband services of next generation wireline infrastructure? How can these obstacles be overcome? A particular focus is given to non-price considerations which come to the fore due to the unique strategic and technological characteristics of optical fibre in the access network.

The methodological approach involves data gathering via three case studies - that of the Telstra/Foxtel pay television network, the TransACT broadband network and fibre-to-the-home networks in general. Although the ultimate focus is on the research question above, these cases are discussed in a holistic way with consideration of a number of contextual factors. The research also examines the relationship between the concepts of ‘open access’ and ‘network neutrality’, visiting the concept of ‘common carriage’ in doing so.

Several findings are reached that illuminate the field of telecommunications access regulation as applied to infrastructure capable of delivering truly next generation broadband services. Since 1993, our politicians have only paid lip service to the importance of competition and have deferred to the demands of the dominant builder of telecommunications infrastructure. From the viewpoints of end-users and access seekers, the access regime is found to be incapable of dealing with the technical and commercial bottlenecks arising from optical fibre in the CAN.

It is concluded that communication between users should be recognised as the prime purpose of telecommunications and that the regulatory regime should not reward discriminatory practices detracting from the development of a networked information economy. It is also concluded that dominant players should never be rewarded with access holidays which could otherwise entrench market dominance through the creation of new bottlenecks. Access regulation is ill-equipped to cope with optical fibre in the CAN until it also recognizes the strategic potential of such infrastructure.

TABLE OF CONTENTS

List of Figures & Tables

List of Abbreviations

ACCC	Australian Competition and Consumer Commission
ACT	Australian Competition Tribunal
ACTEW	Australian Capital Territory Electricity & Water
ADSL	asymmetric digital subscriber line
AFN	advanced fibre network
AOL	America Online
API	applications programme interface
ASX	Australian Stock Exchange
ATM	asynchronous transfer mode
BPON	broadband passive optical network
BSEG	Broadband Services Expert Group
CAN	customer access network
CAS	conditional access system
CIRCIT	Centre for International Research on Communication and Information Technologies
CTV	cable television
CPE	customer premises equipment
DSL	digital subscriber line
DSLAM	digital subscriber line access multiplexer
EPG	electronic programme guide
FCC	Federal Communications Commission
FSAN	full service access network
FTTC	fibre to the curb
FTTH	fibre to the home
FTTN	fibre to the node
FTTP	fibre to the premises
FTTSA	fibre to the serving area
FTTX	fibre to the exchange
GPON	gigabit passive optical network
HFC	hybrid fibre coaxial
LAN	local area network
LTIE	long-term interests of end-users
MMDS	multichannel multipoint (or multipoint microwave) distribution service (or system)
NCC	National Competition Council
NCP	National Competition Policy
NGI	next generation Internet
NGN	next generation network
NRA	national regulatory authority
OFREP	optical fibre residential engineering pilot
OLT	optical line termination
ONA	open network architecture
ONU	optical network unit
OSI	open systems interconnection
PC	Productivity Commission
PON	passive optical network
PSTN	public switched telephone network
QoS	quality of service
RFP	request for proposal
SAO	standard access obligation
STB	set top box
TCP	transmission control protocol
TPA	Trade Practices Act
ULL	unconditioned local loop
UNE	unbundled network element
VDSL	very high rate digital subscriber line
WDM	wavelength division multiplexed/er
Wi-Fi	wireless fidelity

Statement of Original Authorship

"The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made."

Signature

Date

Acknowledgments

I especially wish to thank my wife Helena who has greatly supported me during this life journey, which ended up fortuitously returning us both to our home state of Queensland. Helena also patiently undertook the proof-reading.

My journey of research and investigation on the broad topic of this dissertation began whilst working for Telstra in the early days of developing their pay television business. That experience provided an invaluable grounding in what really happened 'behind the scene'. Immediately following Telstra I was fortunate to be able to undertake an initial research project in this field whilst working for Mark Armstrong at the then Media & Telecommunications Policy Group, RMIT.

During subsequent years as a Senior Research Fellow with the Centre for International Research on Communication and Information Technologies, later CIRCIT@RMIT, I was able to further refine my research skills under the watchful eye of its Director, John Burke. CIRCIT@RMIT provided most valuable opportunities to consult for the Australian Competition & Consumer Commission, again in the broad area of what eventually became this dissertation topic. This enabled me to appreciate the early days of Australian pay television development from the viewpoints of both Telstra as a provider and the ACCC as the regulator. Supriya Singh encouraged me to commence my doctoral studies.

I particularly wish to acknowledge the invaluable assistance of Robin Eckermann in recounting to me the early days of what became the TransACT network. Michael Cosgrave of the ACCC and John Burke, former director of CIRCIT were most helpful as informed sounding boards. I would like to thank Peter Gerrand, Colin Goodwin, Jim Holmes and Paul Brooks for their advice. Supervisory guidance from Greg Hearn was greatly appreciated.

I am sorry that my father William Thomas Kelso, one of Australia's Bright Sparcs, never had the chance to know of this dissertation.

CHAPTER ONE – INTRODUCTION

This research is aimed at achieving a greater understanding of the matter of providing, controlling and desiring access to the next generation of broadband networks and their services - the generation involving significant deployment of optical fibre in the access network, where scarcity of capacity should no longer be a factor. In particular, the research asks the questions: What are the factors that prevent open access to the broadband services of next generation wireline infrastructure? How can these obstacles be overcome?

The regulation of access traditionally distinguishes between 'price' and 'non-price' considerations, granting primacy to the former whilst drawing heavily on economic analyses. In contrast, this research adopts a more multi-disciplinary approach by melding a technical appreciation with strategic, policy, commercial and user-oriented perspectives. Once the access network technology embodies economies of scale and scope only possible with optical fibre, non-price considerations come to the fore. In a strategic sense it might even be said that non-price considerations outweigh price considerations.

1.1 Significance of this Research

The benefits of open access are demonstrable with our roads, railways and airport terminals to mention just a few instances of expensive natural monopoly infrastructure serving the public. Open access is no stranger to Australian telecommunications, given the public switched telephone network or PSTN and now a switched broadband network in the Australian Capital Territory.

Open access provides individual customers with a choice of service providers, offering the promise of choice in accessing all types of information and/or entertainment services plus the freedom to communicate or publish via channels of their choosing. Choice implies competition in service provision and it is competition that offers better value propositions and drives innovation.

The key issue is whether we can preserve the benefits of openness that have long characterized the PSTN for telephony and then narrowband Internet services, where innovation and competition have increasingly flourished, into the era of the next generation broadband. This dilemma is heightened when appreciating that investment in next generation broadband networks and services also brings new opportunities to discriminate in the network operator's favour.

The roll-out by Telstra and Optus of hybrid fibre coaxial or HFC networks from 1995 to 1997 primarily for the delivery of pay television was a watershed in the development of Australia's wireline access network. The only previous wireline infrastructure was that of the paired-copper customer access network or CAN for connecting customers with the PSTN. The paired-copper CAN was and remains ubiquitous and continues to be regulated to provide open access to competing service providers and to non-telephone customer attachments. These characteristics

were pivotal to telephony service competition since 1991 and to the rapid take-up of dial-up access to the Internet during the late 1990s.

Widespread deployment of fibre to the home networks, or their close variants from possibly 2007 onwards will mark another watershed that is unlikely to be overtaken technologically for many decades. Fibre to the home offers a quantum change – the potential to end the scarcity of communications bandwidth available to residential and SME customers and to herald the arrival of a veritable cornucopia of services. At the same time, fibre to the home is likely to reinforce the natural monopoly of much of the existing CAN infrastructure.

These watersheds highlight the importance of reassessing the appropriateness of Australia's telecommunications policy and regulatory environments. If competition continues to be central to national economic and social development, then we need an access regime that continues to be effective. It must cope with ongoing technological innovation and creative commercial challenges. However the access regime must never lose sight of the fact that the telecommunications industry only exists to serve end-users.

The roll-out of HFC networks, the first investment in post-PSTN wireline infrastructure, sorely tested the access regime and found it to be seriously wanting. Through a mix of political intervention and inappropriate regulatory tools, these HFC networks remain effectively closed to competitive access. The second and for decades to come the last investment in post-PSTN wireline investment is now being obstructed by Telstra's threat not to roll out optical fibre in the CAN without an even more favourable regulatory regime. A greater return on capital is envisaged from investing in further political intervention.

The seed for this research was planted when I was working for Telstra in the early days of developing their pay television business when open access was considered the natural way of things, in line with the non-discriminatory principle of common carriage.

1.2 Structure of Thesis

The first three chapters provide an introduction to the research undertaken from March 2003 to March 2007, detailing a review of literature accessed in the first eighteen months and the issues found to be arising. The research question is introduced at this point. The methodology for the proposed research is explained as involving a small number of case studies. An understanding of what constitutes 'next generation broadband' starts to be formulated.

The subsequent four chapters constitute the data gathering phase and each concludes with a summary of interim findings. Chapter Four details the Telstra/Foxtel pay television network rolled out from 1995 to 1997. Its business plan was to actively discourage third party access. Scarcity of channel capacity was inherent in the original analogue transmission technology. The case study revisits the birth of cable television in Australia and examines the attempts by third parties to gain access to this infrastructure so they may deliver their own content and establish

their own customer relationships. Matters such as access to content, mergers within the industry and third line forcing are not explicitly addressed.

Chapter Five examines the TransACT broadband network currently servicing suburbs within Canberra, Australian Capital Territory. Conceived in 1996 and operational by 2000, it was designed from the outset as an open access network capable of connecting a variety of service providers to customers, each with its own data stream of up to 52 Mb/s. TransACT remains unique within Australia and a relatively rare occurrence worldwide.

Chapter Six, concerning fibre-to-the home networks, is the third and final case study. It bears characteristics that position it between the other two. Although subject to extensive regulatory attempts to be prised open, the Telstra/Foxtel pay television network remains effectively closed to third party access despite recent digitisation that, in terms of video channel capacity, substantially lessens the original problem of bandwidth scarcity. By a large measure, the TransACT network remains substantially open to third party service providers, a situation resulting from original choice by those who designed the network and justified its business case.

Whilst the third case study nominally describes fibre to the home networks, many of the findings are also applicable to other network variants that substantially extend the amount of optical fibre in the customer access network. Infrastructure involving optical fibre in the access network inevitably develops into a natural monopoly, thereby negating facilities-based competition. Existing small scale operation of fibre to the home networks involve closed access operation under a vertically integrated business model despite the underlying technology providing a relative abundance of communications bandwidth capable of supporting a multiplicity of service providers.

One of the issues arising from the literature review was to explore the contention that, rather than ‘open access’ to broadband networks and services, the objective should be ‘network neutrality’, that is, not favouring one application over another. Chapter Seven explores how in the United States of America, network neutrality trumped open access from 2002/03 to at least 2006, how the opposing sides in the debate have taken network neutrality to mean whatever supports their case and what elements of the debate could be of relevance to the Australian scene.

In Chapter Eight, the findings arising from the previous four chapters are discussed, common threads gathered and matters of distinction highlighted. Conclusions are then drawn as to the implications for regulating access to services from infrastructure more closely approximating the delivery of next generation broadband.

Chapter Nine discusses the limitations inherent in this body of research, identifies possible areas for future study and presents the concluding remarks.

1.3 Summary of Findings

This research illuminates the field of telecommunications access regulation as it applies to infrastructure capable of delivering truly next generation broadband services. Such infrastructure, involving optical fibre in the customer access network,

can create a natural monopoly of an enduring nature – particularly in the Australian context. It is capable of giving rise to complex technical and commercial bottlenecks that strongly encourage anti-competitive behaviour. The first deep penetration of optical fibre into the customer access network will be the last installed.

A case is made that the access regime is incapable of dealing with this situation. With facilities-based competition being infeasible, the 'stepping stone' theory collapses and the only alternative to monopolistic service delivery of next generation broadband services becomes effective service-level competition. Unfortunately the track record of the access regime as applied to post-PSTN wireline infrastructure augers badly for effective service-level competition via optical fibre in the customer access network.

The access regime is cumbersome and wide open to gaming. Delay and lobbying become prime weapons in preventing third party access. Experience with unbundling the relatively well known paired copper access network bodes ill for the unbundling of future optical fibre. In any case, competitive access will be stymied if unbundling is restricted to incrementally-offered services rather than the underlying optical fibre infrastructure. The regime is now significantly biased in favour of investment by network providers and correspondingly against competitive access seekers.

The TransACT network in Canberra is living testimony to the fact that Australia's next generation telecommunications infrastructure can readily be open to competitive service provision, in both a technical and commercial sense. Paradoxically, TransACT made no call upon the access regime – there was simply a willingness by the network provider to be open. In contrast, Australia's telecommunications access regime has been captured by network providers whose business plans are predicated on either closure or highly restrictive openness. Since 1993, our politicians have been spellbound by the image (and reality) of the 'romantic' or 'heroic' builder of telecommunications infrastructure and have paid only lip service to the importance of competition.

It need not be this way. Whilst this research identifies what I see as being the key problems, it is framed to address a specific research question and not necessarily the full gamut of possible solutions. Realising the economies of scale and scope only possible with optical fibre, non-price considerations come to the fore. The following conclusions are reached based upon a detailed assessment of the experience with or potential for access to three network types involving post-PSTN infrastructure.

Post-1997 Australian telecommunications policy has effectively removed the protection that end-users once had for non-discriminatory connection to other users and non-discriminatory carriage of content, a matter now of particular significance to next-generation broadband services. Instead, the interests of end-users have been left to be determined by the interests of network providers and access seekers. The spirit of common carriage was only poorly represented by the legislative concept of 'any-to-any connectivity' – a concept which in any case was made greatly subordinate to the need to provide incentives for investors. It is concluded that communication between users should be recognised as the prime purpose of

telecommunications and that the regulatory regime should not reward discriminatory practices detracting from the development of a networked information economy.

Focussing on specific aspects of the regime, it is further concluded that dominant players should never be rewarded with access holidays which could otherwise entrench market dominance through the creation of new bottlenecks. Access holidays are the very antithesis of open access and experience to date shows them to have been counter-productive. The availability of access holidays simply encourages access providers not to cooperate with the regulator and access seekers. Access holidays merely become a tool for securing market dominance.

Finally, the regulatory regime is incapable of dealing with the strategic significance of optical fibre extending deeply into the customer access network. Defensive engineering easily prevents effective unbundling and reinforces technical and commercial bottlenecks. Continued focus on access only to services simply encourages the squirrelling away of the strategic potential of optical fibre. There particularly needs to be a regulatory mechanism for facilitating industry arrangements to invest in a cooperative manner as an alternative to enshrining just one player with a natural monopoly. The conclusion is reached that access regulation is ill-equipped to cope with optical fibre in the access network until it also recognizes the strategic potential of infrastructure.

CHAPTER TWO – LITERATURE REVIEW & RESEARCH PROBLEM

This field of research raises issues examinable from legal/regulatory, economic, technical or societal viewpoints. Whilst theoretically self-contained, an evaluation against a single-discipline framework may give rise to interpretations that deny or undervalue alternative and possibly superior outcomes. Instead, the approach adopted for this research study is multi-disciplinary wherever practicable. The review of literature was undertaken in the first eighteen months of the four year research, commencing March 2003. As a result, it preceded the research of the three major case studies – each of which uncovered significant additional literature.

2.1 Literature Review

The following review of existing interpretative or factual analyses in the field is framed to both deconstruct the key elements underlying the research question and illuminate the diversity of arguments developed and approaches taken across the national jurisdictions of the United States, the European Union and Australia. It discovers literature chiefly in the domains of law, information technology, telecommunications and computer science. The analysis is also informed by literature in the areas of communication studies, sociology and political science, economics, business and management studies.

2.1.1 Perspectives on Access

> *Access is an area of continuing contention and controversy where the stakes are high and the stakeholders numerous. (Northfield 1999: Ch. 5 The Heart of the Maze, p.266)*

Price (1995: 195) observes that providing access can mean "creating gateways to sources of information for listeners who have been deprived of such sources in the past or, conversely, providing access for speakers to an audience which has not adequately heard them". 'Access' has dualistic connotations – it can be supplied or used, provided or sought.[1]

The term is commonly used with a more specific descriptor, such as 'community access', and can take on added meaning according to the particular context, namely, regulatory, economic, technical, social & political.

Regulatory & Economic Context

Since the early 1990s, Australia's electricity, gas, telecommunications, water, rail, air services and port services industries have all progressed towards more open markets and greater competition. However, many of these industries involved bottleneck infrastructure for which competition becomes difficult if not infeasible. Following recommendations in the 1993 Hilmer Review, the Commonwealth Government introduced a national access regime for such infrastructure, to be implemented via a new Part IIIA of the Trade Practices Act 1974. (NCC 2002)

[1] Competition policy talks of 'access providers' and 'access seekers'.

This regime established legal rights for third parties to share the use, on reasonable terms and conditions, of certain infrastructure services or facilities deemed of national significance. For example, such a third party could gain the right to access the railway line of another company to run its own trains; similarly, a telecommunications carrier (such as AAPT) could be allowed to access the telephone network of the dominant Australian infrastructure provider (such as Telstra) for the purpose of providing telephone services to its own customers. In this context, 'third-party access' means that a competitive service provider can gain access to the infrastructure or services of another service provider and in so doing establish access to a new customer base.

This falls within the generally accepted framework of an effective access regime for telecommunications services which Northfield (1999: Ch. 5) describes as comprising:

- Access arrangements between carriers and service providers who own infrastructure (also known as 'interconnection');
- Access of service providers and content creators to distribution channels; and
- End-user access to a range of services and content.

Technical Context

The present analogue 'free-to-air' television services are delivered (broadcasted) over wireless networks to which access is free, provided each viewer obtains a television receiver that is compatible with the relevant service standards. However, a pay television service is not free and the providers of programme materials and the service operator (such as Foxtel) understandably desire to be paid for their services and intellectual property. Mead (2000: Ch. 6) describes how the operator must ensure that viewers who agree to pay shall be authorised to receive certain services and not those who do not pay. This is effected by establishing systems through which viewing access is conditional on payment – an arrangement said to be that of 'conditional access'.

The paired copper cabling network used by Telstra to provide telecommunications services directly to its customers is known as the customer access network or CAN. In contrast, the SingTel Optus satellites constitute a series of wireless access networks to regional and rural subscribers for delivering television, Internet, telephony and data communication services. (BIS Shrapnel 2001) As such, the usual connotation of 'access network' is that of a network through which a carrier or service provider accesses its customers, though the reverse may also be implied in that it provides the means for a user or customer to access the relevant services.

Social & Political Context

With the advent of new information and communication technologies (ICTs) such as telephony, television, computing and the Internet, and the belief that information is the base upon which future society will develop, the question of physical access to such technologies has become a social and political concern. (Lax 2001) The technologies enable many-to-many interactions such as with telephony and the

Internet, one-to-many dissemination such as with television or solo working with computer applications.

As cable television spread widely throughout the USA from the early 1970s, the Federal Communications Commission (FCC) mandated that cable systems were required to provide channels for government, for educational purposes, and for public access.[2] With public access television, groups or individuals not affiliated with the cable operator are able to produce non-commercial programme material at no cost and have it distributed free to all subscribers of the particular cable system, that is, such channels are bundled within the 'tier zero' offering. (Lindner 1999) Public access television is said to open cable television to the public, particularly by way of increasing community participation. The Australian equivalent, as applied to free-to-air television, is called community access television or simply community television.[3]

Keller (1995) observes how these terms can have connotations far beyond their literal meanings:

> By public access we mean not only establishing physical connections to the network, but also ensuring that those connections are easy to use, affordable, and provide access to a minimum set of information resources. In particular, network use should not be limited to the passive receipt of information. Instead, the environment should be open, distributed and easily navigable. Even the most basic connection should enable users to act as information sources as well as destinations.

2.1.2 Perspectives on Openness

On this topic we enter a domain where the meaning is truly in the eye of the beholder – being 'open' conjures a variety of strict technical definitions, a multiplicity of policy appreciations and many different understandings held across society. This research concerns those perspectives that are common to a consideration of open access to broadband networks and services.[4]

Commencing with technical meanings that directly impact on telecommunications policy settings, Shah, Sicker et al (2003) survey usage and definitions of 'openness' with the goal of extracting some common principles. Their perspectives include the following:

---

[2] Collectively this has become known as the 'PEG' requirement: standing for public access, educational access and government access, each typically occupying at least one television channel.

[3] The important distinction between the two being that cable television access requires access to the infrastructure of another operator, whereas free-to-air television access only requires access to radio-frequency spectrum.

[4] It is important not to lose sight of the fact that the rapid diffusion of dial-up (narrowband) Internet services is attributable to the availability of the public switched telephone network (PSTN) that was designed and regulated to be 'open'. Bauer, J. M. and S. S. Wildman (2002). "Third Annual Quello Communication Policy and Law Symposium; Rethinking Access: Introduction to the Symposium Theme and Framework." Law Review of Michigan State University - Detroit College of Law **3**: 8.

- Unbundled Network Elements (UNEs), Open Network Architectures (ONAs) and Interoperability

  As a means of creating a more open market, the ONA concept is directed to 'modularizing' or 'unbundling' the various elements comprising a carrier's basic network services so that each element is available to a competing carrier or service provider.

- End-to-End Design Principles

  Said by Shah, Sicker et al to be arguably the broadest application of openness, the Internet was designed to comply with non-proprietary standards and protocols for message transfer and to rely on network architectures that do not impede communications between the end devices.

  Farrell and Weiser (2002: 6 & 11) attribute the Internet's success in exploiting a variety of means for physical transport (dial-up modem, wireless, satellite, cable modem) and the ongoing development of popular applications such as email, the World Wide Web and peer-to-peer working to the openness of its architecture.

- Internet Interconnection

  Also key to the success of the Internet has been the ability of ISPs to negotiate interconnection through peering arrangements or transit agreements, enabling any user to connect to all other users independent of their geographical location. Whereas the end-to-end design delivers openness in a technical sense, it is commercially achieved through interconnection.

- Network Neutrality

  Wu (2003) claims that a network is 'neutral' if it does not favour one application over another. Whilst this is inherently the case for the Internet at large, it would not apply where a given ISP impedes consumer access to information, products and services, such as by blocking or redirecting addresses or adopting differing quality of services mechanisms.

- Open Access

  Against a commercial background of US mergers, regulatory inquiries and policy determinations, 'open access' has tended to mean 'cable open access' whereby cable television companies may be required to provide multiple ISPs access to their systems. In contrast, this dissertation develops a broader definition.

- Open Source Initiative

  Exemplified by the GNU/Linux systems[5], this initiative in 'openness' enables public access to computer source code and the ability to review, use, modify and distribute it.

- Open Standards and Reference Models

  Under this broad umbrella, Shah, Sicker et al examine the operations of various standards bodies which variously promote:
  - o Openness between well-specified layers of networks and systems;
  - o Open participation, non-proprietary standards and widely available documentation;
  - o Open systems enabling applications to run on a variety of platforms from multiple vendors.

- Proprietary Standards

  Being owned by a company or individual, such standards are generally regarded as being the opposite of 'open'.

From the above, Shah, Sicker et al conclude that non-discriminatory access is an integral aspect defining openness in the context of UNEs, cable open access and interconnection but that this concept only makes sense in terms of a scarce resource. (Shah, Sicker et al. 2003: Section 2.2) They propose the following generic tests for openness of a resource or process:

1. Is there discrimination in accessing the resource or process?
2. Is there an alternative to the resource or process?
3. Is participation in determining the future design or operation of telecommunications being impaired?

With US literature and US case history dominating the subject, it is unavoidable that the 'cable open access' interpretation gains a greater airing. However through this vehicle we can appreciate the extent of what has been implied by the descriptor 'open access'. In US parlance, it has been about multiple ISPs being accessible on the networks of cable television companies. The following is a compilation of policy goals that have been proposed by various stakeholders: (Berman, Davidson et al. 2000: Section IV) (DTIS 2000: 63) (Powell 2004)

Access to content

The ability to access and receive any lawful content via the Internet, or speak and post any lawful content to the Internet, free from any limitation imposed by the broadband facility owner. This also implies that consumers should be able to access

[5] For further details, refer to http://www.gnu.org/gnu/linux-and-gnu.html, accessed 13 May 2007

any Internet content they choose by clicking an icon on their computer desktop without having to see content of an affiliated ISP.

Freedom to run any application

Any software application or content delivery technology (such as streaming audio or video applications) should be able to be run unless it exceeds service plan limitations or harms the facility owner's network.

Attachment of personal devices

Consumers should be able to attach any device they choose to the connection in their homes, including items such as telephones or Web servers.

Carriage of unaffiliated ISPs

The facility owner permits unaffiliated ISPs to offer Internet service over the owner's broadband network, without discrimination by way of technical or support functionality. This includes the ability for an Internet user to obtain service from an unaffiliated ISP without also having to purchase Internet service from an ISP that is affiliated.

Departing from these more traditional economic and technical appreciations of the conditions surrounding 'open access', Allen (2001b:10 - 11) posited that there should also be a quite different notion of openness, namely, the need for an open approach to communities of users in framing policy that results in investment in next-generation networks. The alternative would be to let the market decide.

Perhaps the most telling justification for open access (originally stated in terms of the dramatic development of the Internet, initially with narrowband access) is that of Bar, Cohen et al (2000: 496) who argue that "open access to the network led to rich experimentation by many actors whose ideas had previously been excluded from shaping network evolution".

2.1.3 Control of Access

> *Giant media conglomerates and their content providers become the 'gatekeepers' who determine the conditions and terms upon which hundreds of millions of human beings secure access to one another in the coming era. (Rifkin 2001: 11)*

With free-to-air broadcast radio and television, a small number of programme channels are transmitted over the airwaves simultaneously. The viewer simply tunes in to the desired channel via a receiver designed to publicly available or 'open' standards. According to Galperin and Bar (2001), Owen (1999: Ch 4) and Cowie and Marsden (1998: 1), the limited number of channels arising from the shortage of effective spectrum create barriers to entry by other providers and hence governments worldwide justify regulation, through technical standards and unrestricted access, in the public interest.

They further explain how the development of multi-channel service provision, initially via analogue and now digital technology, essentially removes this spectrum barrier to entry but then necessitates introducing a new business model to recover costs of programme material and distribution. Almost exclusively developed by private entrepreneurs and in a domain generally unfettered by telecommunications regulation, the dominant model involves the collection of subscription fees. Delivered either via satellite or cable, such subscription or pay television systems have become closed networks with tight integration between the layers of transmission infrastructure, service provision, and terminal equipment. (Galperin and Bar 2001: 7) The key to this business model has been control of access by means of technological solutions and in general proprietary or 'closed' standards.

Describing America Online's Internet business and interactive television's 't-commerce' respectively, both Aufderheide (2002: 518) and Galperin and Bar (2001: 9) observe how such control strategies have been exploited to capture the attention and expenditure of customers within 'walled garden' environments. The points of control include a mix of hardware, middleware interfaces and software. These elements directly interact with the delivered signals and services, and are realised in the form of a 'gateway' device or set top box (STB) interposed between the provider's system and each customer or end user terminal, typically a television receiver or computer. Noting the subsequent convergence between computing, digital and broadcasting technologies, Galperin (2002: 6-7) finds that "the user terminal has evolved from a simple demodulator/de-scrambler of video signals into a complex terminal that allows storage, browsing, and processing of a number of TV-based services. In essence, a digital set-top box is similar to a stripped-down PC".

A modern subscription television or information delivery business involving a centralised 'Head End' capability and distributed end user set top boxes relies upon three functionally distinct components, each of which may constitute a technical bottleneck facility:

Conditional Access System or CAS

Comprising a subscriber management system and access control facility at the Head End, and signal decoder/unscrambler and smart card in each STB, the conditional access system is effectively a proprietary gateway that enables and disables signals (programmes or information) to be delivered to or from a subscriber. (Kelso 1996)

Applications Programme Interface or API

This software, usually proprietary and often categorized as middleware, runs on the STB between the operating system and the different applications. (Galperin 2002)

Electronic Navigation Software

Evident to the subscriber as an electronic programme guide or EPG, this software enables subscribers to access information about available services and perform scheduling functions. According to Cowie and Marsden (1999: 61) "as the audience becomes increasingly fragmented across multiple channels, the navigation software will become the crucial tool for influencing viewing patterns".

In the view of Helberger (2002: 1):

> The exclusive control over bottleneck facilities, or the standard embodied, gives a wide choice of possibilities to impede potential and actual competitors, particularly where exercised by powerful, vertically or horizontally integrated operators.

Nevertheless, open access needs to be distinguished from open standards, since achieving the former only grants network capacity to the requesting provider whereas the technical platform involving the conditional access system and the set top box constitute the real gatekeeper. (Rosenthal 2003: 8) Cowie and Marsden (1998: 9-10) contend that standardisation of such technical interfaces may provide a route around the bottlenecks.

Rather than governments regulating for formally open standards, the USA (Galperin and Bar 2001) and Europe (Rosenthal 2003) resolved that industry players should endeavour to reach a consensus. One such example was the European Digital Video Broadcasting (DVB) group tasked to produce specifications for all aspects of digital television. Unable to reach a consensus in the case of conditional access, the European Commission had to intervene to salvage credibility for the process. (Cowie and Marsden 1998: 11) These authors claim that "the basic problem with achieving a common standard on conditional access is that there were too many powerful vested interests that were able to block what was not in their own interests". A similar observation is made by Faulhaber (2002: 22) who notes that competitors may be prone to exploit the standards-setting process for their strategic benefit.

2.1.4 US Approaches to Open Access

The debate in the USA over the rights, wrongs and mechanics of 'open' access to broadband, primarily during the period 1999-2002, has led to polarised positions adopted by immediate stakeholders (regulators, cable television companies, telephone companies, Internet service providers or ISPs) and lobby groups (some being related to the former).

Emotive language has been used, ranging from claims of 'forced access' and 'infrastructure socialism' (Thierer and Crews 2003) to predictions of the end of the 'end-to-end' architecture of the Internet. (Lemley and Lessig 2001)

Cable television systems in the USA have been largely unregulated and gained some 70 per cent of the market share in residential broadband services.[6] (Bittlingmayer and Hazlett 2002: 295 - 296) (Thierer and Crews 2003: 66 - 67) Speta (2000a: 975) attributes this success to cable not being subject to the unbundling rules of common carrier telecommunication companies or 'telcos' whose wires are required to transport DSL services of other service providers.

[6] The remaining share comprising mainly DSL/ADSL, but also including some wireless and satellite means of delivery.

Cable operators usually provide Internet access through wholly or partially owned affiliated or ISPs. (Rosenthal 2001: 3) The demands of unaffiliated ISPs to access this same broadband infrastructure in a non-discriminatory manner created the push for 'open access'. A number of municipal franchise decisions and industry mergers were instrumental in triggering the debate, which fuelled legal challenges and regulatory action in the United States, as well as Europe. The prime mergers were that of AT&T with MediaOne/TCI and then AOL with Time Warner. (Aufderheide 2002) (Lee 2000) (Rosenthal 2001) (Speta 2000a)

Consummated and approved during 2000/01, the AOL-Time Warner merger remains the most significant focus for open access considerations in the USA. The case has been extensively analysed by various writers with emphasis on factors such as: possible incentives for conduit or content discrimination (Rubinfeld and Singer 2001); definitional classification by the FCC under the Telecommunications Act of 1996 (Rosenthal 2001); competition effects relating to instant messaging (Faulhaber 2004) and interactive television (Galperin and Bar 2001); and the impact of a commons strategy as a future regulatory approach (Aufderheide 2002).

In approving the merger, the Federal Trade Commission (FTC) decreed that AOL Time Warner: (FTC 2000)

- Must make its cable system available to competing (non-affiliated) broadband Internet service providers;
- Be prohibited from interfering with content passed along the bandwidth contracted for by unaffiliated ISPs and from interfering with the ability of unaffiliated entities to interact with interactive signals, triggers or content;
- Be required to market and promote its DSL services to subscribers in the Time Warner cable areas where AOL cable broadband ISP service or Road Runner is available at the same or comparable level and in the same or comparable manner as it markets and promotes DSL services to subscribers in areas in which neither AOL cable broadband ISP service nor Road Runner is available.

The FCC then added more stringent conditions requiring AOL Time Warner: (FCC 2001)

- To allow unaffiliated ISPs to have an unimpeded 'first-screen' relationship with their subscribers, to have a direct billing relationship with subscribers, to benefit equally in technical features such as quality of service mechanisms and caching, and to be afforded fair carriage contracts;
- To open their 'advanced' instant messaging network to one competitor immediately and to two others within 180 days thereafter;
- To avoid any agreement with AT&T that would make AOL Time Warner the exclusive ISP on AT&T's high-speed cable-modem platform.

The above or similar requirements applied to no other American cable television companies[7] who, not surprisingly, were united in their opposition to such changes being more widely applied – particularly as it would imply wholesale rate regulation and devolution into common carrier status. (Bittlingmayer and Hazlett 2002: 297) According to a study by Lee (2000), an open access requirement leads to cable modem services being regulated as an essential facility which he contends would distort the anti-trust laws and violate the free speech rights of cable operators protected by the First Amendment of the US constitution.

Bittlingmayer and Hazlett (2002) examine the political realities of regulating the telecommunications industry, the economics of broadband markets and the historic application of cable television regulation. They conclude that open access requirements will not increase capacity and innovation, since cable operators take defensive measures to counter possible regulation by restricting the bandwidth available for broadband and reducing investment in Internet-specific developments. Hazlett and Bittlingmayer (2001: 21) cover similar ground and even reveal that "cable systems deter appropriation through defensive engineering", with operators imposing 'slow access' architecture to thwart regulation of increased access. Furthermore, these authors cite evidence of company stock prices increasing with legal and regulatory setbacks for open access, and declining with victories. Such defensive attitudes are also noted by O'Donnell (2000: 25) who said "the natural inclination of facilities owners could be to build networks so hostile to open access that it would be prohibitively expensive ever to open them".

In "Handicapping the Race for the Last Mile?: A Critique of Open Access Rules for Broadband Platforms", Speta (2000b) argued that "the nature of consumer demand for a broadband access platform, which will be strongly responsive to the variety of content services made available over the platform, makes open access rules unnecessary and potentially counterproductive". Demand for broadband access was characterized by indirect network externalities, where value was derived from the combination of broadband access and the complementary information services made available. He claimed that it was against the platform owner's interest to attempt to monopolize content – even if the platform owner was a monopolist in the transmission service. (Speta 2000b: 76) In concluding his reasons against open access, Speta contended that technical standards are not yet established, it may decrease incentives to deploy the platforms in the first instance and any broadband monopoly held by cable operators would likely be temporary. (Speta 2000b: 87)

The same author continues his analysis of open access in "The Vertical Dimension of Cable Open Access" against a backdrop of the then proposed merger between AT&T and TCI. Speta (2000a: 981) notes the concerns that consumers would be obliged to purchase Internet service from an ISP affiliated with the carrier, limits on certain services would be imposed and that those wanting access to another ISP would be forced to pay twice. With cable television operators being substantially vertically integrated across carriage and content, there is a real threat of Internet access over

[7] In fact, Bar, Cohen et al. describe the measures adopted in the AOL-Time Warner case as a 'policy experiment' Bar, F., S. Cohen, et al. (2001). The Open Access Principle: Cable Access as a Case Study for the Next Generation Internet. The Economics of Quality of Service in Networked Markets. L. W. M. J. Wroclawski, MIT Press**:** 25.

cable television wires becoming a substitute for the traditional video programming on cable television.

After analysing all of the arguments in favour of open access, Speta again concludes that cable operators have no economic incentive to foreclose unaffiliated ISPs and suggests that the fight over open access is over something different: (Speta 2000a: 1007)

- An attempt by ISPs to ensure lower cost access by using the regulatory process to garner prices below those that the cable company would otherwise charge;
- An objection to cable companies having control over both video programming and Internet-based information; and perhaps more importantly
- The fear that cable television companies will prevent ISPs from developing direct customer relationships.

Claiming that 'forced access' is not competition but leads to 'mutant markets', Thierer and Crews also document the above points but further argue that such access is unnecessary in an environment of proliferating choices, such as satellite, terrestrial wireless (Wi-Fi, spread spectrum technologies) and fibre-to-the-home. Few would-be entrepreneurs "will install fiber or deploy sophisticated wireless solutions for broadband Internet tomorrow if forced access is a precedent on today's lesser delivery options". (Thierer and Crews 2003:79 - 89) They claim that markets have natural tendencies towards open access, though on a voluntarily negotiated basis.

In contrast, Katkin (2001: 28) reveals that the issues raised in disputing open access to cable television were substantially analogous to those raised in the longstanding dispute over 'direct access' to the INTELSAT satellite system. In that instance, the FCC implemented 'direct access' to INTELSAT even after it was reclassified as being a non-dominant carrier and lacking either market power or bottleneck facilities.

Proponents of broadband open access on US cable systems particularly focus on the different regulatory regimes traditionally imposed on telephone and cable television. "There is no justification in law or policy for giving cable companies special treatment", claim Lemley and Lessig (2001: 2). Their central argument is encapsulated as follows: if cable companies are allowed to dictate a consumer's choice of an ISP, and therefore eliminate competition among ISPs in the broadband market, prices will increase and innovation will be harmed. In particular, allowing bundling will compromise an important architectural principle that has governed the Internet since its inception - the principle of 'end-to-end' design.

First adopted for technical reasons as a part of systems design (Saltzer, Reed et al. 1981), the 'end-to-end' design philosophy places 'intelligence' in a network at its ends, where users put information and applications onto the network, with the intervening communications protocols (the 'pipes' through which information flows) being as simple and as general as possible. (Lemley and Lessig 2001: 4) The authors maintain that with such design "the Internet has enabled an extraordinary creativity precisely because it has pushed creativity to the ends of the network". Legacy monopolies with bottleneck control over broadband pipes will improperly affect the architecture of the Internet for their own benefit. (Lemley and Lessig 2001: 3 & 13)

This is rebutted by Hazlett and Bittlingmayer who contend that "as a goal, 'end-to-end' provides guidance but no answers". Rules that retard infrastructure investment or service penetration would restrict functionality and harm consumers, they say. (Hazlett and Bittlingmayer 2001: 56 - 61)

In a well argued analysis, MacKie-Mason refutes cable company claims that open access will deter investment, saying "carrying out this threat would be irrational and contrary to their shareholders' interests". He argues that customers will find the increased variety and quality of ISP services more appealing, thereby increasing cable operator revenues and reducing the investment risk. (MacKie-Mason 1999) Bar, Cohen, et al. (2001: 16 - 20) also dispute the claims by opponents of open access that such requirements would prevent broadband cable deployment. They disagree that market forces will naturally bring cable operators to open their networks in order to maximise the amount and diversity of content available to their subscribers.

But what other forms of discrimination could 'closed' cable networks give rise to? Examples of 'gate keeping' by cable companies are reported as including: (Saltzer 1999)

- Video limits. Some access providers limit the number of minutes that a customer may use a 'streaming video' connection.
- Server restrictions. While advertising the benefits of being 'always on' the Internet, some providers impose an 'acceptable use' contract that forbids customers from operating an Internet service, such as a Web site.
- Fixed backbone choice. The traffic route may cause distance-related delays or response-slowing congestion which can significantly interfere with some kinds of service, such as video conferencing or interactive file editing.
- Data packet filtering.
- No home networks.

In a similar vein, Wu presents findings of a survey showing significant contractual and architectural limits imposed by broadband operators on certain classes of Internet service applications. (Wu 2003) However, he then questions the degree of fit between structural remedies like open access and the important goal of a neutral network; he proposes that a different type of remedy – a 'broadband discrimination' norm – may better and more directly promote a neutral network and open competition among applications. "Network neutrality, as a shorthand for a system of belief about innovation policy, is the end, while open access and broadband discrimination are the means." (Wu 2003: 3 & 4) He concludes that the operator is ultimately the gatekeeper of quality of service for a given user, because only the broadband operator is in a position to offer service guarantees that extend to the end-user's computer (or network). A neutral network is desirable, but deviations from neutrality can be justified, Wu explains. (2003: 25)

In a paper investigating how open access can be achieved in practice, the cost to cable network operators and associated operational or management issues, Tseng and Gillett note three practical forms of open access: at the physical layer, network/data link layer or at the application layer. (Tseng and Gillett 2000) They find

open access to be financially trivial to implement (incurring a once-off cost of US$5 – $25 per customer) although the real costs may relate to the ongoing operations. Open access is technically feasible according to O'Donnell (2000: 3) and if networks are built with open access and interconnection in mind, then it is naturally easier to implement.

2.1.5 EU Approaches to Open Access

Whereas US attention focusses on the issue of unaffiliated ISPs seeking access to cable television networks, the European scene differs with broadband Internet service being more commonly delivered via DSL technologies facilitated under the well-established regulatory aegis of telephony local loop unbundling. (Rosenthal 2003: 5) Moreover, the prime focus of opening up access has been on dealing with dominant providers of subscription television, delivered both terrestrially and via satellite.

According to Helberger (2002: 3-7), challenges facing the European Union in regulating access in the communications sector concern bottleneck control, vertical integration, market foreclosure and dominance. The difficulty of this task is heightened by:

- the need to harmonize the parallel efforts of the various member country national regulatory authorities or NRAs; and
- conflict between the impact of broadcasting and communications regulation arising from technical and market convergence.

Observing that convergence has now finally become a reality, with television, telephony and Internet access being delivered via DSL, cable television and satellite, Rosenthal (2003: 1) claims:

> In this converged communications environment in which the same communications services can be delivered over a variety of platforms, the issue of open access to these platforms, in particular with regard to broadband services, is of critical importance.

Digital technology has greatly increased the number of channels and facilitated early forms of interactivity, coupled with conditional access systems that allow reception only by authorised viewers or listeners. Cowie and Marsden (1999) describe how this introduces the potential for a new series of bottlenecks and consequently higher barriers to entry by competitive service providers. Vertically integrated operators who control the content, bundling into channels, channel packaging, the means of delivery, conditional access, consumer reception equipment and subscriber management greatly increase the potential for market abuse of such bottlenecks. (Cowie and Marsden 1998) According to these authors, there are a number of general ways through which competition might be undermined:

- Services that are viewed as potentially competitive with the (vertically integrated) service provider's own offerings may be flatly denied access;

- Service providers may exert undue influence to 'encourage' independent third parties to join the proprietary service package;
- Access to the facility may only be granted on non-discriminatory terms;
- Where access is granted on non-discriminatory terms, all users may be charged a monopoly access fee;
- Proprietary services may only be sold when bundled with non-proprietary services, thereby leveraging market power to related markets (foreclosure); and
- Access terms may contain 'unreasonable' restrictions, such as platform exclusivity clauses, which reduce scope for competition.

The European policy approach to regulating access exercises both general competition law and sector-specific regulation. Regarding the former, Rosenthal (2003: 13-20) and Helberger et al (2001: 4-7) report on the few case histories where the European Commission has initiated action under Article 82 of the EC Treaty (abuse of a dominant position within the common market) as well as under the European merger control regime. These cases relate to non-discriminatory access to digital television in broader terms and have not produced situations where access to conditional access systems has been unfairly denied. It is noteworthy however that disputes over competitive access to systems delivering interactive services such as access to the Internet do fall within the ambit of European competition law.

The latest EU directives concerning a common regulatory framework for access to and interconnection of electronic communications networks and services foreshadow the intent of progressively reducing *ex ante* sector specific rules as competition in the market develops.[8] (EC 2002a) (EC 2002b)

Adopted end-April 2002, the new Framework Directive regulates transmission but not the content of services so delivered. (EC 2002b) A critical assessment by Rosenthal concludes that this dichotomy raises classification problems concerning treatment of Internet access. For example, would a claim by an ISP for open access to a network depend on whether it is providing access to the Internet at large versus specific ISP-based content? (Rosenthal 2003: 4-6) He also concludes that television service providers have no right to claim open access with regard to television programming under this Directive.

Within the Framework, the Access Directive presents a new sector-specific approach to regulating technical bottleneck facilities in general and of conditional access facilities in particular. It incorporates two sets of rules that deal with bottleneck issues at the infrastructure level: (EC 2002a)

- Broadcasters' access to an established conditional access system (Article 6);
- More general access to technical facilities in the communications sector (Articles 9-13).

[8] It has been argued in another jurisdiction that ex post action may not be an effective or efficient way of achieving industry competition goals and resolution of access issues; refer to Annual Report 2002, Federal Communications Commission, Switzerland http://www.comcom.admin.ch/org/00452/00562/index.html?lang=en, accessed 13 May 2007

Article 6 refers exclusively to conditional access services for digital television and radio broadcasting services, but not to bottlenecks arising beyond the conditional access device itself, such as via APIs, EPGs or within the set top box memory or operating system, nor even to associated Internet signals. (Helberger 2002) The access obligation is absolute: (EC 2002a: Annex 1)

> All operators of conditional access services … are to offer to all broadcasters, on a fair, reasonable and non-discriminatory basis compatible with Community competition law… technical services enabling broadcasters' digitally transmitted services to be received by viewers or listeners authorised by means of decoders administered by the service operators …

Further, it is not conditional on market power or level of vertical integration but is triggered merely by an operator having control over a conditional access facility. Interoperability between conditional access systems is strongly encouraged, but not enforced, by the Framework and Access Directives which leave the setting of standards for interoperability to industry. (Helberger 2002: 10-11)

In contrast, Articles 8-13 reflect a more general approach of establishing throughout Europe a common, harmonised framework for access questions at the infrastructure level. Rather than automatically labelling certain facilities as bottleneck facilities, which is done under Article 6, Articles 8-13 establish a system of *ex ante* market control in which National Regulatory Authorities are entitled to determine under what circumstances which facilities are considered potential bottlenecks to market entry and competition. Having significant market power is a precondition for such intervention. (EC 2002a) (Helberger 2002)

2.1.6 Australian Approaches to Open Access

Subscription or ‘pay’ television in Australia commenced in 1995, initially delivered via satellite and then also via cable, with the dominant cable provider being Telstra and the dominant service provider eventually being Foxtel. Satellite signal transmission is entirely digital but cable (hybrid fibre coaxial or HFC) commenced with a mix of analogue (television channels) and digital (telephony and cable modem services). (ACCC 2003a: s7.2.5) (Whittle 1996: 61)

As with all HFC networks around the world, the opportunities for competitive service providers to gain access to channel capacity are limited as long as signal transmission remains analogue. (ACCC 2003a: s2.2.3)

Regulatory Framework

With the introduction of open competition into the Australian telecommunications market from 1997 onwards, the Australian Competition & Consumer Commission or ACCC gained the power to mandate access to a carriage service by ‘declaring’ that service under Part XIC of the Trade Practices Act. (Grant 2004: Ch.4) The object of Part XIC includes: the long-term interests of end-users; promotion of competition; and "the objective of achieving any-to-any connectivity in relation to carriage services that involve communication between end-users".

On 1 September 1999, the ACCC declared the analogue pay television service to be subject to a range of standard access obligations (SAO), pursuant to sections 152AL(3) and 152AR of the Trade Practices Act (1974). In brief, the SAOs require an access provider to:

- Supply the declared service;
- Ensure that the declared service supplied is of equivalent technical and operational quality as that which the provider supplies to itself;
- Ensure that the fault detection, handling and rectification in relation to the declared service is of equivalent technical and operational quality as that which it provides to itself;
- Permit interconnection of its facilities with those of the access seeker; and
- Provide particular billing information to the access seeker.

The scope of the declared service was all-embracing but did not extend to digital signal transmission:[9]

> A service for the carriage, by means of lines, of analogue signals used for the purposes of transmitting a subscription television service from a facility owned, controlled or operated by a carrier or carriage service provider to any point on, or in, a line link, customer cabling, or customer equipment connected to that facility.
>
> Examples of this service are the delivery of analogue signals used for the purposes of transmitting a subscription television service to:
> (i) an end-user's television set;
> (ii) conditional-access customer equipment of an end-user, or potential end user, of a subscription television service;
> (iii) a wall socket at the premises of an end-user, or potential end-user, of a subscription television service;
> (iv) a point on a line link from which a lead-in connection may be run to the premises of an end-user, or potential end-user, of a subscription television service.

Section 152AR(8) has particular relevance to analogue pay television services in that it provides a legislated avenue for an access seeker to gain access to the conditional access equipment of another provider:

> Conditional-access customer equipment
>
> (8) If an access provider supplies an active declared service by means of conditional-access customer equipment, the access provider must, if requested to do so by a service provider who has made a request referred to in subsection (3), supply to the service provider any service that is necessary to enable the service provider to supply carriage services and/or content services by means of the active declared service and using the equipment.

[9] For further details, refer to http://www.accc.gov.au/content/index.phtml/itemId/772066/fromItemId/269270, accessed 13 May 2007

In the event that the access seeking and access providing parties are unable to agree on the terms and conditions relating to implementing the above obligations, either the ACCC can arbitrate and make a determination or the access provider can file an access undertaking which, if accepted by the Commission, becomes a legally binding obligation. (ACCC 2004a)

Access Outcomes

Two forms of 'open' access are possible regarding HFC networks, namely, access by competitive ISPs to cable modem capacity (as has been discussed in the US context) and access by competitive service or programme providers to television channels and associated services (as has been discussed in the EU context).

For the former to occur in Australia, barring voluntary action by cable providers Telstra and Optus, the ACCC would need to declare that facet of a cable television network. According to a 2001 interview with an ACCC senior official, "nobody has approached us in any concerted way to ask us to look at declaration" and so to date cable modem access remains closed. (Chirgwin 2001: 60)

However, television programme access is in the throes of opening up. During the period 2000 – 2003, a complex series of legal challenges ensued involving the ACCC, access providers Foxtel and Telstra, and a number of access seekers. Rather than leaving the ACCC to finalise its own access determination, both Foxtel and Telstra filed a number of access undertakings in 2003 relating to their analogue subscription television services involving access to HFC cable infrastructure and set top boxes. These undertakings would enable competitors to provide their own programming content to end-users. (Grant 2004: Ch.4) Foxtel and Telstra also sought and gained ACCC approval for a pay television content sharing agreement with Optus, and applied for individual anticipatory exemptions in respect of access to digital pay television infrastructure. A commitment to 'digitise' their pay television network was conditional upon the passing of the Telecommunications Competition Bill which was assented to in December 2002. (Jones 2003)

In March 2004 the ACCC accepted the undertakings as revised by Foxtel and Telstra. Importantly, Foxtel undertook that it would construct the infrastructure for its digital service to be an 'open access' system, namely, one designed to accommodate multiple access seekers and without substantial delay or expense.[10]

Report on emerging market structures

In the midst of the above activities, the Minister for Communications, Information Technology and the Arts asked the ACCC to advise on "the extent to which emerging market structures are likely to affect competition across the communications sector, including through the provision of bundled pay TV, telephony and broadband services". (ACCC 2003a) By this time, Foxtel and Telstra had already provided

[10] For further details, refer to http://www.accc.gov.au/content/index.phtml/itemId/786596/fromItemId/269329, accessed 13 May 2007

undertakings relating to third party access to their pay television network in response to the Commission's competition concerns about the impact of the content supply agreements with Optus. Hence it would have been inappropriate for the ACCC to revisit such matters in detail on this occasion.

Of relevance to increased opportunities for future competitive broadband access in Australia are the Commission's following recommendations: (ACCC 2003a)

- Significant benefits would result from divestiture of Telstra's HFC network, and its 50 per cent ownership of Foxtel;

  This position is argued from the basis of Telstra's dominance in telecommunications and pay television serving to reinforce each other to the detriment of competition.

- Legislation is required to increase access to pay television content for broadband networks.

  Such legislation should enable alternative network providers to re-transmit Foxtel and Austar's basic and tiered programme packages, in addition to access being gained to individual premium sports and movie channels.

2.1.7 Consumers, Users and Producers

> *It is important to set our eyes on the right prize. That prize is not the Great Shopping Mall in Cyberspace. That prize is the Great Agora – the unmediated conversation of the many with the many. (Benkler 2000: 565)*

As broadcasting, telecommunications and IT-based services converge, so do their respective terminologies. The dominant paradigms of broadcasting (radio, television) and the print media embody customers who are passive listeners, viewers or readers – all of whom are regarded as 'consumers' of pre-packaged information. With telecommunications we have service providers and users, with the latter being subscribers to the services. (Fischer 1992) We speak of users of computers as well as users of the Internet. However, in discussing how the Web has allowed every user to publish their viewpoints rather than simply consume media, Minar and Hedlund (2001) observe a possible trend: "the commercial explosion on the Internet quickly fit the majority of traffic into the downstream paradigm already used by television and newspapers".

As the digitally networked environment matures, Benkler (2000: 562) maintains that regulatory choices will impact on whether the future network will be one of peer users or "one of active producers who serve a menu of pre-packaged information goods to consumers whose role is limited to selecting from this menu". Alluding to the origins of the Internet, he says that users can play the roles of producers and consumers.

Analyzing the 'walled garden' strategies of AOL prior to their merger with Time Warner, Aufderheide sees the model as being old-fashioned in defining "the customer as a consumer of the provider's proprietary services rather than as a user who may both consume and create services". (Aufderheide 2002: 518) The

dichotomy of user as consumer versus user as producer is contrasted by Middleton in her evaluation of a Canadian residential broadband network. For the dominant (broadcast-style) paradigm to be successful, service providers must develop content-based 'killer applications' to drive demand for broadband access by consumers. (Middleton 2002: 78-79) On the other hand, analogies with the development of the telephone, teletext and videotex (not to mention e-mail) suggest a 'user in control' model whereby they create their own content.

But how do the above understandings translate to frameworks for achieving open access to future broadband networks? As we have seen from the previous Australian, European and US assessments, regulation of open access has only been the matter of competing service providers gaining access to the infrastructure and services of an incumbent operator. In defining 'access' as referring to operators seeking interconnection and/or access to networks or associated facilities, the European Access Directive explicitly states that the term "does not refer to access by end-users" (EC 2002a: Article 1)

Benkler's insight into counteracting the 'walled garden' outcome does offer some hope. He claims that where the eyeballs of consumers are kept within the bounds of proprietary services, then many of them will remain as consumers. (Benkler 2000: 579) However, access for competing ISPs (who, presumably, merely deliver access to the Internet at large) will create an environment that will "facilitate the transition of users of broadband Internet access over cable from consumers to users".

2.1.8 Network Technology

The cited Australian, European and US examples considering broadband open access relate exclusively to network technologies involving hybrid fibre coaxial (HFC) and digital television technologies, the latter being either satellite delivered or terrestrially broadcast. Peripherally cited are instances of DSL technologies which are now almost universally legislated for open access.

Confounding claims that multiple ISP access is not possible or technically too difficult involving HFC networks, Bahlmann (2000 - 2001) discusses how this can be readily achieved in terms of connectivity management, service management and cable management, among other key issues. However he reveals that while this may achieve 'open' access in terms of multiple ISP's gaining access to common broadband infrastructure, customers are still constrained only to accept the whole service package from any one ISP. "The next generation (or reincarnation) of open access must be à la carte – meaning the broadband customer will have the freedom to mix and match ISP and third party service provider services to form their broadband service", foreshadows Bahlmann. (2000 - 2001: Part 5 - Transparency)

The pro-market CATO Institute in the US has been the most strident critic of open access, calling it 'forced access' among other deprecatory labels. Declaring that open access is unnecessary in an environment of proliferating choices, Thierer and Crews (2003: 79-89) claim that "numerous facilities-based alternatives are being planned or are already in place in today's market and prove that duplicating facilities is not as unthinkable as the natural monopoly theorists would have us believe".

Underpinning these emerging markets, they survey the following network or delivery technologies in terms of whether forced-access mandates should be applicable:

- Fibre Optics
- Cable 'Overbuilders'
- Undersea Fibre
- Satellite
- Fixed Terrestrial Wireless and 'Wi-Fi' Networks
- Ultra-Wideband (UWB) and Free Space Optics (FSO)

According to Thierer and Crews (2003: 89), "few (entrepreneurs) will install fiber or deploy sophisticated wireless solutions for broadband Internet tomorrow if forced access is a precedent on today's lesser delivery options".

A closing view here comes from David Reed who has undertaken one of the most comprehensive engineering and economic analyses of the extended application of fibre optic networks, particularly in residential environments. (Reed 1992a) In examining the future prospects for unbundling both logical and physical elements of optical fibre networks, admittedly primarily in the context of telecommunication carrier deployment, he drew a link between open access requirements and the design and evolution of future networks: "Policies concerning open network access can directly affect the design of the network, as well as the long term strategies of network evolution …". (Reed 1992b)

2.2 Formulating the Research Problem

In this section, a series of issues are noted that arise from the literature review. They inform the research question and suggest a candidate framework against which the case studies can be assessed.

2.2.1 Issues from Literature Review

The literature review surveys research, analyses and developments in the matter of open access to present-day broadband networks and services. It raises a series of issues which offer scope for shaping the direction of this research.

Most of the citations adopt an economic, legal or policy basis and only a few illustrate an understanding of what may be technically involved in dealing with actual or potential bottlenecks to access. As a result, an incomplete picture may be gained and alternative outcomes may not become evident.

Issue*:* There is scope for a study that adopts a more multi-disciplinary approach, by melding a technical appreciation with the traditional economic, legal/policy and commercial perspectives.

The US scene has developed exclusively about competitive access by ISPs to (digital) cable modem capacity on cable television systems and in Europe about competitive access by service or programme providers to digital television systems, both terrestrially and satellite delivered. The sole Australian example more closely

relates to European precedents, though dealing with access to both analogue and digital cable television programme capacity. According to Bahlmann (2000 - 2001), "the next generation (or reincarnation) of open access must be à la carte – meaning the broadband customer will have the freedom to mix and match ISP and third party service provider services to form their broadband service".

Issue: Consider a broader definition of open access that includes access to all types of technology without any restriction on content or service capability.

All of the access examples involve technologies with inherent capacity constraints (such as hybrid fibre coax, digital terrestrial, satellite television systems) and hence give rise to 'scarce resource' arguments. Shah, Sicker et al (2003) consider that non-discriminatory access only makes sense in terms of a scarce resource.

Issue: Understand how the consideration of open access changes when the capacity of the transmission or distribution technology involved is relatively unconstrained, such as with optical fibre.

Being a case strongly put in the US, but also relevant to the digitisation of Foxtel in Australia, it is argued that open access may reduce incentives to deploy broadband platforms in the first instance. In the words of Thierer and Crews (2003), "few (entrepreneurs) will install fiber or deploy sophisticated wireless solutions for broadband Internet tomorrow if forced access is a precedent on today's lesser delivery options".

Issue: Examine the relationship between open access regulation and incentives to invest in next generation broadband platforms.

Almost all writers approach the issue of access from the viewpoint of one corporation seeking to access the assets of another corporation, with the immediate interests of the consumer or users being only incidentally noted. Aufderheide (2002) and Benkler (2000) highlight that users should be recognised as producers or creators of content in addition to playing the more conventional role of consumers.

Issue: Explore the impact of a more 'user-centric' perspective, where customers are empowered to become users who generate content; one consequence is that traffic flow becomes more symmetrical.

Wu (2003) questions the single-minded focus on open access. He contends that "network neutrality, as shorthand for a system of belief about innovation policy, is the end, while open access and broadband discrimination are the means".

Issue: Explore issues arising from the contention that, rather than open access, the objective should be network neutrality, namely, not favouring one application over another.

In the view of Rosenthal (2003), open access needs to be distinguished from open standards, since achieving the former only grants network capacity to the requesting provider whereas the technical platform involving the conditional access system and the set top box constitute the real gatekeeper.

Issue: Understand the impact of standards on resolving access bottlenecks and explore mechanisms for determining standards that are open and timely.

O'Donnell (2000) claims that if networks are built with open access and interconnection in mind, then such matters are naturally easier to implement. In like vein, Reed (1992b) contends that open access policies can directly affect the design of the network, as well as the long term strategies of network evolution.

Issue: Explore the relationship between open access requirements and the design and evolution of future networks.

Hazlett (2001), Bittlingmayer (2002) and O'Donnell (2000) discuss how US cable operators are liable to deter open access through 'defensive engineering', such as by restricting the bandwidth available, imposing 'slow access' architecture or reducing investment.

Issue: Examine the nature of defensive approaches to thwarting increased access.

2.2.2 Research Question

This research addresses the question:

> What are the factors that prevent open access to the broadband services of next generation wireline infrastructure? How can these obstacles be overcome?

2.3 Untangling the Terminology

> *"When I use a word," Humpty Dumpty said, in rather a scornful tone, "it means just what I choose it to mean – neither more or less." "The question is," said Alice, "whether you can make words mean so many different things." "The question is," said Humpty Dumpty, "which is to be master – that's all." (Carrol 1960, p.269)*[11]

The research question involves terms such as 'open access', 'broadband' and 'next generation' that present a diversity of possible meanings. Section 2.1 has addressed common understandings of 'access', 'openness' and 'open access. The remaining terms are more problematical, with differing meanings driven by industry advertising and dependent on various social, political, legal and regulatory domains. The following is presented as an aid to a non-technical reader.

[11] In his annotated edition of Lewis Carroll's two masterpieces, "Alice's Adventures in Wonderland" and "Through the Looking Glass", Martin Gardner made specific note of a related exposition by Carroll on page 165 of his *Symbolic Logic* Carrol, L. (1958). Symbolic Logic and the Game of Logic, Dover.

A single-volume reprint of Carroll's two books on logic, both intended for children. in which he stated a very 'Humpty Dumpty' view on semantics: "I maintain that any writer of a book is fully authorised in attaching any meaning he likes to any word or phrase he intends to use".

2.3.1 The 'Broadband' Dilemma

In telecommunications parlance, 'broadband' is a descriptor relating to a type or the extent of 'bandwidth' and often has an assumed meaning of 'broad bandwidth' (in contrast to 'wide bandwidth' or 'narrow bandwidth') or even 'broad bandwidth service'.

Technically, 'bandwidth' refers to the difference between two specified frequencies (that is, a 'high' frequency minus a 'low' frequency) on a given transmission medium or of a given service. The unit of bandwidth is expressed in Hertz. A telephone call normally occupies a bandwidth of 4,000 Hertz (4 kHz) while an analogue television signal in Australia occupies a bandwidth of 7,000,000 Hertz (7 MHz). A television signal is clearly of significantly greater or 'broader' bandwidth than a telephone call.

With the advent of digital transmission of data, commencing with telegraphy, and more recently with the popular adoption of the Internet, 'bandwidth' has taken on a meaning of how much information can be carried in a given time period. The unit of bandwidth is then expressed as the number of bits (of information carrying data) carried per second. For example, a commonly used dial-up modem may have a data carrying capacity or bandwidth of 56,000 bits per second (56 kb/s) while an ADSL modem may have a bandwidth of 512,000 bits per second (512 kb/s). An ADSL-based service clearly offers a broader bandwidth than a dial-up modem. However, as we shall see later, in common parlance an ADSL-based service may be referred to as being a broadband service whereas such a descriptor would never be applied to a 56 kb/s modem. In digital terms, bandwidth refers to a measure of the throughput or information carrying capacity of a particular communications media, service or device.

Depending on the particular transmission and information coding protocol employed, there is a mathematical relationship for a given service between the amount of information carried expressed in bits per second and the media bandwidth occupied expressed in Hertz. That relationship is beyond the scope necessary here to appreciate the relevant applications of the term 'broadband'.

It is generally accepted that 'narrowband' refers to a service occupying a 4 kHz bandwidth and hence a service capability offered through a 56 kb/s dial-up modem would also be said to be narrowband. Anything other than narrowband (that is greater than 4 kHz or more than 56 kb/s) could be said to be 'wideband' although that term is not as commonly used nowadays.[12] In contrast, 'broadband' refers to a specific wideband (or non-narrowband) service or capability of a nature such that it may be claimed to be broader or better than another. This open-ended use of the term should make Humpty Dumpty proud. The range of topical descriptions can be seen from the following snapshot of how major players appreciate broadband.

[12] As an indication of how these definitions have changed over time, one authoritative source reported that in the 1980s and early 1990s, 'broadband' referred to rates greater than 45 Mb/s and 'wideband' referred to rates between 1.5 and 45 Mb/s. CSTB (2002). Bringing Home the Bits. Washington, DC, National Research Council, Computer Science and Telecommunications Board**:** 320.

This was a time before mass market adoption of the Internet.

Service Providers & Marketers

Australia's dominant carrier Telstra offers a variety of Internet plans and services under the 'BigPond' product range.[13] Beyond the conventional dial-up modem service, BigPond advertises that broadband can be delivered via ADSL, Cable or Satellite, with ISDN also able to provide Internet access at a 'higher speed' than with a dial-up account (inferring that ISDN is not considered to be as fast as broadband).

A closer examination reveals the following Internet access speeds were being offered for residential users at the time of writing:

Table 1: Advertised BigPond Internet Access Speeds

Big Pond Service	Advertised Speed#		Comment
	Downstream	Upstream	
ADSL	256 -1500 kb/s	64 – 256 kb/s	The popular 500MB Residential Plan offers a 256 kb/s downstream/64 kb/s upstream mix, whereas the significantly more expensive 10GB offering gives 1500/256.
Cable	uncapped	128 kb/s or uncapped	An 'uncapped' speed is said to be unrestricted and is the maximum network speed available at any given time, yet remains unspecified. The popular 500MB Residential Plan offers an uncapped/128 mix, whereas the significantly more expensive 10GB offering is uncapped in both directions.
Satellite	64 – 256 - 400 kb/s	Dial-up or 64 – 256 kb/s	The One-Way Satellite offering promises downstream speeds of mainly 64 kb/s for most residential users but 400 kb/s for 'Giga' or frequent users. The upstream is Dial-up, i.e. not broadband. Two-way users get 64 or 256 kb/s in both directions.
ISDN	64 or 128 kb/s	64 or 128 kb/s	

'Downstream' refers to data flowing from the ISP to the user; 'Upstream' refers to data from the user to the ISP.

In explaining 'Just how fast is Broadband?', Big Pond presented comparative demonstrations of a video clip being played at dial-up or 56 kb/s speed, then Broadband at 512 kb/s and finally Broadband at 1500 kb/s. Not surprisingly, as the (download) speed increases, the viewability of the clip improves. Big Pond was noncommittal as to what could be an 'uncapped' speed although a user-focussed 'Whirlpool' Web site[14] comments that a Cable connection "is shared with others in your street, so speed is not 'guaranteed', but in practice, Cable does run substantially

[13] Refer to http://www.bigpond.com/internetplans/broadband/default.asp, accessed 31 May 2004

[14] Refer to http://www.whirlpool.net.au/, accessed 31 May 2004

faster than ADSL".[15] In fact, it is revealed that Cable-delivered Internet can operate at up to about 6 Mb/s whereas ADSL has a maximum speed of 1.5 Mb/s.

Hence it appears that Big Pond (in reality Telstra) is deploying technology that is capable of a variety of speeds for providing Internet access at a higher speed than with a dial-up modem but that either network conditions restrict what can be actually achieved or, as is the more usual case, certain services are deliberately restricted to lower speeds for the sake of product differentiation. Regardless, the marketing strategy implies that for mass market residential usage, 'broadband' typically equates to downstream speeds in the region of not less than 256 kb/s and upstream speeds in the region of 64 kb/s or more.

In the United Kingdom, British Telecom offered its broadband service utilizing ADSL technology under the banner of 'BT Yahoo!'. The prime benefit of broadband was claimed to include being "up to 10 X faster than a standard dial-up connection".[16] The offered speed was said to be up to 500 kb/s downstream and up to 250 kb/s upstream, with the qualification: "Speeds will vary depending on various factors including the number of other users online at the time and the overall usage across the Internet."[17]

Despite the focus here on the speed or bandwidth of broadband services, Table 2 introduces the relationships with other defining characteristics.

Table 2: Performance & Other Characteristics of Broadband Services ø

Speed	The degree to which broadband can provide increased bandwidth has already been discussed. However, the effective speed for interacting with an Internet host depends not just on the performance of the local access link, but also on the backbone data network and the speed of data routers and switches. Any one element can create a 'bottleneck' by restricting the overall end-to-end speed. For dial-up connections, the bottleneck is typically caused by the 56 kb/s modem over the telephone line. With broadband, any bottleneck is less likely to be due to the local access link (ADSL, cable modem).
Down/upstream symmetry	Although a dial-up connection may offer near symmetry between downstream and upstream capacity, this is not usually the case with current broadband technologies and services for residential users. Broadband ISPs have traditionally engineered asymmetry into their network designs and pricing models for technical and commercial reasons. New applications such as video-conferencing, peer-to-peer data transfer and content hosting are increasingly demanding symmetrical bandwidth. The provision of only downstream capacity to an end-user, regardless of the speed or bandwidth, constitutes only broadcasting and is not regarded here as providing a broadband service enabling interaction with the Internet.

[15] Refer to http://www.broadbandchoice.com.au/isp-info.cfm?id=1, accessed 31 May 2004
[16] Refer to http://www.btyahoo.com/broadband/features, accessed 31 May 2004
[17] Refer to http://www.btyahoo.com/broadband/help/0,8452,692412|SPEED|cat,00.html, accessed 31 May 2004

Always-on	By eliminating the need to establish a telephone line connection with a dial-up modem for each session, users are offered the prospect of communications being initiated on an as-required basis. This 'always available' characteristic is more a result of avoiding the delays of dial-up connection than the speed of broadband per se.
Latency	A measure of the delay in effecting data transmission – the lower the delay the closer the approximation to 'real-time' communication which can be of importance to applications such as video, voice, games, etc. Latency tends to be less of a problem with higher speed services, although the performance of other devices in the overall connection can also have a significant impact.
Addressability	This refers to each user's computer having its own globally addressable Internet Protocol (IP) address. (Dial-up connections are typically provided dynamically-assigned addresses.) With broadband, addressability is more a derivative of being 'always on'.
User network sharing	By virtue of its always-on nature and greater speed, it is more practicable for a broadband service to be connected to more than one computer or other device at a user's premises. In contrast, it has been generally impractical for more than one computer to share the same dial-up connection.

Ø - Loosely adapted from "Broadband: Bringing Home the Bits" (CSTB 2002)

Regulators & Policy Analysts

It is often said that regulatory bodies are creatures of the industries they regulate, in that they have to reflect the realities of those industries and the legislation which they govern. Government-sanctioned inquiries and policy analyses may have some scope to speculate on an emerging industry environment, although in reality this is often tempered by political constraints. The first three broadband inquiries of the US Federal Communications Commission (FCC) are a case in point.

Section 706(b) of the 1996 Telecommunications Act defines advanced telecommunications capability as "high-speed, switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data, graphics, and video telecommunications using any technology". The Act requires the FCC to initiate regular inquiries concerning the availability of advanced telecommunications capability to all Americans and determine whether such capability is being deployed in a reasonable and timely fashion. (US Telecommunications Act 1996, Sec. 706)

By the time of its second Inquiry report, the FCC had declined to further use the term 'broadband' and instead adopted the following nomenclature:

'high-speed' - services with over 200 kb/s capability in at least one direction (either downstream or upstream); and

'advanced telecommunications capability or advanced services' - a subset of the above, with a capability of 200 kb/s or more in both directions.

The data so gathered was intended to "measure what is happening in the current market, not to drive the market" but the measures of advanced telecommunications

capability and advanced services “may change as technology continues to evolve”. (FCC 2002, section 10) Recognizing the emerging requirements of services such as high-definition video, the FCC also sought data on services with over 2 Mb/s in both directions. Despite these semantics, the FCC Inquiries are widely regarded as reporting on the availability of ‘broadband’ services of 200 kb/s or greater.

Within Australia, regular snapshots of broadband deployment are published by the Australian Competition and Consumer Commission. (ACCC 2003b) Customer figures are in terms of cable, satellite, ADSL, other DSL and miscellaneous offerings by carriers who contribute the data. The ACCC similarly takes broadband as any high speed connection greater than 200 kb/s over a mix of media. Such a definition excludes dial-up connections running at 56 kb/s as well as ISDN connections at 64 or 128 kb/s. The federal government’s Broadband Advisory Group (BAG) also accepted this as a workable definition for ‘second generation’ Internet services but went further by recognising a ‘third generation’ of services “with connection speeds of 10 Mb/s or greater on the basis that it is only at these speeds that broadband becomes something more than a faster version of today’s Internet services”. (NOIE 2003, p.7)

The Organisation for Economic Cooperation and Development (OECD), in an assessment of the development of broadband access throughout member countries, took note of the FCC definition but then applied its own modification. Recognising current usage by various network operators and OECD governments, the threshold for a service considered as broadband was taken to be 256 kb/s for downstream access, whereas upstream speeds could be as low as 64 or 128 kb/s. (TISP 2001, p.6) This is despite an admission that the International Telecommunication Union (ITU) Recommendation I.113 (ITU-T) defines broadband as being faster than primary rate ISDN, that is, above 1.5 or 2 Mb/s.

A more expansive appreciation was given by the Canadian National Broadband Task Force which adopted the following key aspects of what defines ‘broadband’: (National Broadband Task Force 2001, p.10)

- A two-way link between end user and access network suppliers capable of supporting full-motion interactive video applications;
- Currently (the year 2001) this would require a minimum symmetrical speed of 1.5 Mb/s per individual user;
- Up to 2004 and beyond, new applications such as peer-to-peer file interactions and video conferencing will increase individual user demand for symmetrical bandwidth in the 4 to 6 Mb/s range;
- Public and commercial facilities will require much higher bandwidth, ranging from this minimum to several hundred times more, depending on their size and user needs.

Although all of the above assessments have been applied equally to wireline and wireless delivery technologies or applications, an Australian House of Representatives inquiry into the use of wireless technologies for broadband communication adopted a range from as low as 64 kb/s but with the FCC figure of 200 kb/s being more common, and as new applications arise, up to the Canadian figure of 4 to 6 Mb/s. (House of Representatives Standing Committee on

Communications Information Technology and the Arts 2002, pp.2-3) The inquiry also noted that equipment designed to the IEEE standard 802.11 (Wi-Fi) can now provide bandwidths up to 11 Mb/s, though in reality actual performance may be less.

Netheads[18], Researchers & Visionaries

'Greenfield' assessments tend to be the preserve of researchers, academics and industry players with often a vested interest – some of whom at times may also have been awarded the 'Nethead' banner.

Sweden was the first country in Europe, and perhaps the world, to develop a broadband policy and to discuss the public funding of broadband infrastructure. In 1999, the Swedish ICT Commission reported to the government on broadband infrastructure and recommended that the State take responsibility for the development of a sophisticated new optical fibre network to serve all households and organisations and to provide high capacity communications for all purposes. (Corning Incorporated 2002) The IT Commission's vision of future-proof broadband infrastructure in Sweden was for everyone to have a fixed Internet connection of at least 5 Mb/s real throughput capacity by 2005, with that capacity doubling each year thereafter. (Berner 2001) Further, mention was made that this increase in capacity would arise from changing the (presumably customers') end equipment, rather than changes to the network itself – implying that the new optical fibre network would inherently have a far greater capacity and not pose a limitation.

Between 1999 and 2001, a period of significant broadband deployment and both boom and bust in the telecommunications and Internet markets, the US Computer Science and Telecommunications Board reported on the technologies, policies and strategies associated with broadband local access connectivity within the United States of America. In examining what constitutes a broadband service, it concluded that a single number – be it 200 kb/s or 2 Mb/s – is not a useful definition of broadband on account of the 'chicken-and-egg' conundrum: an application will not be made available unless a sufficient number of subscribers have broadband connections with performance high enough to support the application, yet service providers will not invest in higher-performance broadband until they know that there will be sufficient demand for the service. (CSTB 2002)

However, barely one year later and possibly in a move to re-invigorate the flagging US high-tech sector, two groups of US technology chief executive officers called upon the US government to declare: [19,20]

[18] This term arises from the 'Netheads' versus 'Bellheads' debate, see Frieden, R. (2002). "Revenge of the Bellheads: how the Netheads lost control of the Internet." Telecommunications Policy **26**: 425-444.

[19] "IT CEOs push for broadband policy", ITworld.com, 24 January 2002, http://www.itworld.com/Man/3830/IDG020124broadbandpolicy/pfindex.html, accessed 31 May 2004

[20] "TechNet CEOs Call for National Broadband Policy", TechNet.org, 14/15 January 2002, http://www.technet.org/news/release/?index=131, accessed 13 May 2007

- an interim goal by 2004 of providing at least 6 Mb/s from two or more providers to at least 50 per cent of users to enable high-bandwidth applications including DVD-quality video, file-sharing and peer-to-peer computing;
- an aggressive goal of reaching broadband deployment of 100 Mb/s connectivity to 100 million homes and small businesses by 2010.[21]

Fearful that the slow pace of broadband deployment in the US would adversely affect national productivity, homeland security and international competitiveness, a IEEE-USA workshop held in June 2002 recommended adoption of 'Advanced Fiber Networks (AFN)' that would provide Ethernet capability of gigabit speeds complemented by broadband wireless technologies. (McAdams 2002a) The significance here is the willingness to leapfrog over the bandwidth-limited technologies of incumbent operators which then enables 'broadband' to take on a hugely expanded functionality, not dissimilar to the Swedish thinking.

Perhaps the ultimate response to the 'broadband' dilemma was that posed by one of the discussion papers supporting that IEEE-USA workshop. Frustrated with the widely accepted FCC definition of broadband as being "anything over 200 kb/s", the author of that particular paper saw fit to adopt the following creative terminology: (IEEE-USA 2002)

- 'K-band' for describing broadband capacity less than 1 Mb/s;
- 'M-band' for capacity measured in Megabits per second; and
- 'G-band' for capacity of at least one gigabit per second.

For now, such definitions have not been adopted by the marketers of broadband services.

2.3.2 'Next Generation'

It is natural that marketers and technologists would wish to categorise new designs or products compared with earlier ones, and particularly to highlight the advantages of the new over the old. Certain stages in the early development of computers were informally categorised so that new designs could be simply differentiated. For example, some consistently defined generations were the 'first generation' (employing valves), the 'second generation' (employing transistors) and so on, with the 'fifth generation' purportedly embodying artificial intelligence. (Simpson and Weiner 1989, p.436) With the maturing of computing and the absence of any incentive to do otherwise, it is not surprising that common usage of this categorisation has since lapsed.

Telecommunication networks have long evolved from one network type to another, with overlay networks implemented from time to time as commercially required. Table 3 depicts the various carrier network 'generations' (as commonly accepted by

[21] The achievability of the latter goal is now being investigated under a US$7.5 million grant from the National Science Foundation; see Carnegie Mellon Press Release, 25 September 2003 "Carnegie Mellon Leads Team Receiving $7.5 Million from NSF to Develop High Speed Telecommunications Network Reaching Every Home in America", http://www.cmu.edu/PR/releases03/030925_highspeedtel.html, accessed 13 May 2007

the industry) that have been built or are being built. At times, generations can be wholly superseded, for example within Australia, the analogue PSTN and analogue mobile networks have already been replaced.

Table 3: Progressive Generations of Carrier Networks

Developmental Progression	Fixed Network	Mobile	Data
	Analogue PSTN	Analogue Mobile (AMPS)	X.25 Packet
	Digital PSTN	Digital Mobile (GSM, CDMAOne)	Frame Relay Internet
	'Carrier Grade IP'	3G (CDMA2000, UMTS)	'Carrier Grade IP'

(Adapted from Peter Darling's presentations for the project http://www.acif.org.au/Activities/ngn)

Taken at face value, application of the label 'next generation' would seem to benefit from its lack of specificity as to which generation has which characteristics and hence becomes a sort of movable feast. However, there are examples where the label has been granted institutional recognition in specific technical domains where it does refer to a forecast or prescribed measure of improved functionality.[22]

Next Generation Internet (NGI)

This US government initiative circa 1996/97 had the goals of:[23]

- Connecting universities and national labs with high-speed networks that are 100 to 1,000 times faster than today's Internet;
- Promoting experimentation with the next generation of networking technologies, such as handling real-time services such as high-quality videoconferencing and increasing the number of Internet users by a factor of 100;
- Demonstrating new applications that meet important national goals and missions, such as supporting scientific research, national security, distance education, environmental monitoring and health care.

Next Generation Internet Protocol

More specifically known as IP version 6 (IPv6), this has been designed by the Internet Engineering Task Force to replace the current version Internet protocol, IP version 4 (IPv4) with the main advantage of increasing the number of available IP addresses and improving performance in areas such as routing and network auto configuration.[24]

[22] Popular usage of the term also grew significantly from 1987 with release of the film "Star Trek: The Next Generation".
[23] Refer to the report "Research Challenges for the Next Generation Internet" at http://www.cra.org/Policy/NGI/research_chall.pdf accessed 13 May 2007
[24] Refer to http://www.isoc-au.org.au/ipv6summit/ accessed 13 May 2007

ITU and ACIF Next Generation Network Studies

Commencing in 2002/03, the International Telecommunication Union (ITU) resolved to establish implementation guidelines and standards for realisation of Next Generation Networks (NGN) based on Global Information Infrastructure concepts it had previously discussed. Factors leading to this study include: (ITU-T 2003)

- Open competition between operators due to the total deregulation of markets;
- Increased use of the Internet;
- Increased demand from users for new multimedia services;
- Increased demand from users for a general mobility.

Growing organically from and integrating the existing PSTN, mobile telephony networks, data networks and the Internet, the NGN is expected to embody:

- Existing voice and data services, including multimedia;
- Packet-based or IP information transfer;
- Broadband capabilities with end-to-end transparency;
- Interworking with legacy networks;
- Open interfaces between services and the new network;
- Unfettered access of users to competing service providers and/or services of their choice.

A related NGN study was undertaken by the Australian Communications Industry Forum (ACIF).[25] In reporting to the ITU in July 2003, the manager of the ACIF NGN project Mr Peter Darling spoke of next generation networks as being an essential part of the 'broadband future'[26] – although, as we shall see, whose future it is can colour one's appreciation of what may constitute a next generation broadband network.

Darling contrasted the 'Internet View' with the 'Telco View' of future interworking, inter-operability and any-to-any connectivity required to bring about a next generation network. Recognising the strong carrier influence on ITU and ACIF, plus an assessment that voice (telephony) is likely to continue as a major (if not the major) service, he surmised that the 'Telco View' could ultimately dominate.[27] It is noteworthy that Table 3 is a carrier-centric representation that doesn't recognise the existence of overlay networks such as hybrid-fibre coaxial ones particularly when used for telecommunications, end-user wireless networks such as Wi-Fi or the infrastructure sub-set of optical fibre in the customer access network. Such a contrast of views has also been depicted as a clash of cultures between the 'Netheads' and the 'Bellheads'. (Frieden 2002)

An alternative approach may be to focus on how access platforms for broadband are now developing in response to market demands and commercial offerings – in other words, we examine the evolving network fringes that directly serve users. Assessing

[25] Refer to http://www.acif.org.au/Activities/ngn , accessed 13 May 2007
[26] Refer to report S8-06 at http://www.itu.int/itudoc/itu-t/workshop/ngn/, accessed 13 May 2007
[27] Refer to report S8-06 at http://www.itu.int/itudoc/itu-t/workshop/ngn/, accessed 13 May 2007

the response of the 'narrowcast' legacy networks (encompassing the PSTN, ISDN and subsequently DSL technologies) and the 'broadcast' legacy networks (encompassing digital television and cable modems) to the increasing demands for interactive broadband services, a European Commission study produced the following estimations for broadband access platform development over the subsequent three, five and 10 years:[28] (EC DG INFOSOC 2001, pp.13-14)

3 Year View (2 Mb/s to the home/SME)

- ADSL & Cable (HFC) will compete for market share, also with speeds upgraded to 2 Mb/s and beyond
- Broadband fixed wireless access (FWA), power line carrier and two-way satellite solutions will serve niche but small markets
- Fibre optic and HFC networks will increasingly reach closer to the home, with a growing minority switching from 'interim' broadband solutions to fibre
- ISDN growth will slow and then decline
- Third generation mobile will grow but not reach the 'broadband' speeds of fixed platforms

5 Year View (2-10 Mb/s to the home/SME)

- Both ADSL & Cable (HFC) will be available in most built-up areas, otherwise FWA will be an alternative; all three technologies will also be applied to broadcasting
- Fibre to the basement of apartments and to SMES will begin to replace copper access platforms
- Two-way satellite will serve remote regions

10 Year View (10+ Mb/s to the home/SME)

- Fibre optic is expected to be the most likely and most appropriate technology for symmetric, unlimited bandwidth
- The market for ADSL will begin to decline and HFC will be replaced by fibre, including fibre-to-the curb alternatives
- Symmetric, high bandwidth via wireless technology may emerge.

This 10 Year View suggests a developmental path that could be an appropriate proxy for being regarded as next generation broadband service delivery in terms of this research.

[28] Rather than being regarded as absolute time frames, they could be taken as encapsulating Short Term, Medium Term & Long Term developments.

CHAPTER THREE – RESEARCH METHODOLOGY

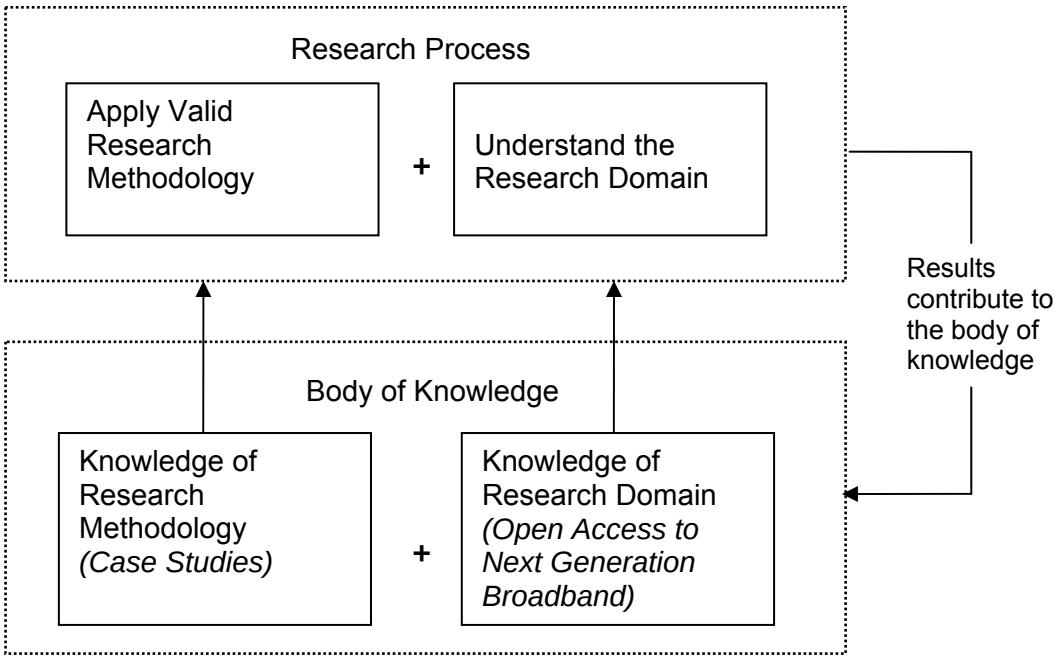
This section discusses case study research as the applicable methodology and discusses multiple case designs. Selection of the cases is then justified.

3.1 Introduction

Research is defined as:

> "An investigation directed to the discovery of some fact by careful study of a subject; a course of critical or scientific inquiry." (Little, Fowler et al. 1984: Ch.9)

A framework for research activity, illustrated in Figure 1, explains the relationship between research domains and research methodologies. (Nunamaker, Chen et al. 1991: 92) The research domain of this research project is *Open Access to Next Generation Broadband*, whilst the appropriate research methodology is that of the case study.

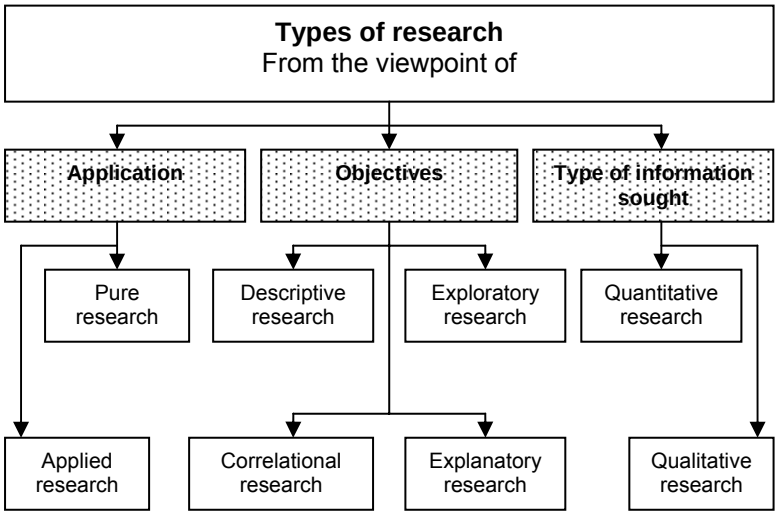


Source: Adapted from Nunamaker, Chen et al., 1991, p.92.

Figure 1 – Framework for Research Activity

Nunamaker et al. explain that the body of knowledge includes both the research domain and research methodology, and the research process involves understanding this domain, asking meaningful research questions and applying a valid research methodology to address these questions. Not surprisingly, the results from a well conducted research project contribute to the body of knowledge by expanding the knowledge in the particular domain.

The typology of research can be described from three perspectives, which are not mutually exclusive: the nature of the application, the intended objectives and the type of information sought. (Kumar 1999: 8) Figure 2 refers.



Source: Adapted from Kumar, 1999, p.8.

Figure 2 – Types of Research

The research designed for this dissertation adopts a historical and contemporary case-based qualitative analysis of relevant strategies, policies, technologies and practices arising in Australia and other comparable countries. As such, the proposed research may be categorised in Kumar's terms as being:

- Applied (the information collected can be used for policy formulation and enhancement of understanding);
- Explanatory primarily (the information attempts to clarify why and how there is a relationship between certain aspects) but also descriptive (in that it attempts to systematically describe a problem) and;
- Qualitative (in that the purpose of the study is primarily to describe a situation or problem, without quantifying variations in parameters or employing quantitative variables). (Stake 1995: Ch.3)

3.2 Case Study Research

Despite describing the case study as 'rather a *portmanteau* term' (Burns 2000: 459), differences in appreciation are small and merely reflect understandings that are developing over time as the research strategy is applied to new areas under study.

Yin (1991: p.13) and Burns (2000: 459) consider the case study as the preferred strategy for undertaking research when 'how', 'why' or 'what' questions are being asked, when the investigator has little control over events or when the focus is on a contemporary phenomenon within a real life context. The setting for such research is not restricted to the domains of sociology or psychology but can equally be applied to research in areas of policy, organisational and management studies, city and regional planning, and even public administration.

Robson adopts a slightly different perspective by defining a case study as “a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence”. (Robson 1995: 52 & 146) The ‘contemporary phenomenon’ or ‘case’ can be virtually anything and not necessarily a study of individuals, but also a group, an institution, an innovation, a decision, a service or a programme.

Regardless, the subject of a case study must be a bounded system, that is, an entity in itself. (Burns 2000: 459) (Merriam 1988: 9) In the view of Robson (1995: 168), the choice of research strategy is virtually self-evident: “if your main concern is in understanding what is happening in a specific context, and if you can get access to, and co-operation from, the people involved – then do a case study.”

While a case study can be either quantitative or qualitative, or even a combination of both, most case studies lie within the realm of qualitative methodology. (Merriam 1988: 16-21) The end product of a qualitative study is narrative or descriptive, expressed in words and pictures rather than numbers. (Winegardner n.d.: 3) According to Yin (1991: 15+), a case study can be seen to satisfy the three tenets of the qualitative method: describing, exploring and explaining.

From the research problem comes the selection of the case or cases to study – but how many cases should there be and on what criteria should they be selected? In addressing a general criticism about how case study results can be generalised, Yin (1991: 21) asserts that case studies are generalisable to theoretical propositions but not to populations. The results of a multi-case study can never be statistically significant.

Miles & Huberman (1994: 29) explain that multiple-case sampling adds confidence to findings: “By looking at a range of similar and contrasting cases, we can … strengthen the precision, validity, and stability of the findings.” Multiple cases strengthen the results by replicating the ‘pattern-matching’ of results. (Yin 1991: 109-111) This can be achieved through literal replication, where cases designed to replicate each other produce corroborating evidence, or through theoretical replication, where cases designed to cover different theoretical conditions produce contrasting results for predictable, theoretical reasons. (Yin 1991: 109-111) (Robson 1995: 161)

Cases are selected by a sampling process for a specific reason. The most appropriate case sampling strategy for qualitative research is non-probability sampling. (Merriam 1988: 47) The usual form of non-probability sampling is termed purposive, purposeful or criterion-based sampling; that is, a case is selected because it serves the real purpose and objectives of the researcher of discovering, gaining insight and understanding into a particularly chosen phenomenon. (Burns 2000: 465) Table 4 lists the characteristics of cases often sought in purposive or criterion-based sampling.

Table 4: Characteristics in choosing the Purposive Case

Typical	Profile of average case made and instance sought.
Extreme/deviant	After norm is established, extreme case sought to enable comparison or contrast to be made.
Convenient	The case is readily available.
Comprehensive	Review of all available instances before choice made.
Quota	Arbitrary number of contexts to form case.
Network	Case collected by referral (one case leads to another).
Unique	A rare case.
Reputational	Chosen on recommendation of expert.
Ideal	Profile developed of most effective, desirable, best instance then search for real world case.

Source: Adapted from Burns, p.465 & Merriam p.49.

Above all, case selection must be done so as to maximise what can be learned, in the period of time available for the study. (Tellis 1997: 6) Merriam (1988: 48) is more explicit: “Purposive sampling is based on the assumption that one wants to discover, understand, gain insight; therefore one needs to select a sample from which one can learn the most”.

‘Triangulation’, involving the use of multiple investigators, multiple sources of data or multiple methods to confirm emerging findings, serves to strengthen reliability as well as internal validity of research findings. (Merriam 1988: 169-172) (Robson 1995: 290) Although case studies do not need to have a minimum number of cases, or to randomly ‘select’ cases, the researcher is called upon to work with the situation that presents itself in each case. (Tellis 1997: 4) According to Eisenhardt (1989: 545), practical considerations such as time and money will dictate when to place an upper limit on the number of cases being studied.

Some interpret triangulation as implying a minimum of three cases or sources of data. (Winegardner n.d.: 12) In reviewing a number of research studies, Eisenhardt (1989: 545) concludes that “while there is no ideal number of cases, a number between 4 and 10 cases usually works well. With fewer than 4 cases, it is often difficult to generate theory with much complexity, and its empirical grounding is likely to be unconvincing ....”

3.3 Case Criteria, Number and Selection

3.3.1 Criteria

Of necessity, the time available posed a limit on the number of case studies and the extent to which they were analysed. Their selection was influenced by a particular network design or business operation of relevance and coloured by experience within various countries of origin. The prime countries initially considered were Australia, the United States of America and those of the European Union.

The case studies, all communication networks of one type or another, were selected according to the predominantly technical criteria in Table 5 which are arranged in approximate order of importance, highest to lowest.

Table 5: Selection by Criteria

Broadband	Given the variable definition of what may constitute 'broadband', a selected case study network should aim at the higher end of data speeds likely to be available over the coming 10 years.
Next Generation	Given the variable definition of what may constitute 'next generation', a selected case study should be considered a pacesetter within its country of implementation; an existing network considered to remain innovative over the coming 10 years would also suffice.
Competitive Access	The network design or operation should have already raised or have potential for raising issues of access by competitive access seekers or of competitive access to end users; the network should preferably not embed any inherent bottleneck to competitive access.
Access not Backbone	The network should be capable of directly connecting end users, in other words be an access network (perhaps among other things), rather than being just infrastructure between carrier nodes, i.e. a backbone facility.
Public not Private	End users should be those regarded as constituting the 'mass market' such as residential and/or SME users, rather than those within a 'closed user group' perhaps serviced by a just local area network or LAN. Nevertheless, it may be possible for some implementations of the network to serve users in public areas though not provide connectivity to other public networks.
Wireline or Wireless	Separate examples of wireline and wireless networks should be considered, though recognising the expectation that wireline solutions could be the most appropriate technology for substantially unlimited symmetric bandwidth into the foreseeable future.
Accessible Information	An adequate amount of information about the network and its services should be available in the public domain or accessible by interviewing relevant stakeholders.
Australian	At least one Australian network, in operation or planned to be

Relevance	operation, should be included. Failing that, overseas network examples should raise issues that are translatable to Australian application.
Country of Deployment	An existing network may be specific to just one country or even one location in a country; however others may be deployed or deployable across a number of countries.

3.3.2 Selection

Four case studies were then selected to satisfy as many as possible of the technical selection criteria as well as the characteristics of purposive cases as noted in Table 4. At least one case study was arranged to be Australian and at least one was to involve wireless delivery.

The case studies were as follows:

- The Telstra/Foxtel pay television-based hybrid fibre/coaxial cable network in Australia, drawing upon the experience of access seekers and the regulatory decisions arising ('Telstra/Foxtel');
- The Australian Capital Territory TransACT fibre-to-the-curb network, drawing upon its open access philosophy; ('TransACT')
- Evolving fibre-to-the-home developments, as technically described mainly in the USA ('FTTH') and
- Evolving fixed wireless broadband networks, particularly including variants which exploit unregulated spectrum and/or adopt a user-centred philosophy. ('FWA – Wi-Fi')

The suitability of each was then assessed against the selection criteria. As discussed in the section thereafter, the fourth case study was eventually eliminated.

3.3.2.1 Suitability of the Telstra/Foxtel Pay TV network as a Case Study

Broadband: This is a traditional HFC network platform installed primarily for broadcasting pay television, namely downstream video signals, however the Internet data cable modem service capability is bi-directional.

Next Generation: Although this Australian installation is modern by world standards, the tree-branch design of HFC networks is decades old and primarily created for broadcasting. Even when digitalised, the coaxial cable band plan embodies inherent bandwidth limitations.

Competitive Access: Access seekers have made sustained attempts to gain access for delivering pay television services; it is understood that no attempt has been made for competitive access to the cable modem capability.

Access not Backbone: The HFC network directly connects to pay television subscribers via set top boxes (STBs) and to Internet users via cable modems.

Public not Private: This is a public though overlay network connecting to mass market users.

Wireline or Wireless: Although the Foxtel pay television service is also delivered via satellite (and therefore involving wireless transmission), the focus here is on the HFC wireline network.

Accessible Information: Information is nominally accessible via court cases dealing with access seeking and jurisdictional matters, in addition to more publicly accessible information about determinations and policy considerations by the ACCC.

Australian Interest: The Telstra/Foxtel network was installed around 1996/97 in some areas of Perth, Adelaide and the Gold Coast, and most of Melbourne, Sydney and Brisbane.

Country Deployment: Similar HFC installations exist in many other countries.

3.3.2.2 Suitability of the TransACT network as a Case Study

Broadband: The network architecture is of fibre-to-the-curb design, involving VDSL technology for the last few hundred metres which is capable of bi-directional data transfer up to 50 – 100 Mb/s.

Next Generation: TransACT is clearly an innovative broadband delivery platform due to its network architecture and open access business model.

Competitive Access: The TransACT broadband network was technically and commercially designed to be 'open access' such that any third party ISP can utilise the network for providing broadband Internet access to subscribers.

Access not Backbone: The network directly connects to subscribers for telephony as well as Internet access (via third party providers).

Public not Private: TransACT is a public network connecting to mass market users.

Wireline or Wireless: This is a wholly wireline network.

Accessible Information: Company information is nominally accessible and some technical/product information is in the public domain. More detailed information, particularly of a strategic nature, may only be accessible by interviewing company or ex-company personnel.

Australian Interest: The network is currently installed only in Canberra but with prospects of deployment in neighbouring regions.

Country Deployment: TransACT is unique within Australia and it is understood that just a few equivalent installations may exist elsewhere in the world.

3.3.2.3 Suitability of FTTH as a Case Study

Broadband: Fibre-to-the-user networks, depending on the particular architecture deployed, inherently provide broadband speeds of 100 Mb/s to 1 Gb/s per user (though commercially available speeds may be less).

Next Generation: Such networks are the most likely and most appropriate technology for providing symmetric, unlimited bandwidth into the foreseeable future.

Competitive Access: Depending on the chosen architecture, the business philosophy and particularly the nature of any conditional access systems, access may be open, closed or somewhere in between.

Access not Backbone: The networks directly connect to end users.

Public not Private: Fibre-to-the home/user networks may be deployed in both public and private (for instance, a university campus) configurations.

Wireline or Wireless: These are wholly wireline networks.

Accessible Information: Architectural information should be available from standards setting fora (such as the IEEE) and from designers or suppliers. Other information, particularly of an operational or of a commercial nature, may be difficult to obtain.

Australian Interest: Telstra announced that it was planning to deploy initial networks commencing 2004.

Country Deployment: Canada, USA, Sweden – in each country, perhaps some dozens of networks exist and the number is growing.

3.3.2.4 Suitability of FWA/Wi-Fi as a Case Study

Broadband: Depending on the available spectrum, the wireless technology deployed and the number of users, data speeds in the order of hundreds of kb/s to low tens of Mb/s can be achieved.

Next Generation: Modern day wireless technologies are considered desirable as they can offer affordable bandwidth to users on the move, and avoid reliance on the fixed cable networks of dominant carriers.

Competitive Access: Depending on the chosen architecture, the business philosophy and particularly the nature of any conditional access systems, access may be open, closed or somewhere in between.

Access not Backbone: The networks directly connect to end-users, who may be mobile or at least movable.

Public not Private: Such networks may be deployed in both public (eg. airports, public streets) and private (eg. a university campus) configurations.

Wireline or Wireless: These are wholly wireless networks, though they are likely to be connected to wireline networks for backbone connectivity.

Accessible Information: Architectural information should be available from standards setting fora (eg. IEEE) and from designers or suppliers. Other information, particularly of an operational or of a commercial nature, may be difficult to obtain.

Australian Interest: Some networks are already deployed in Australia.

Country Deployment: Many such networks are already deployed in various countries, particularly in North America and Europe.

3.3.3 Discussion of Selection

The Telstra/Foxtel HFC network would not ordinarily qualify as a broadband medium, since the main focus of this case study is on third-party access to the pay television capability which lacks bi-directional transmission. Further, the underlying network architecture is dated and in the terms of this study is not classifiable as next generation infrastructure. On the other hand, this is an Australian wireline network about which there has been significant public disclosure of information arising from third-party access disputes. The disputes have created a new Australian precedent for access to telecommunications facilities. Also, limited pay television interactivity has been added with network digitisation commencing 2004. A secondary focus of this case study is on third-party access to the cable modem capability which does embody bi-directional transmission.[29]

In terms of Table 4, the Telstra/Foxtel case exhibits characteristics of convenience and comprehensiveness. In that the researcher previously had some consultancy involvement relating to questions of third-party access, the case could also be said to have been collected by referral.

Being a highly innovative broadband delivery platform due to its network architecture and open access business model, the TransACT network is an ideal fit with the selection criteria. Access to detailed information, particularly of a strategic nature, raised a potential difficulty which was addressed by interviewing company or ex-company personnel.

In terms of Table 4, the TransACT case is currently unique to Australia and rare worldwide, offering an ideal profile in terms of open access but whose business plan could even be considered as extreme when compared to most other broadband telecommunication networks. Its Australian location makes it convenient for assessment.

The other two case studies partly relate to implementations now being deployed in a number of locations in various countries whilst other design aspects remain under development or commercial applications are still evolving. These case studies focus more on generic characteristics of the underlying technologies and opportunities for access, rather than a history of experience.

[29] Third-party ISP access was a key issue identified by the literature review of US examples.

Fibre-to-the-home (FTTH) networks embody highly innovative broadband delivery platforms that may provide either open or closed access, depending on particular architecture variants, business philosophies and conditional access systems employed. In broad terms, they are nominally an ideal fit with the technical selection criteria. Access to detailed information, particularly of an operational or commercial nature, raised a potential difficulty.

In terms of Table 4, the FTTH case offers an ideal profile in terms of delivering next generation broadband though in terms of embodying open access it may or may not present an extreme example.

Although not commonly capable of providing broadband speeds to the same extent as the FTTH examples, modern day wireless technologies are considered desirable as they can offer affordable bandwidth to users on the move, and avoid reliance on the potential (and often very real) bandwidth and access bottlenecks of carrier dominated fixed cable networks. Again, particular implementations can provide either open or closed access, and detailed information of an operational or commercial nature could be difficult to obtain.

In terms of Table 4, the sole wireless case presented a unique contrast to wireline network solutions and would have enhanced the comprehensiveness of findings. It was ultimately excluded due to insufficient time available to gather data of the required quality.

3.4 Data Sources

In the opinion of Stake (1995: 49), there is no particular moment when data gathering begins and it may even occur before there is commitment to do the study. Data are categorised as either primary or secondary. (Kumar 1999) Interviewing, observation and the use of questionnaires are the three main methods classified under primary sources. All other sources, where the information is already available, such as publications, reports and previous research, are called secondary sources. (Kumar 1999: Ch.9)

3.4.1 Primary Sources

A small number of individuals were interviewed. They were public figures (eg. TransACT employees, private consultants) or senior public servants (eg. employed by the ACCC) who have spoken in public fora, written papers and/or been involved in major policy determinations bearing a relationship to the research question.

Interviews were conducted, depending on circumstances prevailing at the time, by telephone, email or face-to-face communication. The particular questions put to the interviewees were open ended in nature and framed to fill in gaps that became evident from the extended literature research. The broad area of questions related to the design, application and commercial operation of telecommunication networks (with particular emphasis on those considered to be ‘next generation’ networks), legislation and regulatory material (telecommunications, broadcasting, competition

law), and forecasted network and industry developments. Data was collected in the form of email responses or written notes.

3.4.2 Secondary Sources

Being a Telco operating in a competitive environment, relevant information on TransACT was difficult to access. Sources were from the company itself (technical, commercial), suppliers (technical), and the Australian Stock Exchange and financial houses (business related). Information made public on the current company Web site was considered likely to be 'sanitised' and therefore treated with caution. Papers of an academic nature were almost non-existent.

Telstra and Foxtel were highly protective of any information in the public domain other than of a retail nature. However a fertile source of information was accessed via the ACCC Web site by way of determinations, reports and access agreements plus the courts as a result of various legal challenges by access seekers. Whilst these information sources were prolific, much if not most was peripheral to the research question. A limited amount of technical information was found that drew on analogous overseas examples.

Technical information concerning fibre-to-the-home (FTTH) networks and their derivative services was available via the Internet from international standards setting fora (eg. IEEE) as well as from network and systems designers and equipment suppliers. Direct contact was also made with Ericsson (Australia).

CHAPTER FOUR –TELSTRA/FOXTEL PAY TV NETWORK CASE STUDY

The introduction of pay television to Australia has a tortured history, colourful at times and even cloaked in intrigue, most of which is beyond the focus of this study. Mark Westfield (2000), a keen observer of events until presumably 1999, could not have foreseen the ongoing pertinence of the title of his book "The Gatekeepers – The Global Media Battle to Control Australia's Pay TV".

Following an effectively 15-year long moratorium on subscription (or 'pay') television[30], the federal government finally gave approval for services to commence from late 1992. By 1995 this was achieved with delivery via MMDS, satellite and cable technologies. A decade later, the dominant service provider is Foxtel and the dominant cable provider is Telstra with their hybrid fibre coaxial (or HFC) network.

In 2003, the Australian Competition & Consumer Commission (ACCC 2003a) released a report calling for a formal demarcation between the infrastructure provider Telstra and the content provider Foxtel regarding the delivery of pay television services. That bold recommendation arose from concerns over the determined action by Telstra and Foxtel to limit access by other service providers to its analogue and digital networks.

This case study revisits the birth of cable television and examines the attempts of third parties to seek access to this infrastructure so they may deliver their content and establish their customer relationships. Matters such as access to content, mergers within the industry or third line forcing are not explicitly addressed.

4.1 The Birth & Closure of Cable

4.1.1 Ending the moratorium

Pay television services did not commence in Australia until 1995, after thirteen years of various public inquiries whose findings were rejected by governments due to political pressure from commercial television broadcasters. It was not until the Broadcasting Services Act of 1992 that regulatory barriers to 'subscription broadcasting' services were finally removed – the moratorium came to an end. (Turner and Cunningham 2000) Thereafter, new entrants could introduce subscription television services via delivery technologies such as satellite, microwave (MMDS) and cable.

However, the introduction of pay television was intertwined with government plans to introduce competition to Australia's telecommunications. The financially troubled national satellite system, AUSSAT, had been sold to Optus Communications in 1991 to enhance its ability to compete against the government-owned Telecom Australia. (Albon and Papandrea 1998) (Turner and Cunningham 2000) The Broadcasting Services Act mandated satellite delivery as the initial delivery platform for pay

[30] Defined in legislation as subscription television, the industry in Australia prefers to market the services as 'pay' television. Harking back to the origins of the industry in the United States, such services there are almost universally referred to as 'cable' television – even when the delivery technology is that of satellite.

television, which made sense in terms of serving an Australia-wide audience from the outset as well as providing a revenue stream for the new Optus satellite.

Despite the licensing of a satellite service, alternative means of delivery such as MMDS or cable were not ruled out. In fact, the Act enabled non-satellite licences to be issued for a minimal cost simply upon application in writing. An attempt by an entrepreneur to 'jump the gun' by accumulating MMDS spectrum licences for the delivery of pay television services prior to that of satellite was stymied in 1993 by legislative amendment. It prescribed that no MMDS licences could be issued before satellite services commenced, with a sunset date of 31 December 1994. (Albon and Papandrea 1998) In any case, satellite delivery was delayed until 1995 awaiting settlement of technical standards for digital transmission. Table 6 provides a chronology of the key events in the delivery of Australian pay television from 1992 to 2004.

Table 6: Key Events in Australian Pay Television Delivery

1992	Nov.	Broadcasting Services Act legalises Pay TV; end of moratorium
1993	Sept.	Telecom Australia trials Pay TV via HFC cable in Centennial Park, Sydney
1995	Jan.	Australis/Galaxy Pay TV service commences via MMDS
"	Sept.	Australis/Galaxy Pay TV service commences via satellite
"	Sept.	Optus Vision Pay TV service commences via HFC cable
"	Oct.	Foxtel Pay TV service commences via HFC cable
1996	June	Optus Vision telephony service commences via HFC cable
1997	April	Telstra cable modem service commences
"	Oct.	Telstra and Optus cable roll-outs end
"	Oct.	Neighbourhood Cable Pay TV services, eventually including telephony & data, commence via HFC cable in Mildura, later Ballarat (2002) and Geelong (2003)
1998	May	Australis/Galaxy collapses; MMDS & satellite Pay TV services effectively taken over by Austar
"		Austar/Windytide Pay TV service commences via HFC cable in Darwin
2000	May	TransACT Pay TV, telephony & data services commence via cable (FTTC/VDSL) in Canberra
"	July	West Coast Radio Pay TV & data services commence via HFC cable in Ellenbrook, WA.
2004	Mar.	Foxtel commences conversion of subscribers to digital Pay TV

Sources: (Albon and Papandrea 1998, p.94), (Andrews 2002), (BIS Shrapnel 2001, pp.98-103), (TISP 2001) ,(Turner and Cunningham 2000, p.69), (Westfield 2000), (Whittle 1997), company Websites.

The government of the day had simply not anticipated delivery via cable. A former Minister was reported as saying "There was no evidence at all about a cable roll-out. We just hadn't anticipated where it was going. When Optus announced its cable roll-out there should have been a complete review (of policy)". (Maiden and Simpson 1997) Nevertheless, cable delivery of pay television did eventuate and before the two main systems became monopoly networks, it is instructive to appreciate why the incumbent Telecom Australia, later to become Telstra, originally envisaged itself as

the nation's common carrier and how this was upset by plans of the newcomer Optus.

4.1.2 The cable guys

In 1975, Telecom Australia[31] released a report, Telecom 2000, which examined the capabilities and role of telecommunications in the society of the future – a future then envisaged to be up to 25 years away. The study drew upon a breadth of views and information from within the Commission, from specialists elsewhere in Australia and from overseas. Among many topics, cable television (CTV) was considered and particularly how Telecom Australia could have a central role in its delivery. Optical fibre was by then still a research novelty and overseas cable television networks constructed only of coaxial cable. Modern systems could provide up to about 36 channels, though 20 channels was said to be a more reasonable figure. With the cable television industry still in its infancy elsewhere and the Australian scene dominated by free-to-air broadcasters, the authors of the 1975 report then considered programme material to be a relatively scarce commodity. Accordingly, they observed that "The initial capacity of CTV systems in Australia would be expected to be well in excess of the availability of potential programmers". (Telecom 1975, s5.5.2) Clearly, one cable would be more than enough!

Note that in 1975, telecommunications was yet to embrace 'competition'. Coupled with the Commission being wholly government owned, this would explain the report recommending that: (Telecom 1975, p.89)

> 4. The Commission should own the physical transmission plant. This stems from substantial economies of common provision which will increase in the long-term if a common-cable medium (optical fibre) becomes available to reticulate both public telecommunications and CTV services.
>
> 5. The principle of separation of ownership and operation be supported in any draft legislation for cable television; this should not exclude provision by the Commission of visual information services.
>
> 6. The Commission lease CTV capacity to CTV operators who might be commercial entrepreneurs, institutions, or community groups; guidelines for franchising and channel assignment should be developed by the government committee proposed in recommendation 9.

[31] The Postmaster-General's Department was corporatised in 1975 and became the Australian Telecommunications Commission, trading as Telecom Australia (also referred to herein as Telecom). It then became the Australian and Overseas Telecommunications Corporation Limited in 1992 and finally Telstra Corporation Limited in 1993, trading thereafter as Telstra. During 1994, many references freely swapped the titles Telecom, Telecom Australia and Telstra but from 1995 the trading name Telstra became widely accepted.

Most respondents[32] to this part of the report, apart from those connected with government, questioned or rejected these recommendations for reasons not published. (Telecom 1978, p.56)

The 1980s saw rapid acceptance of optical fibre as the new standard transmission technology, initially for long distance applications and then increasingly for customer access from the early 1990s onwards. By November 1987, the first long-distance optical fibre link had been opened to traffic between Melbourne, Canberra and Sydney. (Sabine 1988) Telecom's Strategic Management Committee decided in July 1988 that a nationwide optical fibre network would provide the capability for carriage of future broadband services, including, if permitted within the regulatory framework, pay television. (Telecom 1992b, 2.2) The same year witnessed the commencement of two trials of deploying optical fibre to the home, called the OFREP project, to dozens of homes in Toorak, Melbourne and Centennial Park, Sydney. (Rozental, Griffin et al. 1992) These barely publicised trials carried content of minimal commercial significance and were wound up by late 1992.

With at least four reports prepared during the 1980s, the Australian Government surely had a surfeit of advice as to how to move on the matter of introducing pay television. The last report, from a House of Representatives Committee in 1989, was instrumental in continuing the moratorium until 1992. It recommended that: (1989: 4.54)

> (a) Telecom Australia be made the common carrier for cable pay television, as prescribed in legislation; and
> (b) The legislation prohibit Telecom Australia from being a pay television operator and from influencing or determining the program content of such television.

In reaching this conclusion, the committee was strongly influenced by Telecom Australia's progress in laying optical fibre cable and particularly their potential ability to connect 60 per cent of Australian homes for broadband services commencing in 1994[33]. The considerable channel capacity of optical fibre was the other issue of attraction. The committee justified it this way: (1989: 4.52)

> It is therefore almost academic to talk of other providers of optical fibre outside Telecom, including such providers for the final stages of cable. It is a move that would be impractical because of the broadband nature of the services provided.

[32] The sample of respondents was self-selective, including academics, students, technical and lay people, and not a representative of the population at large.

[33] By February 1992, this initiative was being marketed as that of Laserlink™. The target was redefined as attaining a goal of 60 per cent 'connectivity' of optical fibre in the customer access network by 1994/95. By 'connectivity' it was meant that only an average of 700 metres of cable would remain to be installed between the optical fibre cabling end point and customers' premises. Telecom (1992b). Supplementary Submission to the Senate Select Committee on Subscription Television Broadcasting Services concerning Part 7 of the Broadcasting Services Bill 1992. Melbourne, Australian Overseas Telecommunications Corporation (Telecom Australia)**:** 5.

This recommended arrangement would also keep separate the carriage and content businesses of pay television.

The final government inquiry concerning pay television was that of a Senate Select Committee established to assess the proposed Part 7 of the Broadcasting Services Bill 1992. Concerned not to upset the government's plans to initially promote satellite delivery but determined to impress the Senate Committee (and warn off potential competitors) with its ongoing optical fibre roll-out, Telecom Australia made the following points: (Telecom 1992a) (Telecom 1992b)

- In the initial years, cable delivery should not be viewed as a threat to satellite delivery but rather as a complementary service;
- For the benefit of all of Australia and its economy, no pay television licensee should be awarded the exclusive right to determine total industry delivery technology at any time;
- There should be no detrimental regulations that could cause delay in the development of cable delivery of broadband services, including pay television and interactive services.

This stance was further emphasized by highlighting the creation that year of the Lasercast™ service involving optical fibre for delivering narrowcasted television programmes to businesses, government and like entities in Sydney, Canberra and Melbourne. Though a common carriage video network, Lasercast was not designed for delivering to a residential audience.

Also in 1992, Telecom Australia commissioned both fibre-to-the-home (FTTH) and fibre-to-the-curb (FTTC) trials in Wollongong, New South Wales. Though delivering this time to a residential audience, they were limited technical trials and carried content not threatening to aspirant commercial providers of pay television. (Hsieh, Butterfield et al. 1993) By end 1992, Telecom Australia had publicly declared its intention to be in the business of delivering pay television as a common carrier, that is, according to a business model based on open access or non-discrimination principles. Among other things, these plans stated: (Kelso 1992a, pp. 52-54)

The delivery technology

- AOTC/Telecom plans to adopt the hybrid fibre coaxial (HFC) cable means to distribute video services to the mass residential market.

The open access business model

- AOTC could charge the Service Provider according to the following nominal tariff structure:
  - Per video link from 'head end' to local Fibre serving Areas;
  - Per household passed:
  - Per service lead-in to each household;
  - A monthly charge per household connected.
- Blocks of TV channels would be sold, with volume discounts applicable for additional capacity.

The cable service provider

- The Cable Service Provider would operate under a Class Licence, purchase a delivery network from AOTC on a long term basis, create the Cable Pay Television business and then charge customers for the service so delivered.
- AOTC is willing to forge strategic alliances with Service Providers.

To further reinforce its support for an open access business model, Telecom Australia cited the instance in the United States where the Federal Communications Commission had newly determined that telephone companies could offer 'Video Dial Tone', being 'a common carrier access and transport network service for video information'. (Kelso 1992b) In Australian parlance, this was seen as a 'video gateway' network capability that would facilitate entry of a carrier into other value-added video services

Pursuant to the Telecommunications Act 1991, the Commonwealth Government awarded Optus the second carrier licence with the objective that it would compete against Telecom Australia in a range of consumer and business markets with fixed line, mobile and satellite services. Commencing operations in 1992, Optus was well aware that it had five years of duopoly competition for at least fixed line services before open competition was anticipated after July 1997. Whatever network coverage it could create by then would significantly determine how it could defend and grow its market share thereafter.

Westfield (2000:156-157) recounts how the first year of Optus's marketing and service delivery exceeded expectations, grabbing nearly 30 per cent of the mobile phone market and making inroads into Telecom Australia's dominance of the long-distance call market. The next challenge was to compete with Telecom Australia in the $5 billion per year local telephony call market. Clearly, the easiest strategy would be to strike a deal with Telecom Australia for access to its local call network but that would force Optus to be subservient to Telecom Australia by having to accept whatever rates were offered. Optus was said to be already paying $250 million annually in interconnection fees and was concerned that future unilateral changes by the incumbent to its network architecture could have adverse consequences for Optus. (Lewis 1994c) (BTCE 1994) Creation of a separate Optus local access network looked like an attractive proposition.

However, commercial relations between Optus and Telecom Australia were deteriorating, with Telecom playing 'hard ball' to defend its market position. In March 1993, Optus commenced proceedings in the Federal Court challenging the validity of both Strategic Partnership Agreements and certain Corporate Flexi-Plans being marketed by Telecom, on the grounds that they involved discriminatory supply of services contrary to the Telecommunications Act 1991 in markets which Telecom was in a position to dominate.[34] This and other disputes about access and interconnection continued for the remainder of the decade. Optus developed a deep distrust of Telecom, believing the dominant carrier would do everything in its power to

[34] Telstra Corporation Ltd v Optus Communications Pty Ltd and Optus Networks Pty Ltd and Optus Communications Pty Ltd and Optus Networks Pty Ltd v Telstra Corporation Ltd [1997] FCA 501, Federal Court of Australia, 11 June 1997 (cited on page 12).

hinder Optus in its attempts to offer competitive services, especially where use of Telecom Australia infrastructure was involved. (Andrews 2002)

In the meantime, Telecom Australia was continuing to show it had every intention of being a key player in any future pay television industry:

- Telecom joined with News Corporation and the Nine Network from April 1993 in a syndicate to explore a mutually beneficial pay television strategy[35] (Westfield 2000: 155, 267);
- Commencing September 1993, Telecom opened a limited trial of HFC technology to deliver a batch of readily available 'pay' and free-to-air broadcast television channels to some 300 homes in the Sydney suburb of Centennial Park. (Westfield 2000: 232, 234) The locality was selected because its demographics suggested residents were likely to be early adopters of pay television. (Griffin 1993)
- Telecom sought industry responses in December to a tender requesting cable and equipment to build a pay television network. (Meredith 1994a)

The period 1993/94 would also prove to be a highly significant time for pay television developments in the USA that had worldwide repercussions in the arenas of strategic appreciation, business deals, content aggregation and technology deployment. In an October 1993 deal that rocked the US communications and entertainment industries, Time Cable International and Bell Atlantic proclaimed the world's largest merger. Westfield (2000: 229-231) proffered that no combination of companies globally would be better placed to exploit the opportunities on offer down the 'information super-highway' and through the gateway to the home posed by the Set Top Box (STB)[36]. Although that deal had fallen over by February 1994, it had already triggered a frenzy of mergers and investments.

According to Maney (1995: 2, 6):

> Companies across the communications, information and entertainment industries had been caught off guard. They were aware of the industry transformation that had begun early in 1993. They were buzzing about 'technological convergence' – the supposed melding of televisions, telephones, computers and content into one technology, one industry. Cable companies were testing ways to carry phone calls. Computer companies were looking at ways to put video on PC screens. Hollywood was thinking about selling movies over phone lines.
>
> At the start of 1993, telephone companies were boring voice-communications utilities that couldn't come up with anything more exciting than 'call-waiting'. Within a year, they started efforts to become futuristic video and information companies.

Key developments were the technologies to digitally compress television signals for carriage over telephone lines and to carry telephony calls over HFC systems of cable

[35] Thereafter dubbed the Packer-Murdoch-Telecom or PMT consortium.
[36] Some references also refer to the STB as a Set Top Unit or STU.

television companies. Opportunities for the mass market to access the Internet were only just beginning to be appreciated.

During 1993, Optus was in regular discussion with Continental Cablevision, the number three cable television operator in the USA. They were on the threshold of a technological breakthrough to pass both telephone and pay television signals down the same optical fibre and coaxial cables. Well aware of Telecom's intentions, Optus was fast becoming convinced that if it created its own HFC network, pay television could act as a carrot to attract subscribers for telephony and online services. (Westfield 2000: 157)

For Optus the unpalatable alternative of not building its own network was the risk of being marginalized by the expected rush of new competitors entering the market after deregulation in July 1997. That fateful date was then just over three years away. The question confronting both Optus and Telecom was how they should react, not whether they should, recounted Westfield. (2000: 231) The rewards would go to the company which moved first and secured the best content package.

4.1.3 The coming of closure

Events moved during 1994 with a speed perhaps unparalleled in Australian telecommunications and broadcasting history. During January and February, Telecom furthered its selection of a tenderer of the necessary cable and equipment elements of a pay television network and formed a wholly-owned company 'Visionstream' to undertake the roll-out. (Meredith 1994a) (Meredith 1994c) Telecom welcomed the Packer and Murdoch organisations into a newly formed 'PMT' consortium to lease a block of analogue channels, within the limit of the possible 67 available[37], but insisted that the remainder of cable capacity would be open to all comers who wanted to use it. (Westfield 2000: 236) In turn, representatives of the Packer and Murdoch organisations pressed Telecom for a share of the telephony revenue that could be derived from services offered with the proposed network, on the basis that this would improve the economics of any investment by them. Telecom was unimpressed with such a proposal.[38]

Since 1992, Telecom had been distributing a few channels from Turner Broadcasting, including CNN, to certain organisations in Sydney, Canberra and Melbourne via its Lasercast network. The rather small Australian company behind that deal, Cable Television Services (CTS), nurtured a growing interest in expanding such a service to the greater residential market along with Telecom's developing intentions in the field of pay television delivery. CTS also arranged for these Turner channels to be supplied over the trial networks at Wollongong and Centennial Park. In this manner CTS, in addition to the Australian Broadcasting Corporation and the Special Broadcasting Service, established an ongoing dialogue with Telecom regarding possible content for carriage over a future Telstra pay television network.

[37] The analogue HFC network channel capacity was later said to be 64.
[38] Unlike Optus, Telecom/Telstra had no intention of offering a telephony service via its HFC cable as that would have cannibalized its paired copper-based local access network.

These discussions had run for at least a year before the PMT consortium came on the scene.[39]

CTS obtained licences from the Australian Broadcasting Authority (ABA) in February 1994 to operate 10 pay television services over a delivery means other than satellite, for example cable[40], and by early March had reached an agreement with Telecom to be allocated the first 10 channels on its proposed cable-delivered pay television network. (Meredith 1994b) No price for carriage had been initially agreed. CTS gained another 10 licences from the ABA in June the same year. (Meredith 1994d) (Syvret 1994) By April, the board of Telecom Australia gave formal approval to proceed with the first stage of roll-out of an HFC network. (Westfield 2000: 237) The tension between pay television aspirants was palpable, heightened all the more when Australis Media managed to win most of the MMDS licences for microwave delivery.

The above events in early 1994 brought to a head discussions Optus had been having with Continental Cablevision for at least a year. The board of Optus approved plans for a joint-venture partnership from July to build "an advanced broadband network … to deliver local phone calls, pay and cable TV, interactive entertainment and information systems on a hybrid fibre-coaxial cable system". (Meredith 1994f) The potential for a new revenue stream directly from telephony calls and the prospect of reduced interconnection payments to Telecom were the main attractions. No mention was made then as to whether the Optus-Continental Cablevision network would be a closed network, or operated as a common carriage facility like the plans of Telecom Australia.

In the meantime, Telecom was being inundated with approaches for channel capacity on its soon-to-be created HFC network. By end May, CTS had been allocated 20 channels and requests for capacity from other service providers were in various stages of discussion. (Syvret 1994) With a maximum analogue capacity now admitted to be 64 channels, Telecom revealed to the regulator AUSTEL[41] that it recognised a potential problem of channel scarcity arising, and would have to determine who the serious players were in the developing industry before further channel allocation.[42] Other possible contenders for channels included Australis, who wished to also distribute on cable their forthcoming satellite and MMDS channels, the Nine Network and News Corporation, and Channel Ten. (Meredith 1994e) (Westfield 2000: 253)

At least one complaint, possibly from Australis, had been lodged with AUSTEL and the Trade Practices Commission[43] claiming that Telecom Australia was denying

[39] Information in the above paragraph is based on my personal recollection.
[40] Refer to the Australian Communications and Media Authority Website for licences allocated under Section 96 of the Broadcasting Services Act 1992; http://www.acma.gov.au/WEB/STANDARD//pc=PC_90046 accessed 13 may 2007
[41] From July 1997, AUSTEL became the Australian Communications Authority, which in turn became the Australian Communications and Media Authority from July 2005.
[42] Telecom Presentation to AUSTEL on Pay Television, 31 May 1994
[43] From 1995, the Trade Practices Commission became the Australian Competition and Consumer Commission, or ACCC.

access to its HFC network[44]. (Lewis 1994a) Telecom was under increased pressure to devise a fair and reasonable process for channel allocation, in addition to an acceptable pricing plan. The hoarding of channels by parties who gained more than their immediate needs was of particular concern; claims were also made that CTS was trying to on-sell part of its allocation. (Lewis 1994a) Communications Minister Michael Lee was reported as having made it clear he did not want Telecom to hand out channels unless users could guarantee they had the programs. In addition, AUSTEL would need to ensure the public interest was protected when it came time to approving Telecom's charges for the new service. (Burton 1994)

Being a dominant carrier under the Telecommunications Act 1991, Telecom Australia was required to file a tariff with AUSTEL if it desired to supply a pay television service via cable to programme providers as well as the viewing public.[45] On 16 August 1994, Telecom announced the wholesale tariffs and conditions for programme providers to utilise its new 'Videostream' product as including: (Lewis 1994b) (Korporaal 1994)

- A one-off fee of $500,000 for access to the network from a central play-out point; plus
- $50,000 per channel delivered; plus
- 50 cents per channel for every subscriber the programme provider signed up; plus
- No service provider could have more than 15 channels out of the maximum 60 or 64 available.

The PMT consortium, established the previous year primarily to spoil the moves by other satellite and MMDS aspirants but also as a defensive play to watch one another's backs, was going nowhere and was dissolved on 9 September (Westfield 2000: 267-269) (Furness and Lewis 1994) The Nine Network and News Corporation were then legally free to pursue other opportunities about which they had been privately negotiating for some months. Whilst Telecom Australia had been focussing on the roll-out of their cable network and tariffs to entice programme providers, Optus, the Nine Network and News Corporation recognised the critical importance of programming agreements.

The Optus and Continental Cablevision joint venture, formalised on 20 September 1994 as Optus Vision, was further bolstered by agreements with the Seven and Nine Networks. (Korporaal 1994) Strenuous efforts were underway to also bring in News Corporation and thereby totally isolate Telecom. Suddenly, Telecom was faced with the potential of deploying an extensive network but with no major programming

[44] Telstra was later reported to have taken a booking from Galaxy, the Australis pay-tv service, for 15 cable channels. Meredith, H. (1994h). Telstra Races Forward in Pursuit of Viewers. Australian Financial Review**:** 1.

[45] Of necessity, such a basic carriage service had to offered on an 'open access' basis that was non-discriminatory to all providers and customers. This particular tariff was directed only to television programme providers.

customers[46] and, due its reliance on an open access business model, no business partners. The Optus cable roll-out plans would pass half of Australia's six million homes and cost $3 billion. (Westfield 2000: 267) The one cable would deliver both pay television and telephony services.

Optus then dropped a bombshell that would forever change the Australian landscape for pay television. Optus Vision declared that whilst it would be bound by the 'common carrier' requirements of the Telecommunications Act 1991 regarding telephony services, the part of the cable being used to supply pay television was covered by the Broadcasting Services Act 1992 which does not require open access to all comers. (Ries 1994) Optus and its partners, Continental Cablevision and the Seven and Nine Networks would be the sole suppliers of pay television programmes.

Already concerned at the prospect of duplicated cable networks, Communications Minister Michael Lee was confronted with an Optus proposal that ran counter to the Government's philosophy of open access for end-line consumers and content providers. (Furness 1994) Optus sought approval of its plans from the Trade Practices Commission and AUSTEL, and the Minister subsequently requested AUSTEL to report on the legalities of operating a closed network. (Korporaal 1994) (Furness 1994)

Insight into the Optus decision to close access to its pay television cable was given by their legal advisor Bill Spain who reportedly told a conference audience: (Furness 1994)

- Telecom's decision to treat its cable television network on a common carriage basis was not necessarily correct or desirable from a commercial or policy perspective;
- There was virtually nowhere in the world where the common-carrier approach had been adopted in relation to pay television;
- It was misleading to describe the Optus Vision concept as 'closed' because it would acquire most of its programming from third-party sources;
- By securing arbitrary control over content, the commercial rewards would be much greater for those involved, enabling them to choose product that promises to attract the widest market of consumers;
- The alternative would be an open access system enabling education and other community services to make a claim for scarce space that would probably deliver less substantial revenues than, for example, movies and sport.

According to the then Optus Director of Corporate and Regulatory Affairs, Mr Andrew Bailey "We are going to invest $3 billion and we have got to make the pay TV venture work and if you let go of the decision making on content, you let go of a part of your capacity to raise revenue". (Frith 1994a) Commenting on Telecom's tariff application limiting any one service provider to a maximum of 15 channels out of a total of 60 available, Optus chief executive Bob Mansfield pointed out that this could result in

[46] CTS, being the only programme provider then signed up to Videostream channels , was a rather small company without a unique claim to pay television material; the company ran into financial difficulty around October 1994 and its agreement subsequently bought out by Telecom once an exclusive arrangement was being negotiated with News Corporation.

only four service providers on Telecom's pay television network – hardly open slather in terms of general access. "It's a limited competitive model, anyway. It's not competition. It's just a little bit more open", he said. (Korporaal 1994) Mansfield also argued that outside content providers would confuse subscribers and weaken the Optus marketing effort. (Westfield 2000: 286) By packaging its pay television and telephony services, pay television would act as an incentive to 'pull through' customers to the Optus telephone service.

Nevertheless, by end-August as the PMT consortium neared its end, Telecom Australia chief executive Frank Blount did acknowledge Telstra's vulnerability: (Meredith 1994g)

> We do not intend to be marginalised in this business – and that is what we would be if we were only in carriage.
>
> We have to provide carriage services, but the margins are not in basic carriage.

The issue was content, not infrastructure, he said. Blount believed that the way forward for Telecom was to find additional joint-venture partners who could provide the pay television content, including the possibility of Telecom taking equity in these companies. Blount later recalled "We were going to have an open system, they (Optus) would have a closed one. I couldn't see how the two could co-exist". (Westfield 2000: 290)

The Optus Vision plan spurred Telecom to crystallise an alliance with News Corporation to solve the content problem. On 11 November 1994, a joint venture was announced whereby Telecom would accelerate its cable roll-out, bearing the full cost, and a Telecom-News programming company would provide a multi-channel pay television service on the cable.[47] (Furness and Burton 1994) Three days later, Telecom withdrew its Videostream tariff and abandoned its former intention to have an open access network. (Kelso 1996) In so doing, Telecom Australia abandoned a philosophy it had cherished at least since 1975.

4.1.4 The government decides

By the direction of the Federal Minister for Communications and the Arts, Michael Lee, AUSTEL conducted an inquiry into the legality of firstly the Optus proposal for a closed access pay television network and then, given Telecom's late change of heart, an almost matching proposal from Telecom Australia.

Optus Communications had declared it would install a broadband cable network for the delivery of pay television, data and telephony, but with the proviso that access to the network would be closed to other parties. This claim for exclusivity relied on two grounds:

[47] On 9 March 1995, this joint venture was formalised as Foxtel which since October 1998 has had the following ownership: Telstra 50 per cent; News Corporation 25 per cent; Publishing & Broadcasting 25 per cent.

- Analogue transmission over cable gave insufficient channel capacity for others;
- The new broadband cable system would be owned and operated by a non-carrier service provider, Optus Vision, which was not obligated to provide open access under the Telecommunications Act 1991.

The first ground was built upon an inescapable outcome of the only technology available at that time, although it was debatable as to what constituted 'insufficient channel capacity'. However, the second ground was purely the result of a clever legal subterfuge.

Optus Vision was established as a joint venture specifically to own and operate the broadband cable system, with installation and maintenance by Optus Networks utilizing its rights and immunities as a licensed general carrier. Telephony access would be provided by the non-carrier Optus Vision back to the carrier Optus Networks, in addition to carriage services for pay television being provided to another entity Multicom which held the necessary licences under the Broadcasting Services Act 1992. According to Ferguson (1996), the Optus exclusive access arrangement was a key factor in securing investment in the network roll-out.

AUSTEL observed that, whilst Optus Vision could operate as a Service Provider under the Telecommunications Act 1991 to effect 'closed access' to parties other than those in the joint venture, such an arrangement may not have been contemplated under the Act and the impact upon competition should be considered. Nevertheless, other important considerations were that the Optus Vision network would result in a competitive local telephone service for the first time to a broad base of residential customers, and that the pay television carriage services provided for Multicom would further extend competition and consumer choice. (AUSTEL 1994)

In addition to any special status derived from their proposed organisational arrangement, Optus claimed that the analogue technology to be deployed produced only a relatively small number of television channels (64 in fact) which, according to the joint venture's business plan, were a scarce resource that was necessary to fully allocate to Multicom. AUSTEL concluded that with the advent of digitalisation, channel capacity relief would ultimately remove any justification for discriminatory provision of service. On the other hand, Optus Vision could nevertheless continue to operate in the same vein since it was a Service Provider and not a carrier, and hence not be subject to the usual requirements of access.

AUSTEL likewise concluded that Telstra's broadband joint venture proposal with News Ltd was similar to that of Optus in that the cable network was to be installed by a licensed carrier but owned and operated by a Service Provider who in turn would provide pay television carriage on to a licensed broadcaster and telephony carriage back to the licensed carrier. The evidence submitted by Telstra led AUSTEL to believe that the initial (pre-digital) phase of pay television services could extend for at least three years. With the AUSTEL report to the Minister being dated 23 November 1994, limited capacity may then have been said to be a constraint to open access at least until end 1997. In other words, limited channel capacity was seen to be an artefact only of the initial phase of pay television services; the advent of digitalisation should remove any justification for discriminatory provision of service. AUSTEL

considered that where the Service Provider network is characterised by strictly limited capacity, the then current form of the Trade Practices Act should not require either Optus Vision or Telstra to provide pay television carriage to third parties. (AUSTEL 1994)

The Optus and Telstra organisational arrangements are depicted in Figure 3. Despite the differences in detail, in both cases the Service Provider (later to be known as a 'Carrier Associate') would own and operate new broadband cable infrastructure that would be installed and maintained by the relevant carrier.

AUSTEL concluded that Government policy objectives would be met most appropriately by a combination of a direction from the Minister and an amendment to the Service Providers Class Licence.

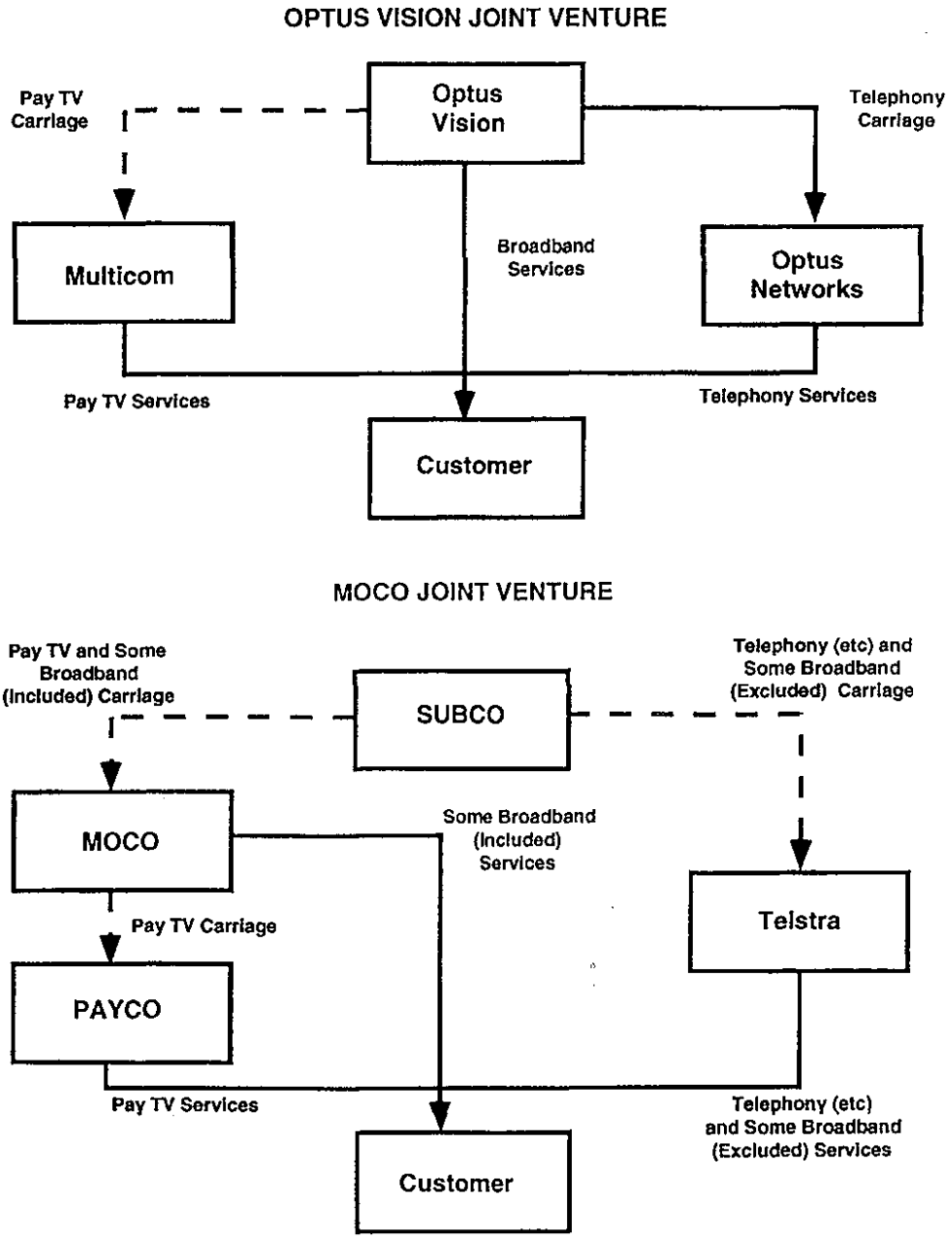


Figure 3 – Comparison of Optus Vision and MOCO (Telstra Multimedia/Foxtel) Proposals (extracted from AUSTEL 1994)

In announcing his acceptance of the AUSTEL report on 24 November 1994, Minister Michael Lee cited the two critical issues as being duplication of cable infrastructure and access to the broadband cable network. (Lee 1994)

He justified the former on the grounds of encouraging greater competition in telecommunications without the need to resort to splitting up Australia into regional monopolies.[48] Regarding the desire of Optus Vision and Telstra Multimedia for closed access to their broadband cabling, the Minister supported the argument that greater benefit would accrue from the roll-out of cable not being delayed if the builders of each cable could share revenue from both content provision as well as carriage. In addition, closed access should be tolerated during the period when the service provider had limited network capacity due to analogue technology. Recognising that closed access could be seen as discriminatory and hence inconsistent with both the Telecommunications Act and the Government's general competition policy, Minister Lee agreed to closed access operating at least until 1 July 1997.

The resultant Direction to AUSTEL from the Minister took the form of the Telecommunications (Service Providers Class Licence) Direction No. 1 of 1995, hereafter called 'the Carrier Associates Direction'. It created the new entity of a 'Carrier Associate', which has a direct or indirect interest in a carrier and a significant influence on the carrier's business activities. The Direction required AUSTEL to issue a class licence governing the conditions under which a carrier associate is permitted to supply certain services. (Butler 1995)

In brief, where Carrier Associates such as Optus Vision and Telstra Multimedia were already providing a pay television service they would be exempted from being required to provide access for another person's (the 'recipient') pay television service up until 1 July 1997, but in any case not if one of the following applies:

- AUSTEL deems connection of the requested service to be not technically feasible;
- The Carrier Associate deems the recipient to be not creditworthy, et al;
- The Carrier Associate deems there to be inadequate capacity to meet it's own reasonably anticipated network requirements, or the needs of the recipient;
- The requested service has not been previously separately supplied to another person.

In like manner to the above, the grounds on which a Carrier Associate may discriminate against another person include the supply of a pay television service prior to 1 July 1997. However, applicable at all times are a wide range of additional grounds such as:

- In relation to the supply of telecommunications services for community, charitable or educational purposes, or for the promotion of health,
- The recipient is a person who is disadvantaged on financial or health grounds;
- The difference in costs that would be borne by the carrier associate;

[48] A suggestion that had been promoted by Kerry Packer and abhorred by the Government.

- The different characteristics involved with the intended service;
- The commercial value of the service to the recipient;
- The desirability of trial programs and demonstrations being conducted (by the carrier associate) that promote the objects of the Act.

Such discrimination, which may relate to the charges for or the performance characteristics of the service concerned, may in particular be justified in terms of costs borne by the carrier associate in respect of service quantities, transmission or bandwidth capacity, the places from or to which the service is supplied and the relevant periods of supply, the required performance characteristics, (unspecified) network matters and costs of an administrative or operational nature. Where the discrimination is argued on grounds of insufficient capacity, the carrier associate may take into account its 'reasonably anticipated requirements' which may extend to the introduction of new kinds of eligible services not currently provided.

On hearing the Minister's announcement, Optus immediately threatened to walk away from its proposed investment: "If the changes announced by the Minister are passed into law, then Optus Vision will withdraw from the race, the monopoly powers of Telstra will be greatly enhanced and the prospect of local phone calls becoming cheaper will effectively disappear". (Optus Vision 1994) This was pure bluff, as Optus had already won the main argument about closing its network.

Commercial cable television in Australia was born in 1995, with the launch of the first Optus Vision pay television service on 20 September and that of Foxtel on 23 October. With government blessing, both commenced as closed networks.

4.2 Potential Bottlenecks with HFC Networks

A hybrid fibre coaxial or HFC network, as the name implies, employs a combination of optical fibre and coaxial cable. Due to its favourable economics, HFC has been very popular for delivering analogue pay television channels to subscribers but is upgradable to digital working once changes are made to the Head End and every Set Top Box (STB). An advanced HFC network is capable of also delivering telephony and Internet access (data) services. As shown in Figure 4, all signals (telephony, video and data) are funnelled to a common point called a Head End, typically arranged to have one per major city, and thereafter distributed by optical fibre in a star topology out into suburban areas. Once a given fibre reaches a group of some 500 to 2000 potential subscribers, the optical signals are converted at a Hub into radio frequency signals for transmission over coaxial cables which run down streets, branching where necessary, and finally terminating on STBs in subscriber premises.

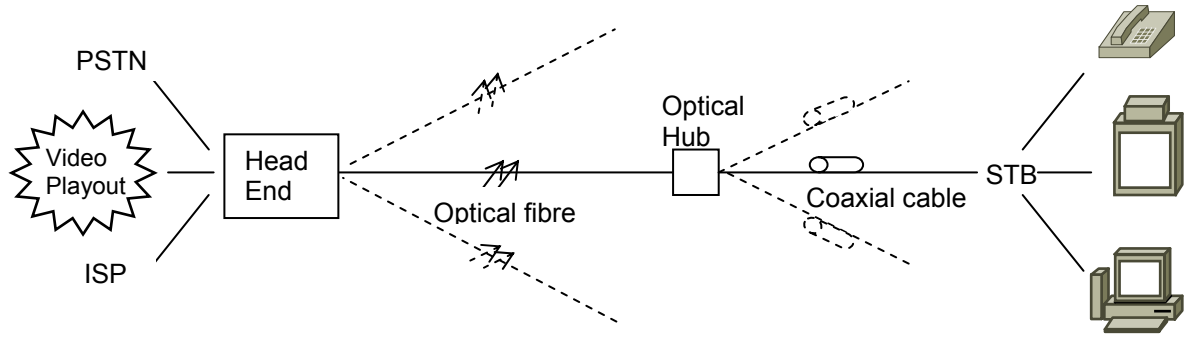


Figure 4 – Basic Topology of a Hybrid Fibre Coaxial Network

An HFC network is a shared delivery medium, such that signals for all the subscribers fed from a given optical hub are available at every household served by that hub. This calls for a system to be in place that identifies each and every subscriber with a unique address and then provides or denies access by subscribers to a desired service on an as-required basis, that is, conditionally. Such a 'conditional access' regime embodies the following basic functions: (Kelso 1996)

- The form of the picture signal is continually changed (that is, scrambled) so that it is unintelligible without a suitable de-scrambler and electronic key at the customer's Set Top Box;
- The electronic key needed to de-scramble the signal is continually changed (via data encryption under control of the operator) so that the keys are secure from piracy;
- A process of subscription management is required in order to receive and process requests for new or discontinued services, and to pass on relevant data to the systems that authorize access as well as initiate billing; and
- These arrangements are economically and securely implemented on a mass market basis via a programmable 'smart card' inserted into each STB.

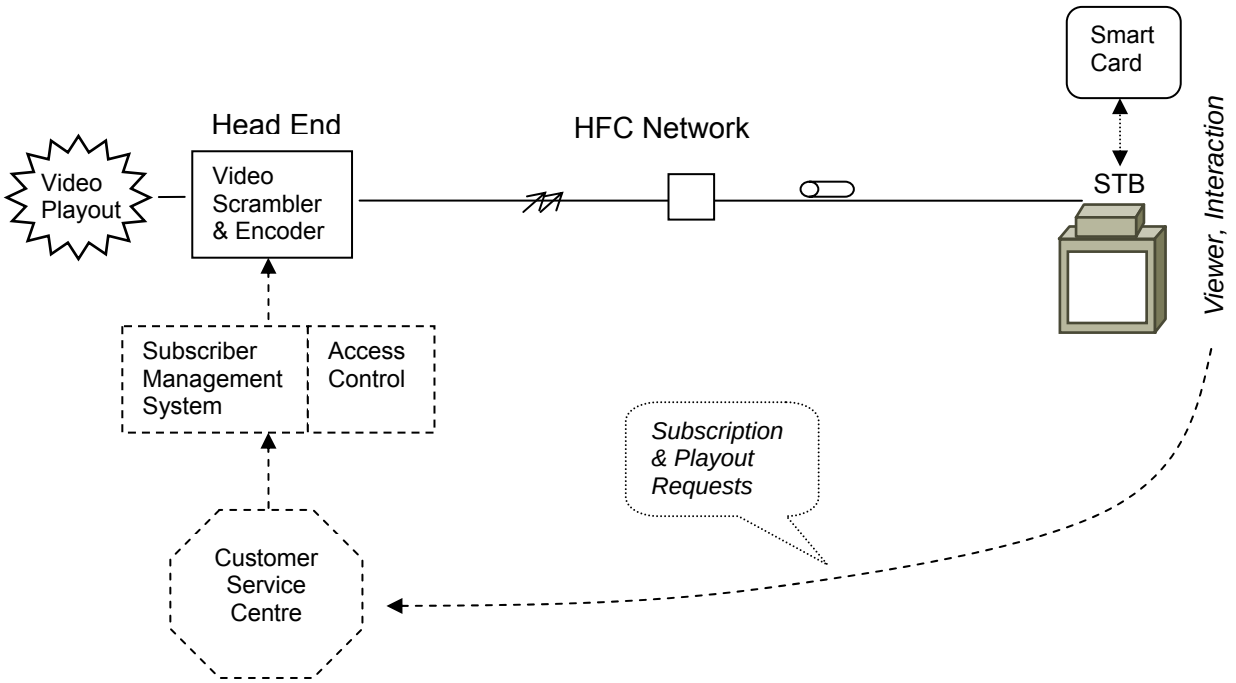


Figure 5 – Functional Diagram of a Conditional Access System

Figure 5 depicts the typical functions of a conditional access system or CAS appended to an HFC network. Additional elements critical to a modern pay television business can be:

- The Applications Programme Interface or API: This software, usually proprietary and often categorized as middleware, runs on the STB between the operating system and the different applications. (Galperin 2002)
- Electronic Navigation Software; EPG: Evident to the subscriber as an electronic programme guide or EPG, this software enables subscribers to access information about available services and perform scheduling functions.

Any of the above elements may present themselves to an access seeker as a technical or commercial bottleneck. The most fundamental is whether there is sufficient transmission capacity to deliver the requested services. The Telstra/Foxtel and Optus pay television services commenced with analogue signal transmission on HFC networks which are inherently limited to about 64 television channels. Their respective carrier associates immediately announced plans to use most if not all of these channels into the near future.

Digital technology greatly increases the number of channels and facilitates early forms of interactivity, but still embodies CAS, API and EPG facilities. Cowie and Marsden (1999) describe how digitisation raises the potential for a new series of bottlenecks and consequently higher barriers to entry by competitive service providers. Vertically integrated operators who control the content, bundling into channels, channel packaging, the means of delivery, conditional access, consumer reception equipment and subscriber management greatly increase the potential for market abuse of such bottlenecks. (Cowie and Marsden 1998) According to these authors, there are a number of commercial bottlenecks which can also restrict access by third parties:

- Services viewed as potentially competitive with a (vertically integrated) access provider's own offerings may be flatly denied access;
- Access providers may exert undue influence to 'encourage' independent third parties to join a proprietary service package;
- Access to the facility may only be granted on discriminatory terms;
- Where access is granted on non-discriminatory terms, a monopoly access fee may be charged (which may not be economically efficient);
- Proprietary services may only be sold when bundled with non-proprietary services, thereby leveraging market power to related markets (foreclosure); and
- Access terms may contain 'unreasonable' restrictions, such as platform exclusivity clauses, which reduce scope for competition.

In the United States where pay ('cable') television companies have also provided access to non-affiliated ISPs, examples of bottlenecks for data services were reported as including: (Saltzer 1999)

- Video limits. Some access providers limit the number of minutes that a customer may use a 'streaming video' connection.

- Server restrictions. While advertising the benefits of being 'always on' the Internet, some providers impose an 'acceptable use' contract that forbids customers from operating an Internet service, such as a Web site.
- Fixed backbone choice. The traffic route may cause distance-related delays or response-slowing congestion which can significantly interfere with some kinds of service, such as video conferencing or interactive file editing.
- Data packet filtering.
- A prohibition on home networks.

4.3 Opening the Door to Access: Deeming & Declaration

With the introduction of open competition into the Australian telecommunications market commencing 1 July 1997, the ACCC gained the power to mandate access to a carriage service by 'declaring' that service[49] under a new Part XIC of the Trade Practices Act 1974 (TPA). The prime object of Part XIC is to promote the long-term interests of end-users or LTIE of what are called 'listed services', that is, carriage services or of services provided by means of carriage services. In determining what constitutes the LTIE, the ACCC must give regard to the objectives of promoting competition in markets for the listed services, achieving any-to-any connectivity in relation to carriage services that involve communication between end-users, and encouraging the economically efficient use of, and the economically efficient investment in, the infrastructure by which the listed services are supplied.[50]

The key effect of declaration is to require the supply of declared services by an access provider to an access seeker on demand. Such supply is described in section 152AR of the TPA in terms of standard access obligations or SAOs. According to Grant (2004: 89), 'access' refers to the ability of carriers and service providers to pass and receive telecommunications traffic over each other's networks, in order to fulfil the imperative that all end-users of similar services be able to connect with one another, irrespective of the particular networks to which they are connected.

The following partial extract of section 152AR highlights the main elements of a standard access obligation:

> (2) For the purposes of this section, if a carrier or a carriage service provider supplies declared services, whether to itself or to other persons:
>
> (a) the carrier or provider is an access provider; and
>
> (b) the declared services are active declared services.
>
> (3) An access provider must, if requested to do so by a service provider:
>
> (a) supply an active declared service to the service provider in order that the service provider can provide carriage services and/or content services; and
>
> (4) Paragraph (3)(a) does not impose an obligation to the extent (if any) to which the imposition of the obligation would have any of the following effects:
>
> (a) preventing a service provider who already has access to the declared service from obtaining a sufficient amount of the service to be able to meet

[49] Under Part XIC of the TPA, there is no general right of access. Rather, the ACCC must first 'declare' (that is, decide to regulate) a particular service.
[50] As per Section 152AB of the TPA.

> the service provider's reasonably anticipated requirements, measured at the time when the request was made;
> (b) preventing the access provider from obtaining a sufficient amount of the service to be able to meet the access provider's reasonably anticipated requirements, measured at the time when the request was made;
> (c) preventing a person from obtaining, by the exercise of a pre-request right, a sufficient level of access to the declared service to be able to meet the person's actual requirements;
> (d) depriving any person of a protected contractual right.

As a vehicle for linking the 1991 telecommunications regime to that of 1997, the ACCC was empowered under section 39 of the Telecommunications (Transitional Provisions and Consequential Amendments) Act 1997 to 'deem' certain services as declared services with effect from 1 July 1997. In the case of the Telstra/Foxtel and Optus pay television networks, deeming was necessary as the 1995 'carrier associates' exemption to permit closed access would expire from 1 July 1997. One of the eleven services so deemed by the ACCC was that of a 'broadcasting access service' defined as:

> An analogue service necessary for the purpose of enabling the supply of a broadcasting service by means of line links that deliver signals to end-users, and of a kind that was used for those purposes on 13 September 1996. This is an access service which provides a basic carriage and distribution access function together with other functions as requested.

The specification of 'line links' clearly encompassed analogue cable television services of the type already provided by Foxtel (via Telstra) and Optus Vision (via Optus Networks) since late 1995. Furthermore, in accordance with section 152AR of the TPA and as recommended by the Telecommunications Access Forum, the resultant SAO would from then on include ancillary services such as the functions of network management access, conditional access and subscriber premises servicing. This could include any in situ set top box or STB. An access seeker could opt to 'mix and match' whichever service elements they required. (ACCC 1997a) Broadly speaking, the intent was to address the full range of technical bottlenecks as previously discussed.

The flexibility of this service definition (… "together with other functions as requested") raised concerns within the industry as to the validity of the declaration, thereby purportedly discouraging access seekers. To resolve the uncertainty, the ACCC commenced a public inquiry in December 1998. (Grant 2004: 107) This led to a new declaration in August 1999 of an analogue pay television service as being subject to a range of standard access obligations, pursuant to sections 152AL(3) and 152AR of the TPA, though removing the element of access seeker choice. In brief, these standard access obligations required an access provider to:

- Supply the declared service;
- Ensure that the declared service supplied is of equivalent technical and operational quality as that which the provider supplies to itself;

- Ensure that the fault detection, handling and rectification in relation to the declared service is of equivalent technical and operational quality as that which it provides to itself;
- Permit interconnection of its facilities with those of the access seeker; and
- Provide particular billing information to the access seeker.

As before, the scope of the declared service encompassed pay television services delivered via cable, but it did not extend to digital signal transmission. The revised service description of an analogue subscription television broadcast carriage service then became: (ACCC 1999)

> A service for the carriage, by means of lines, of analogue signals used for the purposes of transmitting a subscription television service from a facility owned, controlled or operated by a carrier or carriage service provider to any point on, or in, a line link, customer cabling, or customer equipment connected to that facility.
>
> Examples of this service are the delivery of analogue signals used for the purposes of transmitting a subscription television service to:
> (a) an end-user's television set;
> (b) conditional-access customer equipment of an end-user[51], or potential end user, of a subscription television service;
> (c) a wall socket at the premises of an end-user, or potential end-user, of a subscription television service;
> (d) a point on a line link from which a lead-in connection may be run to the premises of an end-user, or potential end-user, of a subscription television service.

Section 152AR(8) was of particular relevance to analogue pay television services in that it provided a legislated avenue for an access seeker to gain access to the conditional access equipment of another provider:

> Conditional-access customer equipment
>
> (8) If an access provider supplies an active declared service by means of conditional-access customer equipment, the access provider must, if requested to do so by a service provider who has made a request referred to in subsection (3), supply to the service provider any service that is necessary to enable the service provider to supply carriage services and/or content services by means of the active declared service and using the equipment.

In justifying its decision, the ACCC said, in part: (ACCC 1999)

> Each of the carriage providers has an incentive to restrict access to the infrastructure it controls, because of the vertical links between the carriage and retail pay television services.

[51] That is, a Set Top Box.

In the event that the access seeking and access providing parties are unable to agree on the terms and conditions related to implementing the above obligations, either the ACCC can arbitrate and make a determination or the access provider can file an access undertaking which, if accepted by the Commission, becomes a legally binding obligation. (ACCC 2004a) However, the ACCC did not formally revoke the original deemed declaration and as we shall see later on, the existence of two current declarations in respect to the same service led to legal challenge. (Grant 2004: 107)

During August and September 1999, Seven Cable Television (C7) formally requested access to the broadcast carriage services of the Telstra cable television network. Likewise, in August 1999 Television & Radio Broadcasting Services Australia (TARBS) sought access to the declared services in a request to Telstra, News Corporation and Foxtel.[52] All requests for access were refused by the access providers, justified on a variety of grounds. Two streams of substantially parallel activity then ensued: legal challenges and ACCC-sponsored arbitration, both extending over a number of years.

So far, we have considered only the matter of access by competitive service or programme providers to television channels and associated services delivered via an HFC network. The second prospect for 'open' access is that of access by competitive Internet service providers to the data capacity via cable modems – an access issue that has been the defining one in the United States. Strangely, the opposite has been the case in Australia. Barring voluntary action by cable providers Telstra and Optus, the ACCC would need to declare a cable modem service delivered via an HFC pay television network. According to a 2001 interview with an ACCC senior official, "nobody has approached us in any concerted way to ask us to look at declaration" and so to date cable modem access remains closed. (Chirgwin 2001: 60) In other words, a subscriber requesting an Internet data capability from the Telstra HFC network can now only receive access to Telstra's BigPond ISP, and a subscriber requesting an Internet data capability from the Optus HFC network can now only receive access to the Optus ISP.

4.4 Challenge & Counter-Challenge

Section 152AR of the Trade Practices Act 1974 has been the prime focus of the resultant flurry of legal actions to both seek and deny access to the analogue pay television service delivered by Foxtel through Telstra's HFC network.[53] Contention initially centred on whether the 1997 Deeming and/or 1999 Declaration by the ACCC were valid and whether section 152AR(4) negated the standard access obligations on the grounds that there was insufficient 'amount of the service' (that is, analogue channel capacity) to be able to meet the 'reasonably anticipated requirements' of Foxtel and that the provision of service by Telstra to Foxtel was subject to a 'protected contractual right'.

[52] Seven Cable Television Pty Ltd v Telstra Corp Ltd [2000] FCA 350, Federal Court of Australia, 27 March 2000.
[53] In contrast, the Optus HFC network has been spared equivalent legal action but nevertheless remains closed to third party access.

4.4.1 Validity of deeming and declaration

The subscription or pay television service marketed as Foxtel is based on a number of agreements between, among other parties, Telstra and its subsidiary Telstra Multimedia, and Foxtel and its subsidiaries. Figure 3 schematically outlines these arrangements. In brief, Foxtel delivers pay television content to subscribers by utilising the carriage services of Telstra.

During 1999 and 2000, the relevant Foxtel and Telstra entities challenged on administrative grounds the validity of both the 1997 deeming and 1999 declaration made by the ACCC relating to access to analogue subscription television broadcasting services. If the actions of the ACCC were found to be invalid, pay television carriage would not be subject to the competition regime set out in Part XIC of the Trade Practices Act. Furthermore, it was claimed that both instruments had no application since Foxtel was neither a carrier nor a carriage service provider.

The Federal Court held that the deemed service declaration was invalid in part but that the revised declaration was valid.[54, 55] Furthermore, it held that in delivering content to the public, Foxtel delivered the listed carriage service known as Foxtel subscription television via network units owned by a licensed carrier, Telstra. Accordingly, Foxtel was a carriage service provider within the meaning of section 152AC of the TPA and therefore an access provider of the services so declared by the ACCC.[56] Appeals to the Full Court and the High Court against this decision were refused. [57, 58] (Grant 2004: 107)

4.4.2 Sufficient amount of service/channel capacity

The Telstra hybrid fibre coaxial (HFC) network commences at a capital city Head End installation in the form of optical fibres radiating out to regional Nodes and local exchanges, and terminating at optical/radio frequency devices in the street called Hubs. From there, coaxial cabling continues towards the customer premises whereupon lead-in cables connect to the Set Top Boxes. The forward signal band operates from 85 MHz to 750 MHz (Whittle 1995/96) and is currently designed to carry: (BTCE 1994: 7)

- 64 PAL-B analogue video channels between 85 and nominally 550 MHz, plus
- 200 MHz of digital channels (video and cable modem) between nominally 550 and 750 MHz

[54] Foxtel Management Pty Ltd v Australian Competition & Consumer Commission [2000] FCA 589, Federal Court of Australia, 8 May 2000.
[55] Telstra Corporation Ltd v Seven Cable Television Pty Ltd [2000] FCA 1160, Federal Court of Australia, 18 August 2000.
[56] Foxtel Management Pty Ltd v Australian Competition & Consumer Commission [2000] FCA 589, Federal Court of Australia, 8 May 2000.
[57] Foxtel Management Pty Ltd v Seven Cable Television Pty Ltd [2000] FCA 1161, Federal Court of Australia, 18 August 2000.
[58] Foxtel Management Pty Limited & Anor v Seven Cable Television Pty Limited & Ors [2001] S228/2000, High Court of Australia Transcript, 10 August 2001.

Figure 6 depicts the nominal band plan of the Telstra HFC network:

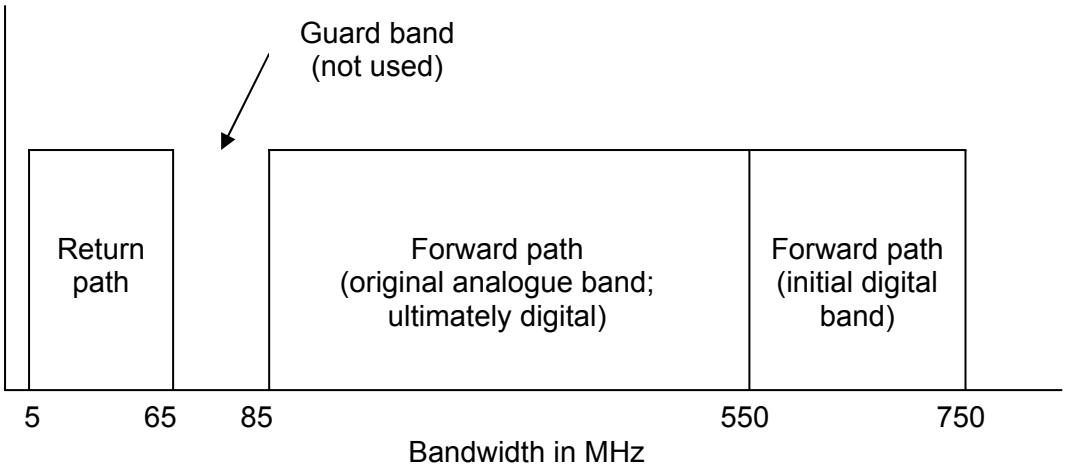


Figure 6 – Nominal Band Plan of Telstra's HFC Network

Prior to March 2004, only analogue video signals were carried. Even without knowing the magnitude of Foxtel's 'reasonably anticipated requirements', those being a confidential figure, it can be seen from the ACCC report into emerging market structures (ACCC 2003a: Attachment A.1, plus allowance for the free-to-air stations) that the figure must be at least 40 channels. It is therefore apparent that, if spare capacity were to be shared with access seekers, the nominal analogue channel capacity of 64 is a relatively scarce resource.

However, once full conversion to digital has been effected, requiring all Set Top Boxes to be replaced by digital units, the full bandwidth from 85 to 750 MHz becomes potentially available. Assuming no other digital signals, such as Internet data, each 8 MHz of bandwidth can potentially support up to nine digital program streams which amounts to a total capacity in excess of 700 digital streams. With Internet data, this figure would be a little lower. Nevertheless, the fully digitalised capacity becomes less of a scarce resource and is more amenable to being shared with access seekers.

4.4.3 Protected contractual right

Telstra and News Corporation challenged the right of Seven Cable/C7 and TARBS to access on the grounds that Foxtel already had the exclusive right to provide and manage these services. As such, this amounted to a 'protected contractual right' under section 152AR(4) of the TPA being in force as at 13 September 1996 and therefore negating any standard access obligation to provide access. The significance of this date was that it was when mention of a 'protected contractual

right' first appeared within the second exposure draft of the Bill that led to the new Part XIC of the TPA which eventually came into force on 30 April 1997.[59]

The trial judge, Justice Tamberlin, dissected the complex web of relationships between various entities associated with Telstra and News Corporation that eventually led to the creation of Foxtel:

- An 'umbrella agreement' between News Corporation and Telstra dated 9 March 1995;
- A version of a Broadband Cooperation Agreement dated 12 July 1995;
- A letter dated 23 October 1995, signed by Telstra Multimedia and Foxtel Management, said to be the source of the 'protected contractual right'; and
- A second version of the Broadband Cooperation Agreement executed by Telstra Multimedia and Foxtel Management dated 14 April 1997.

The exclusivity right claimed by Foxtel was said to be framed in the following terms:[60]

> The right to prevent Telstra Multimedia from using, or permitting the use of its broadband telecommunications network to deliver a subscription television service which is not provided by Foxtel or the provision of which is not managed by Foxtel (by virtue of its having entered into an agreement with a third party to do so) except where Telstra Multimedia is required by law to so use or permit the use of that network.

Justice Tamberlin, held that as at 23 October 1995 there was no legally binding agreement reached between Telstra Multimedia and Foxtel and therefore there was no contract capable of giving rise to a protected contractual right.[61] This was because the conditions of the exclusivity and bundling rights were not negotiated to the stage of a legally binding arrangement by 23 October 1995 and other important clauses were left also outstanding. Negotiations continued even after 13 September 1996 and no final Broadband Cooperation Agreement was reached until 14 April 1997.

Accordingly, Justice Tamberlin held that Foxtel was not entitled to prevent Telstra granting access to TARBS for the purpose of broadcasting the services sought by it on the ground that Foxtel would be deprived of a protected contractual right. On similar grounds it was held that Foxtel was not entitled to prevent Telstra granting access to Seven Cable/C7 for the purpose of broadcasting the Olympic Games or for other purposes for which access was sought by Seven. In an appeal to the Full

---

[59] Pay television service via cable began in September/October 1995 and the first exposure draft of changes to the TPA was tabled before Parliament on 20 December 1995, towards the end of the Keating labour government. The first Howard coalition government took office on 11 March 1996 and among other things revisited this proposed legislation. By the time of the second exposure draft tabled on 13 September 1996, section 152 was modified to include an access exemption in the event of a 'protected contractual right' and hence became the date from which such an exemption could commence.

[60] Paragraph 140 of Seven Cable Television Pty Ltd v Telstra Corp Ltd [2000] FCA 350, Federal Court of Australia, 27 March 2000.

[61] Seven Cable Television Pty Ltd v Telstra Corp Ltd [2000] FCA 350, Federal Court of Australia, 27 March 2000.

Court against this judgement, Justices Beaumont, Moore and Gyles each delivered separate reasons for upholding the decision of the trial judge and so dismissed the appeal.[62]

4.5 Arbitration of Access Disputes

Part XIC of the Trade Practices Act also vests the ACCC with arbitration powers enabling it to make directions and do all things necessary for the speedy hearing and determination of an access dispute.

Where a dispute cannot be resolved after private negotiations, mediation and/or conciliation, either of the access parties may refer the matter to the ACCC as a last resort. The ACCC must then determine the matter, unless it decides to terminate the arbitration or the notification is otherwise withdrawn.

On 27 September 1999, just a few weeks following declaration of cable-delivered analogue subscription television services, TARBS notified the ACCC of an access dispute with Telstra Multimedia under Part XIC of the TPA.[63] C7 likewise gave notice of an access dispute with Telstra Multimedia, Foxtel and related entities on 7 September 2000.[64]

The Commission resolved to settle these access disputes through arbitration, a process not on the public record due to confidentiality. Information considered dealt with issues such as service costs, prices, technical feasibility and channel capacity. Arbitration extended from 1999/2000 to 2004, whereupon it was effectively terminated following acceptance of the Telstra Multimedia and Foxtel access undertakings for analogue pay television services. However, the process suffered repeated delay over this period due to legal arguments over the validity of deeming/declaration and existence of a protected contractual right, coupled with the ACCC's assessment of the eventual undertakings. Despite legislated changes to reform the arbitration regime in 1999 and 2001, Grant (2004: 116) concludes that "an unfortunate side effect is that the regime has now become labyrinthine".

On 10 August 2001, following news of failure by Foxtel for special leave to appeal the decision validating the Commission's pay TV service declaration, Chairman Professor Allan Fels said:[65]

---

[62] Foxtel Management Pty Ltd v Seven Cable Television Pty Ltd [2000] FCA 1159, Federal Court of Australia, 18 August 2000.
[63] Refer to ACCC Press Release "Telecommunications access dispute" MR 182/99, issued 27 September 1999, at http://www.accc.gov.au/content/index.phtml/itemId/322771, accessed 13 May2007
[64] Refer to ACCC Press Release "Telecommunications access dispute" MR 240/00, issued 7 September 2000, at http://www.accc.gov.au/content/index.phtml/itemId/87484, accessed 13 May 2007
[65] Refer to ACCC Press Release MR "High Court rejects challenge to ACCC pay TV declaration" MR 183/01, issued 10 August 2001, at http://www.accc.gov.au/content/index.phtml/itemId/87802/fromItemId/378012, accessed 13 May 2007

> The ACCC trusts this decision will bring Telstra and Foxtel's resistance to this declaration to an end. It is now time for both parties to facilitate the use by others of the Telstra cable to offer pay-TV services that are in competition with Foxtel.
>
> The issues concerning the validity of the ACCC's declaration decision have been before the courts for almost two years as Telstra and Foxtel have challenged the ACCC's decision using every legal avenue available. This has created much uncertainty in the industry and frustrated the development of competition.
>
> This decision means that, subject to capacity being available, Telstra must provide access to its HFC network to access seekers for the supply of analogue pay-TV services. This will assist alternative content providers, such as Television and Radio Broadcasting Services Australia Pty Ltd (TARBS) and Seven Cable (C7), who have requested access to Telstra's cable network to obtain access either on negotiated terms, or failing agreement, on the terms and conditions determined by the ACCC in an arbitration.
>
> Indeed both these alternative content providers have notified the ACCC of a dispute.
>
> Although these arbitrations have been delayed as a consequence of proceedings before the courts the ACCC has issued interim determinations requiring that both C7 and TARBS be given access and, in the absence of agreement by the parties, the ACCC will be looking to finalise its decision on access by TARBS and C7 to Telstra's cable.

Although the substance of this interim determination remains confidential, it would be expected to have been broadly similar to what later transpired with the analogue service undertaking.

4.6 Access Undertakings & Exemptions

By August 2001, all of the court action initiated by the access providers, Telstra and Foxtel, had come to nothing – except for the passage of further years of avoiding the need to provide access. The ACCC arbitration process, at times also delayed by the litigation, had at least produced an interim determination and was heading towards finalisation. Nevertheless, the main industry players were continuing to determine their future.

On 5 March 2002, in a major move towards industry rationalisation, Foxtel and Optus announced a proposal to share pay TV programming whereby Optus would become largely a reseller of Foxtel content.[66] In concluding that such a deal would likely breach the Trade Practices Act through a substantial lessening of competition, the ACCC identified its four principal areas of concern as relating to:

[66] Refer to Foxtel Press Release "Breakthrough Agreement in Subscription Television", issued 5 March 2002, at http://www.foxtel.com.au/236_328.htm, accessed 13 May 2007

- The acquisition of content;
- The likely dominance of the Foxtel distribution network;
- The supply of pay TV services to households; and
- The provision of channels to third parties who wish to supply pay TV to customers.

It then drew from the parties a number of court-enforceable undertakings under section 87B of the TPA. These included, inter alia, agreements to lodge access undertakings under Part XIC of the Act relating to third-party access to pay TV services – initially analogue delivered (already declared) and eventually digital (not then declared). They would apply in the absence of commercial agreement between the parties.

Draft undertakings were opened for public comment from 5 September 2002[67] and revised on a number of occasions. The resultant submissions to inquiries, ACCC reports and final undertakings involve a considerable amount of material which is accessible via the ACCC pay TV portal.[68] Only the key aspects are highlighted here, in keeping with a broad approach of appreciating the nature of the regulatory outcomes rather than the detail of processes involved in getting there.

4.6.1 Undertakings of analogue access

By 25 March 2004, the ACCC had accepted revised undertakings from Telstra Multimedia and Foxtel enabling non-discriminatory access by competitors to Telstra's analogue HFC network and Foxtel's STBs.[69] Under these arrangements, Telstra was thereafter required to make available ten analogue video channels to third parties according to prescribed technical, service and pricing terms deemed reasonable by the Commission. The quantity of ten channels would now appear to be above and beyond Foxtel's 'reasonably anticipated requirements' for an analogue subscription service. The costs refer, inter alia, to enhancements and extensions to the various programme Headends to facilitate signal carriage, transmission of individual channels from the Headends throughout the HFC network to subscriber premises and provision of the conditional access service.

Arrangements are also detailed to allocate analogue channels to aspirant access seekers, for an accepted access seeker to supply its own smartcards and STBs for servicing subscribers not already those of Foxtel and to facilitate the transition from

---

[67] Refer to ACCC Press Release "ACCC seeks comment on section 87B undertakings for Foxtel/Optus proposal" MR 211/02, issued 5 September 2002, at http://www.accc.gov.au/content/index.phtml/itemId/88164/fromItemId/378014, accessed 13 May 2007

[68] Refer to ACCC document index titled "Pay TV" at http://www.accc.gov.au/content/index.phtml/itemId/269329/fromItemId/356715, accessed 13 May 2007

[69] Refer to ACCC document indexes titled "Analogue pay TV access undertakings - Telstra multimedia and Foxtel - 2002/03" and "Revised analogue pay TV access undertakings - Telstra multimedia and Foxtel - 2003/04)" both at http://www.accc.gov.au/content/index.phtml/itemId/786759/fromItemId/786597 accessed 13 May 2007

an analogue to digital pay TV service. Once an access seeker has arranged carriage by Telstra, Foxtel is required to ensure non-discriminatory access to its STBs and fly cables[70] at a price deemed reasonable by the ACCC. Matters such as procedures to deal with faults are also prescribed. Third party pay TV providers utilising the Telstra/Foxtel service are to be responsible for their own subscriber management functions, including billing, and call centre services.

From here on, if requested, third party access to Telstra's analogue cable network and Foxtel's analogue set top boxes could be achieved under prescribed terms and conditions – a regulatory outcome sought since July 1997.[71] According to ACCC Commissioner Ed Willett "The new access undertakings will have implications for the resolution of the long standing pay TV disputes between TMM and Foxtel and TARBS and C7, which the ACCC had been arbitrating".[72] This was because any determination for these arbitrations would need to be consistent with the terms and conditions laid down in the new access undertakings.

Also as part of their section 87B undertakings, Telstra and Foxtel committed to: (Grant, 2004: 108)

- Digitise their pay TV network infrastructure, conditional upon legislation being passed enabling exemption from the standard access obligations;[73]
- Provide competitive access to at least 35 per cent of the total number of digital channels on the new digital platform.

4.6.2 Telecommunications Competition Bill amendments

Only the year before, the Productivity Commission's Inquiry Report on Telecommunications Competition Regulation (PC 2001a) recommended the Trade Practices Act be amended to enable the ACCC to exempt services provided by prospective investments – exactly what Telstra and Foxtel were seeking. In response, the government produced the Telecommunications Competition Bill (2002) which, following a Senate inquiry, gained assent on 19 December 2002.

Among other amendments, a new section 152ATA of the TPA was created to enable an access provider, or a potential access provider, to apply for and receive an exemption from the standard access obligations referred to in section 152AR before an investment in a telecommunications service is made or before the service becomes an active declared service – hence facilitating 'anticipatory exemption'.

---

[70] A 'fly cable' connects the pay television network wall-mounted socket to the Set Top Box.
[71] But with the undertaking for analogue access finally ratified in March 2004 and Foxtel digital services commenced in the same month, this was indeed a pyrrhic victory for any access seeker! Analogue access thereafter had no commercial or strategic value compared to that of digital.
[72] Refer to ACCC Press Release "ACCC accepts the new analogue pay TV access undertakings of Foxtel/Telstra multimedia" MR 045/04, issued 25 March 2004, at http://www.accc.gov.au/content/index.phtml/itemId/510383 accessed 13 May 2007
[73] Seemingly contradicting their declaration of 'no digitisation without legislation', they also undertook to supply access to digital services once retail service delivery commenced, even if exemption had not been granted!

Prior to these amendments, exemption orders could only be sought and gained for active declared services, which was simply not the case for digital pay TV services which didn't then exist.

The intention of the amendments was "to provide certainty for potential investors in telecommunications infrastructure and services in relation to access to that infrastructure or service in the future" by increasing "the level of competition and investment in the telecommunications market to the benefit of consumers and business". (2002)

In making such an exemption order, the ACCC would need to be satisfied that such an order would promote the long-term interests of end-users of the said carriage services or services provided thereby.

For an access or potential access provider, gaining exemption from the standard access obligations of section 152AR of the Trade Practices Act had the advantage of avoiding (or conversely, disadvantage for the access seeker in not having the benefit of):

- The application of any future ministerial pricing determination made pursuant to section 152CH;
- Any access seeker rights including arbitration, enforcement and remedial rights, in accordance with Sections 152AY, 152AYA, 152AZ, 152BB, 152BBA, 152BBB, 152BBC, 152CM, 152CO – 152EB, 152EF and 152EG of the TPA.

4.6.3 Exemptions leading to digital access

Two days after the Telecommunications Competition Act gained assent, Telstra and Foxtel lodged anticipatory individual exemption order applications with the ACCC relevant to the proposed provision of digital pay TV services. Following an inquiry, the Commission concluded that granting an exemption should provide for greater certainty for access than leaving the issue open to potential declaration, as well as resulting in a more timely investment decision. Greater access would also potentially improve the efficiency in use of the Telstra/Foxtel network and enhance the build/buy decision by access seekers for subscription television services.[74]

The ACCC announced its final decision to accept the revised undertakings of Telstra and Foxtel on 12 December 2003.[75] These were the first anticipatory exemption orders made as a consequence of the TPA amendments introduced 12 months earlier. Under the Telstra and Foxtel Digital Access Agreement, the services to be supplied include distribution over the Telstra HFC network and access to Foxtel's Set Top Boxes, conditional access and Smart Card authorisation services. Most importantly, any digital STB had to be "actually in use by a subscriber for reception of

[74] Refer to document index "Anticipatory exemptions: Foxtel and Telstra - digital pay TV services" at http://www.accc.gov.au/content/index.phtml/itemId/754926/fromItemId/786596 accessed 13 May 2007

[75] Refer to ACCC Press Release "ACCC grants exemption to Foxtel/Telstra for digital Pay TV services" MR 267/03, issued 12 December 2003, at http://www.accc.gov.au/content/index.phtml/itemId/424020 accessed 13 May 2007

Foxtel's digital subscription television services" and "as a total package and not as one or more component parts".[76] Other key features of Digital Access Agreement included:[77]

- An annually published rate card, calculated in accordance with a publicly available methodology and independently audited;
- Access to an active customer smart card database designed to support at least 25 access seekers;
- Access to the digital network once 100,000 digital cable STBs are rolled out as part of a commercial digital cable service or 6 months after Foxtel's digital launch whichever date is sooner;
- A fixed percentage of capacity allocated on the Telstra HFC network and Foxtel's STB network available to access seekers, namely:
  - 15% during the dual transmission of both analogue and digital services (likely to be 24 channels); and
  - 35% once Foxtel is only supplying digital services (likely to be up to 192 channels).
- Foxtel to use all reasonable endeavours to obtain the consent of the lessor of the digital STBs, understood to be ABN AMRO and the Commonwealth Bank of Australia, to use those STBs for the supply of services to each access seeker.

No undertaking was given by Telstra for third-party access to its cable modem-delivered Internet service and nor was this sought by the ACCC. The ACCC also acquiesced with Foxtel and Telstra's insistence that their undertakings should exclude 'return path or interactivity functionality' from the digital set top box services provided by Foxtel, in addition to exclusion of, among other items:[78]

- Call centre services;
- Subscriber management and related services, including billing;
- Electronic Program Guide services;
- Any digital STB functionality, other than decryption of the access seeker's digital subscription television services;
- Dedicated access to any second or subsequent tuner and/or hard drive in the Digital Set Top Unit[79]; and
- Magazine and program guide listings.

The Foxtel digital pay television services commenced in March 2004 and over the subsequent three years, analogue STBs were to be progressively replaced by digital STBs. (Lehmann 2005) On 21 February 2005, Foxtel launched its Personal Digital Recorder, iQ, with Chief Executive Kim Williams declaring "The three-way combination of the FOXTEL iQ set-top-box, the vast pallet(*sic*) of FOXTEL Digital

[76] In other words, any access seeker's channel(s) can only serve as a complement to the basic Foxtel package of channels and never as a substitute for it, with the effect that the access seekers offering would have to be purchased as a premium tier once a subscriber had already purchased Foxtel's basic package.
[77] Refer to Foxtel Press Release "ACCC Decisions on Third Party Access to the Foxtel Platform – Explanatory Notes", issued 16 December 2003, at http://www.foxtel.com/209_1265.htm, accessed 13 May 2007
[78] Clause 4.2(a) of the Digital Access Agreement refers.
[79] This effectively excludes access to the Foxtel iQ personal digital recorder.

channels, and the FOXTEL Digital Guide that binds it all together, delivers the ultimate television experience".[80]

4.6.4 Tribunal invalidation of exemption

Seven Network Limited and its cable television arm, C7 (collectively 'Seven Network') first requested access to the Telstra network and Foxtel pay television service in August 1999 and since then had not shied away from the ongoing process of legal challenge and regulatory inquiry. The only other access seeker, TARBS, went bankrupt late 2003.

On 30 December 2003, the Seven Network filed an application with the Australian Competition Tribunal for a review of the decision by the ACCC made on 12 December whereby Telstra and Foxtel were granted anticipatory exemption from the standard access obligations set out in section 152AR of the Trade Practices Act with respect to their digital subscription cable television service. In a stunning reversal of fortunes, the Tribunal set aside the ACCC decision and invalidated the anticipatory exemption. Dated 30 September 2004, the judges' reasons for decision were published on 23 December 2004. The highlights are:[81]

- The exemption order sought by Telstra and Foxtel would not promote the long-term interests of end-users and the exemption would not be likely to achieve the objectives of:
  a. promoting competition in markets for listed service having regard to the extent to which the making of the exemption orders will remove obstacles to end-users of listed services gaining access to listed services; and
  b. encouraging the economically efficient investment and use of the digital infrastructure.
- Digitisation by Foxtel and Telstra was going to occur by the end of March 2004 at the earliest and by October 2005 at the latest, regardless of whether an exemption (in the form of a Final Order as defined in the section 87B undertakings) was granted to each of Foxtel and Telstra;
- Refusal to make the exemption order on the grounds that digitisation is going to occur in any case will not deter future investors;
- The exclusion of interactivity from the exemption orders granted by the Commission, thereby requiring potential entrants to obtain access under multiple parallel regimes would place them at an unjustified competitive disadvantage, and may discourage entry;
- The tie of the Basic Package to access to Foxtel's services as contained in the digital access agreement is a significant deterrent to entry, as it makes a prospective access seeker vulnerable to potential manipulation by Foxtel of the Basic Package to prevent or to preclude competitive conduct;
- The period of the undertakings and the length of the exemption period which may, at Foxtel's or Telstra's option, extend until the end of 2015 provides no certainty to potential access seekers - in contrast, these undertakings appear to

[80] Refer to Foxtel Press Release "Foxtel iQ - Foxtel's Personal Digital Recorder Unveiled", issued 21 February 2005, at http://www.foxtel.com/209_3229.htm, accessed 13 May 2007
[81] Seven Network Limited (No 4) [2004] ACompT 11 (23 December 2004)

have been structured to give Telstra and Foxtel 'an each way bet' such that they can exit their self-constructed access regime if it does not meet their interests or, conversely, they can elect to extend it for a further eight years;

- While accepting the pricing methodologies underlying the Telstra and Foxtel access price, more rigorous verification of the inputs would have been appropriate. One key element not adequately addressed in the decision by the ACCC was that of quantifying the value of Telstra's 'telephony defence' strategy in deploying a HFC network.

4.6.5 The sequel

The decision by the Australian Competition Tribunal (ACT) meant that Telstra and Foxtel no longer had the benefit of an exemption from Part XIC of the Trade Practices Act if the ACCC ever decided to declare a digital cable pay television service in the future. If that eventuated, presumably following notification of a new access dispute, the ACCC would have the power to set its own terms and conditions for digital access. At least in theory, access seekers would then be more likely to become beneficiaries.

According to Foxtel chief executive Kim Williams "The ACT's decision renders Foxtel vulnerable to a declaration by the ACCC which could result in terms and conditions we see as commercially unacceptable". (Sainsbury and Schulze 2005)

Notwithstanding this regulatory setback, Foxtel announced that from 24 February 2005 it was broadcasting the services of the first third party to utilise Foxtel's digital open access regime. TVN or ThoroughVisioN, a thoroughbred racing channel operating independently of Foxtel, would be responsible for marketing its channel and the management and billing of its own subscriber base.[82,83] (Lehmann 2006)

In the meantime, the Seven Network began to pursue PBL, News Limited and Telstra (the three partners in Foxtel), as well as a raft of other media companies and sporting bodies in the courts, accusing them of illegally conspiring to force the closure of its pay television sports channel C7 in 2002. (Schulze 2004b)

Foxtel subsequently lodged a special access undertaking in relation to the digital set top box service in October 2005, which was later replaced by another in December 2006. After agreeing to amendments sought by the ACCC, the Commission accepted the special access undertaking in March 2007. (ACCC 2007) The Seven Network immediately appealed to the Federal Court claiming, in part, that Foxtel is not obligated to supply set top box service in locations where Foxtel does not have subscribers. (Moran and Schulze 2007)

---

[82] Refer to Foxtel Press Release "Foxtel provides open access to its digital platform", issued 24 February 2005, at http://www.foxtel.com.au/209_3248.htm, accessed 13 May 2007

[83] This independence could be short-lived, with Foxtel partner PBL mooted to be interested in taking up a 25 per cent stake in TVN just over a year later. Lehmann, J. (2006). TVN on track to race ahead with Telstra and PBL. The Australian. Sydney.

4.7 Discussion

In this section we discuss possible limitations arising from analysis of the Telstra/Foxtel pay television HFC-delivered network as a case study, followed by a summary of findings that should inform the Research Question.

4.7.1 Limitations of Case Study

In contrast with the other two, this case study has been quite detailed; not only is there a wealth of primary and secondary source material available from which to analyse how and why Telstra's interest in open access to pay television has waxed and waned over the years, the events and reasoning of key players, determinations and judgements are complex by nature.

In my own small way I was one of those players, initially as a manager within Telstra's pay television project team during the era when open access was considered the natural way of things and later providing expert advice assisting the ACCC with their arbitration of access disputes and concurrent legal challenges. While initially generating the interest to commence this dissertation, this background experience provided me in particular with the ability to 'connect the dots' from the large amount of information and so achieve a clearer understanding of the often quite vigorous and often arcane contests between the access seekers and access providers.

Matters such as access to content, mergers within the pay television industry and third line forcing have not been explicitly addressed. The first two in particular certainly had an adverse impact on the business plans for aspirant access seekers but not on the actual denial of access. However, the monopolisation of content by Foxtel and Optus more than likely added to the overall delays in the whole process of attempts to gain access. The case study identified the importance of delay by access providers in thwarting the advances of access seekers.

On entering the realm of the protracted legal and regulatory challenges and counter-challenges, the case study could easily have greatly increased in size by analysing the most complex and detailed judgements and determinations. Instead, the treatment of events and their meanings was restricted to appreciating the nature of outcomes rather than the detail of the processes involved in getting there.

The Telstra-Foxtel HFC network was primarily constructed to deliver pay television, with data carriage for Internet service a secondary consideration. Historically this has also been the case in the United States of America, the home of 'cable' television. However from the viewpoint of third party access, Australia and the USA have differed greatly. If this case study had covered USA experience, it would have dealt with a large amount of material concerning attempts by competitive Internet service providers to gain access to the data capacity of the cable networks. The Australian experience has been the opposite, with no attempts to seek declaration of access to the cable modem service and so this case study instead focussed on the matter of access to the television broadcast capacity.

4.7.2 Findings

The key findings of the Telstra/Foxtel pay television case study are summarised in a stand-alone manner. Interpretations made possible by drawing correlations with the other case studies are withheld until Chapter Eight.

General

The process of gaining access to Australia's dominant cable television network has been tortuous and time consuming – and yet to be fulfilled in any meaningful way. For the first two years from 1995 to 1997, a government mandate denied third party access on the promise of competition which was never effective and is now basically stymied. Between 1997 and 1999, deeming and declaration by the regulator made third party access legally possible but impractical due to regulatory uncertainty. That period was followed by yet another two years of public legal challenges involving the access providers, access seekers and the regulator, running in parallel with private arbitration of the access disputes by the regulator. The end result of these political, regulatory and commercial processes has been nine years of delay in the provision of access to competitive parties.

Threatening not to upgrade to digital working (and thereby perpetuating an inherent shortage of analogue channel capacity) but with the backing of new provisions of the Trade Practices Act aimed at promoting investment in telecommunications infrastructure, Foxtel and Telstra gained regulatory approval via agreed undertakings to permit third party access to their digital service infrastructure from December 2003 and analogue service infrastructure from March 2004. With digital Foxtel services also having commenced in March 2004, no third party would then have sought analogue access. And as the Australian Competition Tribunal revealed in its September 2004 decision, it was quite likely that Foxtel and Telstra would have digitalised regardless.

Since 2002, the supply of pay TV content within Australia has consolidated to the extent that other incumbent operators now effectively draw upon the same pool as that of the dominant provider. (ACCC 2003a) Any third party aspiring to gain access to digital capacity faces the challenge of having to offer content sufficiently enticing to carve out a new share of a market that has been the sole province of monopoly providers since 1995. The prospects of the now dominant access providers, Foxtel and Telstra are now even further enhanced whilst the prospects of any third parties to gain worthwhile access to the Foxtel/Telstra network are greatly diminished. The Seven Network foresaw such an outcome in its submission to the Senate inquiry into the Telecommunications Competition Bill 2002: (Seven Network Supp 2002: 17)

> ….. in the telecommunications and pay TV industries time is of the essence. Access delayed is access denied. Delays in obtaining access entrench the position of incumbents, thereby defeating the purpose of the regime by stripping access-seekers of the intended benefits of access and making it difficult, if not impossible, to generate competition from access-seekers at a later date.

Closure wins over openness

By the end of the moratorium on subscription television, the government was well informed by various public inquiries and commissioned reports as to which delivery technologies could be deployed. Satellites, favoured for their ability to serve an Australia-wide audience from the outset, involved significant capital outlay to launch and at the time offered strictly limited channel capacity. Viable business models called for vertical integration which inevitably led to closed access operation – an arrangement in keeping with the norm established by commercial television broadcasters. Business models for microwave (MMDS) delivery followed a similar pattern.

In comparison, cable then offered some 20 to 36 channels – a capacity 'expected to be well in excess of the availability of potential programmers' according to a 1975 report from the government-owned telecommunications carrier, Telecom Australia. Scarcity of delivery capacity was clearly not seen to be an issue. Imbued with the principle of 'common carriage', the report recommended an open access business model whereby channels would be leased to a variety of operators. The principles of common carriage and open access for cable television services were further emphasized in the House of Representatives committee report of 1989, the last before the moratorium was lifted. Any cable television network was still seen to be the natural province of Telecom Australia to deploy. By end 1992 and the first year of operation by Telecom's only general carrier competitor Optus, Telecom Australia continued to make public its intention of being in the business of delivering pay television as a common carrier.

With no wireline access network, Optus became concerned about the increasing access and interconnection payments being paid to Telecom. Optus further claimed that Telecom was discriminating in the supply of services to corporate customers and took legal action. As their deep distrust of Telecom Australia grew, so did their desire to be independent of Telecom by creating a separate local access network. This was the tipping point that led Optus to become interested in the delivery of cable television.

The 1993/94 period witnessed many US telephone and cable television companies becoming interested in entering each other's markets, aided by new technologies that enabled television signals to be carried over telephone lines and telephone calls over cable television networks. Part owned by US carrier Bell South, Optus began regular discussions with Continental Cablevision, the number three cable television operator in the USA. Optus was fast becoming convinced that if it created its own HFC network, pay television could act as a carrot to attract subscribers for telephony and online services. Failure to build its own network promptly would encourage others to build once full competition arrived after July 1997. In the meantime, Telecom Australia was marketing its common carrier plans but encountered problems in dealing with the allocation of television channel capacity once operating under an open access business model. With around 67 analogue channels available, HFC network capacity was now fast becoming a scarce resource.

In announcing a joint venture to deploy an HFC network throughout Australian capital cities, Optus and Continental Cablevision devised a business model that would

exercise control over the channels delivered so as to attract the widest market of subscription television viewers who could then be 'pulled though' to become customers of an Optus telephony service. All revenue streams would be captured by the one business that would adopt a homogeneous marketing strategy. Optus concluded that such a business model could only be successful if it avoided the common carrier requirements of the Telecommunications Act 1991 by permitting the business to discriminate against unwanted service providers. Clever lawyers and skilful political lobbying would be necessary to bring this about.

The Minister for Communications was confronted with a dilemma – agree with the Optus proposal which ran counter to the government's philosophy as well as the Telecommunications Act, or reject the proposal and lose a golden opportunity to create a wireline local telephone service independent of Telecom Australia's. The Minister relented and legalized the proposed discrimination through the instrument of a Carrier Associates Direction that would operate until 1 July 1997.

As these events unfolded towards the end of 1994, Telecom Australia was experiencing far less success than Optus in garnering service providers for its proposed open access cable television network. Would it roll out an HFC network, primarily now as a 'telephony defence' against Optus, but without secure agreements for the supply of content? Faced with a bold Optus/Continental cablevision joint venture about to win the Minister over to a closed access business model, Telecom's chief executive envisaged great difficulty for a Telecom open access business to co-exist with an Optus closed access business when serious content service providers were enticed by the opportunity to take a share in the revenue of the whole business. Conversely, Telecom Australia did not want to be marginalized by continuing to only earn revenue from basic carriage. Telecom promptly discarded its long held plans for an open access network to deliver subscription video, data and information services. Thereafter the two major Australian cable television networks commenced operation as vertically integrated businesses with closed networks justified on strategic and commercial grounds.

HFC technology restricts access

The Telstra HFC network commenced operation employing analogue transmission. With each length of coaxial cabling required to deliver the same channels to hundreds of subscribers along a given route and being of low cost design with a limited bandwidth, the coaxial cable elements limit the overall carrying capacity of the network emanating from a given Head End to some 64 analogue video channels. Such a limited quantity is potentially an access bottleneck depending on the demand for channels. However in the case of the Telstra/Foxtel pay television business via cable, the bottleneck became immediate as Telstra contracted all channel capacity to Foxtel.

Software within or interfaces between set top boxes, subscriber management, conditional access and electronic navigation systems are invariably designed in anticipation of access being closed. Certain parameters, particularly within set top boxes, may be embedded in firmware or hardware and not possible to change without replacing the units. Regulated attempts to open up access ex-post will generally encounter the need for modifications to be made to software, middleware

and even certain hardware items, all of which result in cost to be recouped from the access seeker and delay in making access effective.

Common carriage sacrificed for investment certainty

Despite many years of government inquiries and reports all concluding that any pay television cable should be operated under a common carrier arrangement, and despite Part XIC of the Trade Practices Act creating the mechanisms to facilitate an (open) access regime, three critically timed government-sponsored interventions provided investment certainty at the expense of the common carriage/open access principle.

- Carrier associates direction of 1995

By August 1994, Telecom Australia had filed a tariff with the regulator for common carriage of pay television services. Optus declared to the government its intention to create a new broadband cable network for the delivery of pay television, data and telephony – on the proviso that both infrastructure and service access would be closed to parties not part of its business model.

Despite alarm over the prospect of duplicated cable infrastructure and closed access for consumers and excluded service providers, the government faced collapse of its policy aim of encouraging facilities-based (that is, infrastructure) competition during the 1992 - 1997 telecommunications duopoly phase. The government was attracted to the creation of an alternative telephony network and supported the argument for closed access through garnering greater investment from sharing both content and carriage revenues. The Telecommunications (Service Providers Class Licence) Direction No. 1 of 1995 was thereby issued to grant the new entities of Carrier Associates exemption from being required to provide access for another entity's pay television service until 1 July 1997.

Optus commenced roll-out of its cable television network which began commercial service in September 1995. Telstra's roll-out substantially mirrored that of Optus by adopting a blatant defensive strategy, although in reality Telstra's plans had been incubating for years beforehand. As a consequence, Australia witnessed the almost parallel deployment of substantially identical HFC networks. The investments in both networks were later substantially written off by up to $4 billion – a clear sign that this duplicated infrastructure, where just one network could service all market needs, was plainly uneconomic. (Budde 1999) Each network was monopolized by its owner and eschewed third party access for alternative programming and services.

- Protected contractual right defence of 1997

Pay television service via cable began in September/October 1995 and the first exposure draft of changes to the Trade Practices Act was tabled before Parliament on 20 December 1995, towards the end of the Keating labour government. In keeping with the statement of Telecommunications Policy Principles post-1997 released on 1 August 1995, Principle 20 stated that "a carrier would be able to deny a request for interconnection or carriage on reasonable grounds, including

connection not being technically feasible or insufficient capacity being available".[84] There was no mention then of any 'protected contractual right'. Dismayed at the prospect of having to provide access, Telstra and Foxtel lobbied the new Howard coalition government for protection from third-party access - insisting that Telstra had already contracted all cable capacity to Foxtel. Accordingly, by the time the second exposure draft was tabled on 13 September 1996, section 152 had been modified to include an access exemption in the event of a 'protected contractual right'. This new defence against access was operable from that date and used by Telstra Multimedia and Foxtel Management to deny requests by Seven Cable and TARBS for analogue access.

Due to circumstances peculiar to the agreement between Telstra Multimedia and Foxtel Management, application of the defence was legally defeated but only after the two access seekers lost valuable time to establish new businesses via cable. Once the ACCC declared cable-delivered analogue subscription television services in early September 1999 and assuming early resolution of the dispute over channel capacity, Seven Cable could have had up to twelve months lead time to provide pay television coverage of the Olympic Games held in Sydney between 15 September and 1 October 2000. The most favourable outcome could have been the ongoing commercial survival of Seven Cable, as well as TARBS, resulting in a more competitive pay television industry.[85] With the sunset date now passed and the claims of Telstra and Foxtel rejected by the courts, the defence of 'protected contractual right' is now no longer applicable. However at the time it served its purpose by providing greater investment certainty for Telstra and Foxtel.

- Anticipatory exemption vehicle of 2002

The origins of anticipatory exemption hark back at least to the 2001 inquiry by the Productivity Commission under the direction of the government to 'review the state of competition in the telecommunications market, and the impact of new technologies and delivery platforms'. Telstra and Foxtel exploited this additional opportunity to bolster their case for restricting third party access to their pay television network and convinced the Productivity Commission that the telecommunications access regime was deficient as long as it allowed the ACCC to declare services only if they were 'active' or in existence. Keen to facilitate investment in new telecommunications infrastructure by reducing regulatory uncertainty for services not yet declared or services not even in existence, the government proposed a new 'anticipatory exemption' vehicle that could be used to bypass standard access obligations.

---

[84] Refer to "Parliamentary Bills Digest No 72 1995-96; Telstra (Dilution of Public Ownership) Bill 1996" at http://www.aph.gov.au/library/pubs/bd/1995-96/96bd072.htm accessed 13 may 2007. Also refer to paragraph 64 of Seven Cable Television Pty Ltd v Telstra Corp Ltd [2000] FCA 350, Federal Court of Australia, 27 March 2000.

[85] In reality, Seven Cable was unable to create a brand name in the nascent pay television industry which, amplified by its subsequent inability to wrestle broadcasting rights to certain other sports events from News Corporation, led to its eventual demise. TARBS ultimately met a similar fate, though for more complex reasons. Given that Seven Cable and TARBS were the only original access seekers, their departure from the market significantly enhanced the opportunity for Foxtel to dominate Australian pay television content and delivery.

Commencing 19 December 2002, actual or potential access providers gained the right to apply to the ACCC for exemption from the standard access obligations detailed in section 152AR of the Trade Practices Act, prior to a telecommunications service becoming an active declared service or even prior to an investment being made in a telecommunications service, that is, they could seek 'anticipatory exemption'.

Telstra and Foxtel immediately applied to the ACCC for anticipatory exemption from the standard access obligation that would otherwise apply to their proposed digital pay television services. Twelve months later, the Commission made the first anticipatory exemption orders and commercial digital service delivery commenced three months thereafter, in March 2004. The Seven Network immediately challenged the Commission's orders by appealing to the Australian Competition Tribunal. In setting aside the orders, the Tribunal revealed flaws in the ACCC decision-making process granting exemption and saw through a series of disingenuous claims by Foxtel and Telstra. Even though this judgement meant that the anticipatory exemption application by Telstra and Foxtel had been wasted, they nevertheless gained a huge strategic advantage by having commenced digital service operation on their own terms – and without third party access. However, the generic right to seek 'anticipatory exemption' remains unaffected as a vehicle available for access providers to call upon in the future.

Business success with closed access

A series of deliberate strategic moves by Telstra and Foxtel since the mid 1990s secured the continued operation of the Foxtel network and conversely the demise of aspirant players in the Australian pay television business desiring to use cable delivery. Advantage was particularly taken of opportunities presented by the evolving regulatory and commercial environments in telecommunications and the media.

- Delayed access

Telstra and Foxtel were resolute in their conviction that continued legal and regulatory delays would enable them to further entrench their market position, particularly by growing subscriber numbers in the final years of analogue provision, before the digital network arrived and removed capacity as the prime argument against additional service providers.

Access delayed was access denied, according to the Seven Network, in that delay caused by regulatory fiat or legal challenges over some nine years stripped access seekers of the intended benefits of access by making it difficult, if not impossible, to generate competition at a later date.

- Terms of access dictated

Telstra and Foxtel exploited the regulatory labyrinth to sufficiently prolong arbitration until they were ready to provide access undertakings to the ACCC. Crafted by their own lawyers, these undertakings were subjected to public inquiry which entailed critical examination by the Commission and the few other parties interested in the matter of access. Although the ACCC extracted a few concessions from the access

providers, in reality Telstra and Foxtel were privy to the greater amount of information and had already dictated the prime grounds for undertakings of analogue and digital access that they considered to be commercially acceptable.

Given digitisation from March 2004, the analogue undertaking settled that same month was immediately of little value to any serious access seeker. On considering Telstra and Foxtel's terms of the digital access agreement, the ACCC concurred with the mandatory inclusion of Foxtel's basic package and the exclusion of interactivity. The Australian Competition Tribunal subsequently found these and other terms of the agreement to be placing an access seeker at an unjustified competitive disadvantage. Prior to this legal setback the incumbent had succeeded in setting the agenda.

- Unrestricted business entry

Australian telecommunications and broadcasting has long followed developments in the United States and Britain, except in the matter of carriers being initially excluded from providing cable television services.

Fearing the infant United States cable industry would be swallowed by telephone companies, Thorne (1995: 487, 489) records why the 1970 FCC Rules and the 1984 Cable Act explicitly forbade telephone companies from offering cable television services to the public. By the time the 1996 Telecommunications Act permitted telephone companies to provide video services and cable operators to provide telephony, the US had gained massive competing sets of broadband infrastructure in consequence of this initial prohibition. (Huber 1997)

Once British Telecom was split from the Post Office and duopoly competition allowed from 1983, the Telecommunications Act segregated the telecommunications and cable television markets. Although cable television companies were permitted to provide telecommunication services after 1991, the prohibition against carriers providing cable television services was extended for another decade. (DTI 1991) The ban on broadcasting by UK carriers was finally lifted in January 2001.

The closest Australia came to a similar regulatory situation was a recommendation from the 1989 House of Representatives Committee that Telecom Australia be made the common carrier for cable pay television but be prohibited from being a pay television operator and from influencing or determining the program content of such television. By the time the ex-AUSSAT satellite had been purchased by Optus in 1992, the government had already selected satellite to deliver the first national pay television service. Although Telecom Australia's intentions to at least provide carriage services for pay television and other information services had been well publicised since at least 1975, by 1992 this was being marketed as not being 'a threat to satellite delivery but rather as a complementary service'. The government of the day had simply not anticipated that cable delivery could occur so quickly, let alone soon become the foundation for the dominant business in Australian pay television. As a result, Telstra Corporation was totally unfettered to enter into a joint venture that ultimately became Foxtel, with 50 per cent ownership as at 2006.

- Minimal competitive threat

Telstra entered the pay television business in late 1995 as a 'telephony defence' strategy to counter Optus. With cable roll-outs duplicated in some 80 per cent of streets, Telstra and Optus effectively neutralised one another's strategic advantage. Once the regulations against aerial cabling killed off any further roll-out by either party and each company wrote off billions of dollars of HFC network investment, the prospect of any other cable competitor operating in the same territory vanished. In March 2002, an agreement was reached to share pay television programming whereby Optus would become largely a reseller of Foxtel content. Foxtel thereby neutralised any competitive threat from Optus Vision and Telstra's 'telephony defence' had finally become effective although at a huge cost.

Telstra and Optus also exploited their HFC networks to provide data capacity via high speed cable modems for their respective ISPs. In the United States, third party access to such data capacity had become a defining issue for 'open access', occupying the attention of judges, regulators and academics for a number of years. In contrast, no Australian ISP approached the ACCC 'in any concerted way' to request declaration of a cable modem service so that it would become subject to the standard access obligations of the Trade Practices Act. Telstra's cable modem service commenced in April 1997 followed by Optus. Ozemail was the only other ISP at the time with sufficient financial resources but they were intent on selling their business. With broadband Internet competition by then still immature and other ISPs seemingly more interested in gaining unbundled access to Telstra's paired copper local loop network, third party access to the cable modem capacity of Telstra and Optus continues to remain closed to competitors. Considering the current attractiveness of ADSL access utilising Telstra's CAN, this situation is unlikely to now change.

The final realm for competitive threat was posed by the Seven Network and TARBS who sought access to Telstra's HFC distribution network and Foxtel's pay television service. Their story of repeatedly rebuffed attempts to gain access has already been told. TARBS is now bankrupt and by 2005/07 the Seven Network was relentlessly pursuing PBL, News Limited and Telstra (the three partners in Foxtel) in the courts, accusing them of illegally conspiring to force the closure of its pay television sports channel C7 in 2002.

CHAPTER FIVE – TRANSACT NETWORK CASE STUDY

This case study assessment examines the TransACT broadband network currently servicing suburbs within Canberra, Australian Capital Territory. Conceived in 1996 and operational by 2000, it was designed from the outset as an open access network capable of connecting a variety of service providers to customers, each with its own data stream of up to 52 Mb/s. TransACT remains unique within Australia and a relatively rare occurrence worldwide.

Perhaps TransACT is more a creature of its times and unlikely to be repeated, but the overwhelming lesson is that open access was achieved voluntarily, not by regulatory fiat, and that it works.

5.1 Background

Two national developments in the period 1993-1995 had a significant impact on the creation of TransACT. These were the agreements on national competition reforms, particularly as they affected government business enterprises such as electricity distributors, and the end of a 15-year long federal government moratorium against pay television, as exemplified by the roll-out of competitive services and the creation of communications infrastructure by entities other than Telstra. At the same time, new 'interactive broadband services' were beginning to excite policy makers, providers and users.

Corporatisation of government business enterprises

In October 1992, Australian governments initiated a national approach to competition policy reform when they established an Independent Committee of Inquiry into a National Competition Policy for Australia. The committee's recommendations were presented the following year and became known as the Hilmer Report, named after its Chair, Fred Hilmer. (Hilmer 1993) Leading on from the recommendations of the committee, all Australian governments reached agreement in April 1995 on a National Competition Policy (NCP). Three intergovernmental agreements underpinning the NCP are contained within the Compendium of Competition Policy Agreements which included, inter alia, agreements that the governments would, where appropriate, adopt a corporatisation model for its government business enterprises and remove any competitive advantage such enterprises may have over privately owned businesses. (NCC 1998, Clause 3(4))

Within the Australian Capital Territory, the supply of electricity, water and sewerage services had been the responsibility of the ACT Electricity and Water Authority, an integrated utility considered unique within the major cities of Australia. In accordance with NCP principles and at the behest of the incoming Liberal government led by Chief Minister Kate Carnell, the authority was transformed into ACTEW Corporation Ltd on 1 July 1995.[86] This privatised entity had two voting government shareholders,

[86] Donovan, P. (1999). Lights! Water! ... ACTEW! A History of ACTEW and its Predecessors. Canberra, ACTEW Corporation.

the Chief Minister and the Minister for Urban Services. The Chairman's Report of September 1996 highlighted that "the change from the Authority structure to that of a company removed some important barriers to progress" and included in the key elements of company strategic view were statements such as: (Service 1996)

> Our added role is to use elsewhere the skills built in our core business, to earn profits for the community that we serve and who are our ultimate owners.
>
> We do not expect or seek favoured treatment from Government. However, parallel to that a substantial degree of commercial independence is necessary if we are to produce satisfactory financial results and high quality service.

Such a strategic view enhanced the prospects of a favourable response from ACTEW management on considering a later proposal for a new enterprise in the communications business.

Roll-out of cable television

By late 1994, Telstra commenced roll-out of its broadband hybrid- fibre coaxial (HFC) network followed by Optus in February 1995. (BIS Shrapnel 2001) What resulted was a frenzied race to cable suburban residential areas initially in Melbourne, Sydney and Brisbane such that some 85 per cent of targeted homes would be eventually passed by two sets of substantially identical infrastructure. By October 1995, pay television begun to be delivered to subscribers via satellite (Galaxy) and cable (Telstra and Optus Vision). From the outset, Optus strung all of its cabling along power poles to achieve a cheaper and faster roll-out that was independent of Telstra's underground conduit. Alarmed that it was being overtaken, Telstra commenced to follow suit by end 1995 and eventually constructed a HFC network that was part underground and part aerial.

By end 1995, Telstra and Optus had yet to announce plans to extend their HFC cabling to the national capital. Clearly, any roll-out in Canberra would occur only after the main capital cities had been exploited. A 1993 scheme by Telstra to provide the suburb of Gungahlin with a state-of the art multimedia network was quietly shelved. However, a few regional operators were developing plans to cable regional areas. The old paradigm of sole reliance on Telstra to create communications infrastructure had come to an end.

Interactive broadband networks and services

In December 1993, the Commonwealth Government commissioned the Broadband Services Expert Group and charged it with the task of examining the technical, economic and commercial preconditions for the widespread delivery of broadband services to homes, businesses and schools in Australia. With mass market adoption of the Internet yet to be realised, the Group considered the future for 'interactive broadband networks' throughout Australia to carry 'interactive information and

---

From here on, ACTEW is taken to refer to either the ACT Electricity and Water Authority or ACTEW Corporation Ltd (both being publicly owned) whereas ActewAGL refers to the part-privatised entity formed in October 2000.

communications services'. In its final report tabled December 1994, the Group spoke of the need for a "managed evolutionary approach, building on opportunities offered by existing services and infrastructure". (BSEG 1994, Ch.2 et al)

Current developments were then seen to be the recently commenced HFC networks by Telstra and Optus for the delivery of broadcast pay television services, followed by 'near video-on-demand' services some years later once transmission on those cables had been digitalised.[87] The Group forecast the next significant step to be "the transition to digital interactive or video-on demand services", noting that "the network architecture of such a system is complex". (BSEG 1994, Ch.2) Only optical fibre technology was then seen to be capable of supporting the required high-bandwidth two-way services. Referring to recent costing studies undertaken by the Bureau of Transport and Communications Economics, the Group concluded that such a transition impacting on all Australian households would cost many tens of billions of dollars and would take decades to occur.

Clearly, the phrase 'managed evolutionary approach' assumed continued nationwide dominance of Telstra's infrastructure and the ongoing challenge of upgrading its legacy technology. The Broadband Services Expert Group could not have anticipated a series of serendipitous events unfolding over the next few years in the Australian Capital Territory that would belie this assumption.

5.2 The TransAct Communications Project (1995 – 1999)

Dr Michael Sargent was appointed Chief Executive Officer of ACTEW in November 1991 and continued until August 1997, a critical period covering corporatisation of the Authority as well as the birth of the TransAct communications project. Mike Sargent insisted on staff development and encouraged people to develop themselves professionally, to ensure change became acceptable and permeated the organisation from below rather than being imposed from above. (Donovan 1999, p.222) In April 1994 he inaugurated a leadership program that featured three main components; a residential retreat during which participants learned appropriate skills, an outdoors component where participants honed some of these skills, and an 'action learning' project. This latter component involved five or six people who were given a project identified by a member of the executive. Each project ran for about five months, typically involving about half a day each week, after which they were required to present their findings to their colleagues. (Donovan 1999, p.225) Participation in the program was a sure sign of advancement and was greatly sought after.

Some time during 1993, Robin Eckermann – an IT consultant who had developed an interest in communications – sketched out some plans for pulling optical fibres through Canberra sewers and put the idea to Wayne Harris, General Manager Northern Region of ACTEW, who had a background in water and sewerage engineering. The idea provoked interest, but was then set aside until around October 1995 when Harris remembered the earlier proposal and literally knocked on the door at Eckermann's home one Saturday with the query "what do you know about broadband".[88] According to Eckermann, Harris got "a full dose of broadband

[87] This eventually occurred in March 2004.
[88] Record of telephone transcript, Kelso/Eckermann, 17 September 2004.

enthusiasm" and mentioned that ACTEW had established a small project team to explore the possible use of aerial bundled conductors – several electricity lines bundled into one cable – which might prove more compatible with the larger, more established trees then being encountered in the older suburbs of Canberra. Donovan (1999, p.276) records this team as being members of the fourth leadership program established by the CEO, Mike Sargent. The team report made a passing note about the prospects of including optical fibre within bundled electricity cables but could do no more than recommend a subsequent team explore the matter in further detail. Telstra and Optus were already well advanced in rolling out pay television cabling by late 1995, including much of it attached to electricity poles, but in cities other than Canberra.

Harris invited Eckermann to talk further about communication issues to ACTEW senior management on 30 November 1995. Eckermann outlined to them the trend starting to emerge overseas where some utilities were becoming interested in communications[89] and discussed the major different technology choices. Importantly, he touched on the many assets of utilities that were potentially a great launching pad to enter the communications business, for example, utilities already had networks, customers and billing systems.[90]

The idea continued to gestate. By early 1996, a team under the fifth leadership program was charged with the task of more closely examining ACTEW's possible role in communications. (Donovan 1999, p.276-277) The team was aware that by then both Telstra and Optus had made some tentative enquiries about attaching their pay television cables to ACTEW poles. To be more clear of trees, each company vied for the higher pole position. ACTEW engineers were concerned as to whether the poles would support two lots of wiring. As time passed, the matter remained unresolved and suspicion grew that Canberra was low on the priority list for the Telstra and Optus HFC roll-outs – perhaps because the poles were primarily located in the backyards of residences.[91,92]

Eckermann was invited in March 1996 to chat with this latest leadership team who, representing a broad cross-section of the organisation, had no background in communications at all. Subsequent discussions led to a small consultancy awarded

---

[89] Reference was made to the pioneering effort of the Glasgow Electric Plant Board in Kentucky, USA (http://www.glasgow-ky.com/epb/, accessed 13 May 2007) which established a cable television network in mid-1989.

[90] Record of telephone transcript, Kelso/Eckermann, 17 September 2004.

[91] Almost exclusive to the ACT, electricity poles installed at the rear of properties (called 'back-spining' or 'rear-spining') ensured picturesque streetscapes but, as trees matured and house extensions occurred, pole replacement became increasingly difficult. Donovan, P. (1999). Lights! Water! ... ACTEW! A History of ACTEW and its Predecessors. Canberra, ACTEW Corporation.

Experience in Sydney and Melbourne showed that two sets of pay television aerial cabling led to a proportion of poles having to be structurally modified.

[92] Other reasons for avoiding Canberra: By 1996, Optus Vision was bleeding financially and attracting tremendous public opposition for its aerial cabling elsewhere; Telstra (before also deciding to go aerial) was concerned over the high establishment costs for a new Head End to serve a relatively small market; furthermore Telstra's underground customer access network in Canberra was reportedly in poor condition, hence requiring too much replacement of conduit and/or telephone cable.

to Eckermann that enabled the leadership team to produce the very 'first cut' of a business case, culminating in the CabTech (cable technology) Report by September 1996. [93] This initial feasibility study produced a rough commercial model exploring the opportunities in communications and suggested a better rate of return than utilities generally get from other infrastructure investment. The analysis contrasted a hybrid fibre coaxial (HFC) with a fibre-to-the curb (FTTC) architecture, whilst a crucial issue identified was whether both Telstra and Optus cables should be allowed on ACTEW poles, or only one cable and the other company excluded, and regardless, should ACTEW workforce install it?[94] In fact, should ACTEW even own such cabling – in the same way as it already owned the poles and electricity wires?

The typical fate of a leadership team report may be to gather dust in a departmental filing cabinet, however the CabTech Report appealed to the CEO who had faith in his staff and was willing to entertain lateral ideas. Perhaps there really were opportunities for an electricity utility in the communications game? Mike Sargent escalated the report to the ACTEW Board who approved a budget to expand the project team, develop the technical options and commission some market research. The TransAct communications project formally began with a staff of four, including Robin Eckermann recruited as project manager. On 18 October 1996, potential service providers and investment partners were invited to register interest in the project, followed by a request for proposal (RFP) seeking comprehensive network infrastructure and service solutions issued on 1 November.

This dual-pronged approach reflected the belief that although ACTEW could demonstrate competence in many areas of relevance to broadband networking through it's distribution network, established customer service facilities and the ability to undertake complex engineering projects, it would need new skills and particularly those of a partner to help run telephony and data-related services.[95] ACTEW's focus would be on the deployment, maintenance and operation of a broadband customer access network – but not the services. It had no desire to become either a telephone company or a pay television operator. (ACTEW RFP 1996, 3.14)

The RFP reflected the promise of a 'green field' communications business only possible without the constraints of incumbency. The proposed ACTEW broadband communication network had to be able to support "a comprehensive range of video, telephony and data communication services as well as providing a communications framework for introducing utility-specific applications such as remote meter reading, customer energy management, outage monitoring etc." (ACTEW RFP 1996, 3.9) Video services could include basic broadcast television channels, premium subscription television channels, pay-per-view (PPV) services, near-video-on-demand (NVOD) and video-on-demand (VOD). The network had to deliver both telephony and data services, with the latter including access to the Internet that "could support a wide range of existing and emerging educational, entertainment, communication and commercial applications. Other data services could include high-

[93] Record of telephone transcript, Kelso/Eckermann, 17 September 2004.
[94] To carry out work on power poles installed in residents' backyards, ACTEW staff had to rely on ladders brought in by foot; it would have been unwise for ACTEW to subject residents to the intrusion of another company's workforce.
[95] Record of telephone transcript, Kelso/Eckermann, 17 September 2004.

speed connection to corporate LANs and video-conferencing to facilitate telecommuting." (ACTEW RFP 1996, 3.11-12)

However the RFP also reflected a crystallisation of project team thinking about the impact of additional communication cables to ACTEW power poles: it made no practical or business sense to allow more than one cable and since ACTEW was already in the 'wires business', it should own and operate that cable. But with neither Telstra nor Optus seemingly willing to provide pay television services to Canberra residents by then, would not such an ACTEW cable be in a monopoly position? The RFP gave the answer: (ACTEW RFP 1996, 3.13)

> **3.13** ACTEW intends that the network be as open as possible, with capacity being made available to a range of providers offering telephony, video and data communication services. The architecture of the network should be independent of particular services and service providers so that new services can be introduced as and when appropriate. It is envisaged that there will be only one type of network equipment at the headend and regional hubs/exchanges and only one type of Network Terminating Unit (NTU) or Set Top Box (STB) in each residence that is connected to the network.

The idea was straightforward – customers would experience one new communication cable leading into their homes[96], providing a single network interface, and through this 'pipe' would flow as many services as possible, all provided by a range of service providers independent of ACTEW. It is not surprising for a utility to think this way. Canberra residents already paid ACTEW a monthly fee for the electricity infrastructure plus a service charge for electricity consumed. In like manner, the cost to customers of the proposed communications network would be structured as a line rental for access to the network plus charges made by the providers of services such as telephony, the Internet and pay television. (Donovan 1999, p.277) A single broadband network would offer competition between service providers. (TransAct Communications Project 1997a) The secret would be to deploy a broadband communications network with an architecture to reflect this demarcation and also of sufficiently advanced design to economically deliver a panoply of services, including ones not currently envisaged – a 'full service network'.[97]

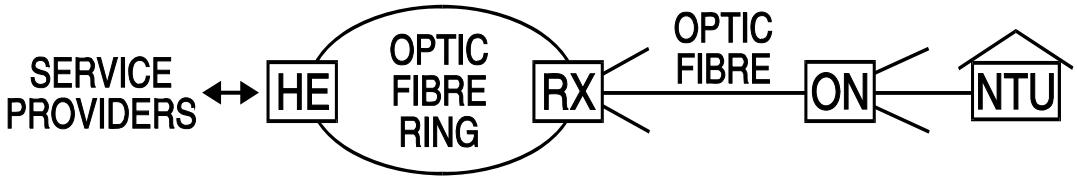
Right at the outset, the project team evaluated both the fibre-to-the-curb (FTTC) and hybrid-fibre-coax (HFC) architectures, but announced in the RFC that fibre-to-the-curb was preferred for the following reasons: (ACTEW RFP 1996, 3.16)

a. The socio-economic profile of Canberra was an ideal environment for pioneering future communications-based applications such as telecommuting, distance learning and electronic commerce;
b. By taking fibre 'deeper' into the network, the FTTC architecture was capable of cost-effectively supporting a high level of interactive demand not possible with the architecture of an HFC network;

[96] That is, in addition to Telstra's existing paired copper cable for telephony.
[97] In the view of the project team, neither Telstra nor Optus could ever compete with such a vision as they were in the midst of deploying HFC networks for only pay television services and would also be loathe to cannibalise their current telephony and data services. Historically, incumbent operators tended to create new networks that are service-specific.

c. Practical deployment of cables in Canberra's backyards necessitated a long-term strategy that avoided the need for subsequent upgrade;
d. The interactive capacity of an appropriate FTTC architecture would enhance options for high-grade telephony and data communication services.

The conceptual model for an FTTC architecture envisaged a fully switched digital broadband system capable of delivering voice, data and video services via a star-topology network from the service area optical node to a digital terminating unit in each residence. A minimum of 25 Mb/s downstream and 1 Mb/s reverse channel bandwidth per residence was requested. A range of service providers would interface with the network via a central 'headend' installation. The optical fibre would typically terminate in curb-side pillars or pits, mounted on poles or installed in the basement of multi-dwelling buildings. Although the conceptual architecture of Figure 7 implied an FTTC solution, the RFC was open to alternative offerings claimed to deliver comparable service functionality.



Key: HE = Headend (one only); RX = regional hub (multiple); ON = optical nodes (many); NTU = network termination unit (one per customer).

Figure 7 – Conceptual Architecture of a Fibre-to-the Curb Network
(Source: Adapted from ACTEW RFP 1996, 3.22)

The project team classified the 11 responses offering total network solutions into two streams: those utilising HFC versus those utilising FTTC technologies. (TransAct Communications Project 1997b) An economic comparison between the best within each stream selected an FTTC offering that deployed shared-use optical fibre to the Optical Nodes followed by individual copper pairs to each customer exploiting very high rate digital subscriber line or VDSL transmission – all configured in a 'switched digital' manner that would present each customer with a dedicated two-way broadband service. This latter requirement was critical for accommodating multiple service providers.

According to Eckermann, "the final straw that tipped it in favour of (V)DSL was that the HFC architecture broke down catastrophically with demand-based video services…. the methodology was to start with the vision (which involved a rich payload of services), then find the platform that most cost effectively supports that vision".[98] By June 1997, the project team had a clear preference for an offering that deployed an FTTC/VDSL architecture. This solution would ultimately be realised as the network for delivering commercial service. The remaining problem would be to attract a 'rich payload of services'.

[98] Record of telephone transcript, Kelso/Eckermann, 17 September 2004.

Eckermann recounts that under the model of ACTEW owning the 'wires' they would need a partner to provide all of the service-related expertise, and particularly in regard to telephony as "that was just a very complicated thing". An approach to Telstra was rebuffed, so the project team focussed business discussions on Optus and AAPT. The open network approach was reflected in the planned commercial structure: the project team used terms such as 'Netco' for the network company that built and owned the infrastructure (that is, ACTEW) and 'Opsco' for the entity that operated the network and provided the key service of telephony. An arm's length separation between Netco and Opsco was essential.

By about March 1997, a relationship with Optus appeared more promising but became deadlocked on some key issues: "We were going to spend what looked like some $150M on building the network – they wanted to come in with a switch (say a $2-3M investment), but be in a strongly dominant position and give a fairly small pittance to us by way of revenue. We would take the big risks building the network, but they would totally control the marketing and hence every aspect of our fate. We wanted them to also put pay television on it and other stuff but telephony was at the centre of their thinking at that stage".[99,100] These service negotiations, though delicate, were independent of whichever broadband technology was chosen.

ACTEW highlighted in July 1997 that the new network could not be monopolised by any one service provider: "Although ACTEW is entering into a business arrangement with one company, the network will still be essentially open to all service providers wanting to run services in Canberra. (TransAct Communications Project 1997c) By then, the prospect of a relationship with AAPT appeared more attractive than one with Optus. AAPT had been awarded a carrier licence on 1 July 1997 when the Australian telecommunications industry was finally opened to competition. However, due to the pending listing of AAPT on the Australian Stock Exchange, the board of AAPT put settlement of such a business relationship with the TransAct project on hold. With these discussions mutually discontinued, TransAct began to absorb the implications of the post-July 1997 deregulation of telecommunications – was having a 'telephony partner' now such a critical success factor?[101] By January 1998, a spokeswoman for ACTEW revealed a significant change in strategic thinking by TransAct: (Connors 1998)

> The more we talked to AAPT, the more we realised that linking up with one carrier would limit us, so we decided to preserve our independence. Any agreement could have left other service providers a bit dubious about how open the network really is.

Thereafter, the TransAct project team resolved to deploy its own telephony switch that would alleviate dependence on a single telecommunications carrier for narrowband services, yet still retain an 'open' network for broadband services.

---

[99] Record of telephone transcript, Kelso/Eckermann, 17 September 2004.

[100] Optus ceased their roll-out later that year (1997), had accumulated a massive debt and were already dismissing staff, so they couldn't have been seriously thinking about pay television! Establishing a telephony-over-HFC capability was a prime part of their original competitive strategy.

[101] Record of telephone transcript, Kelso/Eckermann, 4 February 2005.

University-conducted market research of Canberra and Wollongong residents and businesses showed wide support for ACTEW's involvement in the project, highlighting the services of greatest interest and revealing the estimated take-up figures for the business model to be quite conservative. (TransAct Communications Project 1997c)

The benefits to ACT residents and businesses of the proposed 'open' broadband communications network were claimed to include: (TransAct Communications Project 1997a)

- Profits from an ACT-owned and operated network would remain in the ACT;
- A single broadband network would offer competition between service providers;
- A large variety of services would be available from each PC or TV (probably including a local community channel);
- Competition in telephone calls - local, STD, ISD;
- Excellent free-to-air television reception without a TV aerial;
- Faster Internet access;
- The network would attract new services through state-of-the-art technology;
- ACT businesses would gain better services than currently available in other capital cities; and
- Job creation would result from the construction and ongoing management of the network.

Evaluation of the RFP and service provider responses lead to a refined business case approved by the ACTEW Board on 28 July 1997. (TransAct Communications Project 1997c) Given successful testing of the chosen technology in a laboratory, a pilot roll-out to an area encompassing some 900 homes was then scheduled for the following year. Four possible sites were evaluated against criteria including: results of previous market research, demographics, number of schools in the area and community acceptance and willingness to participate in a pilot. (TransAct Communications Project 1998)

Two new events then arose that could threaten the future of the TransAct Communications Project – one unexpected, the other part of an ongoing process. The project's patron, CEO Mike Sargent, resigned mid-1997 and was eventually replaced in early 1998 by a career bureaucrat John McKay who was most sceptical about it. Eckermann recalls the new CEO's first reaction as being "what the hell are we doing in communications, let's shut this down".[102] However, the project was now part of a bigger event. Progressively since 1995, the ACT government had been implementing structural reforms consistent with National Competition Policy. ACTEW was already a government-owned corporation, but the Liberal government of the Australian Capital Territory was keen to explore privatisation. In considering structure and ownership options, a scoping study by ABN AMRO/DGJ Projects also examined 'non-core' investment activities such as that posed by TransAct. Fortuitously, it concluded: (ACT Government 1998)

[102] Record of telephone transcript, Kelso/Eckermann, 17 September 2004.

> We recommend this project proceed to the conclusion of the pilot stage at which point potential purchasers of ACTEW can assess the viability of the project. If ACTEW is retained in public ownership the risk exposure of ACTEW needs to be substantially mitigated. ACTEW management has commenced discussions with private sector parties interested in TransAct.

The northern suburb of Aranda was chosen for the pilot technical trial which Chief Minister Carnell launched on 27 November 1998. It ran until end-July 1999 and connected some 250 homes. Services tested during the pilot included: (Eckermann 1999)

- High-speed Internet access (with Ozemail and Spirit participating as ISPs and the ACT Government hosting a range of advanced applications);
- Fourteen channels of broadcast digital video (commercial content provided by Foxtel plus several European language channels);
- Two channels of near-video-on-demand (content provided by the Advanced Computational Systems CRC in collaboration with the National Film and Sound Archive); and
- A comprehensive telephony service.

Connections and equipment were provided free of charge, although customers paid for services on a commercial basis, such as telephony and pay television. "Those taking part in the trial were enthusiastic about it and, having a taste of the future, hoped it would succeed." (Donovan 1999, p.278)

Sealing the fate of the original proposal to seek a 'telephony partner', a telecommunications carrier licence was applied for and awarded to TransAct Carrier Pty Limited in February 1999.[103]

5.3 Commercial Operation (2000 onwards)

The decisions and efforts of previous years made by the ACT government, ACTEW management and the TransAct project team laid the groundwork for consolidation in 2000 leading to commercial operation the following year.

Firstly, the ACT government delivered on its promise to explore privatisation of ACTEW. From October 2000, ACTEW Corporation Limited began operating a 50/50 public-private partnership with the Australian Gas Light Company (AGL) in the form

[103] According to the Australian Communications and Media Authority, this was carrier licence no. 26. Though surrendered in June 2001, it was effectively replaced by licence no. 49 awarded to Transact Capital Communications in September 2000. Refer to http://www.acma.gov.au/WEB/STANDARD//pc=PC_1625 accessed 30 May 2007.

of ActewAGL.[104] Secondly, funding was secured to support a territory-wide network roll-out culminating in the official launch of TransACT Communications Pty Limited on 31 May 2000 involving the following partners:[105] (Carnell 2000)

- ACTEW Corporation Limited;
- TVG Transact Holdings;
- AGL TransACT Pty Limited;
- Marconi Corporation plc; and
- Australian Capital Ventures Limited.

ACT Chief Minister Kate Carnell announced that "not only will subscribers be able to get multiple telephone lines, free-to-air and pay television and high-speed *permanent* internet connection, all on the one-line and all on the same account; new services like video on demand, video conferencing and community networks will be offered for the first time". The environment for the new TransACT could not have been more favourable:

- The FTTC/VDSL broadband technology chosen by TransACT was unequalled in Australia (refer to Section 5.4 for further discussion);
- Neither Telstra nor Optus HFC-delivered pay television cabling had eventuated in Canberra; (BIS Shrapnel 2001, p.98)
- The Australia-wide roll-out of ADSL services, offering the only possible competition, was in its infancy by late 2000; (BIS Shrapnel 2001, p.53)
- Relying until then only on dial-up access to the Internet, Canberra was the leading Australian city in terms of households online, with a 35 per cent take up in 1999; (DCITA 2000)
- The security of the ACT government underwrote the financial risk for the private partners. (Cameron 2007, p.216)

No longer a fully government-owned entity, commercial practice limits the availability of details about the subsequent network roll-out. However an ITU report in 2001 on broadband in Australia observed that the developing TransACT service is "tightly focussed on serving the 100,000 residents and 14,000 businesses in the ACT and the neighbouring regional centre of Queanbeyan (population of 25,000)". (Houghton and Morris 2001, p.15) By December 2001 TransACT had publicly reported the

[104] ACTEW's electricity-infrastructure assets and AGL's Canberra and Queanbeyan gas infrastructure became part of the joint-venture, although ACTEW retained ownership of the existing water and wastewater network, catchment and treatment infrastructure and associated water and wastewater assets. ActewAGL now handles all distribution and retail operations of the parent companies relating to electricity and natural gas services, as well as ACTEW's water and wastewater operations under a service-contract arrangement.

[105] Subsequent investors included the Commonwealth Bank of Australia and MTAA Superannuation Fund (TransACT) Utilities Pty Ltd in April 2002, followed by Westscheme Pty Ltd. The end result has been dilution of ACT government/ACTEW Corporation Limited ownership of TransACT from 100 per cent to 24.86 per cent as at May 2004. Refer to page 4, Attachment A of ActewAGL and TransACT lodgement at http://www.accc.gov.au/content/index.phtml/itemId/505972 , accessed 8 February 2005

connection of their 10,000th customer and in January 2005 the first customer had been connected in Queanbeyan.[106]

In reality, TransACT's fortunes have not been without upset, partly due to the novelty and scale of the business venture, and partly due to the financial uncertainty posed by the 'dot com' crash during the period 2000 – 2002. Major technology partner Nortel withdrew, CEO Richard Vincent resigned and then press reports followed that the company was on the verge of collapse. (Mitchell 2001, p.35) In announcing additional debt and equity funding obtained from investors in April 2002, new CEO Michael Del Gigante predicted the TransACT network would pass 50 per cent of Canberra's suburbs by the end of that year. (Osman 2002, p.72)

Residential and non-residential (business, government, education) customers may avail themselves of various service package offerings derived from the following basic TransACT network services:[107]

- TransTALK Premium

  This telephony service offers the usual PSTN capabilities plus the bonus of free local calls to other TransTALK customers. Unless only the TransWEB 2 Mb/s service is ordered, TransTALK Premium is common to all package offerings. The service is directly provided by TransACT as a telecommunications carrier. TransTALK also supplies an ISDN service for businesses.

- TransTV

  As at May 2006, 32 digital quality video channels are provided on a subscription basis in additional to four video-on-demand or VOD services: Adultshop on-demand, ANYTIME, TransTv on-demand and Video On Demand. The former are distributed by TransACT[108] whereas the VOD services derive from service providers to whom separate subscription is required. The channel programming on offer was that of Table 7. The six local free-to-air television channels are also re-broadcasted.

[106] Refer to TransACT media releases at http://www.transact.com.au/about/media.asp, accessed 7 February 2005

[107] For a more complete description of service availability, packages and tariffs, refer to http://www.transact.com.au, accessed 7 February 2005.

[108] According to the Australian Communications and Media Authority, Transact Broadcasting Pty Limited was allocated pay or subscription television broadcasting licences in October 2001 and November 2002. Refer to http://www.acma.gov.au/WEB/STANDARD//pc=PC_90046 under Section 96 licences, accessed 30 May 2007.

Table 7: Channel Programming Line-up

	News and information	
Australian Christian Channel	BBC World	Bloomberg television
Channel NewsAsia	Channel*vision*	Channel One
CNBC Australia	CNN	Deutsche Welle TV
EWTN	House of Representatives	Liaoning TV
Parliamentary Committees	Senate	SBS world news
TV5		
	Kids and family	
Boomerang	Cartoon Network	Disney Channel
	Movies	
Anytime	Turner Classic Movies	Video On Demand
	Documentary and special interest	
Adventure One	Animal Planet	Discovery Health & Health
Discovery Real Time	Discovery Science Channel	Discovery Travel & Living
Fashion TV	National Geographic Channel	
	Music and entertainment	
E!	MCM TOP	Soundtrack Channel
	Sports	
ESPN	FOX Footy Channel	TransTV on-demand

Source: Compiled from http://www.transact.com.au/television/channels.aspx

- TransVPN

  This Virtual Private Network connects network groups of users across multiple sites (offices and homes) with individual private high-speed data networks, allowing the easy interchange of information and ideas in a secure environment. There are no extra charges for data usage.

- TransWEB

  A permanent data connection is provided to an interface with an ISP, offering bandwidth options of (downstream/upstream) 256/64 kb/s, 512/128 kb/s, 1 Mb/s /256 kb/s or 2 Mb/s /512 kb/s for residential users, and from 1 Mb/s / 256 kb/s to 10 Mb/s / 1 Mb/s for non-residential users. Users subscribe to TransACT for TransWEB data carriage and additionally to an ISP chosen by the customer for Internet access. As at May 2006, eleven separate ISPs competed for

broadband customers via TransACT. They are: APEX internet; cbit Internet, CyberOne, GoldWeb Internet, Grapevine, Interact Broadband, NetSpeed, OfficeLink+, PC Users Group (ACT), Velocity Internet and WebOne Internet.

ActewAGL Net Connect became the sixth ISP in May 2003 to establish service on the TransACT network despite ActewAGL being a 25 per cent owner of that network. (Brennan 2003) Then in February 2004 it was announced that ActewAGL would take over the management of day-to-day operations of TransACT so as to rationalise company overheads. (TransACT Communications 2004) Service providers and users have since claimed that TransACT is now refusing to allow new ISPs onto their network – purportedly to protect the viability of the then ActewAGL Net Connect, now Grapevine.[109] [110] The above events now raise questions about the true 'openness' of the TransWEB service in that TransACT may no longer be treating competing ISPs in an impartial manner.

5.4 Designing for Open Access

The TransAct project team took a conscious decision to first develop their service delivery vision, namely to "support a comprehensive range of video, telephony and data communication services" and "be as open as possible, with capacity being made available to a range of providers" and then choose a technological solution to best deliver that vision. The result was an architecture employing fibre-to-the curb (FTTC) and very high rate digital subscriber line (VDSL) broadband transmission configured to offer switched digital services.

On considering the delivery of video, data and telephony services, it was found more suitable for video and data to be delivered by a 'broadband network' whilst telephony is delivered by a 'narrowband network'. Technically, these two networks run in parallel and are substantially distinct though share common physical infrastructure and systems. (Evans 2001) Subscribers are not made aware of this distinction. In a functional and basic topological sense, the TransACT network is described by Figure 8.

The backbone network consists of Synchronous Digital Hierarchy (SDH) optical fibre rings underpinning a city-wide Asynchronous Transfer Mode (ATM) system designed to carry voice, data and particularly video services. A series of fibre rings connect the central Gateway to at least five Hub sites in such a manner as to provide for alternative routing in case of failure. The Hub sites are strategically located to serve all Canberra homes and businesses. For the sake of economy and effectiveness, customers are serviced by individual 'Category 5' paired copper lines over which broadband services are delivered via VDSL transmission up to a maximum length of 300 metres. Optical signals are converted to electrical signals for carriage on the copper lines at points called Nodes; most of these (about 85 per cent) are 'broadband' Nodes for delivering data and video services, whereas the remainder are

[109] Refer to discussion forum at http://www.whirlpool.net.au under 'Regional, Satellite', 'TransACT' and then, among other topics, 'Internode on TransACT', as at 8/2/2005.
[110] ActewAGL Net Connect was re-badged as Grapevine on 20 April 2005. Refer to http://www.actewagl.com.au/news/Article.aspx?id=514 accessed 30 May 2007.

Super Nodes designed to deliver telephony service with enhanced reliability. (Bernstone 2001)

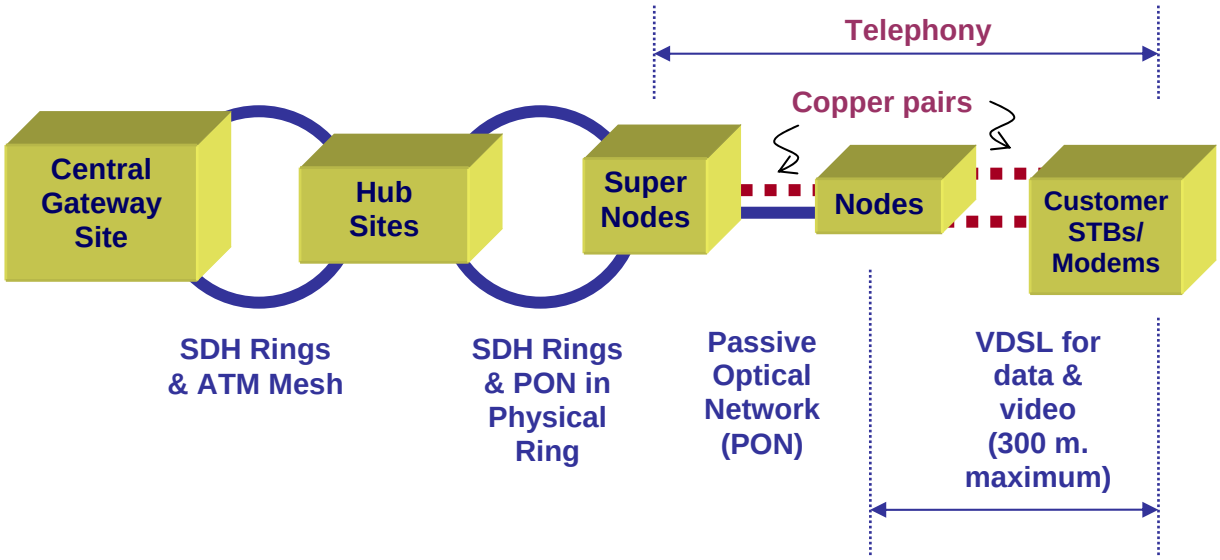


Figure 8 – Schematic of TransACT Network
adapted from (TransACT Communications 2001)

Those fibres terminating on Nodes support a small serving area, typically comprising around 50 homes or businesses. Each residential customer may avail themselves of VDSL capacities of up to 52 Mb/s downstream and 1.6 Mb/s upstream.[111] Broadband signals terminate on Set Top Boxes for video and/or Modems for Internet access, whilst narrowband signals terminate on standard telephones, facsimile machines or voice-grade modems. No encryption of broadband signals is required to implement conditional access because users are only sent those channels they are authorised to receive. (Eckermann 1999)

The TransACT FTTC/VDSL network architecture contrasts with the Telstra and Optus HFC pay television networks deployed elsewhere. Those networks are instead designed with optical fibre serving between 500 and 2,000 homes, and moreover the optical signals are converted to electrical signals on a common coaxial cable. Individual customers on an HFC network share all signals broadcast over their particular length of coaxial cable, resulting in limited service capability and capacity for end-users and requiring stringent control mechanisms at each Set Top Box to prevent unauthorised access to signals. (TransACT Communications 2005) HFC networks are particularly unsuited for delivering a highly interactive service such as video-on-demand.

This is the crucial distinction that enables the TransACT network to operate under an 'open access' regime. With each customer having a dedicated physical connection

[111] By comparison, ADSL technology typically delivers up to 1.5 Mb/s over distances up to some 6 km; DSL speed can only increase by shortening the distance signals need to travel. Another example of this network design approach was the Telstra fibre-to-the-node proposal of 2005/06 to deploy fibre 1.5 km deeper into the traditional CAN and thereafter exploit ADSL2+ technology to deliver downstream speeds of at least 12 Mb/s and in some cases 24 Mb/s.

capable of delivering up to 52 Mb/s, a quantity well in excess of presently conceivable applications, plus a common optical fibre backbone network designed to switch individual service demands to and from the central gateway without contention for capacity, individual service demands can be satisfied without impacting on service quality for others. By itself such 'switched digital access' doesn't dictate open access, however once multiple service providers are interfaced to the central gateway then any service provider is equally able to connect with any customer who requests their particular service. The underlying transport network is designed to be independent of both services and service providers. (Eckermann 1999)

5.5 Success with Open Access

The TransACT network in the Australian Capital Territory came about because the management and staff of ACTEW entertained a vision and then took the steps to implement it. The key enablers of success were: (Eckermann 1999)

- The absence of 'broadband' competition, in that Canberra was bypassed by the HFC roll-out of Telstra and Optus;
- Access to the physical assets of ACTEW such as power poles, substations, ducts and rights of way, as well as the existing relationship with customers;
- The Canberra market which is statistically more information-centric than elsewhere in Australia.

By themselves, these factors could have alternatively resulted in a 'closed' network, one relying on a vertically integrated business strategy. However, ACTEW was a utility with no background in communications and could see no sense in unnecessary duplication of infrastructure. It was attuned to the concept of a network owner throwing open its infrastructure and abstaining from the higher layers of business that might compete with third parties wanting to use the network. (Eckermann 1999) Given that ACTEW was not encumbered with any existing communications infrastructure and possessed no existing communications portfolio vulnerable to being undermined, it was possible to design a 'greenfields' solution able to support multiple service providers, multiple services and even services not currently envisaged - a solution based on the business principles of open access. The switched digital architecture offered by FTTC/VDSL technology was a logical outcome at that time of decision-making.

TransACT would intentionally become dependent upon third party service providers to provide the services, applications and content on its network. This calls for trust between the network owner and service providers, such that third parties "can utilise the TransAct network without fear of the network owner undermining their businesses by competing from a privileged position". (Eckermann 1999) There would however be one crucial qualification – "if there is any service on which the success of the network depends and no service providers step up to the opportunity, TransAct will fill the vacuum". That policy option was exercised in the case of telephony services when the TransAct project team exhausted alternative avenues of supply via existing telephone companies towards late 1997, and opted to provide narrowband services (that is, telephony) by itself.

TransACT's open approach to broadband service provision is argued to have the benefit of allowing new market entrants to focus their resources on a narrower set of activities, and to take advantage of the strengths and resources of others in complementary service and content areas. (TransACT Communications 1999) Successful models of TransACT's approach can be found in other industries such as ports, railways and airports, where companies "derive their success from being very good in a specialised area rather than attempting to be a one-stop shop". (TransACT Communications 1999) Table 8 draws comparisons between the TransACT business model and that of a vertically integrated operator.

Table 8: Comparison of Business Models

Vertical Integration Model	TransACT Model
Resist efforts to force network open to third party content and service providers.	Welcome all third party service and content providers to give real choice to the consumer.
Establish own ISP service and fight to win customers from other ISPs, providing all of the support functions that go with a diverse range of Internet users.	Partner with many major ISPs and cooperate in enhancing service to their tens of thousands of established customers through provision of broadband access.
Try to limit customer's choice to 'own' products and services in order to maximize revenue per customer.	Promote broadest possible array of services and products in order to optimise the value of broadband connection to the maximum number of customers.
Strive to uphold pricing of bandwidth as a multiple of telephony capacity.	'Lead the charge' in introducing broadband communications capacity at prices designed to foster higher usage.
Where wholesaling capacity to third parties, erect 'Chinese walls' but compete vigorously at the retail layer.	In collaboration with service providers, promote all products and services that are available through the network.
Lose a customer whenever they churn to another provider's service.	Retain the customer irrespective of churn between service providers.[112]
Amortise the cost of the network over only 'own' products and services.	Amortise the cost of the network over multiple service streams, service providers and services.

Sources: (TransACT Communications 1999), (Eckermann 1999)

Not surprisingly, TransACT argues that their open access principles are good for the customer, the service provider and the network owner. As at May 2006, a variety of service providers have contracted to provide 32 digital quality video channels, plus four video-on-demand services. The six local free-to-air television channels are also re-broadcasted. Eleven ISPs compete for broadband customers, including one owned by the major partner and entity now operating TransACT, that is, ActewAGL. As at 2002, the proportion of TransACT customers who had subscribed to the following bundles of services were: (Brooks 2002) (Eckermann 2003)

[112] Provided that the customer remains with TransACT, which now may not be the case given increased competition from ADSL technology carried via Telstra's paired copper network.

- All three services (telephony, video & data) 63 - 70 per cent
- Two services (mostly telephony & video) 10 - 12 per cent
- One service only (mostly telephony) 20 - 24 per cent

Another measure of customer satisfaction is that of the 'churn' rate, which had been recorded as less than 2 per cent of customers who disconnected from TransACT during a 12 month period. (Eckermann 2003) Although perhaps not a fair comparison between national figures for broadband adoption and those of a single network such as TransACT, the same author notes that around 2001 – 2002 TransACT broadband customers were signing up (in terms of lines per 100 inhabitants) at a level far in excess of the Australian average and only bettered by that of Korea.

On the other hand, some industry analysts have warned that a strategy of 'making money off the pipe, not the content' is not without pitfalls: (Taggart 1999) (Taggart 2002)

> … if TransACT doesn't quickly lock in customers, other players with less sophisticated offerings could use 'fear, uncertainty and doubt' about the new system to drive customers toward purportedly 'safer' - but less capable – broadband systems.
>
> The downside (in not developing broadband content and services) is that there may not be much money in utility services, which are homogeneous goods.

A typical monthly outlay by a residential customer subscribing to a three-service bundle, involving the TransACT Home Pack 1000[113] and the NetSpeed Plus 5 Plan[114], would be as follows (applicable as at May 2006):

$59.95 paid to TransACT	which offers	• TransTALK AllTime, including free local calls to other TransTALK customers (with other call usage charged accordingly) • TransWEB data connection to an ISP of 1 Mb/s downstream and 128 kb/s upstream • TransTV, including a basic 'Classic' line-up of 15 programme channels, together with the six re-broadcast free-to-air channels
plus		
$27.50 paid to the ISP	which offers	• Internet access with a 5 Giga Byte download data limit (plus a charge for excess data)

[113] Refer to http://www.transact.com.au/packages/HomePack.aspx, accessed 31 May 2007
[114] Refer to http://www.netspeed.com.au/netspeed.cfm?action=p_1, accessed 31 May 2007

For an even higher outlay, residential customers can obtain:

From any of the four video-on-demand service providers	▪ On-demand movie entertainment on a pay by use basis
From TransACT	▪ The remaining 17 television channels ▪ Faster data connection to their ISP of choice
From their ISP	▪ Higher download data limits whilst accessing the Internet.

5.6 Discussion

In this section we discuss possible limitations arising from analysis of the TransACT network as a case study, followed by a summary of findings that should inform the Research Question.

5.6.1 Limitations of Case Study

Accessing information about the TransACT network proved a problematic exercise. No descriptive writings of a substantive and independent nature were identified at the outset, which meant that this case study would need to cover novel ground – although limited with a particular focus on access and openness. Despite its local government origins, the TransACT Communications Project had not been openly and independently documented apart from many smallish articles of a technical or semi-technical nature in the trade press at the time.

Comprising a very small team of persons planning a network for deployment in only one city, the 'knowledge footprint' on industry in terms of involved consultants, designers, manufacturers and installation contractors was likewise quite small. Contrast this with plans for and implementation of a nationwide roll-out by a national carrier where the much larger 'footprint' leaves behind a plethora of knowledgeable persons who could be interviewed as well as more verifiable information sources. If that carrier were Telstra, information could also be gleaned from parliamentary inquiries and analyses commissioned by competing financial analysts. In all these regards, the TransACT Communications Project was literally 'below the radar'. Due to its open business plan it avoided regulatory attention and being rolled out only in Canberra after the other capital cities had already been cabled by Telstra/Foxtel and Optus for pay television, the TransACT network was more or less regarded as a special case and substantially disregarded by analysts.

The problem of information gathering was potentially magnified by reliance on one main source, Mr Robin Eckermann, who led the TransACT Communications Project and subsequently became the network Chief Architect. He also authored most of the technical and semi-technical information appearing in the trade press and gave most of the PowerPoint presentations at conferences around that time. Interviews of Robin Eckermann provided a first-hand account of what led to the open access philosophy and in that regard were unique. Archived images of the early TransACT

project website were recoverable via the Wayback Machine[115] and filled in various gaps in information but this material was probably also substantially based on Eckermann's work.

With a focus on just the TransACT network and the origin of its open access philosophy, the information gathering exercise could only go so far before being exhausted. Possibly triggered by my interviews, Robin Eckermann also began to write a memoir of his time with TransACT. Eventually I was able to reach a high level of confidence that I was gaining a consistent and relatively accurate appreciation of how TransACT came to become an open access network by comparing the primary source information gained by interview with the many secondary sources available. A corporate history of ACTEW by Peter Donovan, compiled independently of Robin Eckermann, provided the keystone source to validate the quality of other information gathered.

Paradoxically the TransACT network is such an ideal candidate for a case study, raising many positive issues and only few negative ones that it can give the appearance of almost being an anticlimax compared to the other two studies.

5.6.2 Findings

The key findings of the TransACT case study are summarised in a stand-alone manner. Interpretations made possible by drawing correlations with the other case studies are withheld until Chapter Eight.

General

Conceived in 1996, the TransACT network would ordinarily be considered now a legacy network yet it was designed to deliver broadband data and video services in a manner that can still be regarded as 'next generation' compared to all other so-called broadband networks in Australia. Designed from the outset as an open access network capable of connecting a variety of service providers to customers via individual data streams of up to 52 Mb/s, TransACT remains unique within Australia and a relatively rare occurrence worldwide.

The TransACT network in the Australian Capital Territory came about because the management and staff of ACTEW entertained a vision and then took the steps to implement it.[116] The overwhelming lesson of the case study is that open access was

[115] Refer to http://www.archive.org/web/web.php?sa=X, accessed 13 May 2007

[116] TransACT remains the only retail telecommunications business in Australia with a electricity utility heritage and a government one at that. Cameron, A. (2007). Enabled to Engage in the Information Age: A Comparative Study of Broadband Take-up in Two Regions of Australia. School of Social Science. Brisbane, University of Queensland: 315.

This stands in stark contrast to the US where about a quarter of the 2,000 or so communities with publicly owned electric utilities provided some type of communications service as of 2003. Gillett, S. E., W. H. Lehr, et al. (2004). Municipal Electric Utilities' Role in Telecommunications Services. Telecommunications Policy Research Conference, Washington.

achieved voluntarily, not by policy fiat or regulatory forbearance, and that it works technically and commercially.

Genesis of an 'open access' philosophy

Inaugural ACTEW CEO Mike Sargeant encouraged staff creativity and supported examples of lateral thinking. Being part of an electricity utility, the TransAct project team and the management of ACTEW were naturally attuned to running a 'wires business'. ACTEW had been recently subjected to 'de-regulation' of its electricity business and so could appreciate the concept of more than one service provider (electricity retailer) operating off a common distribution network. To them, there was no logic for competing service providers to construct parallel sets of wires to effect delivery to the same group of customers.

Given that ACTEW was not encumbered with any existing communications infrastructure and possessed no existing communications portfolio that could be undermined, it was attractive to consider a 'greenfields' solution able to support multiple providers of communication services, multiple services and even services not currently envisaged - a solution based on the business principles of open access. Most importantly of all, the necessary technology was by then available. Modelling suggested a better rate of return than utilities generally get from other infrastructure investment.

The project team therefore considered it made good business sense to incorporate open access into any new communications network to serve residents and businesses in the Australian Capital Territory. This intent was publicly declared in late 1996 by a call for expressions of interest from service providers and investment partners, followed shortly afterwards by a request for proposal seeking network and service solutions. The open access philosophy thereafter guided all commercial, technical and service decisions leading to implementation.

Services deliverable via open access

Each customer must deal with the network provider, TransACT Communications, and one or more service providers. TransACT is also a service provider in regard to telephony and one of the ISPs. It is not possible to obtain a bare network connection without any service, since the network has to be instructed to digitally switch each connection on a service-specific basis. The services available are telephony, video and data. All may be obtained concurrently.

For residential customers, the minimum network connection also requires a telephony service for which TransACT Communications is also the service provider and long distance carrier. All intra-TransACT network telephony calls are free of charge.

Video services include:

- pay television channels sourced from independent service providers, although for regulatory reasons TransACT is licensed as the carrier;
- free-to-air television channels, re-broadcasted; and

- video on demand services from independent service providers.

Data services include:

- a point-to-point data connection for businesses configurable as a virtual private network;
- a data connection to an interface with an Internet service provider or ISP, all but one of which are independent of TransACT Communications.

Separate charges are payable for the services of these service providers and as an incentive to increase network uptake various bundled offers are made through TransACT as the billing entity. Customers make separate arrangements with the ISP of their choice.

Are there degrees of openness?

The above service delivery arrangements raise the question as to what 'open access' really means – can there be various degrees of 'openness'? Why this becomes an issue is discussed in terms of each of the main service types delivered, followed by a concluding assessment.

- Narrowband service - telephony

TransACT initially had no desire to become a telephone company and accordingly sought to partner with an existing telecommunications carrier. Telephony was considered to be "just a very complicated thing". Discussions ensued with Telstra, Optus and AAPT but in the end ceased to be fruitful. TransACT instead became a carrier in its own right and now offers telephony services over a network which it owns and operates. The justification was said to be "we realised that linking up with one carrier would limit us, so we decided to preserve our independence. Any agreement (with one carrier) could have left other service providers a bit dubious about how open the network really is".

Under Australian telecommunications and competition law, TransACT was under no obligation to become a 'carrier's carrier'[117] and if it had gone down that path, it would have become a unique example in Australia – another way of saying that it may not have established a viable business.[118] Residents and businesses within the ACT now have a choice of subscribing to telephony carriage via the distinctly different Telstra paired copper CAN or TransACT FTTC/VDSL networks,[119] in addition to

[117] In this situation, it would not compete at the retail level but supply only wholesale services to one or more carriage service providers. Refer to page 24 of Grant, A., ed. (2004). Australian Telecommunications Regulation. Sydney, UNSW Press.

[118] Anecdotally, revenue earned from telephony usage has been a significant source of overall TransACT revenue and hence a critical success factor for the business case.

[119] An equivalent choice also exists for those in mainly Sydney, Melbourne and Brisbane whose streets are cabled with the Optus HFC network which offers a telephony service independent of that utilizing Telstra's copper CAN.

preselecting any other telephony service provider they prefer via either of those networks.[120]

- Broadband service – video/television

Neither TransACT nor any of its partners has a pecuniary interest in any of the programme channels on offer; from the point of view of television or video-on-demand services, TransACT as a network provider has not vertically integrated into the provision of video or television content. Various channels are packaged, and priced in certain groups to appeal to the tastes of different viewer groups. Although the full package of digital Foxtel channels were not then being carried, this has been attributed to either a supposed system incompatibility with Foxtel or Foxtel's concern that its brand image could be compromised if delivered along with channels that were differently packaged.[121] Regardless, there is no evidence that TransACT discriminates against Foxtel and to the contrary, TransACT is welcoming of all available broadcast television or interactive video-on-demand channels. The switched nature of the delivery technology employed places no capacity limitation on the number of deliverable channels or service providers.

- Broadband service – data, Internet access

Of the eleven separate broadband ISPs now accessible via the TransACT network, Grapevine is wholly owned by ActewAGL which is a 25 per cent owner of TransACT. Provided TransACT does not discriminate in favour of Grapevine, that ownership situation by itself may not raise concern. However, since February 2004 ActewAGL took over the management of day-to-day operations of TransACT so as to rationalise company overheads. Users and at least one service provider have subsequently claimed that TransACT is now refusing to allow new ISPs onto their network – purportedly to protect the viability of Grapevine (then ActewAGL Net Connect), but also reflecting a wider concern that TransACTs telephone revenue could be increasingly cannibalized by Voice over Internet Protocol (VoIP) services.[122]

A more serious claim is that Grapevine may be subsidised through preferential network charges from TransACT. If this is true, TransACT would no longer be treating competing ISPs in an impartial manner and hence it could be questioned whether the TransWEB service is now truly 'open'.

The counter argument is that the other ten broadband ISPs continue to provide retail competition off the same wholesale network – an overall situation infinitely superior to

[120] E-mail communication, Kelso/Bouffler, 2 March 2005. Wayne Bouffler is the National Telephony Manager for TransACT.
[121] Record of telephone transcript, Kelso/Eckermann, 17 September 2004.
[122] Record of interview, Kelso/Hackett, 6 April 2005; also issues raised by users on the discussion list www.whirlpool.net.au . Simon Hackett is the MD of the ISP Internode Systems Pty Ltd.

that of either the Telstra or Optus HFC networks over which cable modem Internet access is monopolized by only their single in-house ISP in each instance.[123]

- Scorecard

According to Cameron (2007, p.88), the owner of a truly 'open' network would offer wholesale bandwidth only, with "all the retail services, including telephony, media services, digital content, Internet access and business networks offered to clients connected to the network" being owned and operated by other parties. This may include ISPs, media and gaming companies, business service providers, owners of Web material and other telecommunications companies. On that basis, TransACT was not a completely 'open' network, in that it has limited the number of ISPs offering services on the network and also regulates the retail media, gaming and video services available to TransACT customers. (Cameron 2007, p.275)

Cameron's initial definition is arguably correct, along with the conclusion that TransACT is not completely 'open', but the picture is not that black and white according to the foregoing assessment of the degrees of openness for each main service type – as summarised in Table 9.

Table 9: Degrees of Openness?

Service type	Open Network	Closed Network
Telephony	See caveat 1	Yes
Video/television	Yes	---
Data, Internet access	Yes	See caveat 2

Caveat 1: Technically speaking, telephony services are delivered in a closed network manner, yet open networks for telephony are probably non-existent worldwide. The key issue is that TransACT permits competitive access to multiple telephony carriers – in addition to that provided by Telstra's PSTN.
Caveat 2: In addition to the ten competitive retail broadband ISPs independent of TransACT, one other (Grapevine) is not independent.

Cameron's claim that openness is in doubt due to a limit on the number of ISPs misses the point that at least ten ISPs are offering retail competition off the same network – a situation unique in Australia and quite rare worldwide. Furthermore, it is not correct that TransACT regulates the retail media, gaming and video services – TransACT is understood to be independent of any such content providing business and benefits as a network provider from encouraging diversity of retail content.

The matter of possible preferential connection for the Grapevine ISP could be determined if the tariffs and terms under which service providers may connect to the

[123] By enabling users to directly access eight broadband ISPs, TransACT offers a degree of customer choice comparable with accessing a range of narrowband ISPs via dial-up modems or broadband ISPs via ADSL, in either instance employing Telstra's paired copper CAN as the carriage infrastructure.

TransACT network were on the public record.[124] The ACT government, through ACTEW Corporation Limited, now owns only one-quarter of TransACT and can no longer require it to be accountable to parliament. With control of the company in private hands, operations are now able to be shielded from competitive view to the extent possible under company law. One aspect not made public is the commercial arrangements between TransACT and its service providers, in particular, the tariffs and terms under which service providers may connect to the TransACT network. As such, these arrangements are no more restrictive than required by any other network provider in Australia.

Technical realisation of open access

The TransAct project team took a conscious decision to first develop their philosophy of open access service delivery and then to choose an appropriate technological solution. The result was a network architecture employing fibre-to-the curb or FTTC plus very high rate digital subscriber line or VDSL broadband transmission delivered over twisted pairs, with the system configured to offer 'switched digital' services.

With each customer having a dedicated physical connection capable of delivering up to 52 Mb/s, a quantity well in excess of presently conceivable applications, plus a common optical fibre backbone network designed to switch individual service demands to and from the central gateway without contention for capacity, individual service demands could be satisfied without impacting on service quality for others.

By itself such a switched digital configuration doesn't dictate open access, however once multiple service providers are interfaced to the central gateway, any service provider is equally able to connect with any customer who requests their particular service and multiple services can be delivered concurrently. The underlying transport network is designed to be independent of both services and service providers. These network characteristics are particularly advantageous to open access delivery.

Business success with common carriage

During the formative planning stages, before the introduction of private equity, the parent organisation ACTEW was highly supportive and given a free rein by the ACT government as the sole ACTEW shareholder. ACTEW provided access to electricity ducts and poles, constituting a critically important and unchallenged 'right of way'. Without any background in telecommunications, there were no existing ACTEW products or services to be cannibalised by a new broadband network.

There were no regulatory barriers to establishing a new carrier entity. By the time of launching the commercial services of TransACT Communications Pty Limited in

[124] In the United States, the Grant County Public Utility District operates the 'Zipp' fibre-to-the curb network on an open access basis. Being wholly owned by a local government authority, there is a legislated requirement by the Senate of Washington State for the applicable tariffs and conditions of service for wholesale service providers deliverable over Zipp to be publicly accessible via the Internet and subject to appeal if considered unduly or unreasonably discriminatory or preferential. Refer to the Grant County PUD Fiber Optic Network policies at http://www.gcpud.org/zipp/policies.htm, accessed 28 April 2005.

2000, ACTEW had become a 50/50 public-private partnership in the form of ActewAGL and TransACT had taken on private partners which reduced ACT government equity to just below one-quarter.

TransACT quickly gained a significant market share in the Australian Capital Territory since:

- it offered a unique 'triple play' of telephony, television and data services, in addition to video-on-demand;
- competing pay television services could only be delivered via satellite as Canberra was bypassed by the HFC roll-outs of both Telstra and Optus;
- Canberra was the leading Australian city in terms of households online; and
- alternative means of delivering broadband access to the Internet (eg. via ADSL or wireless) were initially uncompetitive or not fully deployed by late 2000.

Continued success has relied upon this 'first-mover' advantage and third party service providers trusting that they "can utilise the TransAct network without fear of the network owner undermining their businesses by competing from a privileged position".

In summary, the TransACT network was rolled out in what was tantamount to a 'greenfield' broadband environment and delivered a unique set of services without having to face competition during the initial years of establishment.

CHAPTER SIX – FIBRE TO THE HOME NETWORKS CASE STUDY

This third and final case study bears characteristics that position it between the other two. The Telstra/Foxtel pay television network, although subject to extensive regulatory attempts to be prised open, remains effectively closed to third party access despite recent digitisation that, in terms of video channel capacity, substantially lessens the original problem of bandwidth scarcity. By a large measure, the TransACT network remains substantially open to third party service providers, a situation resulting from original choice by those who designed the network and justified its business case. There has been no reason for TransACT to attract regulatory attention. Roll-out of both networks ceased some years ago and both continue to operate under circumstances that appear to be commercially sustainable in the longer term.

In contrast, fibre to the home networks in Australia commenced to be rolled out by Telstra from 2005 first on a trial basis and then commercially limited to new housing estates. With wider deployment inevitably developing characteristics of a natural monopoly, fibre to the home networks are certain to eventually attract regulatory attention. These initial networks involve closed access operation under a vertically integrated business model despite the underlying technology that provides a relative abundance of communications bandwidth capable of supporting a multiplicity of service providers.

6.1 The Next Generation of Bandwidth Abundance

Modern low-loss glass optical fibre and input/output technology offers almost unlimited bandwidth[125] and unique advantages over all previously developed transmission media. Electrical input signals are converted into an optical beam which is conveyed along a filament of glass, usually circular in cross section and clad with a suitable material that enables transmission over long distances with minimal degradation. A receiver converts information in the beam back into a replica of the original electrical signal. Compared to traditional paired copper and coaxial cables, a cable of optical fibres is typically thinner and lighter, supports much higher data rates over greater distances and is relatively immune to interference.

The most commonly used optical wavelengths or light colours are at or close to 850, 1300 or 1550 nanometres. Using wavelength division multiplexing or WDM technology, two or more wavelengths are combined and carried via a single fibre such that the signals modulating one wavelength are completely independent of those at another wavelength. When a hundred or more wavelengths are closely spaced, the technology is called dense wavelength division multiplexing or DWDM. Multiple wavelengths significantly increase the data carrying capacity of individual optical fibres, though at some expense for increased input/output complexity.

---

[125] Optical fibre is claimed to have a usable bandwidth today of up to 75,000 Ghz. Green, P. E. (2004). "Fiber to the Home: The Next Big Broadband Thing." IEEE Communications Magazine **42**(9): 100-106.

Although commercially available fibre-based systems utilize bandwidths far less than this, in comparison with current wireless, DSL and cable modem technologies, optical fibre bandwidth is hugely greater now and will be so in the future.

By reason of the economics and capabilities of available technologies, most communication networks are designed to serve the functions of either a 'customer access network' or a 'core network'. (Darling 2005: 72-75) A customer access network or CAN[126] provides the connection from each user, customer or subscriber to and from the core network. Whether implemented via shared or individual infrastructure, each user must be able to obtain service whenever desired with the result that economies of scale in the provision of the infrastructure can be poor. Whilst individual users may produce quite low levels of traffic, a typical customer access network is configured to concentrate all traffic at a convenient geographic point whereafter the core network exploits greater economies of scale and scope through the sharing of transmission and switching infrastructure. Figure 9 refers.

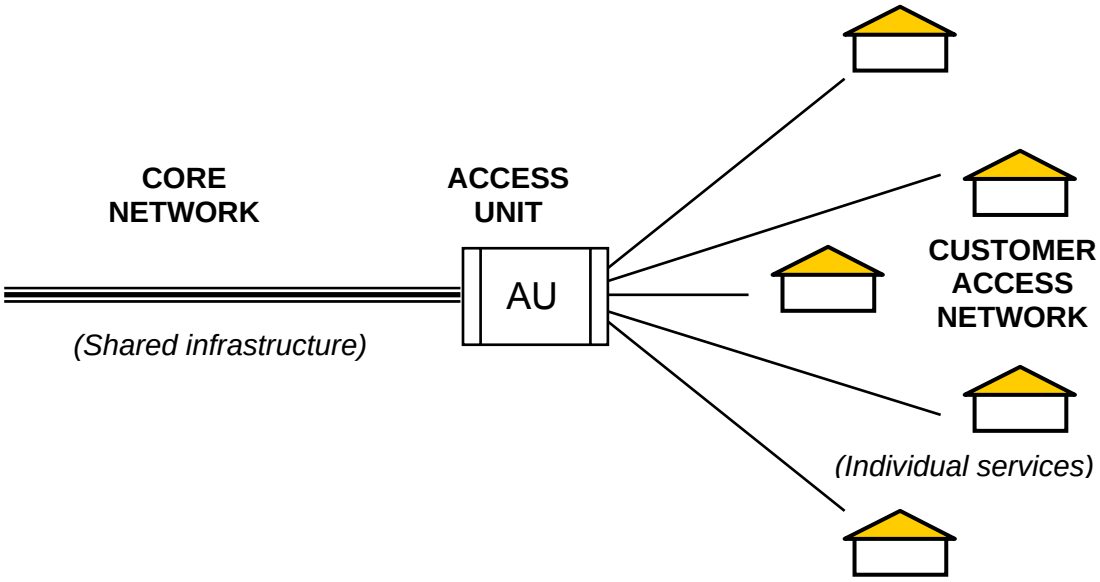


Figure 9 – Schematic of Traditional Telephony Network

In a traditional CAN providing telephony services, a pair of twisted copper conductors is dedicated to each user such that each service is independent of all others. The paired copper cables for a given geographic area terminate at a 'telephone exchange' and thereafter telephony traffic enters the core network. To aid more general explanation, this interface between the CAN and the core network shall be called an 'access unit'. For the last few decades, core networks have been based on optical fibres and digital switching. Apart from paired copper cabling, the CAN may deploy transmission infrastructure based on radio technology, coaxial cabling (such as in a pay television network) or optical fibre. In practice, the nature and location of the access unit changes according to the type of communication network, such as telephony or pay television, as well as design variants of the same network type.

The extent of optical fibre deployment in the CAN provides a basis for appreciating a commonly accepted range of network models. FTT'x' is a generic term for those

[126] In US parlance, the CAN is also called the 'local loop', 'subscriber loop' or merely the 'access network'.

network technologies which extend optical fibre into the CAN and hence closer to the end user, where 'x' can variously mean:

B	- building	C	- curb, cabinet
CP	- customer premises	H	- home
N	- node, neighbourhood	P	- premises
SA	- serving area	U	- user, (multi-dwelling) unit
X	- exchange		

Technologists and marketers in the telecommunications industry are prone to adopt their own meanings from time to time. Figure 10 portrays the basic differences between the major FTT'x' variants primarily in terms of the depth to which optical fibre penetrates into the customer access network.[127] (DCITA 2003) (Green 2004)

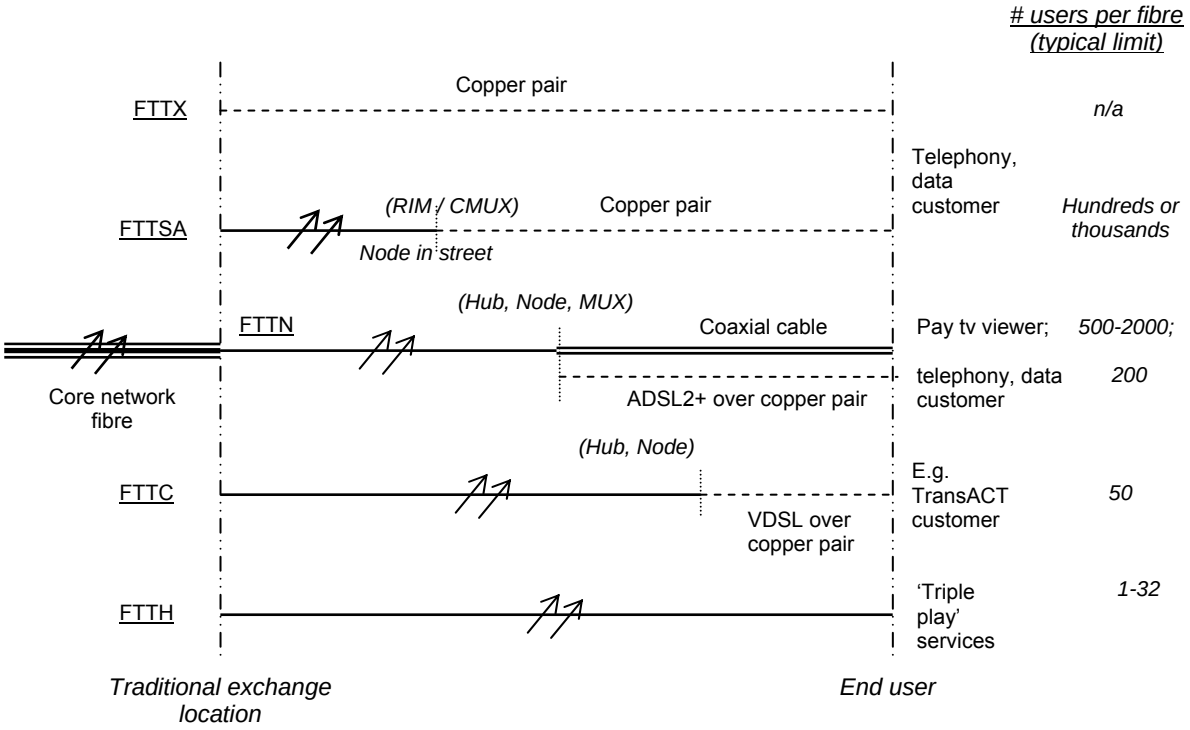


Figure 10 – Deployment of Optical Fibre in the CAN
Source: Compilation from multiple sources, including (DCITA 2003), (Green 2004) and (Darling 2005).

FTTX (fibre to the exchange)

Representing the traditional public switched telephone network or PSTN, optical fibre terminates at 'telephone' exchange buildings representing the boundary between the core network and the CAN. Cables of twisted copper pairs connect to telephony subscribers. DSL-type transmission services, such as ADSL, can also provide data access to the Internet over such copper pairs.

[127] The first variant, and perhaps also the second, does not strictly describe infrastructure designed to provide broadband to end users but are included to illustrate a logical progression of increasing depth of optical fibre into the CAN, from Figure 9 top to bottom.

FTTSA (fibre to the serving area)

A variant typically between FTTX and FTTN, in which the telephone carrier extends the core network optical fibre into the customer access network such that the 'exchange' access unit is now a cabinet, sometimes called a remote multiplexer,[128] whereupon individual copper pairs then connect to telephony subscribers.[129] The group of subscribers are said to fall within a 'serving area' of the access unit. This approach is usually adopted by the telephone carrier either to serve more distant subscribers from the exchange or where the copper cables or conduits closer to the original exchange have become congested. DSL-type services can also be carried and where the length of copper pairs happens to be shorter than typical, higher speed data access may be possible such as that provided by ADSL2 or ADSL2+ technologies.

FTTN (fibre to the node)

A 'node' can mean different things to different technologists, however in this instance it is taken to be where the optical fibre terminates at an access unit or 'hub' located in a street at a distance of 500 to 1500 metres from the end users to be served. Where the medium providing the final connection from the hub is coaxial cabling, the network is described as comprising 'hybrid fibre coaxial' or HFC technology. Such networks are used to distribute pay television programming, as well as providing connectivity for Internet access, as exemplified by the Telstra/Foxtel network case study. Depending on the chosen design, between 500 and 2000 users may share a given hub and hence a fibre. In terms of Figure 9, no traditional 'exchange' location is relevant as the optical fibre extends all the way back to a city central Head End installation. The hub could also be a Remote Multiplexer, as with FTTSA.

Where the medium providing the final connection to the customer is paired copper cabling, the remaining length is sufficiently reduced to enable the working of higher bandwidth transmission technologies such as ADSL2+. Such networks are particularly employed to provide connectivity for Internet access, in addition to voice telephony, to more distant end users or customers.

FTTC (fibre to the curb/kerb)

Where the optical fibre extends further to within a distance of 100 to 300 metres from end users, it is said to terminate at a 'curbside' node.[130] In the TransACT network case study, the medium providing the final connection comprises paired copper cabling over which VDSL transmission provides up to 52 Mb/s downstream data capacity for video and Internet access. In the case of the TransACT design, 50 customers are served by each optical fibre. In terms of Figure 9, no 'exchange' location is relevant as the optical fibre extends all the way back to a city central Head End installation.

[128] Remote multiplexers utilised have been known as Remote Integrated Multiplexers or RIMs and Customer Multiplexers or CMUXs.
[129] FTTSA has also been known as fibre in the loop or FITL.
[130] Where serving a multi-dwelling unit, the fibre could terminate outside or in the basement of the unit and hence the final connecting medium would be cabling within the building. Such a network arrangement could also be referred to as 'fibre to the building' or FTTB.

FTTH (fibre to the home)

The prime subject of this case study, a 'fibre to the home' network architecture implies optical fibre extending all the way to the user premises, a residential home or office building[131], whereafter the final connection medium may be either relatively short lengths of paired copper cabling within the premises or otherwise fibre all the way to an end user interface such as a set top box. In practice, there may be minimal technical or product difference between a FTTC network extending fibre further towards end users and a FTTH network architecture. In the instance of a 'home run' configuration (as explained in section 6.3.1), each user could be served by a dedicated optical fibre.

The significance of contrasting the FTTN, FTTC and FTTH network architectures lies in the impact that extending optical fibre deeper into the traditional CAN has on the bandwidth potentially available to users, a measure also typified by the number of users able to share the bandwidth of a given fibre. Figure 11 depicts this trend.[132]

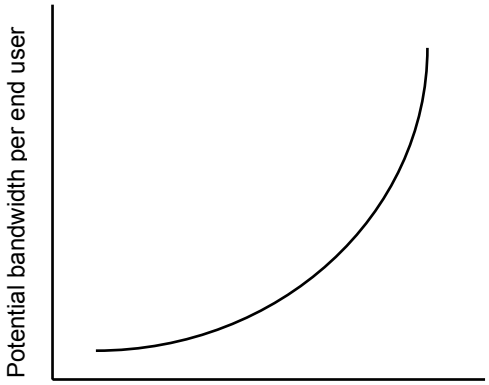


Figure 11 – CAN Fibre Bandwidth
Source: Author's appreciation

Apart from the traditional PSTN, the next most common wireline communications networks are the HFC (fibre to the node) networks delivering pay television and cable modem services. With a tree-branch topology and multiple users connected to lengths of common coaxial cables, there is an inherent scarcity of bandwidth for sharing amongst other users within the neighbourhood and possibly also with other service providers. Such shortcomings are not a feature of 'fibre rich' architectures such as TransACT's FTTC employing switched digital technology, or of certain FTTH architectures which can potentially deliver Gb/s of transmission capacity to individual users.

The closer optical fibre extends towards users, the greater is the potential bandwidth that can be made available to users. (DCITA 2003: 2.3) When optical fibre extends all the way to users as with FTTH architectures, users can experience the next generation of bandwidth abundance – where scarcity of bandwidth is no longer an issue. However, the practical world is not so ideal as we shall later appreciate, in that certain FTTH variants may

[131] To address this broader user market, some carriers have even coined the term 'fibre to the customer premises' or FTTCP.
[132] Between the optical fibre end point and the end user will be either paired copper or coaxial cabling and it is the particular transmission technology used thereon which can limit the actual bandwidth available to end users. For economic or commercial reasons the actual bandwidth often falls well short of the potential bandwidth capacity of such cabling.

employ sharing of fibre capacity which can diminish the potential for an environment facilitating open access.

FTTU (fibre to the user)

In an attempt to lessen confusion in the marketplace arising from the above FTT'x' variants, some equipment suppliers have adopted the all embracing description of FTTU as implying a delivery system sufficiently flexible to address the markets for FTTB, FTTH, FTTP and FTTC. This is understandable since individual residences, multi-dwelling units and commercial premises in a given locality may share the same fibre-based network.

In this study, the description FTTH is mainly used as it has been commonly adopted in literature although the discussion would be little different if it was replaced with FTTU.

6.2 The Natural Monopoly of Fibre in the Access Network

In economic terms, a monopoly exists where production in a given market is by a single firm, though not all monopolies are regarded as being 'natural'. For example, where a firm controls the essential inputs into production through trademarks or patents, or from the exclusive right to sell in a market, then other firms are unable to compete on an equal basis if they are denied access to those inputs. Where control of such inputs may be impermanent, this is not said to be a 'natural' monopoly. (Sharkey 1982, p.54)

Given that natural monopolies usually attract regulation and also involve strong vested interests, the topic of rigorously defining exactly when a natural monopoly exists has concerned economists over recent decades. Their approaches have subtly differed. With the focus in this study on the business of telecommunications in Australia, the prime definitional reference adopted is that concluded by the Productivity Commission (PC 2001a) arising from their 2001 inquiry into telecommunications competition regulation. It represents a measured synthesis from a range of sources. (PC 2001a, Box 2.3)

> A natural monopoly exists where one firm is able to produce the relevant range of outputs at a lower cost than two or more firms. In particular, a natural monopoly requires a strictly and globally subadditive cost function over the relevant range of output – every way of dividing output between two or more firms would result in higher total costs than if the output was produced by one firm.
>
> For this to be the case, the cost of production has to be subject to economies of scale and/or scope over at least part of the output range.
>
> Economies of scale exist where a one percent increase in production raises the total cost of production by less than one percent. A common cause is fixed costs, or costs that are incurred regardless of output. Fixed costs are significant in network industries such as telecommunications, postal services and electricity transmission.

> Economies of scope exist where one firm can supply two products at a lower cost than two firms individually producing each product. For example, the costs of the joint provision of cable TV and telephony services are much lower than their separate provision.

Since economies of scale and scope are influenced by transaction costs which in turn can be strongly influenced by technological change, it is possible for a natural monopoly in a particular market to be a temporary phenomenon. Telecommunications involves a multiplicity of products or outputs that are produced or delivered via a multiplicity of technologies. Some aspects of telecommunications service delivery in Australia are considered to demonstrate natural monopoly characteristics, to a lesser or greater extent according to specific circumstances.

Economies of scale are evidenced by the cost savings for a single firm to serve additional customers in a given market. Telecommunications infrastructure involving cable technology, but to a lesser extent that involving radio technology, require substantial costs for the digging of trenches and provision of cabling on a distance related basis, for the connection to termination equipment and for the installation of exchanges for the interconnection of networks and creation of services. These costs are said to be 'sunk', in that they cannot be transferred readily to other uses. (PC 2001a, p.23) Once the infrastructure is in place, the cost of carrying traffic or services is relatively low as the marginal costs for such activity are almost zero. High sunk costs and low marginal operating costs are typically associated with the business of a natural monopoly. If a competitor were to duplicate such infrastructure to serve the same customers with the same services, a similarly substantial investment would be required but this would produce no additional customer benefit. According to Sharkey (1982, p.56), 'the entry of firms in a natural monopoly market could only reduce welfare by raising total costs of production'. Describing the public switched telephone network or PSTN as a 'strong' natural monopoly, the Chairman of the ACCC referred to cost modeling whereby the PSTN had been assessed as producing 10 per cent increased output for an increased total cost of less than one per cent. (Fels 2002)

Economies of scope refer to cost savings associated with the joint production of different types of services, and exist 'if it is possible to produce any vector of outputs more efficiently in a single firm than in two or more specialty firms, holding constant the level of production of each output'. (Sharkey 1982, p.56) For example, it would be more economic for the one PSTN to provide local, national and international telephone services rather than have separate networks to customers for each service type. (PC 2001a, p.25) The Optus Vision pay television network garnered economies of scope by delivering both pay television and telephony services on the same infrastructure, compared to the alternative of Optus operating a pay television only network whilst re-selling Telstra's existing telephony service. In contrast, at least from the perspective of Telstra, no economy of scope could be appreciated by carrying telephony on the Foxtel pay television network as Telstra already had sunk investment in its own PSTN.

Digital transmission combined with optical fibre magnifies the potential for economies of scope, in that a data bit carried for telephony is indistinguishable from a data bit

carried for video or any other service. The Productivity Commission (PC 2001a, p.26) also noted how ACTEW benefited from economies of scope by using its electricity poles to carry the new broadband services of TransACT.

Definitions aside, econometric evidence regarding the existence of natural monopoly may be difficult to prove conclusively in specific instances. A commonly accepted 'rule of thumb' is that natural monopoly can be identified where there are high fixed costs but low marginal operating costs, which happens to be true for certain parts of telecommunications networks. (PC 2001a: 24 alluding to King) (Huber 1997: 104) The particular market or sub-market in question may also be of key relevance, for example long-distance calls versus local calls, low bandwidth dial-up access versus broadband 'always on' access, especially if a competitor relies on technology that involves different service and cost characteristics. A duplicated access network may weaken a previous natural monopoly network if consumers gain benefits from differentiated products arising from new technology. (PC 2001a: 27-28) King and Maddock (1996: 72-75) conclude that 'judgement of natural monopoly status requires a close examination of the relevant technology' which they specifically refer to as 'cost-minimising technology'. Such technologies are the cornerstone of the telecommunications industry.

Telstra's ubiquitous customer access network is constructed of cables of twisted copper pairs connecting each subscriber to nearby telephone exchanges. In most instances, the cables are laid underground in conduits and pipes which are interspersed with manholes and pits. Individual connections to subscriber premises from the street cables are either laid underground or strung aerially from poles positioned outside the premises. The cost of civil work involved in constructing the CAN has been estimated to comprise some 90 per cent of total capital costs. (DCITA 2003) Many of the conduits and most of the pipes are either occupied by Telstra's cables or are reserved for Telstra's future anticipated requirements. The paired copper CAN of Telstra is commonly regarded as a natural monopoly and this broad assessment also applies to other telecommunication carriers throughout the world involving similar CAN construction. (ECITA 2005b: 4.2) (Sharkey 1982) (Reed 1992a) Sharkey (1982: 9.4) concludes that 'competition for local access must be between one active monopolist and one or more potential, but never active, competitors'. Further, he contends there is no direct evidence that this form of competition is viable and even where given markets are judged to be contestable, there is no guarantee that they will be stable. In these terms, unviable competition refers to delivery of the same set of services as the incumbent, rather than differentiated services arising from, for example, the introduction of mobile technology in the local loop. (Reed 1992a: 5.5.2)

An example of unviable competition and/or an unstable market was that of the duplicated roll-out of HFC pay television networks by Telstra/Foxtel and Optus Vision, which were reported by 1998 to have accumulated losses and write-offs of $3.5 billion. (Budde 1999) According to Sharkey (1982: 2.3), competition resulting in a substantial amount of overbuilding and excess capacity is a classic formula for 'destructive competition'.

However, the deployment of optical fibre in the CAN places an entirely different dimension on considering 'excess capacity'. Huber (1997, p.104) explains that the

costs are largely the same whether the cable contains one pair of fibres or a dozen, and whether the fibre carries a million telephone calls or none at all.

> Once the glass cable is in place, though, the costs of running traffic through it is almost vanishingly small. And the carrying capacity of fiber-optic glass can be increased almost indefinitely, and at very little cost. Every few years engineers double the carrying capacity of that cable.

A fibre to the home (FTTH) network in Australia would appear to exhibit many of the characteristics of a strong natural monopoly. This conclusion is reinforced by the following assessment of the prospects for FTTH in the United States, a country already with far greater wireline competition than Australia: (PWC 2004, p.24)

- A single fibre has the capacity to accommodate all foreseeable services;
- No one will have an incentive to deploy the second fibre;
- The total available market will not justify two fibre deployments.

Such a natural monopoly would normally be a strong candidate for attracting access regulation.

6.3 Network Architecture and Design

In the context of this discussion, the term 'network architecture' refers to the physical and functional configuration, representing the embodiment of topographical layout, electronic design and often also the underlying communication protocols.[133] When deciding which fibre architecture to deploy, a service provider primarily considers the density of potential customers and the network location. Perhaps the most important locational factors are affected by whether the provider is an incumbent or new-start operator, and whether there is a pre-existing access network involving optical fibre.

An incumbent service provider can exploit rights of way through sunk investment in poles or underground conduit, and economies of scale and scope via existing core and access network fibre cabling and systems. On the other hand, existing products and services may need to be cannibalized and existing infrastructure may not be upgradeable.

A new-start provider may experience no such conflicts but is then required to create new rights of way with lower economies of scale and scope. In the case of the TransACT fibre to the curb network, ACTEW benefited from existing rights of way for aerial cabling but not from any previous telecommunications infrastructure. They chose an architecture that served their strategic intent of providing an open access wholesale service.

The cost of network deployment and the expected return on investment are paramount considerations for any service provider. Above all, a critical prerequisite is the 'first mover advantage' - a second parallel or overlaid fibre access network is

[133] There may also be design variants within a given architecture according to, for example, the standards for transmission technology employed such as ATM or Ethernet.

generally impossible to justify economically. Network costs tend to be contained through the competitive supply of equipment designed to agreed standards.[134]

The various architectures may be categorised according to whether multiple customers or end users share a common fibre in the access network, and whether any equipment in the access network involves active equipment:

Home Run > Each customer has a dedicated fibre, similar in concept to the paired copper CAN; also known as a 'Point-to-Point' (P2P) or 'Single Star' architecture.

'Double Star' > Multiple customers share one fibre, similar in concept to the coaxial portion of a HFC network; also known as a 'Point-to-Multipoint' (P2MP) architecture.

- **Active Star >** A remote node in the access network involves active or powered equipment.
- Passive Star > **PON >** Passive Optical Network, involving a single nominal wavelength and passive optical splitters.
- **WDM PON >** Wavelength Division Multiplexed network, involving a different optical wavelength per customer.

According to Tseng (2001: 4.3), the chosen architecture directly impacts on the ability of a given network to facilitate access by third party service providers. As we shall see, a key factor is the extent of sharing of network resources among customers which in turn is determined by network planners who consider CAN transmission costs and the characteristics of the services to be carried. (Reed 1992a)

6.3.1 Home Run Architecture

With the traditional customer access network designed to deliver telephony services, each customer is served by a dedicated pair of copper wires radiating out from the telephone exchange. An item of line terminating equipment within the exchange bears a unique relationship with the service of every customer. In like manner, the optical fibre equivalent is called the 'Home Run' architecture where a dedicated fibre is deployed from the exchange or access unit to each customer as shown in Figure 12. Alternative labels describe a 'Single Star' or 'Point to Point' (P2P) architecture. (Reed 1992a: 2.2)

The interface at the exchange or access unit connecting to the core network comprises an optical line termination or OLT for each fibre where the electrical signals are converted to an optical beam, and vice versa. The reverse function is

[134] The two main standard-setting fora for fibre access networks have been the FSAN (Full Service Access Networks) group of telecommunication companies, and the IEEE Ethernet in the First Mile Task Force of mainly equipment suppliers.

performed by an optical network unit or ONU at the distant end of each fibre and provides the interface with the customer premises equipment or CPE.

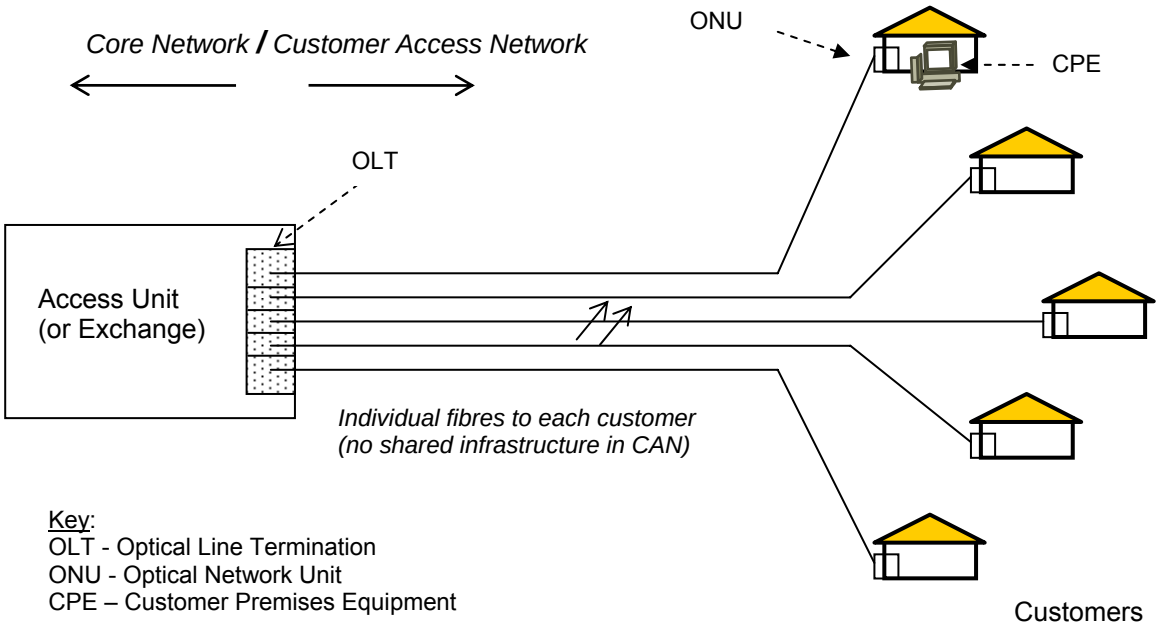


Figure 12 – Schematic of Home Run Architecture

Within an optical CAN constructed to a 'home run' architecture, there is no possibility for contention of network resources between the service of any one customer and another as there is no sharing of optical fibres. (Tseng 2001: 4.3.1) The bandwidth available to each customer is only limited by the design of particular OLTs and ONUs, or the commercial offering by the service provider and in theory can approach the maximum bandwidth capable of each optical fibre. In similar vein, there is nothing inherent in the architecture that prevents the offered bandwidth from being symmetrical. The absence of shared network resources also implies the highest possible security of individual services. The direct one-to-one relationship between a service appearance at the OLT and its corresponding ONU makes the home run architecture ideal for delivering switched services directly from the Access Unit or Exchange. (Reed 1992a)

6.3.2 Active Star Architecture

Compared to the Home Run architecture, the three 'Double Star' architectures all arose as approaches to reduce the total amount of optical fibre deployed in the CAN through the mechanism of traffic aggregation. The Active Star or Active Optical Network variant introduces into the access network a Remote Node containing active devices such as optical transceivers and a router or Ethernet switch to effect

multiplexing and de-multiplexing of signals.[135] (Tseng 2001: 4.3.2) Figure 13 provides a schematic.

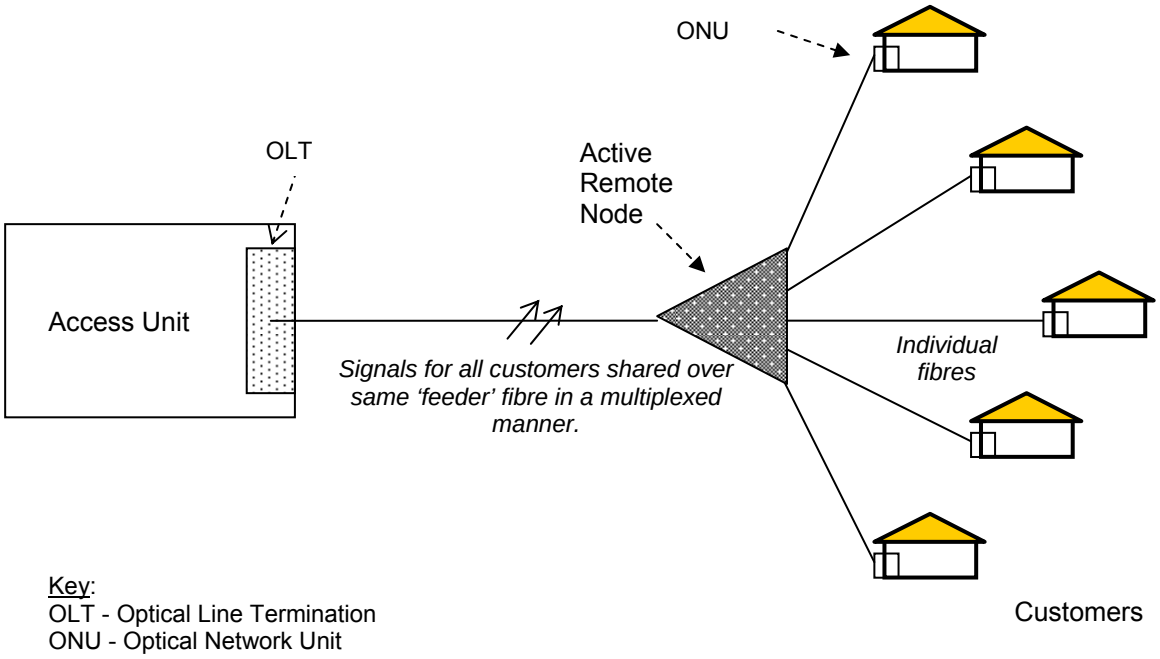


Figure 13 – Schematic of Active Star Architecture

Between the Access Unit and the Remote Node, up to 32 customers share an OLT and the same optical fibre – sometimes called a 'feeder' fibre. (Reed 1992a) On the other side of the Remote Node, the network adopts a star architecture though with shorter lengths of cable connecting to customers. Multiple Remote Nodes would be required to service a whole CAN.[136]

Compared to the Home Run architecture, the economic justification for an Active Star architecture is based upon the capital and operational expense of multiple Remote Nodes being out-weighed by the savings arising from the need to install and maintain less optical fibre overall. (Banerjee and Sirbu 2003: 3.2)

With bandwidth being shared over the 'feeder' fibres between the Access Unit and the Remote Nodes, the maximum bandwidth potentially available to each customer is typically less than with a Home Run configuration but greater than that available from the Passive Star or PON network architecture.

[135] Although not a definitive description of the network architecture at the physical layer level, some vendors offer solutions described as 'Active Ethernet' that are in reality configured with an Active Star architecture.

[136] The TransACT network also adopted an Active Star architecture, although transmission between the Remote Nodes and customers utilized VDSL transmission technology over relatively short lengths of paired copper wires. Fibre from the Remote Nodes extended back to a city central Head End installation.

6.3.3 Passive Star Architecture (PON)

The desire of network operators for the Remote Node to be a passive device with greater reliability and reduced operational costs led to a passive 'double star' architecture commonly known as the Passive Optical Network or PON as depicted in Figure 14.[137]

The degree of shared network resources is similar to that of the Active Star architecture, however the distinguishing feature is that now all customers receive the same downstream signal and all must contend for access to the same upstream data channel. In logical terms, this is similar to a HFC network in that signals for multiple customers are shared across a common 'bus' within the final distribution network. (Tseng 2001: 4.3.3) Both PONs and HFC networks are optimised for point to multi-point broadcasting of common signals such as television programmes.

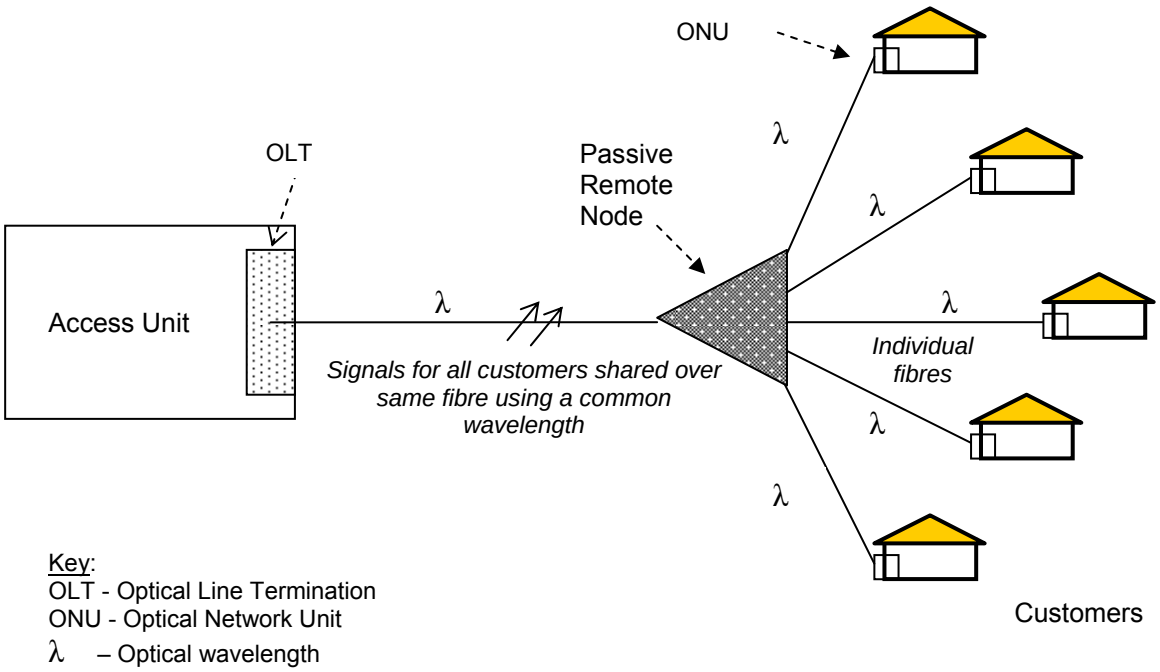


Figure 14 – Schematic of Passive Star Architecture (PON)

The Remote Node comprises an optical splitter/coupler that replicates the same wavelength across a number of distribution fibres serving individual customers, typically in a ratio of one feeder fibre serving from four to 64 customers but more often 16 or 32.[138] Where time division multiplexing is employed across a PON, each ONU extracts the data time slots specific to that customer and undertakes the necessary decryption to maintain privacy in terms of the signals pertinent to the other customers. (Corning Incorporated 2005) Each ONU also multiplexes upstream traffic

[137] All ONU within customer premises are active devices and require powering, regardless of whether the architecture within the CAN is active or passive.

[138] Typically a two-stage splitter arrangement is used, such as an OLT connecting to a 1:4 splitter, followed by four 1:8 splitters to accommodate 32 users. Riverstone (2004). FTTP Shootout - Active Ethernet vs PON. Santa Clara, Riverstone Networks: 6.

on a time slot basis using either the same wavelength or perhaps a separate wavelength.[139]

Specific commercially available design variants exploiting the PON architecture include:[140]

- APON or ATM PON, as defined by the FSAN group of telecommunication carriers to use ATM transmission as the layer 2 signalling protocol;
- BPON or Broadband PON, encompassing a mix of APON, Ethernet access and video distribution systems, ITU-T standard G.983 refers;
- GPON or Gigabit PON, as defined by the FSAN group to operate at bit rates above 1 Gb/s as per standard ITU-T G.984;
- EPON or Ethernet PON, as defined by the IEEE Ethernet in the First Mile or EFM group, IEEE standard 802.3ah refers.

6.3.4 Wavelength Division Multiplexed Passive Star Architecture (WDM PON)

In this third Double Star variant, each customer is assigned a wavelength unique to the particular Remote Node so that traffic streams in the access network are effectively kept separate from one another.[141] Figure 15 refers. The Remote Node, still passive, now comprises an optical filter which blocks out all but the one wavelength intended for a particular customer. (Reed 1992a) That action is designed to be bi-directional.

Called a Wavelength Division Multiplexed Passive Optical Network or WDM PON, it may also be described as a 'Coarse' or CWDM PON if only a few wavelengths are multiplexed onto the same feeder fibre, or a 'Dense' or DWDM PON if many wavelengths are multiplexed. (Banerjee and Sirbu 2003) The limiting factors are the signal power available for splitting at the Remote Node and the quality of ONUs to identify individual wavelengths.

---

[139] Most PON designs use the wavelengths of 1490 and/or 1510 nanometres for downstream signals and 1310 nanometres for upstream signals. Banerjee, A. and M. Sirbu (2003). Towards Technologically and Competitively Neutral Fiber to the Home (FTTH) Infrastructure. Pittsburgh, PA 15213 USA, Carnegie Mellon University.

Also see Alcatel (2004a). Fiber-to-the-User: The Ultimate Endgame. Technology White Paper. Paris, Alcatel**:** 12.

[140] For more detail, refer to http://www.fsanweb.org , http://www.ieee802.org/3/efm/ (both as at 13/5/2007) and Nakamura, M., H. Ueda, et al. (2004). "Proposal of Networking by PON Technologies for Full and Ethernet Services in FTTx." Journal of Lightwave Technology **22**(11): 10.

A further discussion of these variants can be found in section 6.5.3.2.

[141] An alternative WDM PON design whereby unique wavelengths are allocated to individual service providers is not considered in this study due to implementation difficulties.

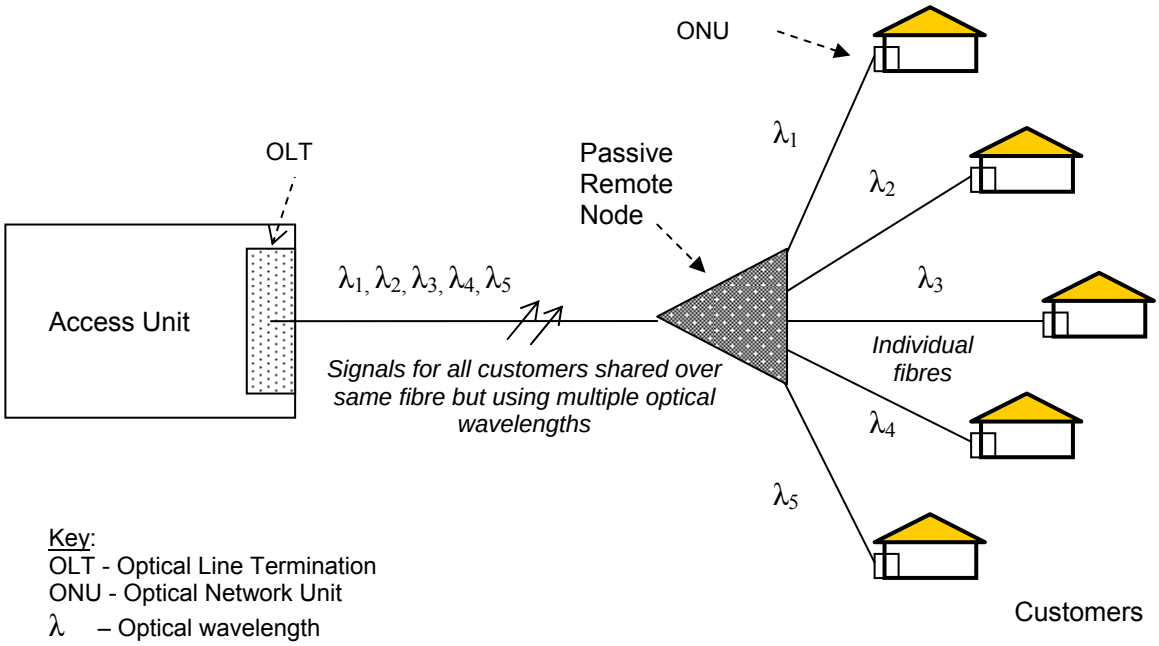


Figure 15 – Schematic of Wavelength Division Multiplexed Passive Star Architecture (WDM PON)

6.3.5 Advantages and Disadvantages

According to Reed (1992a: 2.2) "different services favour different architectures, and with so little known about future service markets, it is not surprising that a wide array of architectures have been proposed to connect fiber to the home". Network planners must anticipate the likely environment to be faced by their company as regards competitors, services, technologies and costs. When the transmission costs are expected to be high relative to switching costs[142], architectures with the most common plant in the access network are favoured, and vice versa.

All equipment costs have tended to fall over time on a per-circuit or per-customer basis, with the optical fibre cost profile showing the greatest downward trend. In the meantime, bandwidth requirements per-customer are rising over time. These trends could perhaps be regarded as favouring the Home Run and WDM PON architectures, but in practice architectural selection is strongly influenced by whether a prospective FTTH network operator is an incumbent telecommunications carrier or a new-start player, and whether there is a pre-existing access network whose right-of-way may be exploited. The decision-making is complex and no two network operators will necessarily experience the same costs for the same architectures, or adopt the same strategic evaluation.

[142] Roughly speaking, transmission costs include the laying of optical fibre plus any passive splitters/combiners/filters in Remote Nodes, whereas switching costs include customer-interfacing switching equipment in the Access Unit and any active switches or routers in Remote Nodes. Most other items could be considered common to different architectures.

Table 10: Advantages and Disadvantages of Various Architectures

ADVANTAGES	DISADVANTAGES
Home Run Architecture	
• Can potentially deliver the greatest bandwidth per customer compared to Active Star or PON architectures. • Highest possible security of services between customers. • Involves no contention for network resources. • Ideal for delivering purely switched services.	• Requires considerably more fibre in the access network. • Requires more OLTs (one per customer).
Active Star Architecture	
• Requires less fibre in the access network due to shared 'feeder' cable. • Can make optimal application of lower cost Ethernet technology and IP protocol. • Active Remote Node enhances network troubleshooting, greater service flexibility. • Can potentially deliver symmetric bandwidth of greater magnitude than for PON architecture. • Active Remote Node can potentially deliver switched services.	• Active Remote Node requires powering and environmentally hardened enclosure. • Requires most OLTs (one per customer plus two per feeder cable).
Passive Star (PON) Architecture	
• Requires less fibre in the access network due to shared 'feeder' cable plus fewer OLTs than Home Run. • Passive Remote Node requires no powering and less environmental protection. • Popular with incumbent carriers in terms of maintenance and operation. • Potentially upgradeable to WDM operation.	• Security of services between customers needs to be guaranteed by encryption within ONUs. • Shared 'feeder' cable and passivity restricts bandwidth potentially deliverable per customer to the lowest of all four architectures. • Customer bandwidth typically asymmetric. • Passive and fixed nature of Remote Node can lead to operational inflexibility.
Wavelength Division Multiplexed Passive Star (WDM PON) Architecture	
• Requires less fibre in the access network due to shared 'feeder' cable plus fewer OLTs than Home Run. • Passive Remote Node requires no powering and less environmental protection. • Can potentially deliver the highest bandwidth per customer, similar to the Home Run architecture. • Involves no contention for network resources.	• Optical filtering within OLT, Remote Node and ONUs in addition to tunable lasers incurs higher cost than other architectures.

Sources: (Banerjee and Sirbu 2003), (DCITA 2003), (OCCAM 2005), (Allied Telesyn 2004), (Tseng 2001), (Riverstone 2004), (Park, Lee et al. 2004), (Kramer and Pesavento 2002).

The intent of the comparison in Table 10 is to better appreciate the commonly perceived advantages and disadvantages of the various main FTTH network architectures so as to broaden the understanding of how each is situated when considering the prospects for facilitating third party access.

6.4 Designing for Competitive Access

The aim of the following analysis is to appreciate which basic characteristics of the various FTTH architectures and designs tend to support competitive access and which impede it. It does not purport to deal with the economic and commercial viability of 'open access' in practice.

6.4.1 Traditional Regulatory Approaches

Reflecting the policy direction of the Australian government through the Telecommunications Acts of 1991 and 1997, in addition to the corresponding parts of the Trade Practices Act concerning telecommunications, the Australian Competition and Consumer Commission or ACCC has adopted a regulatory approach encouraging industry competition through a mix of facilities-based and access or service-based competition. According to the ACCC: (ACCC 2005b: 6)

> Facilities-based competition involves service providers using own network infrastructure, often complemented by the use of lower level access services;
>
> Access or service-based competition is when service providers rely heavily on the access and wholesale services of an incumbent to compete in retail markets, rather than employing their own network infrastructure.

Where economically viable, the Commission considers facilities-based competition to be more effective in the long term in driving efficiency, and in delivering a wider choice of services and more competitive prices to retail users. The market for mobile services is quoted as an example where strong facilities-based competition has been successful. (ACCC 2004b: 17) Access-based competition is often seen as a precursor to greater facilities-based competition.[143] However, the ACCC recognises that where infrastructure creation involves significant economies of scale, facilities-based competition may either be unviable or only partially so. (ACCC 2005b: 11)

[143] The decision to invest in new infrastructure means that facilities-based providers have to compete in how and when to develop new services; on the other hand, access-based providers must await the development of services and facilities by the incumbent and hence their opportunity to innovate is much less. Access or service-based competition offers, at best and over the long run, only a 'stepping stone' to competitors on their way to building their own access network or 'facilities', according to Woroch, G. A. (2002b). Local Network Competition. Handbook of Telecommunications Economics. M. Cave, S. Majumdar and I. Vogelsang, Elsevier.

.

In terms of fibre to the home networks, facilities-based competition requires the construction of parallel optical fibre cabling along substantially the same streets or otherwise arranged to serve substantially the same subscribers with a similar set of services. Whilst this is technically viable, the huge economies of scale available to the first network and large fixed costs of any subsequent network are likely to create significant commercial barriers for a second entrant. (Banerjee and Sirbu 2003: 23) (PWC 2004, p.24) Tseng (2001: 46) moots a possible scenario whereby incumbent telephone and cable television operators in the USA could separately migrate their networks to all fibre as demand outgrows the capabilities of the current infrastructure and each provider desires to capitalize on the ability to provide all services over the one network. Currently, no examples of overlaid or duplicated FTTH networks are known to exist.

The more likely alternative, given a regulatory requirement facilitating 'open access', is creation of a workable access or service-based competition regime applying to FTTH networks. As with the dial-up telephone network, individual service providers and customers could establish direct relationships as depicted by Figure 16, without encountering bottlenecks or gateways dictated by a network provider. At first sight, this should be a rather obvious conclusion – particularly if such a regime already exists for other telecommunication networks and services and merely needs to be applied to fibre to the home networks. Unfortunately the reality can be different, with incumbent providers liable to frustrate attempts to unbundle FTTH networks or services through either intentional design or adoption of industry designs that just happen to assume the network provider to be the sole service provider. (Tseng 2001: 49-52)

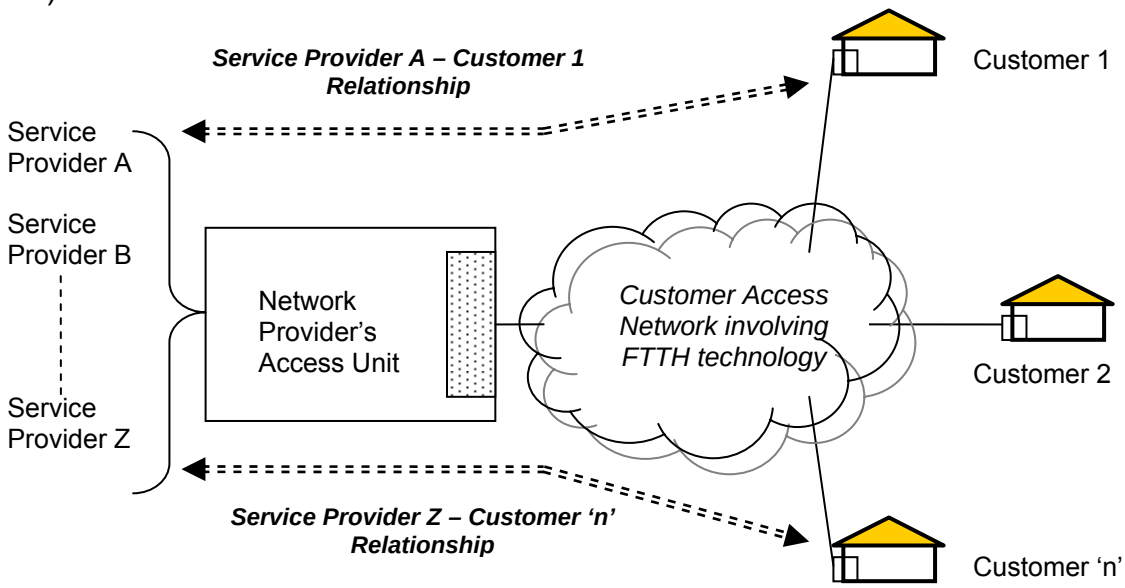


Figure 16 – FTTH Competitive Access Relationships

The accessibility of FTTH architectures can be appreciated against two different yet complementary technological frameworks. One is based on the type and manner of multiplexing employed, the other on a more abstract consideration of design expressed in terms of functional layers and data protocols.

6.4.2 Multiplexing Framework

By definition, multiplexing comprises the combination of two or more information channels onto a common transmission medium, followed by the reverse process known as de-multiplexing with recovers the original channels. The two main techniques are time division multiplexing and frequency division multiplexing, however in optical communications the equivalent of frequency division multiplexing is called wavelength division multiplexing.[144] (Rowe 1999)

With time division multiplexing or TDM, the signals for multiple channels are carried in sequential time slots of data, whereas with frequency division multiplexing or FDM, the signals for multiple channels are simultaneously carried at different frequencies or sub-carriers on the transmission medium. With wavelength division multiplexing or WDM, the signals are carried simultaneously as separate wavelengths of light along an optical fibre.

By its nature, multiplexing involves the sharing of network resources in order to improve the economics of network deployment and/or to provide a required level of functionality. According to Tseng (2001: 63-64), the more a network is shared, the more responsibility and control the network provider has over the management and allocation of network resources. Conversely, the more a network is dedicated, the more responsibility and control the service providers and ultimately the subscribers have over the network traffic providing their services. But how does this relate to open access?

For a FTTH network to be opened to access by a service provider other than that of the network provider, the point of network interconnection must be at the Access Unit or wherever the optical line termination devices or OLT are located.[145] Means must then be had to associate the traffic to and from a particular customer with their designated service provider or providers. Since an open access network requires mechanisms that ensure fair allocation of network resources among different service providers and their customers, the network provider will need to facilitate this, in addition to managing quality of service and otherwise ensuring the maintenance of overall network integrity.[146] (Tseng 2001)

Each of the four main FTTH architectures is now assessed in terms of the extent and nature of multiplexing employed.

---

[144] Also refer to http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci212614,00.html , accessed 20 November 2005

[145] It is generally not feasible for interconnection to be effected at any other point closer to the optical network units or end users, such as at a Remote Node, as this could compromise network integrity.

[146] In particular, the activities of one provider must not adversely affect any other provider, nor any one customer affect the services of another.

Home Run Architecture

With each customer being serviced by an individual fibre all the way to the Access Unit, every customer ONU is represented in the Access Unit by a specific OLT appearance. There is no multiplexing of signals involving different customers at any point in the CAN, implying no shared network resources. (Tseng 2001: 65)

Each service provider physically connects to a particular OLT and hence the corresponding ONU. As a result, there should be no untoward impediments to the network provider implementing open access in a Home Run network. Further, at least in theory, there should be no network-specific limitations on a service provider delivering a unique set of services to each customer.

Active Star Architecture

Although each customer is serviced by an individual fibre to a particular Remote Node, there can be no interconnection to service providers at such points without costly network re-design that would made interconnection an uneconomic proposition. All interconnection must occur at the Access Unit.

Between a given Remote Node and the Access Unit, signals involving different customers are shared over the same 'feeder' fibre using TDM multiplexing. For typical active star network designs, this imposes an upper limit on the bandwidth resource able to be allocated to each customer. The network provider needs to allocate a logical point-to-point connection between each service provider and a particular customer. (Tseng 2001: 67) Accordingly, open access may be implemented with an Active Star network but requires a greater degree of resource management compared to the Home Run network.

Passive Optical Network Architecture

With the Remote Node now performing a passive splitting/coupling function, each customer ONU receives the same downstream transmission of signals and each must contend for access to the same upstream transmission. Even though each customer is serviced by an individual fibre to a particular Remote Node, it is the broadcast nature of the whole architecture that results in all resources being shared throughout the entire network. (Tseng 2001: 67)

Although open access may conceivably be implemented with a PON network architecture, multiple service providers experience restrictions similar to that when accessing a HFC cable television network. In particular, each customer must be offered the identical set of services and the allocation of network resources is controlled to a greater extent than with any other FTTH architecture. According to Tseng (2001: 69), such allocation is effected though Quality of Service or QoS mechanisms implemented by the network provider.

WDM PON Architecture

Although the signals to and from all customers are shared over the same 'feeder' fibre between the Access Unit and the Remote Node, each customer or service

provider is allocated a specific optical wavelength such that there is effectively no sharing of network resources at any point within the CAN. An optical switch or filter within the Remote Node effects the required 'optical switching'. Arbitration of bandwidth among customers then ceases to be an issue, in a manner similar to that with the Home Run architecture. (Tseng 2001: 70, 71)

Two designs are possible – either a specific wavelength is allocated to each customer served by a Remote Node, or a specific wavelength is allocated to each service provider.

In the former case, each service provider interfacing at a given OLT may connect through to the corresponding ONU for an individual customer according to its allocated network wavelength. In this configuration, a Wavelength Division Multiplexed PON network should present no network-specific limitations on a service provider delivering a unique set of services to each customer and hence no untoward impediments to the network provider implementing an open access regime.

In the latter case, each customer ONU must be capable of tuning into the desired service provider wavelength. Whilst technically feasible, such a design is more expensive when it is realised that ONUs are individual to each customer and simplified implementations are necessary to minimise costs. Open access becomes even more complicated if a customer subscribes to services from multiple providers. (Tseng 2001: 71)

Accordingly, consideration of the WDM PON architecture in this study assumes only the more practical design where a specific wavelength is allocated to each customer.

In summarising the above architectural and design comparisons, assessment against a multiplexing framework illustrates that the greater the extent of shared network resources the greater is the need for the network provider to arbitrate access, which in turn raises obstacles to accommodating multiple service providers and hence open access. The PON architecture fares the worst on this assessment.

6.4.3 Layers Framework

The capabilities, services, design and/or implementation of communication networks can be described in terms of conceptual models involving 'layers'. Each layer is described by a set of rules or protocols defining its function and interface to another layer. A series of layers are said to be 'stacked' such that one provides a service to another, the result being a description of the provision of a service to an end-user or perhaps another network. The genesis of such layered descriptions was the need for computer network or data equipments from different vendors to communicate with each other. Provided the interfaces between layers remained constant, different designs or implementations realising one layer could be made without affecting the operation of other layers. (Whitt 2004)

OSI Reference Model

Of the many layer-based reference models devised since the early 1970s, the OSI and Internet models are the most widely appreciated.

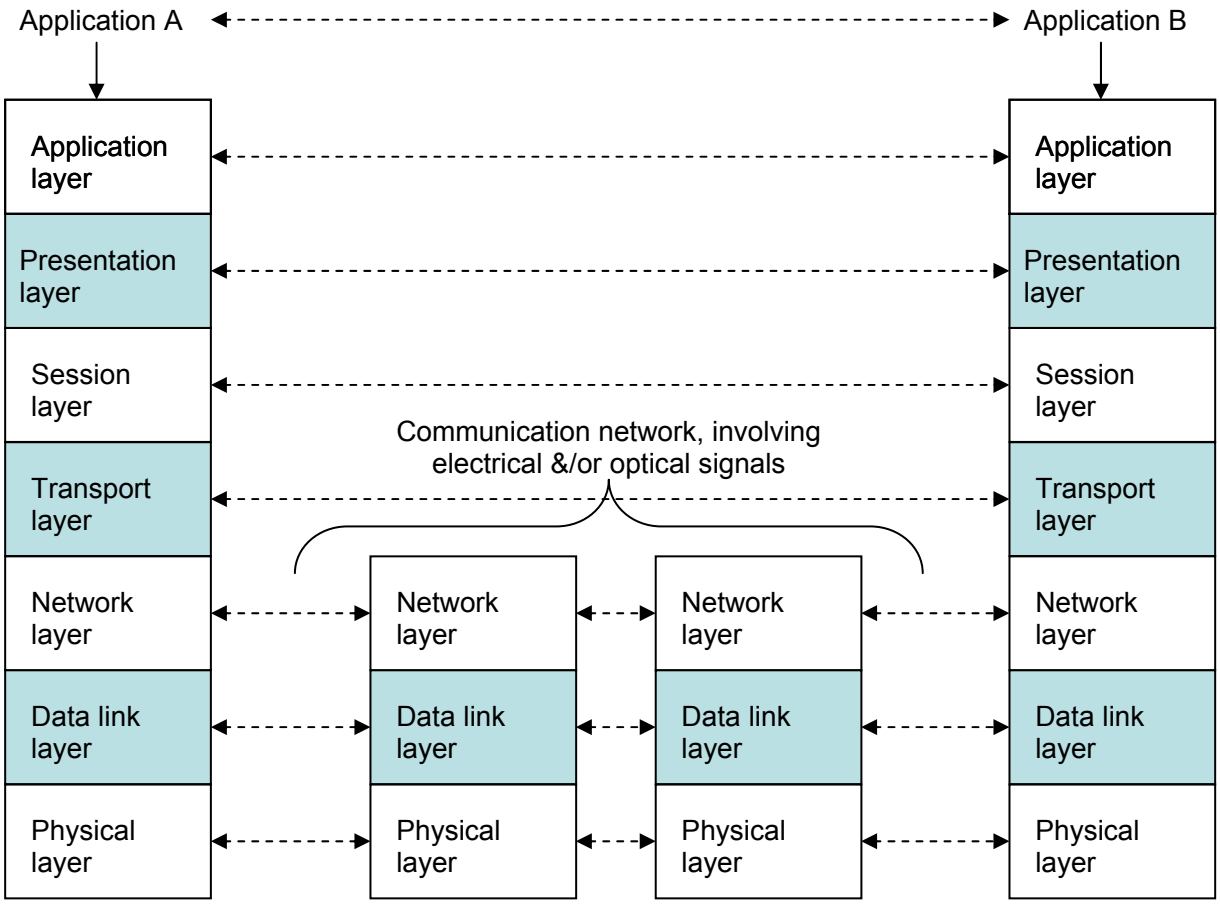


Figure 17 – The Seven-Layer OSI Reference Model
Source: Adapted from (Leon-Garcia and Widjaja 2004, p.44)

During the 1970's, the desire for interoperability led to an effort in the International Organisation for Standardisation (ISO) first to develop a reference model for open systems interconnection (OSI) and later to develop associated standard protocols. (Leon-Garcia and Widjaja 2004) The resultant OSI reference model partitioned the communications process into seven layers and provided a framework for talking about the overall communications process. This is depicted by Figure 17 which portrays the basic communications functions required for two computers to communicate via a communication network.

The functions of each layer are briefly described, in addition to cross-references to key Internet model layers: (Linfield 1994), (Leon-Garcia and Widjaja 2004)

Application layer	Layer # 7	Performs the services required for the application processes, such as file transfer, e-mail and the World Wide Web as accessed through the Internet.
Presentation layer	Layer # 6	Provides the Application layer with independence from differences in machine-dependent data format.
Session layer	Layer # 5	Manages the dialogue between end-user

		application processes.
Transport layer	Layer # 4	Provides transparent transfer of data between end-users; with the Internet, this function is approximated by the Transmission Control Protocol or TCP.
Network layer	Layer # 3	Provides for the transfer of data in the form of packets across a communication network; with the Internet, this function is approximated by the Internet Protocol or IP.
Data link layer	Layer # 2	Determines how two machines on a network 'talk' to one another; a common such protocol in use is Ethernet (IEEE 802.3).
Physical layer	Layer # 1	Deals with the transfer of bits of data over a communication channel provided by a specific transmission media.
Media layer	Layer # 0	Sometimes assumed as part of Layer # 1; refers to the actual transmission media such as optical fibre, coaxial cable, twisted paired conductors or radio waves.

The concept of layered protocols, as exemplified by the OSI reference model, provides a lens or framework through which to appreciate how openness can be facilitated or impeded in various FTTH designs or implementations.

Unbundling

According to Pindyck (2005), the regulation of telecommunications, railroads and other network industries has been based on mandatory unbundling and facilities sharing – entrants have the option to lease part or all of incumbents' facilities if and when they desire, at rates determined by regulators. Alert to the inevitable convergence between telephone networks and computers, the FCC Computer Inquiry III of 1986 declared that US telephone companies could enter markets for so-called 'enhanced' services provided new entrants could enter the phone companies' markets. (Huber 1997, p.82)

The principle of 'equal access' was thereby promoted and would be effected by US telephone companies being mandated under the Telecommunications Act of 1996 to 'unbundle' their networks in both a technical and commercial sense by offering the basic elements of service to aspiring providers on a non-discriminatory basis.[147] The term 'network element' meant both a "facility or equipment used in the provision of a telecommunications service" and "features, functions, and capabilities that are provided by means of such a facility or equipment". This latter definition included items such as subscriber numbers, databases, signalling systems, and information sufficient for billing and collection, or used in the transmission routing, or other provision of a telecommunications service. The Act mandated an access provider to provide an access seeker with "non-discriminatory access to network elements on an unbundled basis at any technically feasible point on rates, terms, and conditions that are just, reasonable, and non-discriminatory …". The intention was that an access seeker would then be able to combine such 'unbundled network elements' or UNEs

[147] Refer to http://www.fcc.gov/Reports/tcom1996.txt, accessed 13 May 2007, noting Sections 3(a)(2)(45) and 251(c)(3).

in order to provide a telecommunications service as an alternative to that of the incumbent's services. (Northfield 1999, s.3.3.1) (Shah, Sicker et al. 2003, s.2.1.2)

In essence, unbundling of a telecommunications network enables the sharing of facilities of an incumbent network provider with one or more 'third party' service providers. The concept and practice of unbundling is now well established as applied to the PSTN which has traditionally comprised twisted pair copper cabling for the 'local loop' that connects customers to telephone exchanges. Publicly available network and equipment standards have meant there have been few technical obstacles to realising the necessary interconnection. But how readily can these PSTN-based concepts translate to fibre to the home networks and services?

Service-based Competition

Given that the first FTTH network in Australia is tantamount to a natural monopoly, facilities-based competition involving replicated customer access networks is most unlikely. Non-facilities or service-based competition can then only arise through multiple service providers sharing the resources of a common optical fibre access network.

Banerjee and Sirbu (2003) consider the design of a generic FTTH network as comprising three layers:

Network & Higher Layers {≈ OSI Layer 3 & above}	Derived voice, video, data services.
Data Link layer {≈ OSI Layer 2}	Asynchronous transfer mode or ATM, Ethernet, amplitude modulation for analogue video.
Physical Infrastructure {≈ OSI Layer 1 & '0'}	Optical layer (multiple wavelengths). Physical medium (optical fibres).

They then proceed to treat each layer in turn, postulating the impact of it being unbundled so that service-based competition may occur at the layer above. This analysis commences at the bottom of the layer stack and works upwards.

- Unbundled optical fibre; data link layer/'UNE-based' competition

Where the optical fibre cabling is amenable to unbundling, that is, in US parlance it is listed as an unbundled network element or UNE, a service provider or access seeker would pay the requisite amount to the network provider and then deliver services over the FTTH network employing the data link layer technology of their choice. The one network would simultaneously support multiple link layer technologies, enabling each service provider to uniquely deliver service to their customers as depicted in Figure 18. However this is not practicable where the access network involves multiple customers sharing a common data stream on the same fibre as they must all share a common data link layer. Hence, data link layer-based competition in this

manner would not be possible with the Active Star and PON architectures, but would be feasible to implement with the Home Run architecture. (Banerjee and Sirbu 2003: 5.1.2)

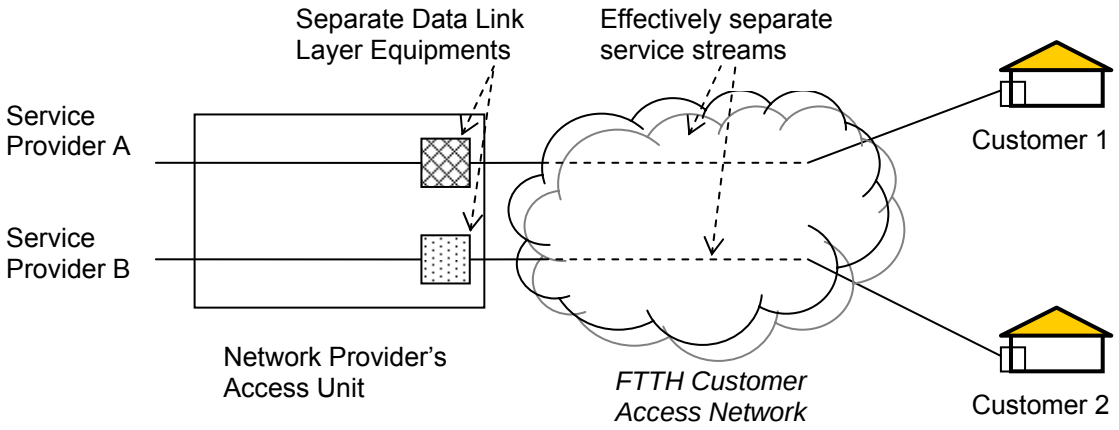


Figure 18 – Data Link Layer Competition through Unbundling of Optical Fibre cabling

- Unbundled optical wavelength; data link layer/'UNE-based' competition

Where multiple optical wavelengths on the same access fibre are technically accessible, they could be allocated to either multiple service providers or to individual subscribers sharing a common Remote Node. The result is a Wavelength Division Multiplexed PON, employing respectively a 'coarse' or 'dense' WDM design. In either way, a unique relationship could then be established between a service provider and a customer, similar to that of the Home Run architecture, and the service provider could employ the data link technology of their choice. Figure 19 refers. This would not be possible with the Active Star and PON architectures, but would be feasible to implement with a WDM PON architecture. (Banerjee and Sirbu 2003: 5.1.3)

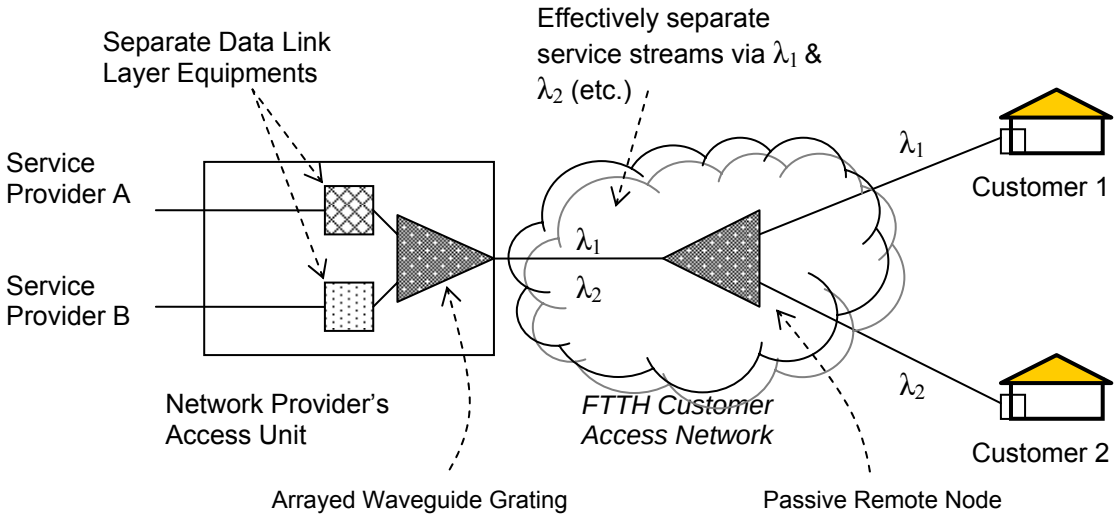


Figure 19 – Data Link Layer Competition through Unbundling of Optical Wavelengths

- Unbundled data link layer; network (& higher) layer/'open access-based' competition

In this model, unbundling occurs at the data link layer in a manner not dissimilar in concept to a dial-up, ADSL or HFC cable modem access arrangement. The customer and/or service provider is delivered a prescribed data link layer protocol which may even be tied to a specific ISP in certain cases. Importantly, no service provider can offer a service beyond that arranged by the network provider, who is more than likely also a service provider. Given that all customers receive the same nominal service stream, such as ATM or Ethernet, and are constrained by the same nominal bandwidth offering, the extent of competitive offering is necessarily reduced to that possible between the derived voice, video or data services as shown in Figure 20. Competition effectively becomes that of retail arbitrage; nevertheless data link layer unbundling can be readily supported by all FTTH architectures. (Banerjee and Sirbu 2003: 5.1.4, 5.2)

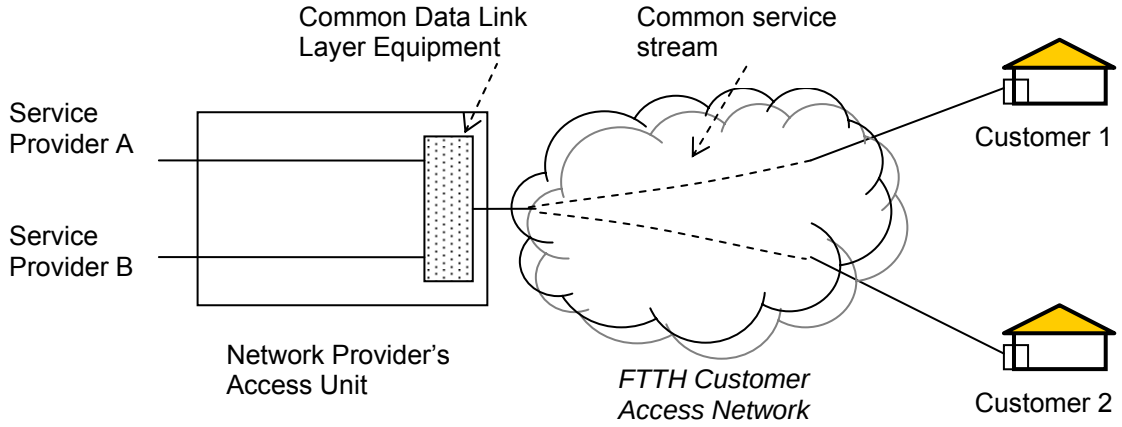


Figure 20 – Service-based Competition through Unbundling of Data Link layer

Video Service Delivery

According to Lehr (2004), how FTTH systems are designed to deliver video services also directly affects their ability to enable competitive access. Video services to the subscriber may be provided in two ways, broadcast or switched.

- Broadcast delivery

With the original PON network designs, multiple broadcast channels are frequency domain multiplexed to form a radio frequency signal which is transmitted in analogue form over the optical fibre. In a broadband PON or BPON configuration, the video multiplex may be carried on a specific optical wavelength and nowadays is more likely to be digitally encoded. As with HFC systems optimised to deliver pay television, all video channels are broadcast to all customers and channel selection is performed within the customers' optical network unit or set top box. However, typical PON designs do not have sufficient channel capacity to allow multiple service

providers to each send their own package of programming to their subscribers. (Lehr, Sirbu et al. 2004: 12)

- Switched delivery

When video signals are carried as part of an IP data stream, only the requested programmes are delivered to each customer. Multiple video service providers can be accommodated just as easily as multiple ISPs.[148] (Lehr, Sirbu et al. 2004: 13) However, the data carrying capacity per customer becomes the deciding issue as far as FTTH architecture and design are concerned. According to Riverstone (2004), currently the highest capacity commercially available PON design is GPON where customers can each receive up to 39 Mb/s. With high definition television or HDTV requiring bandwidths up to 19 Mb/s and customers expecting more than one simultaneous HDTV stream to multiple viewers in a home, GPON systems would provide insufficient capacity. Because Active Star networks typically deliver 100 Mb/s Ethernet to each customer, the Active Star architecture is more amenable to the competitive delivery of video programming than PON architectures.

6.4.4 Commentary

Assessment against either a 'multiplexing' or 'layers' framework reaches a similar conclusion: the architecture and design of a given FTTH network does matter as regards its ability to accommodate access to competitive service providers in a non-discriminatory manner. The differentiating factor is the extent to which a given network architecture and design has been engineered to maintain a 'one-to-one' and symmetrical relationship between service providers and customers.[149] The stronger this relationship, the more readily choice of service providers can be supported as well as services delivered that are unique to particular service providers. On the other hand, the greater the sharing of resources in the access network, the lower the ability to support choice of service providers and the more likely their service packages will be replicas of one another – with there being only monopoly service provision in the limiting case.[150]

It is not feasible that this assessment explores every single FTTH design variant and commercial product on offer. However, the broad trend is clear:

---

[148] This open access friendly characteristic is also shared by the fibre to the curb network architecture and system design of the TransACT network.

[149] In this situation, each customer is uniquely addressable as regards both incoming and outgoing traffic. Connections are effectively 'switchable'.

[150] The precedents for such contrasting outcomes are clearly evident with the traditional telephony and pay television networks. The former was designed to support direct point-to-point connections in order to handle voice traffic between pairs of interacting customers, whereas the latter was primarily designed as a shared network to broadcast television signals from a Head End facility to passive viewers, i.e. in a point-to-multipoint manner. Tseng, E. (2001). Competition in Fiber to the Home: A Technology and Policy Assessment. Engineering Systems Division, Massachusetts Institute of Technology**:** 101.

Both generic networks were optimised for their prime application and also assumed a single provider. In the case of pay television, that provider was typically both a network and service provider whereas with telephony it was originally perceived only as a network provider since the customers provided the content.

- The architectures most amenable to competitive access are those of the Home Run and Wavelength Division Multiplexed Passive Star or WDM PON designs;
- The Active Star architecture is a compromise solution for competitive access, situated between the limit cases of the Home Run and PON designs;
- The architecture least amenable to competitive access is that of the Passive Optical Network or PON design.

The basic characteristics of pertinence are as follows:

Home Run	Individual optical fibres to each customer result in no contention for network resources in the CAN and potentially deliver the greatest bandwidth per customer compared to other architectures; as a result, this architecture is the most amenable to service-based competition regardless of which layer is unbundled.
Active Star	Representing a compromise as regards the sharing of network resources in the CAN, this architecture can deliver a symmetric bandwidth per customer of greater magnitude than PON; it is more amenable to the delivery of multiple video streams and switched delivery in particular.
PON	The broadcast nature of service delivery within the CAN causes the highest contention for network resources and the lowest ability for a 'one-to-one' relationship between service providers and customers; depending on the given design, this architecture is typically the most constrained as regards expanding the bandwidth to each customer and only supports service-based competition at the network and higher layers, that is, no service provider can offer a service beyond that arranged by the network provider, who is more than likely also a service provider.
WDM PON	The ability to optically segregate service streams across the CAN produces an outcome very similar to that of the Home Run architecture.

6.5 FTTH in Australia – Threat or Opportunity?

> *"What would happen if bandwidth scarcity was to end all of a sudden?"*[151]

The roll-out by Telstra and Optus of hybrid fibre coaxial networks from 1995 to 1997 for the delivery of pay television was a watershed in the development of Australia's public wireline access network. Widespread deployment by Telstra of fibre to the home networks, or their close variants, arising from policy decisions taken in 2005 and 2006 will mark another watershed – unlikely to be overtaken for decades to come.

[151] Question posed by Diana McCarty in her message 'Markets and Anti-Markets' to the mailing list www.nettime.org , 7 Feb 1997.

Such watersheds are marked by significant changes in the strategic, technical, commercial and regulatory environments. However, fibre to the home (FTTH) offers a quantum change – the potential to end the scarcity of communications bandwidth available to residential and SME customers. Yet with many aspects of the existing CAN infrastructure comprising a natural monopoly, such an opportunity is being overshadowed by Telstra's threat not to further invest in fibre in the CAN without regulatory relief.

6.5.1 From Technology Trials to Commercial Pilots

FTTH technology has been available to carriers for least a decade, being an incremental development from that employed in long distance and inter-exchange applications, as well as computer-based office LANs. According to Tseng (2001), 'the viability of FTTH has always been primarily a question of economics rather than technology". Telstra has possessed the technological answers for over a decade.

The Optical Fibre Residential Engineering Pilot or OFREP provided a dedicated fibre to dozens of homes commencing 1988/89 in the suburbs of Toorak, Melbourne and Centennial Park, Sydney. (Rozental, Griffin et al. 1992) (Griffin 1993) These barely publicised technical trials carried content of minimal commercial significance and were wound up by late 1992. That same year, Telecom Australia commissioned new trials of both fibre to the home and fibre to the curb technology in Wollongong, New South Wales. Although again primarily technical trials, they differed from OFREP in that some aspects of interactivity were also explored. (Hsieh, Butterfield et al. 1993)

This was the era of the Commonwealth Government's Broadband Services Expert Group and a public policy focus on deploying 'interactive broadband networks' to carry 'interactive information and communications services', including video on demand services. (BSEG 1994) Only optical fibre technology was envisaged to be capable of delivering the necessary high bandwidth both downstream and upstream. In 1993, Telstra devised plans to provide the Canberra suburb of Gungahlin with a state-of-the-art multimedia network but with competition looming in the delivery of broadcast pay television such plans were quietly shelved in the interest of expediency.

Nevertheless, despite its new found focus on rolling out a HFC network between 1995 and 1997, and freezing that infrastructure thereafter, Telstra did not stand still. Telstra's competitive advantage lay not just in its ability to sustain a massive annual capital expenditure and all which that brings, nor in its rights of way embodied in the CAN and backbone infrastructure, but in a less overt way – through the accumulation of written down infrastructure and optical fibre cabling in particular, both backbone and in the CAN, held in reserve to address future demand.

Due to the competitive marketplace, statistics on the extent of fibre in the CAN are no longer made public but reasoned projections can be made from data made available in 1992. Under the Laserlink™ initiative, Telecom Australia publicised a target of attaining a goal of 60 per cent 'connectivity' of optical fibre in the customer access network by 1994/95. (Telecom 1992a) (Telecom 1992b) By 'connectivity' it was meant that only an average of 700 metres of cable would remain to be installed between the optical fibre cabling end point and customers' premises in residential

areas.[152] Figure 21 illustrates the anticipated connectivity profile extending from the 1992 achievement to the 1995 target.

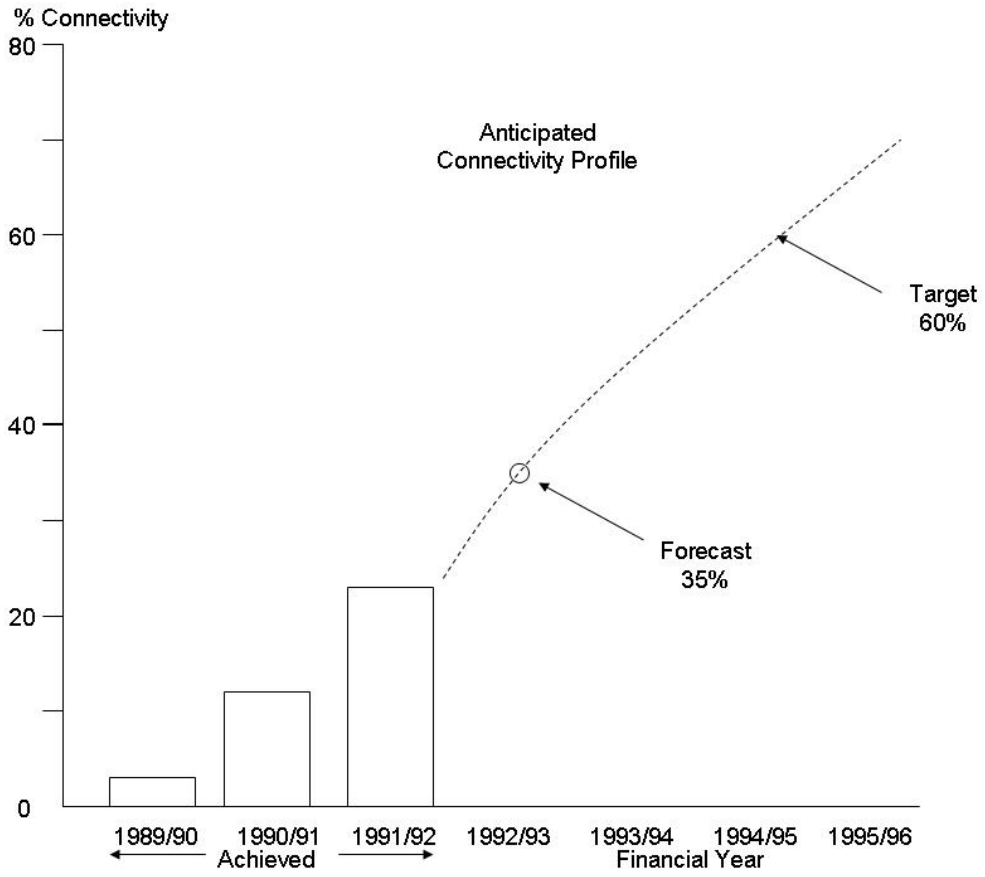


Figure 21 – CAN Optical Fibre Connectivity
Source: Author's publication (Kelso 1992b, Fig. 4)

There is every reason for this target to have been met, if not exceeded, and the trend to have subsequently continued to reach 100 per cent 'connectivity' by the year 2000, if not before. The reasons for this confidence are as follows:

- From 1995 to 1997, Telstra rolled out a hybrid fibre coaxial network passing 2.5 million homes throughout Sydney, Melbourne, Adelaide, Perth and the Gold Coast, advancing the extent of optical fibre in the CAN to within groups of approximately 500 to 750 homes;
- Commencing 1992/93, Telecom began to deploy the next generation of Remote Multiplexers known as RIMs sited centrally within given fibre serving areas or FSAs to provide customers with ISDN Basic Rate Access in addition to the usual voice frequency telephony services; (Rozental, Griffin et al. 1992)

[152] Exchange areas throughout Australia were sectionalized into cellular-like groupings known as Fibre Serving Areas or FSAs, each accommodating approximately 450 customers. Fibres extending from local exchanges throughout the CAN would interlink the FSAs, thereby realizing this connectivity target. Rozental, S., J. Griffin, et al. (1992). "Optical Fibre in the Customer Access Network." Telecommunications Journal of Australia **42**(2).

- Remote multiplexer application has since been extensive throughout Australia, in residential, regional and rural areas, avoiding the need to install new copper cabling in the CAN and over recent years particularly supplanting the creation of new telephone exchanges; (Darling 2005)
- Optical fibre has also been deployed extensively to interconnect mobile telephony base stations throughout residential, regional and rural areas.

With the cost of laying optical fibre cabling substantially independent of the number of fibres within the sheath, it stands to reason that Telstra would always tend to install capacity surplus to its immediate needs. (AIEAC 1999, p. 237) Fibre that is unlit or 'dark', or lit but underutilised, called 'brown', represents a substantial competitive advantage for an incumbent carrier.

Back in 1992, Telecom/Telstra was buoyant about the prospects for utilising its expanding deployment of optical fibre in the CAN: (Rozental, Griffin et al. 1992, p. 14)

> It is likely that FTTC will become cost-competitive with conventional copper in the near future (1995 to year 2000 time frame) for the provision of narrow band services. FTTCP is a relatively more futuristic application and is currently more expensive than the FTTC alternative. Economic application of FTTCP technology is expected to be around the latter part of this decade or early 2000s time frame when opto-electronic integration, miniaturization and associated photonic development occurs.[153]

The latter prediction was not far off the mark.[154] Unveiling its Future Network Evolution and Product Strategy in July 2004, Telstra announced a $34 million program to deploy fibre to the premises or FTTP infrastructure in two new housing estates south of Brisbane as 'greenfield' developments[155], in addition to the very limited retrofit or 'brownfield' deployment of FTTP in situations where replacement of existing copper CAN infrastructure would be efficient. (Telstra 2004b, p.9) These would be commercial pilots and deliver to each customer up to four telephone services, Foxtel pay television plus a broadband Ethernet connection for access to BigPond Internet. (Todd 2004) The Alcatel technology had been tested at Telstra's Research laboratories for at least the previous year.

Telstra's Group Managing Director, Telstra Technology, Innovation and Products Mr Ted Pretty spoke of aggressive industry forecasts suggesting that by 2020 there could be about 6 million lines served by FTTP in Australia compared to around 2 million remaining copper access lines. (Telstra 2004b, p.10) Already, he considered

[153] That author used the terms FTTC for 'fibre to the curb' in the same manner as this paper, and FTTCP for 'fibre to the customer premises' in the same manner as this paper uses FTTH for 'fibre to the home'.

[154] This was despite the element of competitive bypass subsequently introduced by the extensive HFC network roll-out that was in 1992 still only a prospect.

[155] A total of 280 multi-dwellings were reported as being served in the new estate of Brookwater at Springfield, south west of Brisbane and 65 at Emerald Lakes at Carrara, City of Gold Coast. Telstra (2004a). Telstra announces next generation access technology commerical pilot. Media Release. Sydney, Telstra Corporation Limited**:** 1.

FTTP technology a commercially viable alternative to the copper network in new estates, also known as 'greenfield' developments, but from mid 2006 it could even be economical in 'brownfield' situations:

> Within the next 18-24 months, the total FTTP capex for network equipment (including cable) per home passed is expected to equal the cost of provision via the traditional copper based network. Today it is around 1.5 times the cost of copper. The cost to support FTTP will be less than the cost to support traditional copper based network. In addition to savings on the initial activation, we estimate there will be annual savings from a more resilient and flexible FTTP network. Currently, customers use a variety of access infrastructures to receive Telephony (copper), broadband data (Copper/ADSL, HFC, Satellite) and payTV (HFC/Satellite) services. FTTP will offer an equivalent to these existing products and services via one dual-fibre access technology with on-going cost savings in operations and maintenance. Also longer term, FTTP technology will provide a growth path to higher bandwidth internet and entertainment services.

From here onwards, fibre to the home technology could be destined to eventually transform the service capability of Australia's wireline CAN and in so doing reinforce the scale and scope of a putative natural monopoly in that market.[156] And it would exploit a massive sunk investment of optical fibre in the CAN progressively built since 1989. In the meantime there would be at least one major hurdle to jump, and FTTP would end up being sidelined from 'brownfield' deployment – at least initially.

6.5.2 A Mexican Standoff[157]

Two events rapidly changed Telstra's confidence of July 2004:

- In a shock reversal of fortunes, the Australian Competition Tribunal on 23 December 2004 negated the anticipatory exemption from standard access obligations for the pay television business of Foxtel and Telstra;
- In early January 2005, CEO Dr Ziggy Switkowski visited the US and learned that the US regional Bell operating companies or RBOCs had only recently won regulatory relief from mandated access requirements for new fibre networks in the CAN.[158] (Sainsbury 2005)

By February 2005, Switkowski had declared that the planned FTTP deployment would no longer take place without 'iron-clad guarantees' from the ACCC and even mooted the possibility for Telstra to partner with others to build a national fibre network. Appearing before a Senate committee, Telstra's Group Managing Director – Regulatory, Corporate and Human Relations revealed: (ECITA 2005a)

---

[156] That is, the market of providing the scale and scope of next generation bandwidth services only possible with optical fibre.

[157] Being a term describing an impasse or stalemate, it was first applied by the Australian media to this subject matter over a year before the arrival of new Telstra CEO Sol Trujillo and his American 'amigos'.

[158] Refer to FCC Memorandum Opinion and Order No. FCC 04-254 released 27 October 2004, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-04-254A1.doc, accessed 13 May 2007

> If the regulatory environment says that the moment infrastructure is put down then any wholesale customer is able to have access to that at what is effectively marginal cost, that affects the economics quite considerably. It does not necessarily mean Telstra would not do it, but we need to know about that. We need to know what that environment is, because without having that deep understanding it is not possible for us to even build a business case to put to the board as to what might be the appropriate returns and over what time frame those returns might be realised.

The Australian government was pushing hard to sell its remaining shareholding in Telstra and desperately seeking the support of the National Party and regional and rural voters. In March 2005, the Nationals released a proposal to 'future proof' telecommunications in non-metropolitan Australia that included a key option for the roll-out of a non-Telstra funded optical fibre network. (Page Research Centre 2005) Telstra could not lose its strategic advantage and not long after the arrival of new CEO Sol Trujillo, it submitted to the government a 'Digital Compact and National Broadband Plan' with the following key proposals: (Telstra 2005a)

- Telstra and the government would commit to build a world class, high capacity broadband infrastructure within 3-5 years;
- 98 per cent of Australian homes and businesses[159] would have access to the 'next generation' of Internet services at a minimum speed of 6 Mb/s;
- The government and Telstra would assume obligations to each other and to the public to build the network, with Telstra committing $3.1B to provide 6 Mb/s broadband to 87 per cent of homes and businesses, and the government providing the remaining $2.6B to cover the remaining 13 per cent.

Regulatory 'reform' would be an essential element of the proposed Digital Compact, with Telstra calling for, among other things, the new infrastructure and services to be exempted from standard access regulation based on the principle of Telstra holding the property rights. The government was reported to be unimpressed and in turn Mr Trujillo said he would withhold capital investment if telecommunications regulations were not wound back. (Boyd, Crowe et al. 2005)

As part of initiatives arising from a strategic review of its business operations, Telstra re-launched its proposals to invest in new fibre access technology but this time spoke of proposed fibre to the node or FTTN as well as FTTP investments, being part of creating a 'next generation multi-service access network' with an initial emphasis on metropolitan services and the five mainland capital cities in particular[160]. (Telstra 2005b) The demand for regulatory relief was reiterated. (Telstra 2005e)

---

[159] Throughout metropolitan, regional and rural Australia.

[160] Although not explicit at the time, the Digital Compact proposal had almost certainly also been based on the widespread roll-out of FTTN technology though with a greater focus on regional and rural deployment. The Digital Compact proposal was Option A of Telstra's 'Project Titan' with Option A2 being the FTTN roll-out focused more on metropolitan areas. Option B was to upgrade the HFC network and also focus more on the 3G mobile network, according to Sainsbury, M. (2006). $500m bill for Telstra's plan B. The Australian. Sydney.

The Minister dismissed Telstra's call for its proposed fibre investment to gain a permanent 'regulatory holiday',[161] saying that the current framework was adequate, in that Telstra could always submit an undertaking or seek an exemption from the access regime prior to making an investment. (Coonan 2005) One week later, on 21 December 2005, Telstra formally advised the Australian Stock Exchange or ASX that it would not proceed with some parts of its Next Generation Network or NGN program: (Telstra 2005f)

> Telstra confirms that the 'fibre to the node' component of the NGN remains on hold and vendors have been notified accordingly. As a result, Telstra will retain various legacy elements of the copper access network and therefore does not expect to accelerate the depreciation or write down of these elements in fiscal 2006.

The Minister had already claimed it was inevitable that Telstra would invest in the new networks regardless (Coonan 2005, p.5) and this view was subsequently supported by an investment analyst who declared "any decision by Telstra to abandon FTTN would have a significant negative impact on the value of the company".[162] (Guerra 2006)

Nevertheless, Telstra was sensitive about its sincerity on this issue and in a public submission to the ACCC re-affirmed: (Telstra 2006, p.22)

> Telstra has made clear in a statement to the ASX that it will not roll out a broad scale FTTN network unless and until the necessary regulatory safeguards are in place. The company is aware of its legal obligations in making such a statement.

6.5.3 The Next Generation CAN Technology

The technology briefing of 16 November 2005 revealed Telstra's plans to transform their customer access network from delivering telephony and data over a substantially copper-based CAN augmented by optical fibre connected multiplexers and increasingly involving 'piggy back' ADSL technology, to one with a lower dependence on paired copper cables all the way from exchange to customer, a greater penetration of optical fibre into the CAN to feed more multiplexers but instead involving a higher bandwidth ADSL technology known as 'ADSL2+'. (Telstra 2005b) The CAN optical fibre would be configured as FTTN for existing or 'brownfield'

[161] Alternatively known as an 'access holiday'; the concept is discussed further in Chapter 8.
[162] The inevitability of Telstra's replacement of its copper CAN had been previously highlighted in a Senate committee hearing on 12 November 2003; in response to the question "Is Telstra investing in new networks and new infrastructure that bypasses the existing copper network and will help improve penetration of broadband", Telstra's group manager of regulatory strategy replied "I think it is right to suggest that ADSL is an interim technology. It is probably the last sweating, if you like, of the old copper network assets. In copper years, if you like, we are at a sort of transition – we are at five minutes to midnight." ECITA (2003). Competition in Broadband Services. Environment, Communications, Information Technology and the Arts References Committee (ECITA). Canberra**:** 74-75.

locations and as FTTP for new or 'greenfield' locations, with the former initially comprising the greater investment. (Alcatel 2005)

The exchange and inter-exchange network would be substantially replaced with one involving only five pairs of 'soft switches' based on IP/MPLS[163] technology and capable of delivering to customers an 'integrated triple-play' of voice, data and video services. Interfacing with each customer premises would be a 'home gateway' device arranged to provide and manage services including entertainment, gaming, home automation and security. (Telstra 2005b) (Alcatel 2006a) Such a gateway was claimed to 'remove complexity for customers' by instead having Telstra as the single provider.

6.5.3.1 Fibre to the Node

Telstra proposed to modernise the wireline CAN such that it would deliver Internet access bandwidth up to at least 12 Mb/s[164] to the large majority of customers by segmenting the service area of each traditional exchange on an annular basis, as follows: (Telstra 2005b) (Telstra 2006)

- Those 40 per cent[165] of customers living within a radius of 1.5 kms of an exchange building would continue to be served with voice telephony plus Internet access delivered via exchange-based equipment, with the latter utilising ADSL2+ technology capable of a minimum of 12 Mb/s bandwidth per copper pair;
- The remaining 60 per cent beyond the 1.5 km radius would be served from newly constructed nodes connected back to the exchange network via optical fibre. Copper pairs between each node and the approximately 250 lines[166] within its service area would deliver voice telephony plus Internet access, with the latter utilising node-based ADSL2+ technology similarly capable of a minimum of 12 Mb/s bandwidth per copper pair.

Harking back to section 6.1, the 40 per cent group of existing customers to be served via entirely exchange-based equipment imply a conventional fibre to the exchange or FTTX network architecture. By contrast, the 60 per cent group of existing customers would be served by remotely located multiplexer equipment in an arrangement described as fibre to the node or FTTN. Figure 22 depicts this arrangement.

[163] Internet protocol (IP) and multi-protocol label switching (MPLS).
[164] Telstra's proposal is for a minimum standard access speed of 12 Mb/s for most households, although some could receive up to 24 Mb/s depending on distance and network configuration.
[165] The 16 November 2005 technology briefing spoke of a one-third/two-thirds split whereas the submission to the ACCC of February 2006 spoke of 40 per cent/60 per cent.
[166] Derived from 20,000 FTTN nodes said to be serve 5 million PSTN lines or services in operation (SIOs). Telstra (2005c). Transcript from Analysts Q&A session - Telstra Investor Day. Melbourne, Telstra Corporation Limited**:** 53.

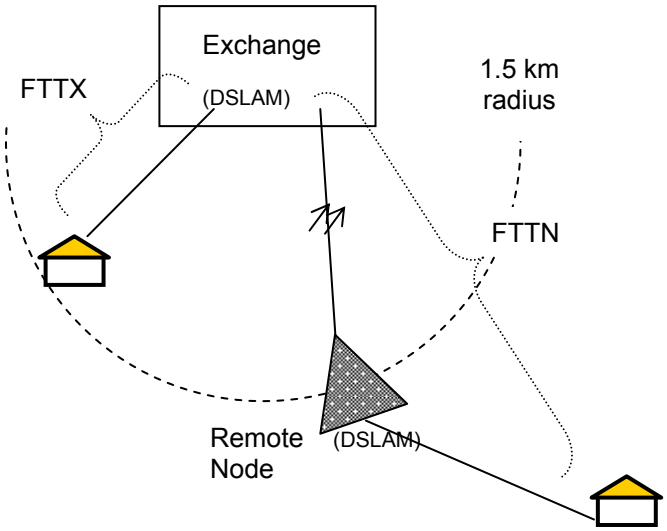


Figure 22 – Proposed Fibre to the Node Configuration
Source: Graphical representation of text of (Telstra 2006)

By reducing average paired copper lengths, such CAN segmentation enables increased DSL bandwidth. Alcatel highlight that its series 7330 FTTN equipment is ideal when time-to-market pressures and short term economic concerns are paramount and describe FTTN deployment as an interim step before the deployment of FTTU for triple play services. (Alcatel 2006b) (Alcatel 2006c)

6.5.3.2 Fibre to the Premises (or Home)

Earmarked for deployment in 'greenfield' or new estates[167], Telstra has revealed little about the technology involved apart from a reference to it "evolving from Broadband Passive Optical Network or BPON to Gigabit Passive Optical Network or GPON" as time goes by. (Telstra 2005b) Video carriage was said to be either "video on RF overlay or over IP". However, it had been previously revealed that Alcatel are to provide their series 7340 Fibre to the User or FTTU product to fulfil Telstra's FTTP/FTTH plans and it is from these technical specifications that further information can be gleaned.[168] (Riley 2004)

The product is based on ITU-T standards derived from deliberations of the Full Service Access Network or FSAN group of telecommunication carriers. Involving a Passive Optical Network or PON network architecture as discussed in section 6.3.3, signals for up to 32 customers are shared over a common optical fibre deployed from an exchange site or access unit to a passive optical splitter situated in the CAN. Thereafter, individual fibres connect to customers over the last few hundred metres. The CAN infrastructure of optical fibres and splitters remain unchanged as the

[167] Interestingly, since the mid-November 2005 launch of Telstra's strategy to achieve a next generation network, the demands for the regulatory relief have been specifically linked to FTTN investment and not FTTP, presumably since the latter was by now considered to be economically justified in new estates compared to paired-copper deployment.
[168] Personal discussion with Geof Heydon, Director Innovation & Market Development, Alcatel Asia Pacific on 22 November 2005.

network performance is eventually upgraded from BPON to GPON. (Alcatel 2004a) (Alcatel 2004b)

The data bandwidth available to each customer approximates the PON line transmission rate divided by the number of customers served by the optical splitter, i.e. typically 16 or 32 for BPON and 16, 32 or 64 for GPON. Line transmission rates are set to the carrier requirements and can be selected from the following possibilities:

	Downstream (to customer)	**Upstream** (from customer)
BPON	622 Mb/s; 1.25 Gb/s	155 Mb/s; 622 Mb/s
GPON	1.25 Gb/s; 2.5 Gb/s	155 Mb/s; 622 Mb/s; 1.25 Gb/s; 2.5 Gb/s

Assuming a 32-way optical split, the maximum possible bandwidth available to individual customers is then of the order of 15 or 31 Mb/s for BPON and 37 or 74 Mb/s for GPON.[169] For residential service installation, the Alcatel 7340 optical network terminal provides a port enabling a 10/100Base-T Ethernet LAN connection for Internet access. (Alcatel 2004b) In the BPON configuration, video service for pay television delivery is effected via a separate downstream wavelength of 1550 nanometres that is coarse wavelength division multiplexed with the downstream wavelength of 1490 nanometres for data delivery. With GPON in the future, video signals could alternatively be carried within the total Internet Protocol or IP data payload.

6.5.4 Regulatory Certainty

> *"Legacy regulation for legacy network, new arrangements for new networks." (Telstra 2005e, transcript p.5)*
> *"The regulatory regime has long been a whipping boy for those who claim we are in (a) period of regulatory uncertainty and change." (Coonan 2006)*

Despite all the talk about new networks, the focus of Telstra's public lobbying and representations to the government and the ACCC has been more on the bread and butter issue of lessening the impact of 'legacy' regulation for their legacy or existing network since they claimed this critically affected their immediate financial fortunes. The regulatory reforms Telstra insisted as being essential to 'promote competition, investment and equal services to all Australians' were: (Telstra 2005e, Media Release)

[169] Calculated on the basis of 80 per cent protocol efficiency for BPON and 94 per cent for GPON. Nortel (2004). Ultra broadband access: Unleashing the power of PON. White Paper, Nortel Networks**:** 16.
George, J. (2005). "FTTH Design with the Future in Mind." Broadband Properties: 6.

- An average ULL price of $30;[170]
- Limiting operational separation requirements to existing wholesale core services; and
- Exempting new services from mandated third party access.

By highlighting this third issue, Telstra was alerting the ACCC and the government to the prospect of future battles arising from unsatisfactory resolution of the ULL matter and that the legacy services of today should be quarantined from being regarded as evolving to the new services of tomorrow.

Only a few months earlier, Telstra had raised two other issues in the context of their Digital Compact and National Broadband Plan that illuminated their regulatory thinking: (Telstra 2005a, Tab 4)

- The regulatory certainty sought should also apply to new facilities, i.e. infrastructure, whereas ACCC declaration traditionally applied only to telecommunication services;
- A possible outcome could be no third party access at all.

Addressing a broader forum raised by the government task force on reducing the regulatory burden on business,[171] Telstra contended that it suffered from excessive regulation compared to other industries and that continued over-regulation would reduce investment, reduce consumer choice, stifle innovation and create competitive imbalances. (Telstra 2005d, s.3.5) (Telstra 2005e, slide 7) Furthermore, in its submissions to this task force and the ACCC strategic review of the regulation of fixed network services,[172] Telstra contended that it was no longer a monopolist in much of the retail access market and since "only true bottlenecks are subject to regulated competitor access", future implementation of Part XIC of the Trade Practices Act should be more carefully targeted to regulate only those remaining bottleneck hotspots. (Telstra 2006, p.10, 17)

Underpinning its strategy announced mid-November 2005 to create a 'next generation multi-service access network' was reliance on a 3-year rolling investment in a new network embodying fibre to the node or FTTN technology. But in the same breath Telstra declared that such FTTN deployment would not progress unless there was 'regulatory reform'. (Telstra 2005b) (Telstra 2005e) The so-called regulatory certainty required to unleash this FTTN investment could only be had by amending the Trade Practices Act to achieve the following outcomes: (Telstra 2005e, slide 19) (Telstra 2006, p.22)

[170] Unconditioned local loop or ULL, comprising the traditional copper paired CAN; Telstra had long been at loggerheads with the ACCC in determining a suitable price for third party access to its CAN and as at August 2005 the Commission had issued a draft pricing decision which Telstra strongly rejected.
[171] Refer to http://www.regulationtaskforce.gov.au/index.html, accessed 13 May 2007
[172] Refer to http://www.accc.gov.au/content/index.phtml/itemId/719844, accessed 13 May 2007

- A freeze on the declaration of new services under Part XIC[173];
- Limit the operation of Part XIB[174] to those services already declared under Part XIC; and
- Clear exclusion of new services from the scrutiny of the recently imposed operational separation requirements.

In effect, implementing these changes to the Trade Practices Act would remove the access pricing powers of the ACCC and grant Telstra a 'safe harbour' for its new network investments. (Telstra 2005d, p.24)

> Being required to open access to new infrastructure to competitors at low prices that are not set in a way that allows recovery of costs discourages the construction of new infrastructure. These new markets and technologies are intensely competitive markets and there is no bottleneck market failure justification for regulation.

If granted, Telstra would then have the power to dictate the price and non-price terms of access in a manner that they considered should reward their risk and enterprise, i.e. access should be on 'commercial terms'. (Telstra 2005e, transcript p.18) Another inference was that Telstra considered fibre to the node deployment not to create a new access bottleneck.

By early 2006, the ACCC and the Minister for Communications, IT and the Arts Senator Helen Coonan had continued to reject Telstra's demands. At a Senate hearing in February 2005, ACCC Chairman Graeme Samuel accepted that "what business needs and is entitled to is regulatory certainty" but that should not be confused with 'regulatory holidays'. (ELC 2005) He then proceeded to outline the mechanism already within the Trade Practices Act that provided for regulatory certainty, being the process of anticipatory undertakings and/or exemptions. Public interest considerations would take account of the need for investment certainty, reasonable investment returns and, ultimately, the long-term interests of end users.

Nevertheless, the markets were continuing to change and regulation needed to be adaptable to stay relevant. By December 2005, the ACCC launched a broad-ranging review of the future regulation of fixed network services, partly in response to the challenges posed by Telstra's FTTN proposal. (ACCC 2005c) According to the ACCC Chairman, a key objective of the review was to ensure that the overall regulatory environment does not hinder investment in innovative technologies whilst still providing competitive safeguards where necessary. (ACCC 2006a)

Minister Coonan contended that regulatory certainty was achievable within the current framework of the Trade Practices Act which allowed a company such as Telstra to submit an undertaking or to seek an exemption from the access regime, including prior to making an investment. (Coonan 2005) Furthermore, these

[173] Part XIC of the Trade Practices Act deals with a pro-competitive access regime; refer to section 4.3 onwards of the Telstra-Foxtel case study for further detail.
[174] Part XIB of the Trade Practices Act deals with anti-competitive conduct; both parts of the Act are telecommunications specific.

provisions have never been properly tested, despite the December 2004 adverse ruling by the Australian Competition Tribunal regarding an anticipatory exemption granted by the ACCC to Foxtel and Telstra.

The Minister also contended that Telstra's proposed fibre to the node network would likely exhibit natural monopoly characteristics and hence be economically unsuitable for duplication. (Coonan 2006) In those circumstances, third party access would be critical. Also noting the unlikelihood of duplicated fibre networks in the CAN, the ACCC Chairman made the bold suggestion that "perhaps there is scope for the industry to invest jointly – although as the competition regulator the ACCC is conscious of the risk of trying to engineer structural outcomes".[175] (ACCC 2006a, p.7)

Increasingly concerned about the prospect of Telstra further entrenching its CAN monopoly, various parties floated proposals for more cooperative investment. By early April 2006, Optus had suggested three possible access regime models arising from a new fibre network built through co-investment with Telstra: (Boyd 2006)

- Telstra would maintain the network on behalf of all parties who would gain access perhaps related to their investment;
- Each operator would lay fibre in a specific geographic territory but provide access and inter-operability to the other networks;
- A joint-venture company would run the network through which all carriers would work, in like manner the 3G network built between Optus and Vodafone.

A more ambitious proposal, launched 21 April 2006 by a group of seven companies comprising Internode, Macquarie, Optus, PowerTel, Primus, Soul and TransACT extended these by adding a fourth model: (Corner 2006)

- Integrate existing high speed access networks such as those of the Optus and Telstra HFC networks, the TransACT network, Soul's, etc.

Optus CEO Paul O'Sullivan claimed the advantages of a cooperative approach would include a more extensive roll-out due to the increased investment available and a higher take-up due to greater choice for consumers and lower prices. With a more open design of the network, participating companies could offer differentiated services to customers. (ABC RN 2006, pp.2-3) In contrast, under Telstra's proposal, O'Sullivan contended that "we'd pretty much have to live with whatever Telstra decided the rest of us would resell".

Commencing about 23 March 2006, Telstra and the ACCC commenced discussions which, according to the ACCC Chairman "should put Telstra in a position to develop a comprehensive undertaking, which can be submitted to full public consultation". (ACCC 2006b)

The investment/regulatory impasse continued at least until mid-2007. Who would blink first, Telstra or the government? The former demanded regulatory certainty

[175] Such a suggestion is tantamount to admitting the failure of facilities-based competition within the CAN. Joint investment was also mooted by Telstra CEO Dr Ziggy Switkowski as noted in section 6.5.2.

whilst the latter said they already had it. Unless the government relented, maybe Telstra could commence a lesser FTTN roll-out that isn't really 'broad scale'? If the Telstra-Foxtel case study is any guide, years of litigation could also be a likely outcome.

6.6 Discussion

In this section we discuss possible limitations arising from analysis of fibre to the home networks as a case study, followed by a summary of findings that should inform the Research Question.

6.6.1 Limitations of Case Study

Whilst the Telstra/Foxtel network remains effectively closed to third party access and the TransACT network remains substantially open, the fate of access to next-generation fibre to the home networks has yet to unfold. At the time of writing, FTTH developments in Australia had not generated regulatory precedents and hence the case study could not enter this realm.

This case study further differs from the other two in that it necessarily becomes more technical to explain, though expressed in a manner that is hopefully understandable to a generalist reader. Despite telecommunications legislation purportedly framed to be 'technologically neutral', the reality is that regulatory activity nowadays can easily be drawn into at least this level of technical detail in order that the detail of and challenges to regulation are adequately appreciated.

Section 6.4, the kernel of the case study, was substantially based on the work of only Tseng, and Banerjee and Sirbu. This limited breadth of literature seems to arise from an inherent asymmetry in information relating to access to FTTH networks; being at the very least disinterested in third party access, network providers and equipment designers are unlikely to publicise options that benefit such access and it transpires that only these few researchers have ventured to ask the relevant questions. Much effort was taken to validate the conclusions made here, backed up by alternative sources where possible, to the extent that I am now confident in relying upon these few literature sources.

Explanation of the major FTT'x' variants was necessary in order to position fibre to the home networks as part of a continuum of architectures and designs that extend the reach of optical fibre closer and closer towards customers as the end users. When the case study was first conceived, it was not envisaged that Telstra's business plans during 2005 and 2006 would quickly develop to the extent that its initial FTTH offerings would be overshadowed by controversial plans to also deploy FTTN infrastructure. Regulatory determinations relating to these FTTN plans are likely to be made from mid-2007 onwards and any legal challenges could extend well beyond then. It remains to be seen whether such regulatory determinations also encompass FTTH, a matter which may possibly be more affected by the extent of competitive interest in third party access to FTTH compared to FTTN.

Nevertheless, this case study terminated during the early phase of such developments and so could not be informed by marketplace and/or regulatory happenings that signal the ultimate fate of attempts to access FTTH or FTTN networks individually, or in contrast to one another. The aim of the case study was instead to be a vehicle for understanding the principles involved in enabling third party access to those next generation networks where, at least in theory, scarcity of capacity should not pose a restraint on access.

6.6.2 Findings

The key findings of the fibre to the home case study are summarised in a stand-alone manner. Interpretations made possible by drawing correlations with the other case studies are withheld until Chapter Eight.

Whilst the case study is titled 'fibre to the home', the initial section discussed a range of FTT'x' variants with FTTN and FTTC being those architectures most closely related to FTTH as the reach of optical fibre extends further into the CAN. Many of the case study findings also apply substantially to these variants and particularly to the FTTN architecture and design as described by Telstra commencing mid-2005.

General

Modern low-loss glass optical fibre and input/output technology offers almost unlimited bandwidth and unique advantages over all previously developed transmission media. When fully deployed in the customer access network or CAN, the underlying technology of fibre-based systems should at least in theory provide an abundance of communications bandwidth capable of supporting a plethora of information and information services in addition to a multiplicity of service providers. Fibre-based access networks truly offer the potential to end the scarcity of telecommunications bandwidth currently experienced by residential and SME customers.

The capital cost of deploying optical fibre is largely the same whether the cable contains one pair of fibres or a dozen, and whether the fibre carries a million telephone calls or none at all. Exhibiting economies of both scale and scope, a customer access network involving optical fibre would appear to exhibit many of the characteristics of a strong natural monopoly and therefore attract access regulation.

As the reach of optical fibre extends further into the CAN and hence closer to customers, individual customers should be more able to access the increased bandwidth capacity offered by the fibre but that depends on the particular network architecture and system design adopted. The case study appreciated the broad impact of progressing from fibre to the exchange (FTTX) and fibre to the serving area (FTTSA) network architectures, through intermediate stages of fibre to the node (FTTN) or (FTTC) curb and concluding with the 'end game' of fibre to the home (FTTH). However, the potential to end or at least significantly lessen the scarcity of bandwidth can be negated by architectures and designs that employ sharing of the optical fibre capacity amongst a group of users together with any bandwidth-limiting transmission medium that users must access in order to join with the optical fibre.

The various fibre to the home architectures may also be categorised according to the extent of capacity sharing and the presence or absence of active equipment in the CAN. The four main FTTH architectures are:

- 'Home Run' where each customer is served by a dedicated fibre, similar in concept to the paired copper CAN;
- 'Active Star' where a remote node in the access network involves active or powered equipment;
- 'Passive Optical Network' or PON, a variant of Active Star involving a single nominal wavelength and passive optical splitters; and
- 'Wavelength Division Multiplexed Passive Optical Network' or WDM PON where each customer is served by a different optical wavelength.

In practice, architectural selection is strongly influenced by whether a prospective FTTC, FTTN or FTTH network operator is an incumbent telecommunications carrier or a new-start player, and whether there is a pre-existing access network whose right-of-way may be exploited. The selection is ultimately dictated by the network provider's business plan, which in turn is a matter of economic analysis and strategic intent.

Importance of FTTH network architecture and design

Given that the first FTTH network in Australia is tantamount to creating (or perpetuating) a natural monopoly in the CAN, facilities-based competition involving replicated customer access networks is most unlikely. Non-facilities or service-based competition can then only arise through multiple service providers sharing the resources of a common optical fibre access network. Since that network provider will generally also be an incumbent operator and additionally a service provider, the access seekers must usually await the development of services and facilities by the incumbent and hence experience much less opportunity to innovate themselves.

Although the concept and practice of competitive access through unbundling is well established with the PSTN, such application to fibre to the home networks and services continues to be novel. Incumbent network providers can frustrate attempts to unbundle FTTH networks or services through either intentional design or merely the adoption of industry designs that just happen to assume the network provider to be the sole service provider.

A prime finding of this case study is that the architecture and design of a given FTTH network is the crucial determinant of its ability to accommodate multiple service providers in a non-discriminatory manner. The differentiating factor is the extent to which a network architecture and design has been engineered to maintain a 'one-to-one' and symmetrical relationship between service providers and customers. The stronger this relationship, the more readily choice of service providers can be supported as well as services delivered that are unique to particular service providers. Conversely, the greater the sharing of resources in the access network, the lower the ability to support choice of service providers and the more likely their service packages will be replicas of one another – with there being only monopoly service provision in the limiting case.

The architectures most amenable to competitive access are those of the Home Run and WDM PON designs. The Active Star architecture is a compromise solution for competitive access, situated between the limit cases of the Home Run and PON designs. The architecture least amenable to competitive access is that of the PON design. In greater detail, the distinctions are as follows:

Home Run	Individual optical fibres to each customer result in no contention for network resources in the CAN and potentially deliver the greatest bandwidth per customer compared to other architectures; as a result, this architecture is the most amenable to service-based competition regardless of which layer is unbundled.
Active Star	Representing a compromise as regards the sharing of network resources in the CAN, this architecture can deliver a symmetric bandwidth per customer of greater magnitude than PON; it is more amenable to the delivery of multiple video streams and switched delivery in particular.
PON	The broadcast nature of service delivery within the CAN causes the highest contention for network resources and the lowest ability for a 'one-to-one' relationship between service providers and customers; depending on the given design, this architecture is typically the most constrained as regards expanding the bandwidth to each customer and only supports service-based competition at the network and higher layers, i.e. no service provider can offer a service beyond that arranged by the network provider, who is more than likely also a service provider.
WDM PON	The ability to optically segregate service streams across the CAN produces an outcome very similar to that of the Home Run architecture.

Appreciating Telstra's fibre in the CAN proposals

Whenever scoping new investment in the CAN, Telstra immensely benefits from the rights of way inherent in its installed underground conduit and optical fibre infrastructure. Not only do the existing core and access network fibre cabling and systems embody technologies with significant economies of scale and scope, much of these investments have been substantially written down.

Coupled with the ability to sustain an annual capital expenditure considerably greater than any competitor, Telstra thereby gains a 'first mover advantage' with much of its new CAN investment that makes competitive entry impossible to economically justify throughout much of Australia. When this investment entails optical fibre extending deeper into the CAN and hence closer to residential and small business customers, the additional scale and scope advantages further reinforce Telstra's natural monopoly in terms of delivering the next generation bandwidth services only possible with optical fibre.

In July 2004, Telstra announced trials to deploy fibre to the premises/home or FTTP/H infrastructure in selected new housing estates as 'greenfield' developments, plus very limited retrofit or 'brownfield' deployment of FTTP/H in situations where replacement of existing copper CAN infrastructure would be efficient. Bullish forecasts spoke of about 6 million lines being served by FTTP in Australia by 2020 compared to around 2 million remaining copper access lines. However by February 2005 Telstra began to adopt a revised strategy in dealing with the regulator and the government.

Chastened by a regulatory rebuff in late December 2004 affecting third party access to its Foxtel venture but buoyed by recent US telco regulatory wins relieving them of access requirements for new fibre networks in the CAN, Telstra declared that the planned FTTP deployment would no longer take place without 'iron-clad guarantees' from the ACCC regarding a future access regime. Telstra's regulatory stance hardened further with the arrival July 2005 of a CEO from the US who called for the exemption of any new CAN infrastructure and services from standard access regulation based on, among other things, the principle that Telstra held the property rights.

In August 2005 Telstra re-launched its proposals to invest in new fibre access technology but this time spoke of proposed fibre to the node or FTTN as well as FTTP investments, with the former delivering at least 12 Mb/s to existing metropolitan customers whilst the latter would still be deployed in areas of new growth. By segmenting each CAN service area on an annular basis to reduce average paired copper lengths, increased DSL bandwidth would then be possible. Customers within the inner 'ring' would be served via entirely exchange-based equipment implying a conventional fibre to the exchange or FTTX network architecture and minimal additional capital expenditure. In contrast, customers within the outer 'ring' would be served by remotely located multiplexer equipment engineered in a fibre to the node or FTTN configuration and this would comprise the major capital expenditure.

Concurrently, Telstra declared that it would not roll out any such FTTN network without the necessary regulatory safeguards and by late March 2006 had commenced discussions with the ACCC with the expectation of concluding a comprehensive access undertaking. Telstra's ambit claim was that only true bottlenecks should be subject to regulated competitor access and the proposed FTTN deployment would not create a new access bottleneck. Telstra was seeking a 'safe harbour' for its new network investments.

The ACCC confirmed that whilst public interest considerations would take account of the need for investment certainty and the making of reasonable investment returns, ultimately the long-term interests of end users had to be protected. It was expected that Telstra would exploit the mechanism of gaining an 'anticipatory exemption' despite failure with this approach for its Foxtel venture.

Alcatel, supplier of the FTTN equipment and systems, revealed that FTTN deployment was ideal when time-to-market pressures and short term economic concerns were paramount, describing it as an interim step before the deployment of fibre to the home. To complete development of its 'next generation multi-service access network', Telstra's strategy was to provide a gateway device within each

customer premise to provide and manage services including telephony, entertainment, gaming, home automation and security.

Increasingly concerned about the prospect of Telstra further entrenching its CAN monopoly, other carriers floated proposals for more cooperative investment. Claimed advantages included a more extensive roll-out due to the increased investment available and a higher take-up due to greater choice for consumers and lower prices. The alternative would be a next generation broadband network delivering only Telstra's services.

Due to the obvious regulatory parallels, lessons could also be learned here from the findings of the Telstra-Foxtel case study.

CHAPTER SEVEN – MOVING GOALPOSTS: FROM OPEN ACCESS TO NETWORK NEUTRALITY?

Research involves a journey in discovery of information and understanding over time, and research encompassing contemporary events risks being overtaken by the passage of time. At the very least, common appreciation of terminology can change. The Literature Review focussed on open access to broadband networks and services. One of the issues arising from this review was to explore the contention that, rather than 'open access', the objective should be 'network neutrality', that is to say, not favouring one application over another. Could the open access question have been 'just the tip of the iceberg',[176] a proxy for deeper questions of Internet communications policy?[177] (Wu 2003, p.2)

This chapter explores how in the United States of America, network neutrality trumped open access from 2002/03 to at least 2006, how the opposing sides in the debate have taken network neutrality to mean whatever supports their case and whether certain elements of the debate could be of relevance to the Australian scene. It avoids the minutiae of the blow for blow aspects of the sometimes heated debate that commenced in 2005 and swelled to a crescendo in 2006.

7.1 Origins of the US Debate

In this section, we examine how in the US the regulatory histories of telecommunications, cable television and the Internet gave birth to a debate over whether network operators should be allowed to differentiate their services by charging for prioritisation of Internet-based data.

7.1.1 Uncommon Carriage Rules the Telecosm[178]

This summary of events belies the intensity of stakeholders over the years in their the positive and negative impacts of industry mergers and regulatory changes within the US. Concern by consumers, service providers and academics about the adverse

---

[176] Jerome H. Saltzer, "Open Access is Just the Tip of the Iceberg", 22 October 1999, available at http://mit.edu/Saltzer/www/publications/openaccess.html, accessed 13 May 2007

[177] Not only that, could the very phrase 'open access' have been appropriated by another agenda? A quick search of http://www.wikipedia.org , whose content is admittedly subject to topical change, provided the following amount of information as at 4 July 2006:

Search Term	No. of Pages
'open access'	15
'broadband open access'	½
'network neutrality'	15

Ironically, 'open access' was by this time taken to mean "the free online availability of digital content, best known and most feasible for peer-reviewed scientific and scholarly journal articles, which scholars publish without expectation of payment". What I had previously understood by 'open access' was now demoted to a mere ½ page under the heading of 'broadband open access' and seemingly hijacked by the new issue of 'network neutrality'!

[178] With apologies to Huber, P. W. (1997). Law and Disorder in Cyberspace: Abolish the FCC and Let Common Law Rule the Telecosm. Oxford, New York, Oxford University Press.

consequences of restrictions on access hark back to the days of 'closed' online services from the 1980s such as CompuServe, Prodigy and America Online which prospered by selling subscribers dial-up access to 'walled gardens' involving proprietary content and the ability to exchange e-mails with other subscribers to the same service. (Nuechterlein and Weiser 2005, pp.155, 555.) (Lessig 2001, p.162-163.) By the mid to late 1990s, these companies relented by also granting their subscribers access to the public Internet as competition grew from higher speed Internet access offered directly by other service providers.

Cable television systems had gained the ability to offer cable modem access to the Internet and later on also offered telephony service – the beginning of a 'triple play' capability the envy of telecommunication carriers. By the late 1990s, carriers began to deploy DSL technology likewise enabling Internet access of much higher speed than dial-up means. Table 11 illustrates that cable modem delivery in the US has long surpassed DSL, satellite and wireless as the preferred conduit for accessing the Internet, although as at June 2005 ADSL take-up was beginning to accelerate.

Table 11: US Growth in High-Speed Lines for Internet Access[179]

Technology	June 2000	June 2001	June 2002	June 2003	June 2004	June 2005
ADSL	951,583	2,693,834	5,101,493	7,675,114	11,398,199	16,182,076
SDSL, etc.	758,594	1,088,066	1,186,680	1,215,713	1,407,121	905,648
Cable Modem	2,284,491	5,184,141	9,172,895	13,684,225	18,592,636	23,938,908
Fibre	307,151	455,593	520,884	575,613	638,812	864,831
Satellite & Wireless	65,615	194,707	220,588	309,006	421,690	970,133
Power Line, etc.						4,872
Total Lines	4,367,434	9,616,341	16,202,540	23,459,671	32,458,458	42,866,468

Note: The FCC defines 'high-speed lines' as those enabling over 200 Kbps in at least one direction

By 2004, voice over Internet protocol or VoIP technology began to deliver telephony over higher speed Internet-capable lines, posing a commercial threat more to telecommunication than cable television companies. This trend only exacerbated a long-standing disparity between the two classes of companies in a regulatory sense.

Since the late 1990s, there had been a boom in mergers and acquisitions between telecommunication companies, and between telecommunication and cable television companies. (Kim 2005) According to evidence from the US Department of Justice (Klein 1998), "the telecommunications industry was in the midst of not only profound technological change, but unprecedented regulatory change as well". As service differentiation lessened, competition on price necessarily grew and all providers were keenly exploring avenues to attract additional revenue. (Litan and Noll 2004) Perhaps a new variant of the 'walled garden' concept could be the answer?

[179] Refer to FCC report on High-Speed Services for Internet Access, Status as of June 30, 2005, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-264744A1.pdf, accessed 13 May 2007

The US Telecommunications Act (1996) had codified the distinction between a basic service and an enhanced service, alternatively known as a telecommunications service and an information service. Telecommunications services, delivered by wireline carriers and including telephony and DSL, have been subject to traditional common carriage obligations whereas information services had been exempted. (Nuechterlein and Weiser 2005, Ch.5) As a consequence, telecommunication carriers have been traditionally required to interconnect and unbundle for competitive access, whereas cable television companies have been relatively free of regulatory control.

Once cable modem services became available, cable television companies offered their customers Internet access through ISPs with which they were typically affiliated. Pressure soon grew for such cable systems to provide 'open access' to unaffiliated ISPs, in like manner to what was the norm for carriers regarding dial-up and DSL Internet access. The merger of AOL and Time Warner brought such matters to a head in 2000 with the FTC imposing an 'open access' requirement on cable modem services offered by the merged entity. Local government regulators began to impose similar requirements on cable television companies in general, who responded with legal challenges. A crucial point was whether cable modem services could also be classed as information services under the 1996 Telecommunications Act and thereby be exempted from common carriage obligations. (Nuechterlein and Weiser 2005, Ch.5)

In March 2002, the FCC issued its Cable Modem Order[180] declining to impose any open access regime, which it described as 'multiple ISP access', and reaffirming that cable modem providers would be exempt from any obligation to unbundle the transmission component of their service for wholesaling to unaffiliated ISPs. Legal challenges eventually failed to dislodge this ruling and telecommunication carriers demanded that DSL services be similarly released from any requirement to connect to all ISPs or carry all services. In August 2005, the FCC granted its Wireline DSL Order[181] which met this demand.

The FCC, through its Triennial Review proceedings, had been frequently reminded by telecommunication carriers that cable television companies were dominating the market for broadband service delivery. The carriers, smarting from their inability to match the 'triple play' capability of the cable networks, sought incentives from the FCC so they might be encouraged to deploy optical fibre to customers. In October 2004, the FCC extended forebearance from enforcing the Telecommunication Act requirements with regard to unbundling broadband services delivered over fibre to the home, fibre to the curb and related networks.[182]

---

[180] Refer to FCC Declaratory Ruling and Notice of Proposed Rulemaking, http://www.fcc.gov/Bureaus/Cable/News_Releases/2002/nrcb0201.html accessed 8 July 2006.

[181] Refer to FCC Report and Order and Proposed Rulemaking, released 23 September 2005 http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-05-150A1.pdf accessed 8 July 2006.

[182] Refer to FCC Memorandum Opinion and Order No. FCC 04-254 released 27 October 2004, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-04-254A1.doc accessed 8 July 2006

From here on, all Internet broadband service delivery whether via cable modem, DSL or optical fibre would be free to discriminate if so desired by not providing access to competing ISPs.[183] (Crawford 2007)

7.1.2 Alleged Discriminatory Practices

Debate over the adverse consequences of industry mergers on network and service innovation, and hence the broader consumer interest was precipitated by the 1998 acquisition of TCI, then one of the largest cable television operators in the US, by major telecommunications carrier AT&T. TCI had already partnered with the popular Internet content portal and ISP Excite@Home, and so now AT&T took over this relationship. According to Bar, Cohen et al. (2000), AT&T argued that it should retain control over which ISPs could have access to the Excite@Home broadband network, just as cable operators have always controlled which video programmes are sent over their network. Other cable companies were said to share this view.

Early experience with Excite@Home around 1999, being the only ISP of choice on the network, raised concern over end use restrictions and biased access to content. (Bar, Cohen et al. 2000: 4.2) For example, the @Home 'acceptable use policy' imposed the following restrictions on customer usage: [184,185]

- Limits on up-stream traffic, curtailing the ability of a customer to experiment with new services such as Internet telephony and video conferencing;
- Prohibitions on setting up any kind of server for operating a customer's own Web site;
- Prohibitions on certain work-related activities, such as connection to a corporate LAN from home;
- In order to enforce these rules, @Home would constantly monitor customers' data traffic thereby raising privacy concerns.

AT&T/@Home offered speedier service to Internet content providers who agreed to become 'content partners' and share their revenue stream. Such arrangements were not revealed to customers leading to the charge that AT&T/@Home was biasing access to content. Sandvig (2006) describes such secrecy as 'chilling', in that a cable modem subscriber trying Internet gaming using both a Sega Dreamcast and a competing platform would find the former more responsive unaware of a private agreement between SegaSoft and AT&T/@Home. According to Bar, Cohen et al. (2000: 4.2) if the single ISP affiliated with the cable modem network provider has sole access to such strategies, then it alone can 'systematically shape what content and services gets to the end-users', shaping 'the very terms of innovation on the internet, deciding who gets to experiment and who can capture the resulting benefits'.

---

[183] This situation was indeed ironic, since the foundation for mass market Internet adoption was laid in the truly open access regime of dial-up yet narrowband telecommunications where multiple ISPs blossomed.

[184] Even if a customer paid an additional amount for Internet service from another ISP, the terms of this acceptable use policy would continue to apply.

[185] Similar examples of 'gate keeping' exposing actual or potential conflicts of interest were noted by Saltzer, J. H. (1999). "Open Access" is Just the Tip of the Iceberg, MIT**:** 6.

Whilst a comprehensive survey of the ten largest cable operators and six major DSL operators in the US discerned no broad effort to ban everything that might be said to threaten their interests, many instances were identified of restrictions on certain uses. (Wu 2003: Part 3) For example, every cable operator and one-third of DSL operators placed restrictions on operating a server and/or providing content to the public. Although justified as an architectural feature, asymmetric bandwidth directly discriminated against user-originated content.[186] The use of a basic residential connection for 'commercial' or 'enterprise' purposes was also widely banned, preventing home users from connecting to their work network via a Virtual Private Network or VPN. One outstanding restriction followed from the definition by AT&T Broadband of home networking as 'theft of service'. (Wu 2003: Part 3) Notwithstanding the above, it was noted that cable companies no longer barred streaming video despite the potential for competing with their own cable television services.

Two celebrated cases of discrimination, one being more a threat thereof arose from third party Internet service providers and their applications whose success has become the envy of network operators. In March 2005, the FCC announced a Consent Decree in which the Madison River Telephone Company was fined US$15,000 and forbidden from blocking Internet protocol ports used for VoIP applications or otherwise preventing customers from using VoIP applications.[187] The Voice over IP services in question were being provided by Vonage. When SBC Telecommunications CEO Edward Whitacre was asked in October 2005 whether he was concerned about the plans of 'Internet upstarts' Google, MSN, Vonage and other companies to further expand their services that critically depended on broadband networks for accessing customers, he responded with a surprisingly frank admission:[188]

> How do you think they're going to get to customers? Through a broadband pipe. Cable companies have them. We have them. Now what they would like to do is use my pipes free, but I ain't going to let them do that because we have spent this capital and we have to have a return on it. So there's going to have to be some mechanism for these people who use these pipes to pay for the portion they're using. Why should they be allowed to use my pipes?
>
> The internet can't be free in that sense, because we and the cable companies have made an investment and for a Google or Yahoo! or Vonage or anybody to expect to use these pipes [for] free is nuts!

Although few in number, the above allegations of discriminatory practices fuelled a debate that Internet-based network operators should be required to be neutral as regards the treatment of third party service providers and their applications.

---

[186] To this day, almost all broadband service providers operate on a broadcasting-type business model whereby users are assumed to receive downloaded content and generate little.

[187] Refer to FCC Consent Decree, In the Matter of Madison River Communications, LLC and affiliated companies, File No. EB-05-IH-0110, DA 05-543, March 3, 2005.

[188] Refer to Business Week, 31 October 2005, "At SBC, it's all about 'scale and scope'", http://www.freepress.net/news/12110 accessed 8 July 2006

7.2 Neutrality Principles

The public debate has almost always been framed as being about 'network neutrality' or 'net neutrality' and rarely about 'Internet neutrality', whereas in reality the terms 'network' and 'net' were shorthand for the Internet rather than networks delivering cable television. Although the latter are private networks and operated as such, the Internet remains a global network accessible by the public at large despite being accessed via predominantly private networks that connect with end users. Lessig (2005) feared that Internet access could become like cable television and fervently spoke for the need to change public policy to prevent this happening.[189]

For a decade, Stanford Law School professor Lawrence Lessig had studied the relationship between the architectural design of the Internet and innovation. (Lessig 2001: Ch.3) He argued that the explosive growth of the Internet is a direct result of its innovation-promoting design based on the 'end-to-end' principle. (Saltzer, Reed et al. 1981) In his testimony to a US Senate hearing, Lessig declared that "if this Committee wants to preserve that growth and innovation, it should take steps to protect this fundamental design" by incorporating certain principles of Internet neutrality into the telecommunications law guiding FCC policy. (Lessig 2006, p.1)

After surveying a plethora of suggestions made over a number of years as to what neutrality should embody, Lessig threw his support behind ex-FCC Chairman Michael Powell's statement of the Internet's four 'Internet Freedoms' provided it was augmented by one additional requirement arising from the work of University of Virginia law professor Timothy Wu. If implemented, this total package would protect consumers from the adverse effects of certain kinds of discriminatory practices.

According to Powell, "usage and deployment of high-speed Internet depends on access to content" and "network owners, ISPs, equipment makers, and content and application developers *all* benefit when consumers are empowered to get and do what they wish". (Powell 2004) In his view, "it is time to give the private sector a clearer roadmap by which it can avoid future regulation on this issue[190] by embracing unparalleled openness and consumer choice". Powell issued a challenge to the broadband network industry to preserve the following 'Internet freedoms':[191]

[189] "Simple ideas fix public policy, but simple ideas also break it. A simple idea about how markets in networks should function has fixed U.S. policy regulating those networks. That idea is also slowly breaking those networks. The Internet is not cable television. The opportunity costs in allowing it to become cable television are huge. Yet increasingly, government policy is relaxing any regulation that might secure this infrastructure commons. The market, alone, is thought to be a sufficient regulator." Lessig, L. (2005). "Re-Marking the Progress in Frischmann." Minnesota Law Review **89**(4): 1031-1043.

[190] That is, unfettered access to the Internet by consumers.

[191] Subject to the legitimate needs of operators to manage their networks and not being exposed to theft of service.

- Freedom to Access Content – consumers should be allowed to reach the legal content of their choice;
- Freedom to Use Applications – consumers should be able to run applications of their choice;
- Freedom to Attach Personal Devices – consumers should be permitted to attach personal devices they choose to the connections they pay for in their homes;
- Freedom to Obtain Service Plan Information – consumers must receive clear and meaningful information regarding their service plans and plan limitations.

Preserving 'Internet Freedom' in this manner would "serve as an insurance policy against the potential rise of abusive market power by vertically integrated providers" and promote innovation "by giving developers and service providers confidence to develop applications that will reach consumers and run as designed".[192] (Powell 2004)

However Lessig considered Powell's principles to be missing one important requirement – network providers would still be able to impose restrictions on whichever application[193] and content providers they desired, in the form of charges unrelated to the bandwidth used by those providers. (Lessig 2006) Describing this as 'access tiering', Lessig distinguished such discrimination from that of 'consumer tiering' which he reckoned should be encouraged as consumers would merely be paying for different levels of service. In other words, any tiering of a service package should be neutral – for example, consumers could be offered a connection of higher speed or quality for a particular service but not if that service was only from a particular content provider.

This distinction proximates with Wu's proposed anti-discrimination principle, namely, "to forbid broadband operators, absent a showing of harm, from restricting what users do with their Internet connection, while giving the operator general freedom to manage bandwidth consumption and other matters of local concern". (Wu 2003: Pt. IV) Service restrictions imposed by the local network would be allowable whilst those of an inter-network nature[194] would be ultimately forbidden.

With Internet-based applications in a battle for the attention and interest of end users, it was considered important that the delivery platform be neutral to ensure that competition remained meritocratic and not stifled by the self-interest of network operators.

[192] The FCC, under the following chairman, instead adopted a policy statement outlining four principles embodying a set of 'entitlements' that consumers should be able to expect from the Internet; refer to FCC (2005). FCC Adopts Policy Statement: New Principles Preserve and Promote the Open and Interconnected Nature of Public Internet. Media Release. Washington, DC 20554, Federal Communications Commission**:** 1.

[193] Voice over IP is an example of an 'application'.

[194] That is, beyond the local access network – implying the Internet at large.

7.3 Issues in Contention

If the opposite of neutral network is one offering services in some form of discriminatory manner, what are the arguments for and against neutrality or for and against discrimination? The main issues in contention from the US perspective are discussed in the hope that they may offer an insight into the possible application of new models for regulating next generation broadband networks in a country such as Australia where the competitive and regulatory environment is different. The issues of diversity/differentiation, investment incentive, last-mile competition and vertical integration are closely interrelated.

7.3.1 Diversity or Differentiation

Variously described as the principle of network diversity, network differentiation or product differentiation, the economic argument is that different groups of end users or consumers may derive utility (that is, value) from differentiated goods that are closer to their ideal preferences.[195] (Yoo 2005: Pt. III) (Yoo 2006) Such differentiation could be exploited by a new entrant competitor who, particularly if competing on non-price as well as price dimensions, could theoretically generate sufficient revenue to cover its upfront costs despite having a turnover much smaller than that of the incumbent operator. Differentiation could occur through adopting a non-standard routing and control protocol, that is to say, other than TCP/IP, or by entering into exclusivity arrangements with respect to content. (Yoo 2005: Pt. III) Both these practices run counter to the principle of network neutrality.

A neutral network would have the intent or effect of commoditising broadband transmission and Internet services, resulting in firms only being able to compete on price. In instances where the market is determined by a network with large fixed/sunk costs and low marginal costs, such as that of a local broadband network and most particularly optical fibre in the CAN, price-only competition exacerbates the tendency towards industry monopolies. (Ford, Koutsky et al. 2006) By giving firms alternate avenues of rivalry, differentiation allows for entry and gives consumers the benefits of not only price competition but also increased choice and innovation. According to economic modelling by Yoo (2005: Pt. III), differentiation can ameliorate the demand-side economies of scale created by network economic effects[196] and thereby increase overall economic welfare.

The counter argument is that these economic models fail to address the substantial loss in consumer welfare likely to occur should telephone and cable companies become gatekeepers and discriminate against Internet services, content, and applications considered to be inconsistent with the gatekeepers' revenue generation

[195] Though never explicitly stated, differentiated service delivery would more likely arise across different delivery networks available to the same group of end users (eg. cable modem, DSL, wireless, fibre) rather than within a common network. This assumption is made not only on broad technical grounds but because the opponents of network neutrality are also opponents of 'open access' which is necessarily implied by having competing services delivered over a common network.

[196] That is, by staving off the onset of a natural monopoly.

plans. (Roycroft 2006b) The following existing differentiation in services would be lost: (Roycroft 2006c)

> For example, consumers typically receive e-mail services from their ISP. However, numerous other e-mail providers offer services, some for free and some for a charge, which allows the consumer to select the e-mail offering which best suits their needs. Similarly, consumers are presented with differentiation among e-commerce providers, which allows consumers to benefit from market leaders, such as Amazon.com, and niche market providers who may offer specialty services better suited to the needs of some customers.

Arguing that network neutrality and differentiated last-mile networks are not incompatible, Roycroft (2006c) notes that the cable modem and DSL networks currently dominating the market for last-mile broadband are inherently different technologies and consumers can take advantage of these differences by way of plans involving different download and upload speeds. Yoo's suggestion of enhancing network diversity by dispensing with current Internet protocol standards was dismissed as a recipe for reducing consumer benefits, increasing purchase risks and decreasing network effects. (Roycroft 2006a, p. 22-23) The standardisation associated with the Internet operates at the logical network layers below the 'application level' which is the platform supporting the wide variety of content, applications and services enjoyed by consumers.

7.3.2 Investment Incentive

According to Thierer (2004a, p. 17), network neutrality proposals would discourage investment and innovation in broadband networks and services. He argues that if policymakers grant the broader 'commons' of Internet users more say about how networks operate, they will send a powerful signal to infrastructure operators and potential future operators of high-speed networks: "your networks are yours in name only and the larger community of Internet users - through the FCC or other regulatory bodies - will be free to set the parameters of how your infrastructure will be used in the future". Why would a current or potential operator who hears that message ever want to invest risk capital in such a sector, Thierer asks?

Yoo (2005) further develops the case for incentives, arguing that whilst entry by new last-mile providers is ongoing and other last-mile broadband technologies are pending then it would be unwise to impede investment. With the potential for short-run supracompetitive returns being a primary mechanism upon which markets relied to stimulate entry, a reduced incentive to invest could cement any existing last-mile oligopoly into place and reinforce the likelihood of market failure.

Network neutrality proponents, also supporters of the end-to-end design philosophy as being central to the success of the Internet, argue that innovation derives from the 'edge' of the network rather than inside the network. From this perspective, network neutrality should promote, not retard, broadband deployment for two reasons: (Windhausen 2006)

- If the consumer can reach any Web site, use any equipment and access any service he or she wants, then the value of the connection is more valuable than if the consumer can only reach the services and use the equipment that the network owner chooses;
- Innovators of applications and services delivered over the Internet as well as devices that attach to end user terminals will gain confidence that, once developed, access to the network and hence to consumers will be guaranteed.

Increased consumer demand for broadband networks and services would motivate network operators to build or enhance network infrastructure and entrepreneurs would be more willing to invest to develop new services and devices. Adopting a line of argument that could also be used by the anti-network neutrality camp, Lessig and Wu (2003, p.8) highlight the need for regulatory certainty to stimulate new investment:

> The question an innovator, or venture capitalist, asks when deciding whether to develop some new Internet application is not just whether discrimination is occurring today, but whether restrictions might be imposed when the innovation is deployed. If the innovation is likely to excite an incentive to discrimination, and such discrimination could occur, then the mere potential imposes a burden on innovation today whether or not there is discrimination now. The possibility of discrimination in the future dampens the incentives to invest today.

Crawford (2007) suggests that emotional arguments are at play – US telephone companies are beginning to use the figure of the 'romantic' or 'heroic builder' in their debate with government and the public, in that their vision of rolling out optical fibre to homes throughout the nation can only be realised if they gain an incentive to build.

Conceding that it remained an open question as to whether network neutrality regulation would reduce incentives to deploy network infrastructure below the necessary level, van Schewick (2005, p.39) considers that network neutrality regulation would not forbid network providers from vertically integrating into complementary markets as it only bans them from using discrimination to increase their sales at the expense of rivals. It would also not prevent them from making profit in the market for Internet services. The remaining profit could still be sufficient to motivate them to deploy the necessary infrastructure.

But what if there really was justification for infrastructure providers to receive an incentive to increase network capacity, to relieve congestion for example? Frischmann (2005, p.1021) suggests some viable options as including:

- Direct subsidisation of infrastructure expansion;
- Tax incentives;
- Co-operative research and development projects, and
- Joint ventures.

7.3.3 Last-mile Competition

7.3.3.1 The main academic author in favour of network diversity and against network neutrality, Christopher Yoo examines the possible relationship with last-mile competition in the US. Perhaps his overall position is best summarised by the observation that 'network neutrality focuses on the wrong policy problem' which should be to address any deficiency with last-mile competition. His various statements are summarized as follows:

Network neutrality will not affect the current makeup of last-mile competition

"The economic relationship between last-mile providers and end users is largely determined by the fact that most end users currently only have two options in terms of last-mile providers: the cable company and the telephone company. Mandated network neutrality would not change the makeup of this market." (Yoo 2005, p.72)

Network neutrality should instead focus on last-mile competition

"In the broadband industry, the level of production that is the most concentrated and protected by barriers to entry is the 'last mile'." "In directing their efforts towards promoting competition in applications and content, network neutrality focuses on the wrong policy problem." (Yoo 2006, p.3)

Last-mile competition is already adequate

"Measured against any of these standards, the overall broadband market is sufficiently competitive to protect against anti-competitive harms." (Yoo 2005, p.60)

Improving last-mile competition will overcome concerns about neutrality

"If 2-3 wireless broadband or broadband over powerline providers emerge so that consumers have 4-5 last-mile broadband options (including cable modem and DSL), there would be little danger in allowing one of those networks to experiment with exclusivity arrangements." (Yoo and Wu 2006, p.3)

"Once a sufficient number of alternative last-mile providers exist, the danger of anti-competitive effects disappears, as any attempt to use an exclusivity arrangement to harm competition will simply induce consumers to obtain their services from another last-mile provider." (Yoo 2004, p.35)

Network diversity could facilitate three different last-mile networks to co-exist

These would be "one optimized for traditional Internet applications such as e-mail and website access, another incorporating security features to facilitate e-commerce and to guard against viruses and other hostile aspects of Internet life, and a third that prioritizes packets in the manner needed to facilitate time-sensitive applications such as streaming media and VoIP." (Yoo 2005, p.31)

7.3.3.2 In contrast, advocates for network neutrality are resigned to the inadequacy of last-mile competition and its inability to protect against discriminatory

practices affecting Internet services and applications, as depicted by the following views:

Last-mile competition is inadequate now and unlikely to improve

"Chris (Yoo) believes that, at least when it comes to information networks, technology is changing the conditions for market entry in physical networking. He points to fiber optics and the potential use of wireless spectrum as examples. He believes that over the next decade we're likely to see vigorous competition among new entrants and old, like in any other 'regular' market." "At the risk of sounding like a dinosaur, I am skeptical. I'd be willing to bet Chris that over the next decade the infrastructure market will continue to heavily favor the main incumbents." (Yoo and Wu 2006, p.4)

Even adequate last-mile competition won't overcome concerns about neutrality

"A network provider may have the ability and incentive to exclude rival content, applications or portals from its network, even if it faces competition in the market for Internet services. Apart from increasing the number of cases in which unaffiliated providers of complementary products face a real threat of discrimination, this result also implies that neither facilities-based competition nor open access regulation are the appropriate tools to mitigate this threat." (van Schewick 2005, p.26)

Yoo's three network proposal would be counter-productive

"The three separate networks described by Professor Yoo, according to his vision of network diversity, are not delivered over shared facilities … not only must separate last-mile broadband networks be built, but they will be built to provide unintegrated (and therefore lower value) network services." "The existence of 'separate but optimized' data networks undermines the investment incentives which are critical to the network diversity argument." (Roycroft 2006a, p.17)

Nevertheless, Wu proffered three 'classic' solutions to any need to encourage the deployment of last-mile broadband infrastructure: (Yoo and Wu 2006, p.3)

- The government spends money and builds the infrastructure itself, in like manner as it does for roads;
- The government subsidises build outs, one way or another; or
- Do nothing, presuming that the market will 'now and then get around the infrastructure economics problem'.

7.3.4 Vertical Integration

Demands for networks to be neutral are a consequence of the manner in which networks are or could be operated and in general these tend to be vertically integrated businesses. The concern is that owners of the physical layer will use their control over the logical layer to give preferential treatment to selected applications and content. (Yoo 2006, p.11) The intent of network neutrality is to regulate the physical layer to preserve competition in the applications and content layers.

Yoo (2006, p.14) recounts that, according to Chicago School theory and providing the barriers to entry in a particular market segment are low, vertical integration does not pose as much of a threat as previously thought. In fact, it can yield significant consumer benefits. Even in a broadband industry characterised by a duopoly structure, Thierer (2004b, p.11) maintains that cable and DSL providers still have a strong incentive to carry more content and websites to maximise consumer utility and encourage consumers to spend more money for access to the service. "The platform monopolist has a powerful incentive to be a good steward of the applications sector for its platform", say Farrell and Weiser (2002, p.21)

Nevertheless, Yoo (2006, p.4 in his debate with Wu) concedes there may be a case for regulatory intervention that prohibits vertically integrated network owners from blocking content and applications that directly compete with their own offerings. Post-Chicago School literature utilising modern industrial organisation theory to analyse more complex market structures has thrown light on how firms with market power can raise the costs for potential rivals. (Roycroft 2006a, p.39-41) In the business of broadband delivery, incumbent operators with sunk investments in optical fibre in the access network are in a powerful position to make price cuts in the face of entry, defending their existing customer relationships and market share. The potential for harm to consumers is compounded if the incumbent is also free to discriminate in providing applications and content.

The antithesis of a vertically integrated broadband operator is a common carrier in that it can have no interest in the content carried, its chief obligation being non-discrimination. This led Vint Cerf to comment: "One might think of the notion of [network] neutrality as the 21st Century version of common carriage". (As cited in Sandvig 2006, p.19) Perhaps this observation signals the fate of the network neutrality movement in the US since the FCC had already removed any vestige of common carriage for Internet broadband service delivery via cable modem, DSL or optical fibre and the telecommunications industry would never countenance its re-imposition.

7.4 Settling the Score

The opening question to this chapter was whether the research focus should be on 'open access' or 'network neutrality'. The verdict isn't unanimous: whereas neutrality antagonists posit a clear difference between open access and network neutrality, neutrality proponents are somewhat ambivalent. In any case, which arguments or issues should be more relevant to the Australian scene?

7.4.1 The Connection with Open Access

Both open access and network neutrality proponents are seeking to address alleged discriminatory practices, though in different ways and to differing extents.

The debate was originally framed in terms of open access to cable modem systems in that the owners of cable television networks should be required to allow access to independent ISPs. (Yoo 2005, p.43) (van Schewick 2005, p.3) In other words, they should not be allowed to discriminate against other ISPs with whom they had no

commercial affiliation. If enshrined in law, open access would create a new right for ISPs rather than for customers. (Wu 2004, p.89) Although customers would benefit through an increased choice of service in broad terms, the debate never laid down any prescription as to how such services should then be treated.[197] The prime goal of open access was to protect competition between ISPs.

But according to the economic modelling of van Schewick (2005, p.40), even the threat of such competition may not necessarily impede the ability and incentive of a network provider "to discriminate against unaffiliated producers of complementary products or exclude them from its network". A stronger prescription, that of rules favouring network neutrality, would be necessary "to protect competition in complementary products such as Internet applications, content and portals from anticompetitive behaviour by network operators or ISPs". (van Schewick 2005, p.3) Network neutrality would create the right for users to access the content, applications and equipment of their choice. (Wu 2004: Pt.3) The prime goal of network neutrality was to protect competition between Internet-based content, applications and equipment rather than between ISPs.

Van Schewick's explanation goes at least part way towards understanding why the push for 'open access' fell by the wayside in the US by 2002 and 'network neutrality' became ascendant thereafter. However, network neutrality was a convenient label that belied a complexity of concepts. Although championed as a founding proponent of neutrality, Wu actually argued for a policy of 'broadband discrimination' – reflecting the realisation that there could be occasions where discrimination against certain content and applications was acceptable yet on other occasions it could be unacceptable. (Wu 2003) Since open access ran counter to vertical integration, Wu envisaged circumstances where the lack of vertical integration could hurt the cause of network neutrality. This led him to conclude that "it is best to understand network neutrality as an end, and open access and broadband discrimination as different means to that end". Simply put, a goal of open access could be inadequate and in some instances counterproductive.

Frischmann adopts a different approach by developing a theory of infrastructure that better explains why, for some classes of important resources such as the Internet, there are strong economic arguments for managing and sustaining the resources in an openly accessible manner. With much more at stake than the current debate reflects, he argues that "a new lens is needed": (Frischmann 2005: 920, 1020 - 1022)

> The network neutrality debate is not really about neutrality per se; nor is it about innovation alone. The debate must broaden its focus from the merits of sustaining an *innovation commons* to the merits of sustaining an *infrastructure commons* - that is, of sustaining open, public access to infrastructure. The debate ought to be about optimizing the Internet for society as a whole and it ought to take into account the full range of interests at stake. This type of optimization problem raises the familiar issues and choices seen in other

[197] For example, where two ISPs were accessible via a cable network the unstated assumption was that at least one would not discriminate against certain services such as voice over IP, though in reality when the movement for open access took root in the US around 1999/2000 the opportunity for service-related discrimination was not commonly appreciated.

> debates over open access or restricted access[198]. What type of infrastructure do we as a society desire? Do we prefer an Internet infrastructure managed in an openly accessible manner? Or, do we prefer an Internet infrastructure managed to maximize the profits of property owners? There are benefits and costs to both types of management regimes that need to be carefully evaluated and balanced.
>
> The theory[199] brings into focus the social value of sustaining an Internet infrastructure commons, and strongly suggests that the benefits of open access (costs of restricted access) are significantly greater than reflected in the current debate.

In other words, Frischmann elevates the importance of open access well beyond that considered by Wu which confirms the ambivalent attitude of some network neutrality proponents towards open access.

Commenting on Frischmann's theory, Lessig observes that the policy debate since the late 1990s has bounced between two different strategies: (Lessig 2005)

- The open access strategy, the basis of which was that competition in access providers would disrupt the conditions under which it would make sense for network providers to interfere with the 'end-to-end commons'; and
- Adoption of the four 'Internet freedoms' articulated by FCC chairman Michael Powell, such that a network provider would not bias or hinder choice provided to consumers. (Powell 2004)

In his testimony to a US Senate hearing on 'network neutrality', Lessig reiterates his long-standing contention that the wide range of innovation inspired by the Internet has come primarily from the 'edge' or 'end' of the network through application competition. (Lessig 2006, p.4-5) He had once assumed that competition in broadband access would prevent any compromise in end-to-end neutrality, with no individual ISP having the market power to successfully restrict the range of Internet applications, but now the scholarship of van Schewick had drawn into doubt that open access would protect network neutrality – the question of such a linkage was "now effectively moot". Open access was only an indirect means to preserving the main goal of end-to-end neutrality. (Lessig 2005, p.1041)

Since Lessig had invested so much intellectual effort in making the case for a neutral Internet, it is understandable he should see the relationship with open access in this light. Perhaps a more independent appreciation is given by Neuchterlein and Weiser (2005) who examine instances where a dominant provider of physical layer transmission infrastructure exploits its control of bottleneck facilities to stifle competition in the adjacent markets for applications and content. They present the three basic regulatory approaches to deal with these monopoly leveraging concerns as being non-exclusive: (Nuechterlein and Weiser 2005: Ch.5)

---

[198] Frischmann coins the phrase 'restricted access' as meaning the opposite of 'open access'.

[199] That is, the 'infrastructure theory' developed by Frischmann.

- Multiple ISP or open access;
- Network neutrality and preservation of the end-to-end principle; and
- Unbundling rules for wireline broadband, particularly as applied to new builds of optical fibre in the CAN.

Access to such a suite of regulatory tools would be a start in achieving Frischmann's goal of sustaining an infrastructure commons.

7.4.2 Relevance to Australia

The preceding analysis identifies the main debating issues as being those of diversity/differentiation, investment incentive, last-mile competition and vertical integration. The first, diversity/differentiation in Internet applications and services, appears to be the *cause celebre* for proponents of network neutrality yet it is primarily a consequence of the last two issues: inadequate last-mile competition and vertical integration resulting in discriminatory practices. The matter of investment incentive is usually aired when an entrant seeks to counter an incumbent's last-mile broadband infrastructure or an incumbent threatens not to undertake further investment considered to be nationally important. It is generally promoted as a cure for ills arising from the last two issues.

The US and Australian telecommunication scenes differ significantly as regards last-mile competition, Australia being in a much worse situation, and this exacerbates problems attributed to vertical integration. According to the Australian telecommunications regulator: (ACCC 2005c, p.4)

> The overriding issue in this industry is the dominance of the telecommunications sector by just one player - Telstra - by virtue of it being the sole provider of the ubiquitous local access network connecting virtually every home and business in the country. This monopoly means that even in the more competitive markets, those seeking to compete with Telstra continue to rely on Telstra for some form of access to its network.

An assessment of telecommunications infrastructure as at 2004 indicates that Telstra held the majority of local access connections, 92.94 per cent, with SingTel Optus being the main alternative carrier with 6.54 per cent of connections. Together they held approximately 99 per cent of subscriber connections, confirming a high level of concentration in the business of fixed network local access services. (ACCC 2005b) Only 15.5 per cent of Telstra's local access network capacity was being used by third party service providers, primarily for the provision of xDSL broadband services.

The extent of concentration in Australian last-mile infrastructure is further compounded on realising that the overwhelming amount of HFC network roll-out is also owned only by Telstra and SingTel Optus, mostly duplicated in the same streets of just the capital cities, and the cable modem capacity of each is monopolised by their respective ISPs. The extent of infrastructure concentration becomes even more stark on considering the potential for delivering broadband at 'next generation' speeds, defined for the sake of this argument as having a symmetric capability in the realm of 100 Mb/s but in any case depending on the future deployment of

technologies such as DOCSIS 3.0, VDSL, ADSL2+ and/or optical fibre in the customer access network.

DOCSIS 3.0 technology can only be deployed on the monopolised and duplicated HFC networks, whilst technologies such as VDSL and ADSL2+ are substantially only deployable on the paired copper network of Telstra, regardless of whether they are operated by Telstra or a third party provider. As to the roll-out of optical fibre deeper into the CAN, a prerequisite for wider availability of VDSL or ADSL2+ delivered services, or in the long term for fibre to the premises-based services, the situation of Telstra threatening not to invest in its own 'fibre to the node' infrastructure is a sign of ongoing dominance in the market for next generation broadband services. Furthermore, Telstra has strenuously demanded regulatory forbearance for its proposed FTTN network, in other words it seeks an investment incentive by way of an 'access holiday'.

Telstra is the lead player in most segments of the Australian telecommunications sector, except for free-to-air broadcasting, and is arguably "the most vertically integrated telecommunications operator in any member of the OECD", according to Cutler (2001).

Whilst the debate in the US has been quite heated particularly during 2005/06, by mid-2006 only whispers were beginning to be heard in Australia. According to Gans (2006), the proponents of network neutrality don't really hit on the key point: that users who choose a high-speed content provider over another do not internalise the costs they are causing by this. He considers the core problem of network neutrality to be that it is not neutral for the providers but too neutral for the users and proposes a new concept of 'neutral networkity' – where the content providers decide the speed of their connection, with access given to all users at equal speeds. Gans says "the debate should not be over network neutrality per se but the use of exclusive deals offered through particular content providers and integration of content and infrastructure providers", with Telstra's BigPond, an ISP with the greatest share of the Australian market, being a prime example.

7.5 Conclusion

The network neutrality debate has provided the opportunity to appreciate the main issues in contention in the US and how they relate to the principle of open access. It is about as traditional a competition policy debate as you can get. Central to much of the debate are concerns about inadequate last-mile infrastructure for the current realisation of broadband service delivery and fears about the scope for discriminatory practices capable with subsequent technologies.

With the prime focus of this dissertation being on open access to next generation broadband infrastructure, the identified issues and the nature of the arguments employed should positively inform the new policy questions arising. Yet, to re-paraphrase Frischmann (2005), "a new lens is needed":

- What type of next generation broadband infrastructure do we as a society desire?
- Do we prefer such infrastructure managed in an openly accessible manner, or do we prefer it to be managed to maximise the profits of property owners?

There are benefits and costs to both types of management regimes which need to be carefully evaluated and balanced.

CHAPTER EIGHT – DISCUSSION & CONCLUSIONS

This research is founded on three case studies, each pertaining to a wireline network capable of delivering broadband services of a generation more advanced than that possible with the paired copper-based PSTN. Each case study concluded with a set of findings. Chapter Seven then explored the nexus between the concepts of 'open access' and 'network neutrality'.

The issues arising from the above are now discussed, common threads gathered and matters of distinction highlighted. The summative response to the research question is explicitly addressed in section 8.7, where conclusions are drawn as to the implications for regulating access to services from infrastructure more closely approximating the delivery of next generation broadband. Concluding remarks are given in section 9.3.

8.1 Rationales for Opening up Access

The debates about 'open access' and 'network neutrality' have generated a plethora of recommended solutions to alleged problems. Whilst Lessig sees the final goal as being end-to-end neutrality, could neutrality in fact be a means to yet a higher purpose goal? This section examines possible raisons d'être for pursuing the ultimate goal of achieving and maintaining access to telecommunication networks and services – access for end-users and service providers on a non-discriminatory basis. The two prime rationales are those of realising the policy goals of any-to-any connectivity and of common carriage.

8.1.1 Any-to-Any Connectivity

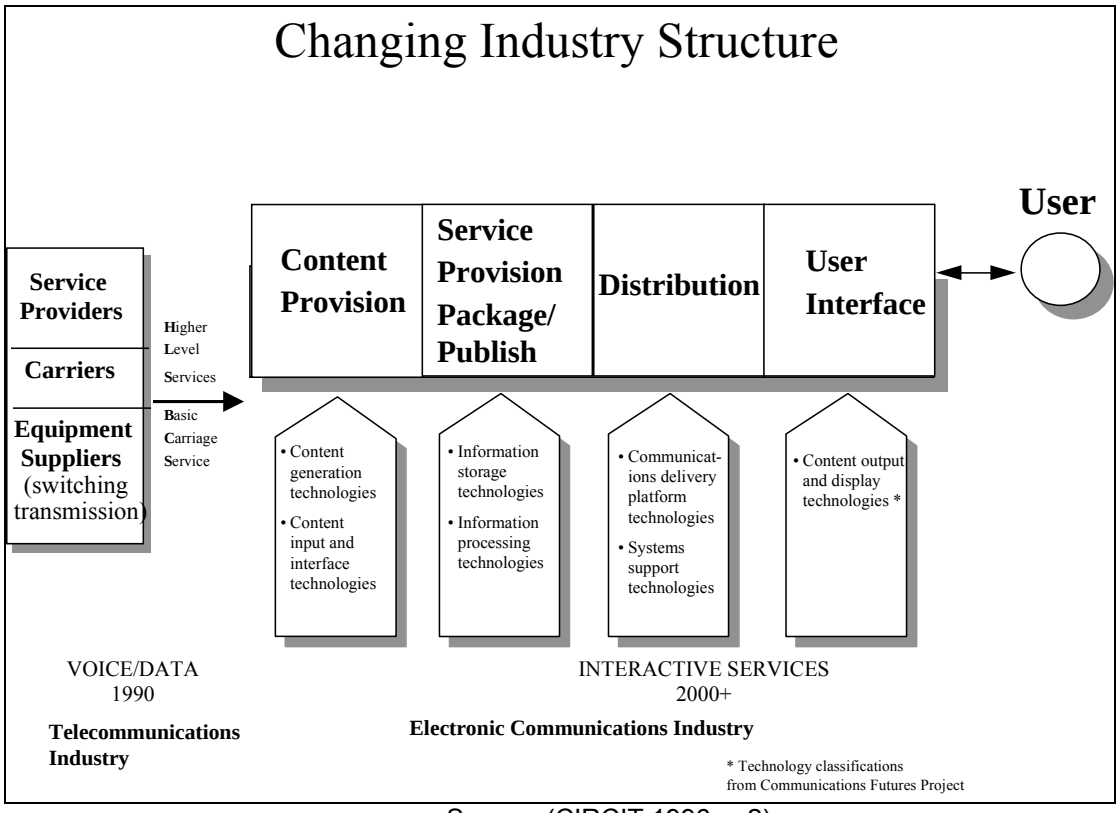
For Australia's converging information and communication industries, 1991 to 1997 was a period of unprecedented change heralded by new investments, new technologies and services and new policy considerations. The Telstra/Optus duopoly since 1991 was heading towards open competition by 1997 (Grant 1997, p.26) and competitive pay television services commenced in 1995 (section 4.1 refers). Significant reports were finalised on the matters of national competition policy (Hilmer 1993), broadband services (BSEG 1994), communications futures (BTCE 1995), a review of the standard telephone service (DCA 1996) and the possible privatisation of Telstra (1996).

Against this background, a group of industry, government, consumer and academic representatives assembled in 1996 to consider national objectives for Australia's information and communications services (ICS) sector, including identification of key issues, strategies and benefits of promoting competition in ICS. (CIRCIT 1996) After three days of deliberation, a new policy concept was born – that of 'any-to-any connectivity' – which quickly gained formal recognition by being incorporated into telecommunication legislation of first Australia and then New Zealand, and adopted worldwide into the lexicon of the data communications industry.[200] With its original

[200] The data communications industry was quick to equate "any-to-any connectivity" with what it knew as "multipoint-to-multipoint connectivity".

meaning now corrupted in legislation, it is instructive to re-visit what was intended by those who framed this concept.[201]

Discussion was grounded in the context of the emerging ICS industry structure, as depicted by Figure 23. The convergent marketplace was envisaged as an interlinked and continuous value chain consisting of content providers, information service providers, distribution networks, user interfaces and users.[202] With the traditional telecommunications sector considered to be constrained largely to the distribution component, this new model represented a departure from traditional thinking.



Source: (CIRCIT 1996: p.2)

Figure 23 – Changing Industry Structure

In the realm of telephony services, carriers are obliged to connect calls from any person to any other person connected to the worldwide telecommunications network; they are known as 'common' carriers. But in the new era how could this concept be extended to include an obligation of distribution providers to connect end users to any legitimate information source connected to the same worldwide network, be they people, computers, Internet servers, electronic publishers or video servers?

[201] Telephone communications, Ross Kelso/John Burke and Ross Kelso/Peter Gerrand, 19 January 2007. The Policy Forum in question was organised by CIRCIT. John Burke was the Director of CIRCIT at the time. Peter Gerrand, a participant, was instrumental in convincing the group of the appropriateness of adopting the policy concept.

[202] Though prepared in 1996, this representation had foreshadowed that users would increasingly becoming significant creators of content.

Significant barriers to the development of ICS in the Australian context were identified in terms of the various instances of access across the prime interfaces of the ICS value chain, namely: (CIRCIT 1996, Ch. 6)

- User access to services, that is, at the user interface;
- Access within distribution, that is, interconnect between carriers;
- Access of content creators to information service providers and hence to distribution; and
- Access of all industry players, but particularly users, to international distribution channels and services.

Discussants were attempting to grapple with these complex access issues arising in the era of interactive broadband services, quite likely with the Internet at its core. Representing different interest groups, they encountered substantial difficulties in seeking to balance economic with social policy goals and the measurement of outcomes of market versus non-market strategies. Ultimately the group adopted the more encompassing term 'any-to-any connectivity' in preference to that of 'access'. Extending this putative policy concept to include the international importance of ICS as an enabler in key information intensive industries, the group further recognised the importance of achieving 'global any-to-any connectivity'.

Nevertheless, the importance was recognised of: (CIRCIT 1996, p.30)

- maintaining incentives to invest in infrastructure and service development; and
- balancing the costs to consumers of 'any to any connectivity' against the benefits to them of access to a range of content services.

In summary, the 1996 CIRCIT Policy Forum initiated the high level concept of '(global) any-to-any connectivity' to imply an obligation of distribution providers "to connect end-users to any legitimate information source connected to the same worldwide network, be they persons, computers, Internet servers, electronic publishers or video servers".[203] (CIRCIT 1996, p.1, 26) Intended to go far beyond the obvious technical implications, 'any-to-any connectivity' was to be a goal of social policy for ensuring that Australia maximises the national benefits of its growing information and communications sectors.[204] Connecting 'any' with 'any' necessarily implies the absence of discrimination.

Section 8.6 reveals how the concept of 'any-to-any connectivity' was subsequently adopted into the 1997 Australian telecommunications legislation, but with a less precise meaning.

[203] End-user access was interpreted in terms of "control of two-way access to (a) user or information source".

[204] The making of this case in no way implies that the 1996 CIRCIT Policy Forum also unveiled the concept of "connectivity", which of course is fundamental to the very essence of telecommunications. For example, section 53 of the Telecommunications Act 1989 No. 53, 1989 defined 'primary communications carriage' as consisting of arranging, operating and managing connectivity across the telecommunications network.

8.1.2 Common Carriage

> *To preserve some of the policy goals behind common carriage, one will therefore have to rely, where market forces result in restrictiveness, on other protective legal arrangements, such as antitrust law, interconnection and access rules, and non-discrimination protections. (Noam 1993, p.1)*

The principles of common carriage are rooted deeply in English common law. (Thorne, Huber et al. 1995: 5.1) Early examples of common or public occupations that attracted special obligations included those of "bakers, brewers, cab drivers, ferrymen, innkeepers, millers, smiths, surgeons, tailors and wharfingers". (Noam 1993, p.3) 'Common' in that context meant 'open to serving the general public' or 'general'.

In more modern times, businesses such as postal services, railways, telecommunications, airplanes, taxis, roads and utilities have been treated as common carriers. While each has a different history of attaining such classification, they appear to share two dominant characteristics:

Public interest

A business offering service to the general public at rates announced in advance could be construed to be a 'public' business, even if it were privately owned and operated. (Nachbar 2006, pp.9-15) (Thorne, Huber et al. 1995: 5.1) (Noam 1993, p.5,7)

Transportation and communication

The public has a strong interest in transportation and communication infrastructure, particularly for the delivery of undifferentiated services such as carriage or commodities like water or electricity. (Nachbar 2006, pp.31-39) (Noam 1993, p.7,8) As long as a tariff is paid that accounts for certain characteristics relevant to the carrier (size, weight, speed of delivery, etc.), the carrier usually has no interest in the particular content carried. (Frieden 1995, pp.692-693)

Yet another characteristic is that of market power. According to de Sola Pool (1983, p.106):

> The law of common carriage rests on the opposite assumption that, in the absence of regulation, the carrier will have enough monopoly power to deny citizens the right to communicate.

On the other hand Nachbar (2006, p.31, 41), equating open access with common carriage, concludes that "market power has been neither a necessary nor a sufficient criterion for imposing open access regulation on an industry" but rather

> the inherently 'public' nature of even privately owned transportation and communication networks has generally justified their regulation without the benefit of economic reasoning, so long as they have been offered for use by the general public.

Common carriage principles have played an important role in the infrastructure services of transportation and communications, aiding telecommunications users' access and thereby also stimulating the development of networks. These principles typically implied that: (Noam 1993)

> … no customer seeking service upon reasonable demand, willing and able to pay the established price, however set, would be denied lawful use of the service or would otherwise be discriminated against.

In return for this reduced discretion, a (common) carrier obtained certain benefits, including limited liability for the consequences of its own actions. In some instances, governments have also awarded some types of common carriers powers to expropriate private property, use public rights-of-way and be protected from competition. (Noam 1993, p.2)

From the basic principle of common carriage in telecommunications that all users must be served without discrimination, it follows that carriers must also accept bilateral interconnection.[205] Thorne, Huber, et al. (1995, p.293) argue that the right to interconnect is simply a mirror image of the obligation to carry.

The most critical factor in mass adoption of the Internet has been the common carriage obligation of telephone companies which permitted dial-up access between users and ISPs. (Nuechterlein and Weiser 2005, p.170,171) This non-discriminatory connection of modems, using signals that mimic telephony calls, connected customers with narrowband ISPs who in turn had established data lines to the public Internet.

In summary, Noam (1993, p.1) argues that:

> common carriage, after all, is of considerable social value. It extends free speech principles to privately-owned carriers. It is an arrangement that promotes interconnection, encourages competition, assists universal service, and reduces transaction costs.

The underlying policy goals of common carriage, even if implemented through other arrangements, remain central to the realisation of any open access regime. (Nachbar 2006)

8.1.3 Commentary

These two policy goals persist in contemporary Australian telecommunications legislation, though in different ways.

Prior to 1975, network and service access could not be an issue as the Postmaster-General's Department was a monopolistic common carrier and competition was simply not permitted. After 1975, the Australian Telecommunications Commission (Telecom) continued the national responsibility for providing a standard telephone

[205] Not surprisingly, the same outcome follows from the principle of any-to-any connectivity.

service. It could only discriminate by refusing such provision on the grounds of impracticality or the services not being reasonably required.[206] The Minister could also direct the Commission as necessary 'in the public interest'.

During the 1980s, the monopoly powers of Telecom were increasingly brought into question by the government, inquiries and embryonic competitors. By 1989, Telecom retained the monopoly to provide services via the PSTN but all services other than those 'reserved' for Telecom were open to competition, such as the provision of value added services and private networks. Where Telecom refused or failed to supply a standard telephone service, the new regulator (AUSTEL) could direct Telecom to carry out its community service obligation. Telecom was also obliged to connect to these embryonic competitors and was prohibited from discriminating against them.[207]

This semblance of common carriage continued through the Telecommunication Acts of 1991 and 1997, in the form of requirements for all carriers to interconnect and for Telstra to be obliged to deliver a standard telephone service to the whole community. The key point to note is that this spirit, if not reality of common carriage, has been limited to telephony or telephony-like services. It also encompasses an obligation to deliver only low bit-rate data services.

The Telstra/Foxtel and TransACT case studies illuminate the second key point, that of the tension between common carriage and resource scarcity – the typical remedy being to operate a vertically integrated business that discriminates against competitors. Telstra had resolved to enter the business of delivering pay television as a common carrier, but encountered problems in allocating the relatively scarce television channel capacity available from the HFC distribution technology it had chosen. It was then confronted by a competitor who argued that whilst Optus Vision would be bound by the common carrier requirements of the Telecommunications Act 1991 for telephony services, the part of the cable being used to supply pay television was covered by the Broadcasting Services Act 1992 which did not require open access to all comers.

In contrast, the experience of TransACT was the exact opposite. The TransAct project team deliberately chose a switched digital broadband network that would accommodate their philosophy of open access service delivery. Competing service providers would not encounter any scarcity of broadband resource in delivering their services to customers of the common carriage network. Furthermore, TransACT gained a 'first-mover' advantage in that neither Telstra/Foxtel nor Optus Vision rolled out their HFC networks in the Australian Capital Territory.

Hence, the implementation of common carriage is strongly favoured by a relative abundance of capacity and the closest possible approximation to one-on-one connectivity. From these first two case studies, it is not possible to conclude what could have been the outcome if the respective competitive environments had been different. Both Telstra/Foxtel and Optus Vision became vertically integrated

[206] Sections 6 & 7, Telecommunications Act No. 55 of 1975
[207] Sections 3, 33, 52, 68, 97 & 98, Telecommunications Act No. 53 of 1989

businesses, whereas TransACT became a common carrier at least for broadband and video services, and arguably also for telephony.

The other policy goal behind opening up access, 'any-to-any connectivity', succeeded in being incorporated into the 1997 Australian telecommunications legislation. Section 8.6 reveals that this occurred but with a diminished meaning and less than satisfactory outcomes.

8.2 Dominance of CAN Fibre

Of all telecommunications media, optical fibre in the customer access network or CAN presents the greatest opportunity for dominating the market for delivering to end users services that are bandwidth intensive and non-mobile. This section discusses the significance of sunk investments in CAN fibre for facilities-based competition.

8.2.1 Naturally a Monopoly

Chapter Six discussed how optical fibre in the CAN, exhibiting very large economies of both scale and scope, exhibits many of the characteristics of a strong natural monopoly and as a consequence is likely to attract access regulation. With the cost of civil works (digging trenches, laying conduit, installing manholes and pits, pulling cable) comprising some 90 per cent of total capital cost, an asset is created which is largely non-recoverable, i.e. it is said to be 'sunk'.

However for an entrant wishing to compete with an incumbent owner of CAN fibre, the nature of this sunk cost poses considerable disadvantage. An entrant wishing to overbuild with the same optical fibre technology must incur at least the same capital cost which in turn would become immediately sunk. If, as in almost all instances, the incumbent had exploited an existing copper-based CAN involving in situ and written-down conduits, then the entrant must incur comparatively greater initial costs to replicate the same network design.

With the incumbent also having the advantage of established customer relationships, the entrant must create market share from a zero base. Accordingly the business case for investment by an entrant is likely to be much less attractive than for the incumbent. Capital raising is correspondingly more problematical for the entrant.

This adverse situation can only improve somewhat if the entrant adopts a cost-saving approach not available to the incumbent, such as by installing aerial cabling as was the case when Optus Vision rolled out its HFC network versus the initially underground cabling by Telstra (Chapter Four refers). In any case, the usual market behaviour of an incumbent would be to drop prices to a level so low as to generate insufficient revenue to cover the entrant's sunk costs, thereby greatly worsening the entrant's business case. (Roycroft 2006c, p.11)

The first mover, usually the incumbent operator, would be expected to protect its market position by warding off facilities-based competition from any access technology deemed to be threatening. Australian experience in this regard has been illuminating:

- When Optus rolled out an HFC network during 1995/97, it was the first wireline access network investment ever to threaten the monopoly position of Telstra's copper-based CAN. However Telstra countered with an almost identical street-by-street roll-out also with HFC technology and eventually passed more homes. Despite both investments subsequently incurring massive write-offs, Telstra enjoyed the greater financial resilience and ultimately achieved dominance in the pay television market through its partner Foxtel, with Optus eventually agreeing to resell mostly the same content as Foxtel.

  The unique outcome of this exercise was that the incumbent overbuilt its own CAN as a means of neutralising the impact of being overbuilt by an entrant. Noting that Telstra's initial commercial strategy was one of defending its telephony market, Telstra succeeded in also dominating, via Foxtel, the new pay television market. The key message to future competitors was that Telstra would fight to protect its dominance in delivering services based on a wireline CAN.

- On first examination, what transpired in the Australian Capital Territory belies that message. As discussed in Chapter Five, neither Optus nor Telstra had planned to include Canberra in their roll-outs of HFC cabling. By exploiting the aerial right-of-way of its parent company ACTEW, TransACT was able to bypass Telstra's copper-based CAN with a next-generation broadband network, however not in suburbs where the ACTEW electricity distribution was already underground. Although denied access to the more commercially attractive television content of Foxtel and Optus, TransACT nevertheless survived with other video content and Internet access delivered on an open access basis in addition to telephony services.

  Despite TransACT gaining the first mover advantage, Telstra assessed the situation differently on this occasion.[208] By the time TransACT commenced commercial roll-out in 2000, Telstra had already experienced a massive write-off of its HFC network investment and the business of pay television had lost its commercial lustre. The TransACT network was seen to be only a threat in Canberra yet Telstra continued to retain a dominant share of federal government business. For residential and SME customers Australiawide, the future was by now seen to be in providing Internet access and the copper-based CAN was ideally placed to provide ADSL services. Telstra's underground pit and pipe network remained capable of accommodating optical fibre cable to deliver fibre-to-the-node or home services in the future.

- Telstra's proposal to roll-out fibre-to-the-node or FTTN infrastructure, first floated in 2005, was shelved in 2006 after being unable to gain from the ACCC what Telstra called 'regulatory relief'. The Minister, ACCC Chairman and competitors all publicly referred to such infrastructure becoming a new natural monopoly in the CAN. A consortium of competitors contended it would be

[208] Similar outcomes resulted from the regional pay television HFC networks rolled out by small-scale operators in Darwin (Austar/Windytide), Western Australia (West Coast Radio) and Victoria (Neighbourhood Cable) – Table 4 refers.

> impractical for them to use 'unbundled' elements of the FTTN and the alternative of resale competition would be much more inferior. (Allen Consulting Group and dandalopartners 2006b)
>
> Remembering the fate of the dual HFC infrastructure roll-out, the consortium was convinced that any Telstra FTTN access network would become a new bottleneck to competition. They therefore proposed an arrangement for joint stakeholder participation in a future nationwide FTTN access network such that overall control would be on a non-discriminatory or 'open access' basis.[209] The proposal was summarily rejected by Telstra and as at mid-2007 no FTTN roll-out was proceeding by any party. In the meantime, Telstra continued to roll-out fibre-to-the-home or FTTH infrastructure in selected new housing estates on a closed access basis.

8.2.2 Strategic Capability

Another entrant strategy could be to adopt an access technology with an even more attractive cost structure, such as that of wireless. On encountering competition, the incumbent may claim to the regulator that its CAN is no longer monopoly infrastructure since the barriers to entry have been lowered; the CAN is no longer an "enduring or sustainable bottleneck". (Telstra 2005d) For example, Telstra has submitted that: (Telstra 2006, p.11)

> A bottleneck occurs where there are no alternatives to a facility and no alternatives could be economically developed such that through ownership of the facility the facility owner is able to reduce, distort, harm or hinder competition in some other market.

In similar vein but describing the US telecommunications scene, Thierer and Crews (2003, Ch. 3) declare that "network proliferation spells the end of the essential facilities doctrine". Many alternative broadband technologies are "on the proverbial drawing board, or even currently at work in today's marketplace" they claim, citing optical fibre, cable television networks, satellite, fixed terrestrial wireless, 'Wi-Fi' networks, ultra-wideband and free space optics as contenders. (Thierer and Crews 2003, Ch. 6) This broad argument could be strengthened if, for example, the bandwidth offered by a competing network is comparable to that of the incumbent.

On the other hand, once the incumbent network is upgraded to fibre-to-the-home, the inherent economies of scale and scope significantly exceed that of any other available access technology for delivering non-mobile services. Even if the incumbent FTTH network is artificially de-rated so as not to cannibalise other products of the incumbent, a plausible case can still be made that the strategic capability of an appropriately designed fibre-to-the-home network may nevertheless create an enduring bottleneck in the market for non-mobile access services. The FTTH network can, for many decades to come, continue to deliver ever-increasing levels of bandwidth for almost no added cost to the network provider. Where this infrastructure has exploited an earlier copper-based CAN, the opportunities for facilities-based competition are particularly chilled.

[209] This jointly controlled network would itself be a monopoly but an all-inclusive one.

8.3 Open and Shut Design

Drawing upon the three case studies, this section discusses why the network architecture and system design of a next generation broadband network can be a critical factor in facilitating open access and what the implications could be for the regulation of access.

Wireline telecommunication access networks are modern-day behemoths, extensive in coverage, expensive to build and slow to change. When each opportunity for change does arise, the occasion could be of national significance as the next opportunity may be decades away. The purpose of generational change is to significantly upgrade service capability and this is often effected through a wholesale change in network architecture and system design.

Australian telecommunications witnessed a generational change of sorts with the roll-out by Telstra and Optus of hybrid-fibre coaxial or HFC networks to the major capital cities and key regional areas. The technology deployed was service specific – it was good at broadcasting pay television services and considered to be economic at the time. The HFC network architecture and system design also reflected the business model of a monopoly operator in each case.

Commencing with analogue transmission, the limited channel capacity posed an immediate bottleneck to third party access – particularly since Telstra had contracted all of its network capacity to Foxtel. Digitisation increased the capacity somewhat yet most was still contracted to Foxtel for their new Near Video-on-Demand services. The combined bottlenecks of channel capacity, integrated conditional access, dedicated set top boxes and complex subscriber management interfaces emboldened Telstra and Foxtel to obstruct third party access through political influence and years of regulatory gaming.

On the other hand, the TransACT network represented a true generational change albeit restricted to the national capital of Canberra. The TransAct project team took a conscious decision to first develop their philosophy of open access service delivery and then to choose an appropriate technological solution. The result was a network architecture employing fibre-to-the curb or FTTC plus very high rate digital subscriber line or VDSL broadband transmission delivered over twisted pairs, with the system configured to offer ‘switched digital’ services.

With multiple service providers interfaced to the central gateway, any service provider may connect with any customer who requests their particular service without impacting on service quality for others. Designed to satisfy an open access business model, the TransACT network has literally set itself apart from the access provisions of Australian telecommunications.

With the Optus HFC network no longer an effective competitive threat to Telstra and the TransACT network limited to Canberra, only the following wireline telecommunication networks remain to serve the vast bulk of Australian end users:

- The ubiquitous Telstra public switched telephone network or PSTN, inherently designed for open access and thereby facilitating competitive DSL providers, yet ultimately incapable of providing symmetric next-generation bandwidth to the mass market;
- The Telstra HFC network, inherently designed for closed access and providing only Foxtel pay television and Telstra's BigPond Internet services, and also incapable of providing symmetric next-generation bandwidth to the mass market.

Hereafter, the likely scenarios for wireline network development to serve the mass market are:

- Telstra-provided FTTH initially only in 'greenfield' locations, but subsequently deployed in 'brownfield' locations as the economics improve;
- Variants of a re-purposed Telstra HFC and/or Telstra-provided FTTN in 'brownfield' locations, with the prospects of a competitive 'G-9' consortium-provided FTTN rapidly receding.

Whatever the outcome, the inevitable natural monopoly will make facilities-based competition infeasible so the key factor will be whether the next generation wireline network will permit service-based competition via unbundling to the lowest possible network element. This is the only way end users can experience true innovation arising from competition. Although the concept and practice of competitive access through unbundling is well established with the PSTN, such application to fibre to the home networks and services continues to be novel. Incumbent network providers can frustrate attempts to unbundle FTTH networks or services through either intentional design or merely the adoption of industry designs that just happen to assume the network provider to be the sole service provider.

A prime finding of the third case study is that the architecture and design of a given FTTH network is the crucial determinant of its ability to accommodate multiple service providers in a non-discriminatory manner. The differentiating factor is the extent to which a network architecture and design has been engineered to maintain a 'one-to-one' and symmetrical relationship between service providers and customers. The stronger this relationship, the more readily choice of service providers can be supported as well as services delivered that are unique to particular service providers. Conversely, the greater the sharing of resources in the access network, the lower the ability to support choice of service providers and the more likely their service packages will be replicas of one another – with there being only monopoly service provision in the limiting case.

The architectures most amenable to competitive access are those of the Home Run and WDM PON designs. The Active Star architecture is a compromise solution for competitive access, situated between the limit cases of the Home Run and PON designs. The architecture least amenable to competitive access is that of the PON design – the very design most appealing to incumbent network operators.

The inevitable conclusion is that incumbent network operators can minimise the outcomes for competitive access through defensive engineering and that this outcome should be factored into regulatory considerations. Nowadays, such a

conclusion is counter-intuitive. Under the rubric of being 'technology neutral' or of 'not picking winners', telecommunication policy makers and regulators traditionally decry such market intervention. This approach may not be appropriate in dealing with such future access network technologies.

8.4 The Regulatory Scorecard

This section examines the experience of applying Australian telecommunications access regulation to the services of wireline access infrastructure that has succeeded the paired copper-based CAN. The only significant examples of such 'post-PSTN' infrastructure are that of the hybrid fibre coaxial networks rolled out by Telstra and Optus from 1995 to 1997 and the TransACT network rolled out commercially from 2000. The Optus HFC network is not discussed as it did not attract regulatory attention. To this actual regulatory experience is added what is known of Telstra's attempt to gain regulatory forbearance for its proposed FTTN investment and the 'G-9' consortium counter-proposal.

8.4.1 Hybrid Fibre Coaxial Network

The process of gaining access to Australia's dominant cable television network has been tortuous and time consuming, and remains unfulfilled. For the first two years from 1995 to 1997, a government mandate denied open access on the promise of competition which was never effective and is now basically stymied. Between 1997 and 1999, deeming and declaration by the regulator made open access legally possible but impractical due to regulatory uncertainty. That period was followed by yet another two years of public legal challenges involving the access providers, access seekers and the regulator, running in parallel with private arbitration of the access disputes by the regulator. The end result of these political, regulatory and commercial processes has been nine years of delay in the provision of access to competitive parties.

The then ACCC Chairman Professor Alan Fels expressed his clear frustration with such processes in a speech on 26 March 2001:[210]

> …. potential suppliers of retail programming need to have access to the networks if competition is to develop in digital service provision and diverse service choices are to be made available to consumers.
>
> Telstra and Foxtel have frustrated every effort to open up access to competitors. They have engaged in a lengthy campaign to prevent access to competing pay TV providers and slow down the processes. They are clearly both able and willing to devote considerable energy and resources to such activities.

Exploitation of delay in the regulatory process has highly favoured the now dominant access providers, Foxtel and Telstra, and conversely highly disadvantaged any third

[210] Refer to ACCC Press Release "Cable owners put on notice" MR 064/01, issued 26 March 2001, at http://www.accc.gov.au/content/index.phtml/itemId/87682, accessed 13 May 2007

parties wishing to gain access. The Seven Network foresaw such an outcome in its submission to the Senate inquiry into the Telecommunications Competition Bill 2002: (Seven Network Supp 2002: 17)

> ….. in the telecommunications and pay TV industries time is of the essence. Access delayed is access denied. Delays in obtaining access entrench the position of incumbents, thereby defeating the purpose of the regime by stripping access-seekers of the intended benefits of access and making it difficult, if not impossible, to generate competition from access-seekers at a later date.

By itself, delay wouldn't have been so strategically beneficial if it wasn't for multiple occasions when the telecommunications access legislation was deliberately skewed in favour of the HFC network providers and against any access seekers. Of the three instances of access exemptions, one arose from a threat to withhold investment[211] and another was exploited in association with a separate threat. The relationship between these access exemptions and incentives for investment is explored in section 8.5.

The first access exemption arose in late 1994 when the Minister for Communications was confronted with a dilemma - agree with the Optus proposal to create a new broadband cable network for the delivery of pay television, data and telephony provided it was closed to other parties, or witness a refusal to invest in a new wireline local telephone service that would compete with that of Telecom Australia's. If Optus was rejected, the government's policy of encouraging facilities-based (that is, infrastructure) competition during the 1992 - 1997 telecommunications duopoly phase would be stymied. The alternative would be duplicated HFC cable infrastructure and the exclusion of independent service providers. The Minister relented and legalized the proposed access discrimination through the instrument of a Carrier Associates Direction that would operate until 1 July 1997.

The second occasion for an access exemption derived from a right to exclude access seekers from utilizing capacity that had been contracted to another party yet not taken up. This became known as a 'protected contractual right' and arose from Telstra and Foxtel lobbying the incoming Howard coalition government for protection from third-party access, insisting that Telstra had already contracted all cable capacity to Foxtel. Accordingly, new provisions of the Trade Practices Act 1974 absolved an access provider of any standard access obligation if there would otherwise be an insufficient amount of the service available to meet the 'reasonably anticipated requirements' and any person would be deprived of a right under a contract in force at the beginning of 13 September 1996. Not surprisingly, Telstra and Foxtel had signed their Broadband Cooperation Agreement on 12 July that year.

The third instance arose from an amendment to the Trade Practices Act enabling access providers to be exempted from the standard access obligations prior to an investment being made in a telecommunications service, i.e. they could seek 'anticipatory exemption'. The sole purpose of the amendment was to promote investment in telecommunications infrastructure by reducing the regulatory uncertainty. After threatening not to upgrade to digital working, an outcome that

[211] Otherwise euphemistically known as a 'capital strike'.

would have perpetuated the inherent shortage of analogue channel capacity, Foxtel and Telstra subsequently gained regulatory approval from the ACCC via agreed undertakings that permitted third party access to both their analogue and digital pay television service infrastructure. After so many years of delay and lost opportunities for access seekers, these undertakings would presage an illusory outcome.

Both Telstra and Optus also exploited their HFC networks to provide data capacity via high speed cable modems for their respective ISPs. Not surprisingly, neither voluntarily offered to provide third party access. Yet it does remain a puzzle as to why no Australian ISP ever approached the ACCC to declare a cable modem service so that it would become subject to the standard access obligations of the Trade Practices Act. The matter of cable modem access has been the defining one in the United States but remains stillborn in Australia.

8.4.2 TransACT Network

Services of the TransACT network are subject to the same standard access obligations under Australian telecommunications and competition law as any other. However, being intentionally designed to accommodate multiple video and Internet access service providers, none of the services were ever declared by the ACCC and so there is no access regulatory experience to discuss.

8.4.3 Fibre-to-the-Home Network

In a formal sense, the experience of applying access regulation to fibre-to-the-node (FTTN) or fibre-to-the-home (FTTH) networks is presently non-existent. That is simply because Telstra has to date avoided attracting formal regulation of services from either network. Instead, it has opted for applying pressure on the government and ACCC through public announcements, coupled with limited confidential discussions with the ACCC – seemingly adopting a strategy of 'regulatory shadow boxing'.

Commencing mid-2005, Telstra resolved that any new wireline infrastructure and services must be exempted from the standard access obligations under Part XIC of the Trade Practices Act, justified on the following grounds:

- Only true bottlenecks should be subject to regulated competitor access and in much of the CAN, Telstra was no longer a monopolist;
- Since any new network would be Telstra's private property, it could do with it what it wished.

Quoting the mantra of "legacy regulation for legacy network, new arrangements for new networks", Telstra further resolved that unless it received this exemption there would be no investment in FTTN infrastructure. If granted such an exemption, Telstra would probably agree to third party access provided the price and non-price terms of access rewarded their risk and enterprise, i.e. access would be on 'commercial terms'.

Both the Minister and the ACCC reiterated that the current framework of the Trade Practices Act could provide Telstra with regulatory certainty if it submitted an access undertaking or sought an exemption from the access regime. Telstra was clearly loathe to do this, recalling the adverse ruling by the Australian Competition Tribunal in December 2004 regarding an anticipatory exemption granted by the ACCC to its HFC network.

Arguing that any exemption for Telstra would further entrench its CAN monopoly, most of Telstra's competitors banded together and put forward a proposal for cooperative investment in new nationwide FTTN infrastructure. With a more open design of the network, participating companies could offer differentiated services to customers. Telstra rejected this proposal which now appears to have been shelved. The 'G-9' consortium of competitors was well aware that any roll-out without Telstra was highly likely to confront an immediate overbuild – reminiscent of the disastrous dual HFC roll-out. In the meantime, Telstra's own FTTN investment has been subject to a 'capital strike'.

But what of Telstra's FTTH roll-out in selected 'greenfield' or new estates? Being initially trials and clearly evolving on a patchwork basis across Australia for a number of years, none of the resulting services have been declared by the ACCC and Telstra has not sought exemption. Hence there is currently no access regulatory experience to discuss pertaining to fibre-to-the-home networks.

8.5 Holidays, Harbours & Incentives

The record of Australia's regulatory experience with 'post-PSTN' wireline access infrastructure provides salutary lessons: the Telstra/Foxtel HFC network remains effectively closed, Telstra's FTTN investment remains 'on strike' and the G-9 co-operative proposal remains stillborn.

Is there a rational explanation for this impasse? If nothing changes, Australia is unlikely to obtain a fibre-based access network capable of delivering next generation broadband and certainly not an 'open access' one. Simply put, the player with the greatest market power in the wireline access arena demands exemption from standard access obligations. In the jargon of regulatory economics, Telstra is seeking an 'access holiday' on the basis that this will give them an incentive to invest in the new infrastructure. Telstra would then regard that infrastructure as being parked in a 'safe harbour' – safe from the desires of access seekers.

The very term 'access holiday' can sound deceptively innocent, yet access holidays are antithetical to the principle of open access. This section explores what is conventionally understood with the regulatory vehicle of an 'access holiday', whether access holidays by another name have already been provided and to what extent recent regulatory experience with the HFC network could be construed to have provided 'public benefit'.

8.5.1 Access Holidays

The regulation of existing 'bottleneck' or 'essential' infrastructure, such as Telstra's CAN, taps into quite different industry dynamics than that of new infrastructure. For a start, existing infrastructure can't go away whilst new infrastructure won't necessarily get built. Yet the in-situ infrastructure of the existing wireline CAN and the market power it creates can have an overwhelming bearing on the regulatory and competitive outcomes for new infrastructure.

According to the Productivity Commission, the stated aim of access regulation is to promote competition in markets that use the services of bottleneck infrastructure facilities, without compromising incentives to develop and maintain such facilities. (PC 2001b, p.39)

> In the absence of regulation, providers of essential infrastructure services may be able to earn monopoly rents through inefficient pricing or denial of access to those services. If access regulation reduces the scope for such practices, investment in essential infrastructure will potentially be more efficient. As well, investment in markets that use the services of that infrastructure will be facilitated. (PC 2001b, p.279)

In its review of the generic national access regime[212], the Productivity Commission canvassed some specific measures that could be used to exempt from the purview of Part IIIA of the Trade Practices Act proposed infrastructure projects expected to be only marginally profitable, namely (PC 2001b, p.282)

- 'Access holidays';
- Exemption from the regime for 'greenfield' investments; and
- Provision for a higher regulated rate of return on risky new investments.

The Productivity Commission broadly defined an 'access holiday' as a time-limited exemption from exposure to any access requirements, and then entertained possible variations relating to the length of time and permitted rate of return. During this time, the infrastructure providers would be freely able to charge monopoly prices or deny access to competitors. (Gans and King 2003) Third party access could be allowed but on terms dictated by the infrastructure provider.

Concurrently, the Productivity Commission examined the impact of access regulation on Australia's telecommunications, highlighting concern that the access regime should not overly weaken the incentives for access providers to invest in core infrastructure. (PC 2001a: 9.6) Investments in telecommunications were seen to be "fast moving, risky and innovative" and could be put at risk by "fallible regulators" through mandated access. One solution would be to introduce 'holidays' from the standard access obligations for a period of time, similar to that enjoyed by a patent owner. There could still be scope for the regulator to declare a service after the holiday period, if the carrier concerned developed substantial market power. (PC 2001a: 9.6)

[212] That is, Part IIIA is generic whereas Part XIC is telecommunications specific.

The Productivity Commission canvassed industry views and found no consensus – at one end of the spectrum Telstra was strongly in favour and at the other end the ACCC was strongly against the introduction of access holidays. That was in 2001, yet as has been recounted in section 6.5, by 2006 and continuing at least to mid-2007 Telstra's investment in fibre-to-the-node infrastructure remains 'on strike' until they win an exemption from the obligations under Part XIC of the Trade Practices Act.

8.5.2 Exemptions & their Benefits

In Chapter Four, the three instances were considered of access exemptions enjoyed by the HFC network providers to give investment certainty at the expense of the common carriage/open access principle. These are now examined from the perspectives of whether each was tied to a specific infrastructure deployment outcome or failing that, whether some other benefit to the public could be construed. A fourth instance is also considered; briefly noted in section 8.6.5, it refers to the 2005 amendment to the definition of long-term interests of end-users that requires the ACCC to place greater weight on incentives for and the risks involved in investment in new infrastructure.

As to what could be interpreted by the 'public benefit', the obvious response is whatever satisfies the 'long-term interests of end-users'. However, as discussed in section 8.6, this particular test is now framed and interpreted so as to significantly elevate the importance of network investment and downplay the relevance of 'any-to-any connectivity'. In particular, the test of satisfying the long-term interests of end-users is now strongly biased against the provision of access to third parties. Although the 'public benefit' is not defined by the Trade Practices Act, the ACCC accepts a broad understanding which recognises public benefits of an economic and non-economic nature. (ACCC 2001) Within the quoted range of possible benefits, the following nominal tests are easily encompassed:

- Would any-to-any connectivity be enhanced?
- Would sustainable competition be more likely?
- Would end-users benefit in some other manner that otherwise could not be possible?

Carrier associates direction of 1995

Effective from 1995 to 1997, this exemption from the standard access obligations was granted in return for the roll-out by Optus of an HFC network that, *inter alia*, gave major Australian cities and some regions the first wireline access infrastructure in competition to that of Telstra. Whilst the Ministerial Direction did not prescribe the roll-out, there was a strong presumption that a roll-out would immediately occur. Despite the investment having been substantially written-off a few years later, the infrastructure remains in place and continues to operate. Though not appreciated at the time, the Ministerial Direction did signal the beginning of the end of open access to post-PSTN wireline access infrastructure. On balance, it would be reasonable to

conclude that the Optus HFC network had potential to deliver some benefit to the Australian public but that this was not realised in the longer term.

Protected contractual right defence of 1997

With a use-by date of 13 September 1996, this defence was effective until 1999/2000 as a means to thwart legal challenges from access seekers. The defence failed in the courts but the delay in having to provide access was a strategic success in the eyes of the access providers. When this new provision was written into the Trade Practices Act, it was not accompanied by any off-setting requirement. The HFC network roll-out had ceased by end-1997 in any case and thereafter each HFC network continued to be monopolised by its respective owner. Unless an argument could be put that a vertically integrated monopoly is superior to service-level competition via shared infrastructure, it must be concluded that the protected contractual right defence has delivered no benefit to the Australian public.

Anticipatory exemption provision of 2002

Effective from 2002 and ongoing, the Trade Practices Act has been amended to allow network providers to seek an exemption from the standard access obligations prior to the making of an investment or the declaration of a service. The amendment was intended "to provide certainty for potential investors in telecommunications infrastructure and services in relation to access to that infrastructure or service in the future" by increasing "the level of competition and investment in the tele-communications market to the benefit of consumers and business" (section 4.6.2 refers).

Telstra/Foxtel exploited this exemption on the grounds that without it they could not justify conversion of their HFC network to digital working. The Australian Competition Tribunal found this to be untrue – digitisation was going to occur regardless as the supply of analogue set top boxes was ceasing. Although the new anticipatory exemption provision was generic as to which investments were to be favoured, Telstra/Foxtel gave a voluntary undertaking to digitise their HFC network and permit third party access on terms that they prescribed. The exemption provision was also intended to increase the level of competition, yet following the successive legal and regulatory barriers arising from the carrier associates direction of 1995 and the protected contractual right defence of 1997, the strategic and commercial advantage remains overwhelmingly with Telstra and Foxtel. There is still no service-level competition.

It is difficult to conceive how the anticipatory exemption provision has benefited the Australian public, since the same outcome of digitalisation of the HFC network would have arisen without it. As at mid-2007, no other network providers have attempted to exploit this provision.

A key but easily overlooked aspect about the anticipatory exemption regime is that it refers to services not infrastructure. At a Senate Committee hearing, Dr Warren, General Manager of Regulatory Affairs, Telstra confirmed that: (ECITA 2006)

> ... we actually do not invest in services but in infrastructure. The current regime as it is written gives exemption for services, so one of the problems we have is trying to fully disclose and describe all of the services that we would need an exemption for when many of those services have not even been thought of yet. So that is part of the problem with the way the legislation is currently drafted.

If access regulation continues to focus only on offered services, then network operators are encouraged to 'de-rate' the service capability so as to disguise the strategic potential of the access fibre infrastructure.

Investment incentive and risk allowance of 2005

Effective from 2005 and ongoing, the ACCC is now required to specifically consider incentives for and the risks involved in investment in new network infrastructure when assessing the long-term interests of end-users. This benefit for a network provider compounds with that possible from the provision for anticipatory exemption. The import of the allowance is to elevate further the interests of network providers against those of access seekers.

When the amendments were made to section 152AB of the Trade Practices Act, there was no added requirement to also ascertain whether the investment risk could be lowered if the infrastructure in question was to be shared by multiple service providers, thereby conceivably increasing network utilisation and growing the overall market. Whilst the jury is still out on the effectiveness of this added allowance in favour of investment, there is currently no evidence that decisions based upon the amendments will lead to new infrastructure and services that ultimately benefit the Australian public.

Of the above four instances actually resulting in or providing scope for access exemption, the first two are now expired. The first was specifically addressed to serve the interests of the Optus pay television business, whilst there is strong circumstantial evidence that the second and third were specifically addressed to serve the pay television interests of Telstra and Foxtel. As to the likelihood of the third and fourth means enhancing the prospects of investment in next generation telecommunications infrastructure in the longer term, there is every chance that network providers other than Telstra will not exploit these means for fear of being overbuilt by Telstra. In other words, the third and fourth instances for seeking regulatory forbearance would appear in practice to primarily serve the interests of Telstra, being the player with dominant market power in the arena of wireline access infrastructure and services.

8.5.3 A Less Permissive Holiday

In its 2001 report on telecommunications competition regulation, the Productivity Commission floated the idea of a "less permissive access holiday", whereby a network investor would enter an "open access regulatory compact" with the ACCC. (PC 2001a, pp.292-294) It noted that in telecommunications there is a substantial concern that vertically integrated incumbents could lever off upstream (that is,

network access) investments to foreclose[213] downstream (that is, retail) markets. The report only cursorily noted the risks of foreclosure possible with forthcoming generations of broadband networks.

Via an "open access regulatory compact", the network provider would be free to establish whatever access price it saw fit, regardless of the infrastructure posing a bottleneck. However, this freedom would be contingent on maintaining a genuine open access network – taken to imply that all access seekers agreeing to the price and non-price conditions would have to be allowed access, provided those conditions also apply to any retail business operated by the network provider. (PC 2001a, pp.292-294) The TransACT network, just one year into commercial operation by the time of the report, was quoted as an example of such an open access network.[214]

The Productivity Commission envisaged regulatory compacts applying where the risk of foreclosure was high, such as where:

- the competition, market power, national significance and other declaration tests are likely to apply;
- technology and demand is moving rapidly and first mover advantages are substantial; and
- there is substantial scope for new services by entrants based on access that might threaten incumbent interests — thus risking foreclosure in the absence of a requirement for open access.

A possible area of application of a regulatory compact was suggested to be the digitisation of the HFC networks. In the end, the report made no such recommendation to the government – which instead adopted a separate recommendation by the Productivity Commission that called for anticipatory exemption provisions[215], an outcome somewhat antithetical to achieving an open access regulatory compact. Clearly, the Productivity Commission and the government ranked the need for investment incentives above that of the adverse impacts of foreclosure.

8.5.4 Commentary

Parties such as the Productivity Commission (2001b) and economists Gans and King (2003) speak of access holidays as new measures yet to be introduced to promote network infrastructure investment. What they fail to acknowledge is that any exemption from the standard access obligations of section 152 of the Trade Practices Act is also tantamount to an access holiday and that such measures already exist in abundance. Section 8.5.2 outlines the four holidays impacting on post-PSTN telecommunications infrastructure, of which two remain as active measures. Until these have been proved to be ineffective, there is no justification for introducing new types of access holidays.

---

[213] Foreclosure is the exclusion of other parties by means of strategic behaviour; a denial of access.

[214] This wasn't exactly correct as TransACT saw no need to reach any compact with the ACCC yet operated as an open access network regardless (Chapter 5 refers).

[215] As discussed in sections 4.6.2 and 8.5.2

Sections 8.5.2 and 8.6.5 have discussed the most recently introduced access holiday in the form of a direction to the ACCC to specifically consider incentives for and the risks involved in investment in new network infrastructure when assessing the long-term interests of end-users. However the 2005 amendment to the Trade Practices Act omitted to guide the ACCC as to how to judge a claim that a specific investment would entail risk that needed to be ameliorated. It would be natural for access providers to exaggerate their claims of risk.

Perhaps the most glaring omission from section 152 the Trade Practices Act, also not identified by the Productivity Commission in its 2001 report (2001a), is the failure to appreciate that a vertically integrated telecommunications operator is much more likely to seek an access holiday, whereas one whose carriage and content businesses are structurally separated (or alternatively a common carriage operator) is much less likely to seek a holiday. An access regime that does not care whether an access provider is vertically integrated or structurally separated is blind to a significant factor in successfully achieving open access.

8.6 Any-to-Any Connectivity

The origin of the concept of 'any-to-any connectivity' was explored in section 8.1.1. Here we discuss how the concept was incorporated into Australian telecommunications legislation and how its relevance to the policy and practice of access regulation has been progressively downgraded.

8.6.1 Connectivity & Access

There is nothing new about 'connectivity' - it of course fundamental to the very essence of telecommunications. For example, section 53 of the Telecommunications Act 1989 No. 53, 1989 defined 'primary communications carriage' as consisting of arranging, operating and managing connectivity across the telecommunications network. Yet the addition of 'any-to-any' as a qualifier has significant implications for regulated access in a competitive environment. Open competition was introduced through the new Telecommunications Act 1997 (No. 47 of 1997) and amendments to the Trade Practices Act 1974 (No. 58 of 1997) by way of the new Parts XIB and XIC.

According to Grant (2004, p.89), access refers to the ability of carriers and service providers to pass and receive telecommunications traffic over each other's networks, achieving 'any-to-any connectivity' whereby all end-users of similar services are able to connect with one another irrespective of the particular networks to which they are connected. The legalistic concept of 'access' takes its meaning from the nature and scope of the rights and obligations created under Part XIC of the Trade Practices Act, in particular the 'standard access obligations' first discussed here in section 4.3.

8.6.2 Long-term Interests of End-users

The main object of the Telecommunications Act 1997 is to provide a regulatory framework that promotes:[216]

> (a) the long-term interests of end users of carriage services or of services provided by means of carriage services; and
> (b) the efficiency and international competitiveness of the Australian telecommunications industry.

This is to be read together with Part XIC of the Trade Practices Act 1974 whose object is likewise to promote "the long-term interests of end users of carriage services or of services provided by means of carriage services".[217] The Telecommunications Act does not define the long-term interests of end-users but instead refers to the definition in section 152AB of the Trade Practices Act, where the promotion of the long-term interests of end-users would be likely to achieve the objectives of:

- the objective of promoting competition in markets for listed services;
- the objective of achieving any-to-any connectivity in relation to carriage services that involve communication between end-users;
- the objective of encouraging the economically efficient use of, and the economically efficient investment in the infrastructure by which listed services are supplied, …

For the purposes of section 152AB, the objective of any-to-any connectivity is said to be achieved if:

> each end-user who is supplied with a carriage service that involves communication between end-users is able to communicate, by means of that service, with each other end-user who is supplied with the same service or a similar service[218], whether or not the end-users are connected to the same telecommunications network.

[216] Section 3, Telecommunications Act 1997.
[217] Section 152AB, Trade Practices Act 1974.
[218] According to the Explanatory Memorandum to the Trade Practices Amendment (Telecommunications) Bill 1996 as noted on page 40 under the proposed section 152AB, reference to 'similar services' is intended to enable consideration of the need for any-to-any connectivity between end-users of services which have similar, but not identical, functional characteristics, such as end-users of a fixed voice telephony service and end-users of a mobile voice telephony service, or end-users of Internet services which may have differing characteristics.

8.6.3 End-users

Importantly, the objective of any-to-any connectivity is only to be relevant when considering whether a particular service promotes the long-term interests of end-users of a carriage service that involves communications between end-users. When considering other types of services (such as carriage services which are inputs to an end-to-end service or distributive services such as the carriage of pay television), this criterion is to be given little, if any, weight compared to the other two criterion (that is, of promoting competition and encouraging the economically efficient use, ….).[219]

The Explanatory Memorandum further reveals that the term 'end-users' recognises that telecommunications networks and services are used both by customers with a direct contractual relationship with a carrier or service provider and other end-users of carriage or content services (such as the members of a customer's household).[220] The most obvious example of a service demanding any-to-any connectivity would that of telephony, involving real time communication between two persons. Conversely a service that only broadcasts to end-users or is only a sub-set of a more communicative service could be deemed to not demand any-to-any connectivity.

8.6.4 Telecommunications Legislation

The prime focus of this research is on any-to-any connectivity rather than the matter of the long-term interests of end-users, yet understanding the latter is a means to appreciating the former. The concept of 'long-term interests of consumers' was first raised as an object of part of the Telecommunications Act 1991 though only with a competition-based understanding and no explicit mention of any connectivity-related requirement.[221,222] This was the duopoly era of Telecom Australia and Optus as the only general carriers.

With the advent of competition heralded by the Telecommunications Act 1997, the concept of long-term interests of end-users came into being but seemingly with a schizophrenic meaning, according to the relevant Explanatory Memorandum:[223]

> The reference to promoting 'the long-term interests of end-users' is intended to have a wide meaning, and is not intended to be read down by reference to the narrower definition of promoting the long-term interests of end-users in

[219] Explanatory Memorandum to the Trade Practices Amendment (Telecommunications) Bill 1996 as noted on page 41 under the proposed section 152AB.
[220] Explanatory Memorandum to the Trade Practices Amendment (Telecommunications) Bill 1996 as noted on page 41 under the proposed section 152AB.
[221] Section 136(2)(iv) of the Telecommunications Act 1991 No. 98 of 1991, pertaining to the right to interconnection between Telecom Australia and Optus as the two general carriers, between mobile carriers (Telecom Australia, Optus and Vodafone) and between general and mobile carriers.
[222] The only earlier reference of a similar nature was to "the interests of users" in section 58(2)(a) of the Telecommunications Act No. 53 of 1989, being a requirement placed on the regulator, AUSTEL, in making approvals for the supply of incidental services.
[223] Explanatory Memorandum (Volume 1) to the Telecommunications Bill 1996 as noted on page 12 in discussing Clause 3 - Objects.

> proposed section 152AB in the proposed Part XIC of the TPA. That section sets out an object for proposed Part XIC alone.

The Telecommunications Act 1997 then fails to provide any wider meaning other than referring to its meaning under the new Part XIC of the Trade Practices Act. (Peters 1998) Furthermore, the Telecommunications Act 1997 omits any specific reference to a requirement for 'any-to-any connectivity' presumably on the basis that, as previously noted, a reasonable person could assume this would be implied if one carrier is to access the facilities of another.

The importance of end-users connecting to other end-users via services other than telephony was apparently not considered central to the Telecommunications Act 1997 which mentions 'connectivity' only once as a requirement of a 'standard telephone service':[224]

> A service passes the connectivity test if an end-user supplied with the service …. is ordinarily able to communicate, by means of the service, with each other end-user who is supplied with the same service for the same purpose, whether or not the end-users are connected to the same telecommunications network.

8.6.5 Trade Practices Legislation

Section 152AB of the Trade Practices Act 1974, from 1997 onwards, is then obviously the touchstone for the objective of achieving 'any-to-any connectivity' in Australian telecommunications, rather than the Telecommunications Act 1997. Even if assessed on a crude arithmetic basis, the ACCC is obliged to consider the objective of achieving any-to-any connectivity as but one of three objectives – the other two being to promote competition and to encourage efficient use of infrastructure. However, current regulatory interpretation gives less weight to the importance of achieving the any-to-any connectivity objective relative to achieving the other two objectives.

For a start, any-to-any connectivity is said to imply a communicative rather than a distributive or broadcast service. Barring the subterfuge of creating sub-sets of communicative services that interface with end-users only in a single-ended fashion, the era of broadcasted services such as pay television is likely to cede dominance in next generation broadband networks of the future to a greater demand for end-to-end connectivity inherent with non-proprietary Internet access. Nevertheless, any-to-any connectivity will not necessarily be applicable as a valid objective in all cases.

Peters (1998) argues that a 'principled position' for the ACCC to adopt in its assessment of the long-term interests of end-users should give primacy to the purpose and function of competition policy. She claims that the ACCC interprets any-to-any connectivity as being a competition issue: (ACCC 1997b, p.6)

[224] Section 17 of the Telecommunications Act 1997 No. 47 of 1997, in reference to voice telephony or its equivalence.

> Any-to-any connectivity is the ability of end-users of different networks to communicate. In addition to the benefit of allowing users of one network to communicate with users of other networks, any-to-any connectivity has important implications for competition in the provision of carriage services.
>
> It is a common feature of telecommunications networks that the value of the network to an end-user depends on the number of other users that network allows the end-user to reach. For providers of network services to compete effectively they will, in most cases, require access to other networks to provide services to end-users. In effect, if smaller networks could only offer services to their own end-users they would find it difficult to attract new users, regardless of their long-term efficiency.

Not all readers would reach this conclusion from the above, but Peters argues that once any-to-any connectivity is assigned a pro-competitive characteristic, the objective of achieving 'any-to-any connectivity' appears to have an "uneven fit" with the other two objectives which in any case are synergistically related. Peters (1998, p.9) then substantially reads down the relative merit of achieving any-to-any connectivity:

> The writer would argue that, in view of this uneven fit and the ancillary competition role of any-to-any connectivity (particularly in light of the existence of subsection 152AB(2)(c) of the Trade Practices Act), issues of competition per se are better left addressed by application of subsection 152AB(2)(c) and (e) of the Trade Practices Act and the any-to-any connectivity criterion in subsection 152AB(2)(d) treated principally as a technical issue (although, of course, with implications for competition). Hence, in the suggested decision tree, any-to-any connectivity is treated, first, as a technical issue, and second, as a competition issue (by taking into account any pro-competitive effects from any-to-any connectivity in terms of the cost benefit analysis which follows).

Following a reference by the government in June 2000 to conduct a review of all telecommunications-specific competition legislation, the Productivity Commission reluctantly concluded that an access regime 'of some sort' was warranted. (PC 2001a, p.245) It specifically examined what it called the three 'sub-tests' or secondary objectives to which the ACCC must have regard when establishing whether a service meets the long-term interests of end-users. Regarding any-to-any connectivity, the Productivity Commission viewed the matter substantially in terms of only telephony services, both fixed and mobile, and equated it merely to interconnection between competing networks. (PC 2001a, pp.264-265) In similar vein to Peters, the Productivity Commission concluded that "the any-to-any connectivity sub-test would more properly be seen as a matter relevant to the assessment of the objective of promoting competition (akin to subsection 152AB(4))" of the Trade Practices Act.

Arguing that an explicit focus on preserving incentives for investment and innovation may better serve the long-term interests of end-users, the Productivity Commission saw any-to-any connectivity as "not always desirable" but perhaps "an important aspiration, where it appears likely that market power might frustrate interconnectivity". (PC 2001a, pp.260 & 264) Accordingly, the report of the

Productivity Commission recommended that the objects clause in section 152AB(1) of Part XIC of the Trade Practices Act be changed from the long-term interests of end-users to only reflect the promotion of the economically efficient use of, and investment in, telecommunications services. This would also require sympathetic amendments to the relevant sections of the Telecommunications Act 1997.

The government's response to the Productivity Commissions report on telecommunications competition regulation was "not all-embracing" and retained the test of long-term interests of end-users with its underlying principles.[225] (Grant 2004, p.146) Two years later, section 152AB of the Trade Practices Act was further amended to ensure that, in determining "whether a particular thing promotes the long-term interests of end-users", the ACCC must also consider the incentives for and the risks involved in investment in new network infrastructure.[226] The immediate impact of this amendment is that, of the three secondary objectives pertinent to the ACCC establishing whether a service meets the long-term interests of end-users, the objective of promoting competition remains unchanged while the objective of encouraging economically efficient investment is greatly strengthened. It follows that the relative weighting awarded to the objective of achieving any-to-any connectivity must be correspondingly weakened.

8.6.6 Commentary

When viewed against the backdrop of the 'regulatory scorecard' demonstrating an incapability for providing effective access to the only current example of post-PSTN infrastructure and services, the analysis of section 8.6 presents a rather stark picture. It suggests there could be systemic problems in Australia's telecommunications regime encouraging this situation.

Firstly, the Telecommunications Act 1997 defines neither the 'long-term interests of end-users' nor 'any-to-any connectivity', despite the former being a main object of the Act. By leaving these definitions to the Trade Practices Act, the policy makers at the time clearly saw both overwhelmingly in competition terms, despite the Explanatory Memorandum to the Telecommunications Bill 1996 wishing for a wider meaning which it did not offer.

Secondly, under the Trade Practices Act, end-users would appear to be only persons and not inanimate things such as file servers. Furthermore, to be relevant to promoting the long-term interests of end-users, these end-users must be connected by communicative rather than distributive services. Both these interpretations are far narrower than the original CIRCIT conception discussed in section 8.1.1. It is therefore concluded that any-to-any connectivity currently applies only to real time communication between two persons via fixed or mobile telephony and perhaps not any communication involving data transmission. Internet-based services such as e-

[225] The Telecommunications Competition Act 2002 No. 140 of 2002 implemented the Government's response to the Productivity Commission's Inquiry Report on Telecommunications Competition Regulation.
[226] Explanatory Memorandum to the Telecommunications Legislation Amendment (Competition and Consumer Issues) Bill 2005. The consequent Act of the same name became No. 119 of 2005.

mail and the Web involving intermediate file servers and non-real time communication, as well as all pay television and video-on-demand services are all disqualified.

Thirdly, there has been decreasing tolerance of giving regard to any-to-any connectivity as a worthwhile objective. Commencing 1997 it was, at the most, just one of three 'sub-tests' for promoting the long-term interests of end-users. The importance of any-to-any connectivity was further diminished by being seen more as a proxy for promoting competition, in addition to being restricted solely to communicative services. From 2005, the increased weighting given to the investment 'sub-test' further sidelined any-to-any connectivity. The Productivity Commission, whose recommendations tend to be followed by governments, is so dismissive of any-to-any connectivity that it sought its removal from the test of long-term interests of end-users.

The prime object of telecommunications legislation should be to empower communication between end-users, whether animate or inanimate. Presently, Australia's telecommunications legislation gives primacy to the welfare of the industry rather than to end-users.

8.7 Conclusions

The regulatory, technical and commercial lessons arising from the three case studies are salutary, particularly as they relate to the matter of third party access to post-PSTN infrastructure. The experience of the TransACT network is a perfect foil to that of the HFC network case study, which in turn would appear to be a predictor for the fate of fibre-to-the-home networks.

By bringing together the issues arising from the previous discussion, conclusions are drawn as they relate to the Research Question:

> *What are the factors that prevent open access to the broadband services of next generation wireline infrastructure? How can these obstacles be overcome?*

The conclusions initially address the nature of the problem and then suggest a range of solutions of a non-price nature. Reference is limited to future generation broadband telecommunications in Australia delivered by wireline technology. This generation involves significant deployment of optical fibre in the access network, where scarcity of capacity should no longer be a factor.

8.7.1 What is preventing open access to next generation broadband

The Telstra/Foxtel and TransACT networks are the only examples of significant Australian investments in post-PSTN telecommunications infrastructure. As such, their case studies present the best available opportunities for appreciating the lessons to be learned about access to next generation broadband.

Section 6.4.1 discussed how the ACCC considers facilities-based competition to be more effective in the long term in driving efficiency, and in delivering a wider choice of services and more competitive prices to retail users. Facilities-based competition involves the creation of separate infrastructure over which competing service providers gain connectivity with nominally the same customer base.

The only instance of such competition via post-PSTN wireline infrastructure, that of the Telstra/Foxtel and Optus HFC networks designed primarily to deliver pay television services, resulted in a duopoly situation that ultimately delivered only minimal benefit to end-users. Despite the Optus network passing some 2.1 million homes, commencing first and adopting a cheaper roll-out of entirely aerial construction, it was overbuilt by the incumbent carrier Telstra which passed some 2.4 million homes. (Budde 1999)

After five years of operation, billions of dollars of value was written off each network. By 2002, the Optus threat was strategically neutralised through a content sharing agreement with Foxtel, which remains 50 per cent owned by Telstra. Optus also delivers telephony service via their HFC network, yet they failed to challenge the Telstra telephony market delivered over the paired copper CAN. To exacerbate this dismal track record for facilities-based competition, each of the two near-parallel HFC networks continues to offer monopolised cable modem services – an outcome not challenged by the regulated access regime.

In competition policy terms, the next best outcome is access or service-based competition requiring a regulatory regime that facilitates access agreements framed in the appropriate price and non-price terms. The following conclusions illuminate key non-price considerations based on developments since 1994.

The historical record shows that successive Australian governments have never really committed to third party access for services derived from infrastructure beyond that of the paired copper PSTN. Once broadband services deliverable via post-PSTN ‘access’ infrastructure came into contention from 1994 to at least 2006, the telecommunications access regime has been repeatedly compromised by the granting of incentives for investment that favoured incumbency. These government interventions have had the practical outcome of being generally anti-competitive, effectively killing off open access to the services of post-PSTN infrastructure. In summary, our politicians would appear to have been spellbound by the image (and reality) of the ‘romantic’ or ‘heroic’ builder of telecommunications infrastructure (Crawford 2006) and have paid only lip service to the importance of competition.

The regulatory regime for access is now labyrinthine and wide open to gaming. It has been exploited by access providers to cause years of delay, wearing down the ability of access seekers to ultimately compete. This conclusion is a derivative of that above – the repeated granting of incentives for investment, in reality a series of access holidays, has been excessively liberal in favour of access providers. The outcome has been that access providers are encouraged to be obstructive in dealing with access seekers.

It is a commonplace practice in many countries that if permitted to do so, a dominant provider of physical layer transmission infrastructure will exploit its control of

bottleneck facilities to stifle competition in the adjacent markets for applications and content. Once access was sought to the Telstra/Foxtel HFC network, that behaviour was fully played out but in this instance there was reasonable technological justification – the HFC technology deployed is difficult to unbundle and the television channel capacity is inherently scarce. Both insufficient transmission capacity and an architecture that inhibits one-on-one connectivity act as strong impediments to open access.

The final conclusion concerns the consequences of significant market power. Telstra's market power derives from three factors – its existing market share and financial capability, its ability to exploit natural monopoly elements of the CAN in deploying post-PSTN infrastructure and its ability to operate vertically integrated businesses. Of these three, the last serves to magnify the practical impact of the other two. If Telstra had been prohibited from entering the pay television business in 1995 or had been constrained to do so as a common carrier as suggested by government inquiries, the competitive makeup of Australian telecommunications would now be arguably significantly different. Correspondingly, the consequences for future next generation broadband infrastructure and services would have been profound.

Notwithstanding the above, the TransACT network serves as a shining if not solitary example of a successful business operation based on an open access business model. TransACT was established to operate intentionally as an open access network and has done so without recourse to access regulation. There are currently no other Australian examples of service-level competition utilising shared infrastructure.

The Telstra/Foxtel HFC network is now of a past generation, though in the matter of testing Australia's telecommunications access regime it was a highly educative exercise. The TransACT network, operating since 2000, continues to approximate a next generation broadband network but had no need to test the access regime. Its main success factor as an open access business was the absence of competitive threat during the critical start-up phase, that is, it was not overbuilt by Telstra or Optus HFC infrastructure.

As Australia contemplates the next wave of investment in fibre-to-the-node infrastructure, possibly as a prelude to eventual fibre-to-the-home infrastructure, the following developments are precursors of the likely outcome if nothing else changes:

- Telstra is threatening not to invest in its own 'fibre to the node' infrastructure unless it receives further regulatory concessions; rather than illustrating a lack of telecommunications investment, this should be interpreted as evidence of the unfettered use of market power.
- Proposals for cooperative investment to create shared fibre-to-the-node infrastructure appear to have failed, being forever exposed to the threat of overbuilding by the dominant access provider, Telstra.
- Telstra was not structurally separated prior to the sale of the third tranche of shares.
- Since the inevitable natural monopoly of fibre in the CAN makes facilities-based competition infeasible, the key issue then becomes the possibility of service-

based competition which can only be effective if there is unbundling to the lowest possible network element.

8.7.2 How the obstacles to open access could be overcome

The present regulatory regime encourages avoidance of an obligation to provide access that creates sustainable retail competition. Moreover, the preceding analysis suggests that the problems are systemic. Australian telecommunications infrastructure and the competitive environment are indeed at another watershed – the technology of optical fibre in the access network brings new opportunities for competitive access through its potentially abundant capacity but at the same time it brings new threats to competitive access by creating an enduring natural monopoly and engineered bottlenecks.

The following conclusions, suggestive of ways to overcome obstacles to open access of a non-price nature, are grouped under three headings for clarity. If fully adopted, they would represent a substantial reform of the current regime for telecommunications access regulation. Perhaps only a subset might be sufficient to make a noticeable difference in opening access to next generation broadband but an exercise of that nature is beyond the scope of this study.

8.7.2.1 Make users the primary focus of telecommunications policy

The progressive diminution of the requirement for common carriage from Australian telecommunications legislation from 1989 to 1997 effectively removed the protection that end-users once had for non-discriminatory connection to other users and non-discriminatory carriage of content, a matter now of particular significance to next-generation broadband services. The telecommunications amendments to the Trade Practices Act in 1997 heralding more open competition introduced a regulatory regime pitting access seeker against access provider. The portion of wireline infrastructure interfacing with users, the customer access network or CAN, was overwhelmingly dominated by one player, Telstra, and the intention of the regime was to permit the re-utilisation of this bottleneck facility by competitors. If an access provider didn't adequately serve the interests of users then an access seeker could step in and do so. The paradigm then was of users utilising relatively dumb customer premises equipment to access a relatively intelligent network.

The subsequent decade has witnessed dramatic advances in information technology that have reversed this paradigm. Thanks mainly to non-proprietary Internet protocols and affordable personal computing power, there has been a marked shift in intelligence towards the ends of any network connection – and at these ends the equipment is owned and operated by users. Users have taken much more control of their connectivity and are becoming decidedly more participative, rather than being passive recipients. In comparison, the CAN is relatively dumb, more of a pipeline, and the Internet acts in a substantially non-discriminatory manner to packets of information sent to and from users.

The spirit of common carriage was in part resurrected in the 1997 Trade Practices Act amendments with the insertion of 'any-to-any connectivity' as one of three objectives under the rubric of promoting the 'long-term interests of end-users'.

Originally conceived as connecting 'any' with 'any', be they persons, computers or IT servers, any-to-any connectivity implied the absence of discrimination and was a forerunner of network neutrality. However from the outset the objective of achieving any-to-any connectivity was interpreted more in terms of technical interconnection between competing telephony networks and limited only to communicative services between persons. Internet-based services appear to have been excluded.

By 2005, the objective of achieving any-to-any connectivity had been substantially eroded by the much greater emphasis on incentives for and the risks involved in investment in new network infrastructure. This bias towards investment at the expense of achieving any-to-any connectivity, let alone that of promoting competition, becomes particularly insidious when considering the bottleneck nature of fibre in the CAN, the technological potential to close access and the propensity for a 'capital strike' of investment until the regulatory regime submits to closure. The welfare of the telecommunications industry is being promoted ahead of the end-users it is supposed to be serving.

It is concluded that communication between users needs to be recognised as the prime purpose of telecommunications and that a regulatory regime that rewards discriminatory practices detracts from the development of a networked information economy. The objects of the Telecommunications Act and Part XIC of the Trade Practices Act should be amended to reflect the achievement of any-to-any connectivity as a prime national goal and the meaning of any-to-any connectivity should revert to what was originally intended.

8.7.2.2 Do not reward dominant players with access holidays

An access holiday should be called what it is: an exemption from the Standard Access Obligations of Part XIC of the Trade Practices Act 1974. As such, access holidays are the antithesis of open access. They are granted solely as an incentive to encourage investment and not to promote competition. New telecommunications infrastructure may well improve connectivity for some users, but since access holidays often have the effect of restricting access for third party providers and also often restrict access to a closed group of users, it does not follow that any-to-any connectivity would always be enhanced – and less likely in a global sense.

If any access holiday were justifiable, it should pass some form of 'public benefit' test, for instance:

- Would any-to-any connectivity be enhanced?
- Would sustainable competition be more likely?
- Would end-users benefit in some other manner that otherwise could not be possible?

With the possible exception of the 1995 access holiday leading to roll-out of the Optus HFC network, it is difficult to appreciate how the public has benefited from access holidays granted so far. At the very least, exemption from Standard Access Obligations should never be granted without a binding requirement to satisfy pertinent national objectives. This could include the roll-out of next generation broadband throughout a prescribed geographic area or in accord with a technical

design facilitating eventual open access. Another alternative could be to put all awarding of access holidays out to competitive tender. Yet another could be to restrict such benefits only to network providers who lack significant market power.

Claims in favour of access holidays due to a high investment risk need to be assessed against the likelihood that such risk is self-fulfilling, that is, it is a consequence of monopolisation arising from the closure to third party access, whereas shared access could lower risk by increasing infrastructure utilisation, overall service demand and return on investment. There is definite evidence that holding out for access holidays promotes adverse behaviour, namely, delays in settlement of access agreements, capital strikes and a prolonged threat of overbuilding. Not surprisingly, examples of this nature can be attributed to network providers possessing significant market power. The availability of access holidays would appear to encourage potential access providers not to cooperate with access seekers.

It is concluded that there is no justification for introducing new types of access holidays to encourage investment. If existing access holidays are to be retained, they should be accompanied by roll-out preconditions and not be awarded to entrench market dominance through the creation of new bottlenecks. Greater transparency and competition would also result if access holidays were put out to tender. The ACCC should receive guidance as to how to give increased weighting to business proposals that are not vertically integrated and how to independently assess claims of investment risk. A more drastic response would be to repeal the anticipatory exemption provision of 2002 and the investment incentive and risk allowance of 2005.

8.7.2.3 Regulate access to infrastructure, not just services

The architecture and design of a given fibre-to-the-home or FTTH network is the crucial determinant of its ability to accommodate multiple service providers in a non-discriminatory manner. Incumbent network providers can frustrate attempts to unbundle FTTH networks or services through either intentional design or merely the adoption of industry designs that just happen to assume the network provider to be the sole service provider. Either way, such actions amount to defensive engineering with adverse competitive consequences and the likelihood of this outcome needs to be factored into regulatory considerations.

Once the paired copper-based CAN of an incumbent is upgraded to FTTH, the inherent economies of scale and scope significantly exceed that of any other foreseeable access technology for delivering non-mobile services. Yet if access regulation continues to focus only on offered services, the network operator is encouraged to ‘de-rate’ the service capability so as to disguise the strategic potential of the access fibre infrastructure. For example, if competitive service providers offer 15 Mb/s Internet bandwidth via paired copper-based DSL infrastructure, the fibre access provider could simply match that service offering in order to lessen the chance of access declaration even though the fibre-based infrastructure is capable of subsequently delivering perhaps 100 Mb/s at the flick of a switch. Existing service-based access regulation is incapable of dealing with the technological and hence market dominance of fibre in the CAN.

Network architecture and design taken together are of crucial importance to achieving open access, since the implementation of common carriage is strongly favoured by a relative abundance of transmission capacity and the closest possible approximation to one-on-one connectivity.

There needs to be a regulatory mechanism for facilitating industry arrangements for cooperative infrastructure investment where the alternative would otherwise be the creation of an enduring natural monopoly by an incumbent. Shared infrastructure lowers commercial risk by encouraging differentiated competition that increases infrastructure utilisation and overall market demand. Even the Productivity Commission in its 2001 report on telecommunications competition regulation could envisage the need for what it called a 'regulatory compact' based on open access principles.

It is concluded that the telecommunications access regime will be incapable of achieving satisfactory competitive outcomes involving natural monopoly infrastructure unless it recognises the strategic potential of infrastructure such as optical fibre in the access network as well as its architecture and design characteristics. There also needs to be a regulatory mechanism for facilitating industry arrangements for cooperative infrastructure investment where the alternative would otherwise be the creation of an enduring natural monopoly by an incumbent.

CHAPTER NINE – STUDY LIMITATIONS, FURTHER RESEARCH & CONCLUDING REMARKS

9.1 Study Limitations

Whilst the history of Australian telecommunications pre-1991 has many parallels with that in Europe, the introduction of competition thereafter took on characteristics more in line with US developments. For this research, academic references were found to be almost unknown from Australian sources, uncommon from Europe but relatively prolific from the US. The result may be a bias towards arguments with a US flavour but this has been unavoidable.

Most references adopt an economic, legal or policy basis and only a few illuminate the technical nature of actual or potential bottlenecks resulting from next generation broadband access infrastructure. This research has striven for a more multi-disciplinary approach by melding a technical appreciation with strategic, policy, commercial and user-oriented perspectives.

Conscious steps were taken to avoid being corralled into the narrative of solely economic considerations. In particular, there is no discussion of price-related considerations.

This research does not directly consider the matters of access to content by third party service providers or social issues relating to equity of access by consumers or users who are unable to gain physical access to next generation broadband infrastructure or services. Nevertheless, an attempt has been made to explore how access to next generation broadband can meet the needs of users rather than just the commercial requirements of providers.

With the data gathering phase substantially based on the analysis of three case studies, their appropriate selection was of vital importance. The limitations peculiar to each of these are documented in sections 4.7.1, 5.6.1 and 6.7.1. In brief, the highlights are as follows:

Telstra/Foxtel Pay TV Network

- Contrary to the well documented attempts by third parties to gain access to the data capacity of US cable television systems, in Australia there has been no declaration of access to the cable modem service and so this case study instead focussed on the matter of access to the television broadcast capacity.
- Due to the wealth of primary and secondary source material available, this case study has been quite detailed. It could readily have further increased in size by analysing the most complex and detailed judgements and determinations arising from the many legal and regulatory developments. Instead, the treatment of events and their meanings was restricted to appreciating the nature of outcomes rather than the detail of the processes involved in getting there.

TransACT Network

- Accessing information about the TransACT network has proved a problematic exercise. No descriptive writings of a substantial and independent nature were identified at the outset, which meant that this case study had to cover novel ground – although limited to a focus on access and openness.
- Paradoxically the TransACT network was found to be an ideal candidate for a case study on open access next generation networks, raising many positive issues and so few negative ones that it can give the appearance of being an anticlimax compared to the other two studies.

Fibre to the Home Networks

- Whilst the Telstra/Foxtel network remains effectively closed to third party access and the TransACT network remains substantially open, the fate of access to next-generation fibre to the home networks has yet to unfold. At the time of writing, FTTH developments in Australia had not generated regulatory precedents and hence the case study could not enter this realm.
- The case study has been focussed on understanding the principles involved in enabling third party access to those next generation networks where, at least in theory, scarcity of capacity should not pose a restraint on access.
- Of necessity, the analysis has been somewhat technical with a focus on the potential for creating a natural monopoly and the options for unbundling.

9.2 Further Research

The research has raised a plethora of issues but of necessity must focus on those that address the chosen Research Question. Many of the outstanding issues would be more suited to examination via a subsequent phase of research that builds upon understandings of this dissertation. Possible areas for future research include the following topics:

- Investigate the almost silent demise of common carriage in Australian telecommunications law and its replacement by a regime that sanctions, yet does not prescribe, a capability for network and service discrimination. Such a study could appreciate how arguments in the US for and against 'network neutrality' may impact on future reform of the Australian regulatory regime.

- Noting the significant trend towards user-generated content and social networking, explore the justification for placing the Internet at the centre of future communications policy and detail the necessary changes to the Australian regulatory regime. This study could develop further the concept of achieving 'any-to-any connectivity' as a prime object of any regulatory regime.

- Australia urgently needs an infrastructure vision of future communications networks that secure our future by encouraging innovation and facilitating a range of consumer services necessary for ongoing economic re-structuring. This calls for fundamental thinking. We have yet to appreciate the consequences for Australia of Lawrence Lessig's visionary call for an

'innovation commons', let alone Brett Frischmann's proposal for sustaining an 'infrastructure commons'.

- Regimes for regulated access are traditionally justified where one or more major players exert market power to the detriment of the benefits of greater competition. Natural monopolies pose particular opportunities for dominant players to set unreasonable price and non-price terms. Australian telecommunications policy and law need to achieve a satisfactory balance between the interests of users, competitive access for service providers and incentives for investment in infrastructure.

9.3 Concluding Remarks

This research illuminates the field of telecommunications access regulation as it applies to infrastructure capable of delivering truly next generation broadband services. Such infrastructure, involving optical fibre in the customer access network, creates a natural monopoly of an enduring nature. It is capable of giving rise to complex technical and commercial bottlenecks that strongly encourage anti-competitive behaviour. The first optical fibre in any customer access network will be the last installed.

A case is made that the access regime is incapable of dealing with this situation. With facilities-based competition being infeasible, that is, the 'stepping stone' theory of investment collapses, the only alternative to monopolistic service delivery of next generation broadband services will be effective service-level competition. Unfortunately the track record of the access regime as applied to post-PSTN infrastructure augers badly for effective service-level competition via optical fibre in the customer access network.

The regime is cumbersome and wide open to gaming. Delay and lobbying become prime weapons in preventing third party access. Experience with unbundling the relatively well-known paired copper access network bodes ill for the unbundling of future optical fibre. In any case, competitive access will be stymied if unbundling is restricted to incrementally-offered services rather than the underlying optical fibre infrastructure. The regime is now significantly biased in favour of investment by network providers and correspondingly against competitive access seekers.

The TransACT network in Canberra is living testimony to the fact that Australia's next generation telecommunications infrastructure can readily be open to competitive service provision. Paradoxically, TransACT made no call upon the access regime. There was merely a willingness by the network provider to be open. In contrast, Australia's telecommunications access regime has been captured by network providers whose business plans are predicated on either closure or highly restictive openness. Since 1993, our politicians would appear to have been spellbound by the image (and reality) of the 'romantic' or 'heroic' builder of telecommunications infrastructure (Crawford 2006) and have paid only lip service to the importance of competition.

It need not be this way. Whilst this research identifies what I see as being the key problems, it is framed to address a specific research question and not necessarily the

full gamut of possible solutions. Realising the economies of scale and scope only possible with optical fibre, non-price considerations come to the fore. The following conclusions are reached based upon a detailed assessment of the experience with or potential for access to three network types involving post-PSTN infrastructure.

Post-1997 Australian telecommunications policy has effectively removed the protection that end-users once had for non-discriminatory connection to other users and non-discriminatory carriage of content, a matter now of particular significance to next-generation broadband services. Instead, the interests of end-users have been subsumed by the interests of network providers and access seekers. The spirit of common carriage is only poorly enunciated by the legislative concept of 'any-to-any connectivity' – a concept which in any case was made greatly subordinate to the need to provide incentives for investors. It is concluded that communication between users should be recognised as the prime purpose of telecommunications and that the regulatory regime should not reward discriminatory practices detracting from the development of a networked information economy.

Focussing on specific aspects of the regime, it is further concluded that dominant players should never be rewarded with access holidays which could entrench market dominance through the creation of new bottlenecks. Access holidays are the very antithesis of open access and experience to date shows them to have been counter-productive. The availability of access holidays simply encourages access providers not to cooperate with access seekers. They become a tool for securing market dominance.

Finally, the regulatory regime is incapable of dealing with the strategic significance of optical fibre extending deeply into the customer access network. Defensive engineering easily prevents effective unbundling and reinforces technical and commercial bottlenecks. Continued focus on access only to services simply encourages the squirrelling away of the strategic potential of optical fibre. There particularly needs to be a regulatory mechanism for facilitating industry arrangements to invest in a cooperative manner as an alternative to enshrining just one player with a natural monopoly. The conclusion is reached that access regulation is ill-equipped to cope with optical fibre in the access network until it also recognizes the strategic potential of the infrastructure and its design characteristics.

- - 0 - -

BIBLIOGRAPHY

(1974). Trade Practices Act (Cth). **No. 51 (as amended)**.

(1989). To Pay or not to Pay? Pay Television and Other New Broadcasting-Related Services. House of Representatives Standing Committee on Transport, Communications and Infrastructure. Canberra, Australian Government Publishing Service**:** 139.

(1996). Telecommunications Act. USC. **47**.

(1996). Telstra - To Sell or not to Sell? Senate Environment, Recreation, Communications and the Arts References Committee. Canberra, Australian Government Publishing Service.

(2002). Telecommunications Competition Bill 2002 - Explanatory Memorandum.

ABC RN (2006). Telco dramas. Saturday Breakfast with Geraldine Doogue. Sydney, ABC Radio National.

ACCC (1997a). Deeming of Telecommunications Services - A statement pursuant to section 39 of the Telecommunications (Transitional Provisions and Consequential Amendments) Act 1997 on 30 June 1997. Canberra, ACT, Australian Competition and Consumer Commission.

ACCC (1997b). Access Pricing Principles - Telecommunications. Canberra, ACT, Australian Competition and Consumer Commission.

ACCC (1999). Declaration of Analogue Subscription Television Broadcast Carriage Service - A report on the declaration of an analogue-specific subscription television broadcast carriage service under part XIC of the Trade Practices Act 1974 in August 1999. Canberra, ACT, Australian Competition and Consumer Commission.

ACCC (2001). The Public Benefit Test in the Trade Practices Act 1974; address by Professor Allan Fels, Chairman. National Competition Policy Workshop. Melbourne, Australian Competition and Consumer Commission.

ACCC (2003a). Emerging market structures in the communications sector. Canberra, ACT, Australian Competition and Consumer Commission**:** 132.

ACCC (2003b). Snap Shot of Broadband Deployment as at 31 March 2003. Canberra, ACT, Australian Competition & Consumer Commission**:** 6.

ACCC (2004a). A report on the assessment of the Analogue Pay TV Access Undertaking proffered by FOXTEL Management Pty Ltd on 22 December 2003. Melbourne, Australian Competition and Consumer Commission**:** 23.

ACCC (2004b). Telecommunications competitive safeguards for the 2002-03 financial year. Melbourne, Australian Competition and Consumer Commission**:** 52.

ACCC (2005b). Telecommunications competitive safeguards for 2003-04: Report to the Minister for Communications, Information Technology and the Arts. Melbourne, Australian Competition and Consumer Commission**:** 69.

ACCC (2005b). Telecommunications Infrastructure in Australia 2004. Melbourne, Australian Competition and Consumer Commission**:** 73.

ACCC (2005c). Lessons from the regulation of energy and telecommunications infrastructure; address by Mr Ed Willett, Commissioner. Conference Australian Centre for Regulatory Economics. Canberra, Australian Competition and Consumer Commission**:** 15.

ACCC (2005c). A Strategic Review of the Regulation of Fixed Network Services. An ACCC Discussion Paper. Melbourne, Australian Competition and Consumer Commission**:** 84.

ACCC (2006a). Emerging telecommunications competition; address by Mr Graeme Samuel, Chairman. Australian Telecommunications Users Group 2006 Annual Conference. Sydney, Australian Competition and Consumer Commission**:** 8.

ACCC (2006b). ACCC reassures industry on fibre to the node discussions with telstra. Media release. Canberra, Australian Competition and Consumer Commission**:** 2.

ACCC (2007). ACCC accepts digital pay TV undertaking from Foxtel. Media release. Canberra, Australian Competition and Consumer Commission**:** 2.

ACT Government (1998). Scoping Study of ACTEW Corporation Report: Executive Summary and Key Recommendation. Canberra**:** 23.

ACTEW RFP (1996). Optic Fibre Communications Network Request for Proposal. Canberra, ACTEW**:** 10.

AIEAC (1999). National Bandwidth Inquiry. Canberra, Australian Information Economy Advisory Council**:** 273.

Albon, R. and F. Papandrea (1998). Media Regulation in Australia and the Public Interest. Melbourne, Institute of Public Affairs.

Alcatel (2004a). Fiber-to-the-User: The Ultimate Endgame. Technology White Paper. Paris, Alcatel**:** 12.

Alcatel (2004b). Alcatel 7340 Fiber to the User (FTTU): Increasing Service Revenue from a 21st Century Network (ETSI version) Feature Group 2.1. Paris, Alcatel**:** 19.

Alcatel (2005). Telstra selects Alcatel to drive transformation to an IP-based network in estimated EUR 2.18 billion proposed agreement. Media Release. Paris, Alcatel**:** 1.

Alcatel (2006a). Alcatel Triple Play End-to-End Solution for Fixed Service Providers. Product introduction. Paris, Alcatel**:** 2.

Alcatel (2006b). Fiber-to-the-Node. Paris, Alcatel**:** 1.

Alcatel (2006c). Alcatel 7330 ISAM FTTN: Intelligent Services Manager Fiber to the Node. Paris, Alcatel.

Allen Consulting Group and dandalopartners (2006b). A Competitive Model for National Broadband Upgrade: An alternative to telstra's fibre-to-the-node proposal thast is in the national interest**:** 107.

Allen, D. (2001b). Policy for access: Framing the question. 29th TPRC, Alexandria, VA.

Allied Telesyn (2004). PON vs. Active - FTTx Technology Choices, Allied Telesyn, Inc.**:** 10.

Andrews, J. (2002). Residential Broadband Technologies in Australia 1993 - 1998: Applying and Developing the Social Shaping of Technology Approach. School of Social Science and Planning. Melbourne, RMIT University**:** 404.

Aufderheide, P. (2002). "Competition and Commons: The Public Interest In and After the AOL-Time Warner Merger." Journal of Broadcasting & Electronic Media **46**(4): 515-531.

AUSTEL (1994). Report to the Minister for Communications and the Arts on the Optus Vision Joint Venture Proposal and the Telstra Broadband Joint Venture Proposal. Melbourne, Australian Telecommunications Authority.

Bahlmann, B. (2000 - 2001). Open Access - The Freedom to Choose, et al. Home page of http://www.birds-eye.net.

Banerjee, A. and M. Sirbu (2003). Towards Technologically and Competitively Neutral Fiber to the Home (FTTH) Infrastructure. Pittsburgh, PA 15213 USA, Carnegie Mellon University.

Bar, F., S. Cohen, et al. (2000). "Access and innovation policy for the third-generation internet." Telecommunications Policy **24**(6/7): 489 - 518.

Bar, F., S. Cohen, et al. (2001). The Open Access Principle: Cable Access as a Case Study for the Next Generation Internet. The Economics of Quality of Service in Networked Markets. L. W. M. J. Wroclawski, MIT Press**:** 25.

Bauer, J. M. and S. S. Wildman (2002). "Third Annual Quello Communication Policy and Law Symposium; Rethinking Access: Introduction to the Symposium Theme and Framework." Law Review of Michigan State University - Detroit College of Law **3**: 8.

Benkler, Y. (2000). "From Consumers to Users: Shifting the Deeper Structures of Regulation Toward Sustainable Commons and User Access." Federal Communications Law Journal **52**(3): 561-579.

Berman, J., A. Davidson, et al. (2000). Comments of the Center for Democracy & Technology in the Matter of Inquiry Concerning High-Speed Access to the Internet Over Cable and Other Facilities. Washington, DC**:** 17.

Berner, J. (2001). General guide to a future-proof IT infrastructure. Stockholm, Sweden, Swedish IT Commission**:** 64.

Bernstone, R. (2001). "TransACT aims to conquer Canberra with digital broadband network." BEN (Broadcast Engineering News): 23.

BIS Shrapnel (2001). Telecommunication Infrastructures in Australia 2001. Melbourne, Prepared for ACCC**:** 190.

Bittlingmayer, G. and T. W. Hazlett (2002). "‘‘Open access:’’ the ideal and the real." Telecommunications Policy **26**: 295–310 (16).

Boyd, T. (2006). Optus pushes for joint broadband role. Australian Financial Review. Sydney**:** p. 70.

Boyd, T., D. Crowe, et al. (2005). Telstra to freeze spending unless Coonan backs off. Australian Financial Review. Sydney**:** 2.

Brennan, L. (2003). ActewAGL signs Broadband ISP Agreement with TransACT. Media Release. Canberra, TransACT Communications**:** 1.

Brooks, P. (2002). Hey, I've got TransACT - Now What? Canberra, TransACT Communications**:** 33.

BSEG (1994). Networking Australia's Future: The Final Report of the Broadband Services Expert Group. Canberra, Commonwealth Government**:** 117.

BTCE (1994). Costing new residential services: Paper 5. Communications Futures Project. Canberra, Bureau of Transport and Communications Economics.

BTCE (1995). Communications Futures - Final Report. Communications Futures Project. Canberra, Bureau of Transport and Communications Economics.

Budde, P. (1999). Australia - Pay TV - Industry Overview, Major Players, Paul Budde Communications Pty Ltd**:** 11.

Burns, R. B. (2000). Introduction to Research Methods. Australia, Longman.

Burton, T. (1994). Crunch Nears for Pay-TV's Players. Australian Financial Review**:** 3.

Butler, A. (1995). "Towards Competition and Open Access on Cable Networks." Communications Law Bulletin **14**(4): 5 - 7.

Cameron, A. (2007). Enabled to Engage in the Information Age: A Comparative Study of Broadband Take-up in Two Regions of Australia. School of Social Science. Brisbane, University of Queensland**:** 315.

Carnell, K. (2000). TransACT to make Canberra world leader in high-tech. Media Release. Canberra, ACT Government**:** 2.

Carrol, L. (1958). Symbolic Logic and the Game of Logic, Dover.
A single-volume reprint of Carroll's two books on logic, both intended for children.

Carrol, L. (1960). The Annotated Alice: Alice's Adventures in Wonderland & Through the Looking Glass. New York, Bramhall House.

Chirgwin, R. (2001). "Opening up the Cable." CommsWorld: 59-84.

CIRCIT (1996). Promoting Competition in the Converging Information and Communications Industries: Will the Australian Model Deliver? Policy Forum. Mossman, Queensland, Centre for International Research on Communication and Information Technologies**:** 59.

Connors, E. (1998). ABN AMRO helps $130m ACT broadband network. The Australian Financial Review. Sydney**:** 26.

Coonan, H. (2005). 2005 - A Telecommunications Odyssey: Address to Deutsche Bank. Sydney, Minister for Communications, Information Technology and the Arts**:** 8.

Coonan, H. (2006). A legacy to be proud of - A decade of investment and reform in telecommunications. Address to ATUG Conference. Sydney, Minister for Communications, Information Technology and the Arts**:** 8.

Corner, S. (2006). Telstra rivals call for jointly-funded FTTN network. iTWire (www.itwire.com.au)**:** 2.

Corning Incorporated (2002). European Broadband Initiatives, Corning Incorporated.

Corning Incorporated (2005). Broadband Technology Overview: White Paper - Optical Fiber**:** 16.

Cowie, C. and C. T. Marsden (1998). "Convergence, Competition and Regulation." International Journal of Communications Law and Policy(1): 21.

Cowie, C. and C. T. Marsden (1999). "Convergence: Navigating Bottlenecks in Digital Pay TV." info **1**(1): 14.

Crawford, S. (2006). "Network Rules." Duke Journal of Law & Contemporary Problems: 36.

Crawford, S. (2007). "Network Rules." Duke Journal of Law & Contemporary Problems: 36.

CSTB (2002). Bringing Home the Bits. Washington, DC, National Research Council, Computer Science and Telecommunications Board**:** 320.

Cutler, T. (2001). Telstra in a league of its own. Business Review Weekly. Sydney.

Darling, P. (2005). "The 21st century CAN." Telecommunications Journal of Australia **55**(2): 3-14.

DCA (1996). Review of the Standard Telephone Service. Canberra, Department of Communications and the Arts**:** 204.

DCITA (2000). The Current State of Play: Australia and the Information Economy - Readiness: Population and Household Readiness. Canberra, Department of Communications, Information Technology and the Arts**:** 5.

DCITA (2003). Broadband Technology Rollout Costing Study. Canberra, Department of Communications, Information Technology & the Arts**:** 177.

de Sola Pool, I. (1983). Technologies of Freedom. Cambridge, MA, Harvard University Press.

Donovan, P. (1999). Lights! Water! ... ACTEW! A History of ACTEW and its Predecessors. Canberra, ACTEW Corporation.

DTIS (2000). Open Access Report, in accordance with Resolution 718-99. San Francisco, USA, City and County of San Francisco, Department of Telecommunications and Information Services**:** 76.

EC (2002a). "Directive 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities (Access Directive)." Official Journal of the European Communities **L 108**: 7 - 20.

EC (2002b). "Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services (Framework Directive)." Official Journal of the European Communities **L 108**: 33 - 50.

EC DG INFOSOC (2001). The Development of Broadband Access Platforms in Europe: Technologies, Services, Markets. Brussels, Directorate General Information Society, European Commission**:** 163.

ECITA (2003). Competition in Broadband Services. Environment, Communications, Information Technology and the Arts References Committee (ECITA). Canberra**:** 74-75.

ECITA (2005a). Estimates (Additional Estimates). The Senate Environment, Communications, Information Technology and the Arts References Committee (ECITA). Canberra**:** 165-168.

ECITA (2005b). The performance of the Australian telecommunications regulatory regime. Environment, Communications, Information Technology and the Arts References Committee (ECITA). Canberra, The Senate Printing Unit**:** 244.

ECITA (2006). Estimates (Budget Estimates). Environment, Communications, Information Technology and the Arts References Committee (ECITA). Canberra**:** 30-31.

Eckermann, R. (1999). Daring to be Different. Canberra, ACTEW Corporation**:** 8.

Eckermann, R. (2003). Building the e-Community. Intelligent Cities Conference. Melbourne, City of Whittlesea**:** 44.

Eisenhardt, K. M. (1989). "Building Theories from Case Study Research." Academy of Management Review **14**(4): 532-550.

ELC (2005). Estimates (Additional Estimates). The Senate Economics Legislation Committee (ELC). Canberra**:** E10-11.

Evans, S. (2001). "Australian Telecommunications: R&D Innovations are Brewing Down Under (Part Two)." CommsWorld: 59-63.

Farrell, J. and P. J. Weiser (2002). Modularity, Vertical Integration, and Open Access Policies: Towards a Convergence of Antitrust and Regulation in the Internet Age. Berkeley, Economics Department, University of California**:** 53.

Faulhaber, G. R. (2002). "Access $\neq$ Access$_1$ + Access$_2$." Michigan State DCL Law Review(3): 26.

Faulhaber, G. R. (2004). Bottlenecks and Bandwagons: Access Policy in the New Telecommunications. Handbook of Telecommunications Economics (forthcoming). Vogelsang and Cave.

FCC (2001). Subject to conditions, Commission approves merger between America Online, Inc. and Time Warner, Inc., Public Notice FCC 01-11. Washington, DC 20554, Federal Communications Commission**:** 8.

FCC (2002). Third Report: Matter of Inquiry concerning the Deployment of Advanced Telecommunications Capability to all Americans in a Reasonable and Timely Fashion, and Possible Steps to accelerate such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996. Washington, DC 20554, Federal Communications Commission**:** 178.

FCC (2005). FCC Adopts Policy Statement: New Principles Preserve and Promote the Open and Interconnected Nature of Public Internet. Media Release. Washington, DC 20554, Federal Communications Commission**:** 1.

Fels, A. (2002). Regulating for Efficient and Competitive Utilities. ACCC Regulation Conference. Sydney, Australian Competition & Consumer Commission.

Ferguson, S. (1996). "Developing Australia's Telecommunications Infrastructure." Communications Law Bulletin **15**(3): 21.

Fischer, C. S. (1992). America Calling: A Social History of the Telephone to 1940. Berkeley, University of California Press.

Ford, G. S., T. M. Koutsky, et al. (2006). Network Neutrality and Industry Structure. Policy Paper. Washington, Phoenix Center for Advanced Legal & Economic Public Policy Studies.

Frieden, R. (1995). "Contamination of the common carrier concept in telecommunications." Telecommunications Policy **19**(9): 685-697.

Frieden, R. (2002). "Revenge of the Bellheads: how the Netheads lost control of the Internet." Telecommunications Policy **26**: 425-444.

Frischmann, B. M. (2005). "An Economic Theory of Infrastructure and Sustainable Infrastructure Commons." Minnesota Law Review **89**(4): 917-1030.

Frith, J. (1994a). Pay TV battle on access. The Australian. Sydney.

FTC (2000). In the Matter of America Online, Inc. and Time Warner Inc., Agreement Containing Consent Orders, including the Decision and Order, File No. 001 0105, Docket No. C-3989. Washington, DC, Federal Trade Commission**:** 20.

Furness, M. (1994). Bid Bucks, Big Boys and the Battle for the Super Highway. Australian Financial Review**:** 6.

Furness, M. and T. Burton (1994). Telecom, News Corp get Pay-TV Clearance. Australian Financial Review**:** 1.

Furness, M. and S. Lewis (1994). Race on for New Telecom Alliances. Australian Financial Review**:** 2.

Galperin, H. (2002). "Can the US transition to digital TV be fixed? Some lessons from two European Union cases." Telecommunications Policy **26**: 3 - 15.

Galperin, H. and F. Bar (2001). Open Access beyond cable: The case of Interactive TV. 29th TPRC Conference, Alexandria, VA.

Gans, J. (2006). Neutral Networkity. Melbourne, home page of CoreEcon: Commentary on economics, strategy and more, at http://economics.com.au/**:** 22 May.

Gans, J. and S. King (2003). "Access Holidays for Network Infrastructure Investment." Agenda **10**(2): 163-178.

George, J. (2005). "FTTH Design with the Future in Mind." Broadband Properties: 6.

Gillett, S. E., W. H. Lehr, et al. (2004). Municipal Electric Utilities' Role in Telecommunications Services. Telecommunications Policy Research Conference, Washington.

Grant, A., ed. (1997). Australian Telecommunications Regulation. Sydney, Communications Law Centre.

Grant, A., ed. (2004). Australian Telecommunications Regulation. Sydney, UNSW Press.

Green, P. E. (2004). "Fiber to the Home: The Next Big Broadband Thing." IEEE Communications Magazine **42**(9): 100-106.

Griffin, J. (1993). "Centennial Park Residential Video Pilot." Telecommunications Journal of Australia **43**(3): 37-44.

Guerra, C. (2006). Telstra will roll out network 'regardless'. The Australian. Sydney**:** 1.

Hazlett, T. W. and G. Bittlingmayer (2001). The Political Economy of Cable "Open Access", AEI-Brookings Joint Center for Regulatory Studies**:** 63.

Helberger, N. (2002). "Access to technical bottleneck facilities: the new European approach." Communications & Strategies **2**: 33.

Helberger, N., A. Scheuer, et al. (2001). "Non-Discriminatory Access to Digital Access Control Services." IRIS plus - Legal Observations of the European Audiovisual Observatory **2**: 8.

Hilmer, F. G. (1993). Independent Committee of Inquiry into National Competition Policy (F.G. Hilmer Chairman). Canberra, AGPS.

Houghton, J. and P. Morris (2001). Case Study: Broadband The Case of Australia. Geneva, ITU**:** 45.

House of Representatives Standing Committee on Communications Information Technology and the Arts (2002). Connecting Australia! Wireless Broadband. Canberra, Australia, The Parliament of the Commonwealth of Australia**:** 109.

Hsieh, R.-C., J. Butterfield, et al. (1993). "Wollongong Optical Fibre Trial." Telecommunications Journal of Australia **43**(3).

Huber, P. W. (1997). Law and Disorder in Cyberspace: Abolish the FCC and Let Common Law Rule the Telecosm. Oxford, New York, Oxford University Press.

IEEE-USA (2002). The Broadband Dilemma. Washington, DC, IEEE-USA/Cornell University Workshop**:** 7.

ITU-T (2003). NGN 2004 Project Description, International Telecommunication Union, ITU**:** 8.

Jones, R. (2003). Competition, broadcasting and pay TV. Australian Broadcasting Summit, Sydney.

Katkin, K. (2001). "Open Access" to Monopoly Cable Platforms Versus "Direct Access" To Competitive International Telecommunications Satellite Facilities: A Study In Contrasts. 29th TPRC, Alexandria, VA.

Keller, J. (1995). Public Access Issues: An Introduction. Public Access to the Internet. B. Kahin and J. Keller. Cambridge, MA, The MIT Press**:** 390.

Kelso, R. (1992a). "Cabling Australia for Television, & More ..." Telecommunications Journal of Australia **42**(1): 9.

Kelso, R. (1992b). Migrating Today Towards a Broadband Future. IIR Conference on Pay TV & Subscription Services, Golden Gate Park Plaza, Sydney.

Kelso, R. (1996). Opening Up Access to Broadband Media Services. Communications Research Forum, Melbourne.

Kim, J. K. (2005). Telecommunications Merger Trends in the Context of the Convergence - Using the U.S. Merger Cases. 33rd TPRC, Arlington, Virginia, USA.

King, S. and R. Maddock (1996). Unlocking the Infrastructure: The Reform of Public Utilities in Australia. St Leonards, Allen & Unwin.

Klein, J. I. (1998). Statement of Joel I. Klein, Assistant Attorney General, Antitrust Division, US Department of Justice. House Committee on the Judiciary Concerning Consolidation in the Telecommunications Industry. Washington, DC**:** 6.

Korporaal, G. (1994). Vision Splendid. Australian Financial Review**:** 4.

Kramer, G. and G. Pesavento (2002). "Ethernet Passive Optical Network (EPON): Building a Next-Generation Optical Access Network." IEEE Communications Magazine **40**(2): 66-73.

Kumar, R. (1999). Research Methodology: A Step-By-Step Guide for Beginners. London, SAGE Publications.

Lax, S., Ed. (2001). Access Denied in the Information Age. Hampshire, UK, Palgrave.

Lee, M. M. (1994). Competition and Access on the Information Highway. Press Release Statement. Canberra, Parliament House.

Lee, W. E. (2000). "Open Access, Private Interests, and the Emerging Broadband Market." Policy Analysis **No. 379**.

Lehmann, J. (2005). Digital or nothing for pay-TV users. The Australian. Sydney**:** p.7.

Lehmann, J. (2006). TVN on track to race ahead with Telstra and PBL. The Australian. Sydney.

Lehr, W., M. Sirbu, et al. (2004). Broadband Open Access: Lessons from Municipal Network Case Studies. Telecommunications Policy Research Conference, Washington.

Lemley, M. A. and L. Lessig (2001). "The End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era." UCLA Law Review **48**(4): 925 - 972 (48).

Leon-Garcia, A. and I. Widjaja (2004). Communication Networks: Fundamental Concepts and Key Architectures. Boston, McGraw Hill.

Lessig, L. (2001). The Future of Ideas: the fate of the commons in a connected world. New York, Random House.

Lessig, L. (2005). "Re-Marking the Progress in Frischmann." Minnesota Law Review **89**(4): 1031-1043.

Lessig, L. (2006). Testimony of Lawrence Lessig on "Network Neutrality". Commerce, Science and Transportation. Washington**:** 11.

Lewis, S. (1994a). Pressure on Telecom over Cable Access Policy. Australian Financial Review**:** 1.

Lewis, S. (1994b). Lee Warns on Cable Network Empires. Australian Financial Review**:** 2.

Lewis, S. (1994c). Telecom Dials Up $2Bn Profit. Australian Financial Review**:** 1.

Lindner, L. R. (1999). Public Access Television: America's Electronic Soapbox. Connecticut, London, Praeger.

Linfield, R. F. (1994). Telecommunications: Present Status and Future Trends. Park Ridge, NJ, Noyes Data.

Litan, R. E. and R. G. Noll (2004). The Uncertain Future of the Telecommunications Industry. Washington, DC, The Brookings Institutioin**:** 5.

Little, W., H. W. Fowler, et al. (1984). The Shorter Oxford English Dictionary on Historical Principles. Oxford, Clarendon Press.

MacKie-Mason, J. K. (1999). Investment in Cable Broadband Infrastructure: Open Access is Not an Obstacle. Ann Arbor, University of Michigan**:** 50.

Maiden, M. and K. Simpson (1997). Pay's $3b Black Hole. The Age. Melbourne**:** 5.

Maney, K. (1995). Megamedia Shakeout: The Inside Story of the Leaders and the Losers in the Exploding Communications Industry. New York, John Wiley & Sons, Inc.

McAdams, A. (2002a). Report from the Workshop: This Decade's (R)evolutionary Telecommunications Paradigm. Washington, DC, IEEE-USA/Cornell University**:** 34.

Mead, D. C. (2000). Direct Broadcast Satellite Communications: An MPEG Enabled Service. New Jersey, Prentice Hall.

Meredith, H. (1994a). Telecom Close to Decision. Australian Financial Review**:** 2.

Meredith, H. (1994b). $700M Cable Contract to Deliver Pay-TV by July. Australian Financial Review**:** 2.

Meredith, H. (1994c). Philips a Big Winner in Fibre-Optics Deal. Australian Financial Review**:** 2.

Meredith, H. (1994d). Cable Pay-TV Service Delayed While Telecom Ponders Tariffs. Australian Financial Review**:** 2.

Meredith, H. (1994e). Cable Pay-TV Service Delayed While Telecom Ponders Tariffs. Australian Financial Review**:** 2.

Meredith, H. (1994f). Optus Says 'Yes' to Pay-TV Partnership. Australian Financial Review**:** 1.

Meredith, H. (1994g). Telstra's Vision leaves PMT Partners out of Pay-TV Picture. Australian Financial Review**:** 1.

Meredith, H. (1994h). Telstra Races Forward in Pursuit of Viewers. Australian Financial Review**:** 1.

Merriam, S. B. (1988). Case Study Research in Education: A Qualitative Approach. San Francisco, Jossey-Bass Inc.

Middleton, C. A. (2002). "Who Needs a 'Killer App'? Two Perspectives on Content in Residential Broadband Networks." Journal of Research and Practice in Information Technology **34**(2): 67-81.

Miles, M. B. and A. M. Huberman (1994). Qualitative Data Analysis: An Expanded Sourcebook. Thousand Oaks, SAGE Publications.

Minar, N. and M. Hedlund (2001). A Network of Peers. Peer-to-Peer: Harnessing the Power of Disruptive Technologies. A. Oram, O'Reilly**:** 448.

Mitchell, S. (2001). TransACT gets back on track. The Australian. Sydney**:** p. 35.

Moran, S. and J. Schulze (2007). Seven appeals against Foxtel's access deal. The Australian. Sydney.

Nachbar, T. B. (2006). Open Access. 34th Research Conference on Communication, Information and Internet Policy (TPRC), Arlington, Virginia.

Nakamura, M., H. Ueda, et al. (2004). "Proposal of Networking by PON Technologies for Full and Ethernet Services in FTTx." Journal of Lightwave Technology **22**(11): 10.

National Broadband Task Force (2001). The New National Dream: Networking the Nation for Broadband Access. Ottawa, Canada, Industry Canada**:** 103.

NCC (1998). Compendium of National Competition Policy Agreements. Canberra, National Competition Council**:** 130.

NCC (2002). The National Access Regime: A Guide to Part IIIA of the 'Trade Practices Act 1974'. Canberra, National Competition Council.

Noam, E. M. (1993). The Impending Doom of Common Carriage. Queenstown, Maryland, The Aspen Institute**:** 26.

NOIE (2003). Australia's Broadband Connectivity. Canberra, ACT, National Office for the Information Economy**:** 66.

Nortel (2004). Ultra broadband access: Unleashing the power of PON. White Paper, Nortel Networks**:** 16.

Northfield, D. (1999). The Information Policy Maze: Global Challenges - National Responses. Melbourne, Australia, RMIT University Press.

Nuechterlein, J. E. and P. J. Weiser (2005). Digital Crossroads: American Telecommunications Policy in the Internet Age. Cambridge, London, MIT Press.

Nunamaker, J. F. J., M. Chen, et al. (1991). "Systems Development in Information Systems Research." Journal of Management Information Systems **7**(3): 89-106.

OCCAM (2005). FTTx: Selecting the Best Architecture for the Access network. Santa Barbara, OCCAM Networks Inc.**:** 11.

O'Donnell, S. (2000). Broadband architectures, ISP Business Plans, and Open Access. 28th Telecommunications Policy Research Conference.

Optus Vision (1994). Telecom Monopoly Entrenched By Change In Pay-TV Rules By Minister Lee. Media Release. Sydney**:** 1.

Osman, R. (2002). TransACT gets welcome shot in arm. The Australian Financial Review. Sydney**:** 1.

Owen, B. M. (1999). The Internet Challenge to Television. Cambridge, Massachusetts, Harvard University Press.

Page Research Centre (2005). Future-Proofing Telecommunications in Non-Metropolitan Australia. Canberra, The Page Research Centre Limited**:** 35.

Park, S.-J., C.-H. Lee, et al. (2004). "Fiber-to-the-Home Services Based on Wavelength-Division-Multiplexing Passive Optical Network." Journal of Lightwave Technology **22**(11): 10.

PC (2001a). Telecommunications Competition Regulation. Inquiry Report. Melbourne, Productivity Commission**:** 746.

PC (2001b). Review of the National Access Regime. Inquiry Report. Melbourne, Productivity Commission**:** 536.

Peters, A. (1998). "Competition in Telecommunications: Promoting the Long-term Interests of End-users." Competition and Consumer Law Journal **5**(3): 16.

Pindyck, R. S. (2005). Pricing Capital under Mandatory Unbundling and Facilities Sharing. NBER Working Paper Series. Cambridge, MA, National Bureau of Economic Research.

Powell, M. K. (2004). "Preserving Internet Freedom: Guiding Principles for the Industry." Journal on Telecommunications & High Technology Law **3**(1): 12.

Price, M. E. (1995). Television, the Public Sphere, and National Identity. Oxford, Clarendon Press.

PWC (2004). Competition in The First Mile: Why Fiber to the Premises is Not the Issue. connectedthinking - A Technology Forecast Publication, PricewaterhouseCoopers International Limited**:** 43.

Reed, D. P. (1992a). Residential Fiber Optic Networks: An Engineering and Economic Analysis. Boston, Artech House.

Reed, D. P. (1992b). Taking It All Apart: Principles of Network Modularity. Conference on Private Networks and Public Objectives, Columbia Institute for Tele-Information.

Ries, I. (1994). Telecom about to get Clawed. Australian Financial Review**:** 3.

Rifkin, J. (2001). The Age of Access: How the shift from ownership to access is transforming modern life, Penguin Books.

Riley, J. (2004). Alcatel ploughs $4m into fibre network. The Australian. Sydney.

Riverstone (2004). FTTP Shootout - Active Ethernet vs PON. Santa Clara, Riverstone Networks**:** 6.

Robson, C. (1995). Real World Research: A Resource for Social Scientists and Practitioner-Researchers. Oxford, Blackwell.

Rosenthal, M. (2001). "Open Access of Internet Service Providers to the Cable Operators' Facilities in the United States." International Journal of Communications Law and Policy(6, Winter 2000/2001): 26.

Rosenthal, M. (2003). "Open Access from the EU Perspective." International Journal of Communications Law and Policy(7, Winter): 21.

Rowe, S. H. (1999). Telecommunications for Managers. Columbus, Prentice Hall.

Roycroft, T. R. (2006a). Network Diversity - A Misguided Policy. Brewster, MA, Roycroft Consulting**:** 53.

Roycroft, T. R. (2006b). Network Neutrality, Product Differentiation, and Social Welfare. Brewster, MA, Roycroft Consulting.

Roycroft, T. R. (2006c). Economic Analysis and Network Neutrality: Separating Empirical Facts from Theoretical Fiction. Brewster, MA, Roycroft Consulting**:** 20.

Rozental, S., J. Griffin, et al. (1992). "Optical Fibre in the Customer Access Network." Telecommunications Journal of Australia **42**(2).

Rubinfeld, D. L. and H. J. Singer (2001). "Open Access to Broadband Networks: A Case Study of the AOL/Time Warner Merger." Berkeley Technology Law Journal **16**(2, Spring): 631-675.

Sabine, H. (1988). Trends in Optoelectronics. Telecommunications Through the 90's. T. R. Laboratories. Melbourne, Australian Telecommunications Commission**:** 6.

Sainsbury, M. (2005). Telstra eyes fibre partners. The Australian. Sydney**:** p. 31.

Sainsbury, M. (2006). $500m bill for Telstra's plan B. The Australian. Sydney.

Sainsbury, M. and J. Schulze (2005). Foxtel in push for pay-TV over DSL. The Australian. Sydney**:** 1.

Saltzer, J. H. (1999). "Open Access" is Just the Tip of the Iceberg, MIT**:** 6.

Saltzer, J. H., D. P. Reed, et al. (1981). End-to-End Arguments in System Design. Massachusetts, MIT**:** 5.

Sandvig, C. (2006). "Network Neutrality is the New Common Carriage." Info: The Journal of Policy, Regulation, and Strategy.

Schulze, J. (2004b). Stokes prepares for battle. The Australian. Sydney**:** 15, 18.

Service, J. G. (1996). Chairman's Report - ACTEW Corporation 1996. Canberra, ACTEW Corporation Ltd**:** 3.

Seven Network Supp (2002). Seven Network Supplementary Submission. Senate Environment, Communications, Information Technology and the Arts Legislation

Committee - Inquiry into Telecommunications Competition Bill 2002. Canberra, Parliament House**:** 30.

Shah, A., D. C. Sicker, et al. (2003). Thinking About Openness in the Telecommunications Policy Context. TPRC.

Sharkey, W. W. (1982). The Theory of Natural Monopoly. Cambridge, Cambridge University Press.

Simpson, J. A. and E. S. C. Weiner (1989). The Oxford English Dictionary. Oxford, Clarendon Press.

Speta, J. B. (2000). "Handicapping the Race for the Last Mile?: A Critique of Open Access Rules for Broadband Platforms." Yale Journal on Regulation **17**: 39-91.

Speta, J. B. (2000a). "The Vertical Dimension of Cable Open Access." University of Colorado Law Review **71**(4): 975-1010.

Stake, R. E. (1995). The Art of Case Study Research. Thousand Oaks, SAGE Publications.

Syvret, P. (1994). Pay-TV Hopeful Aims for $42M Public Float. Australian Financial Review**:** 1.

Taggart, S. (1999). "Aussie Open Access." tele.com: 2.

Taggart, S. (2002). "An Odd Broadband Offer in Oz." Wired News: 3.

Telecom (1975). TELECOM 2000: An Exploration of the Long-Term Development of Telecommunications in Australia. Melbourne, Australian Telecommunications Commission (Telecom Australia)**:** 166.

Telecom (1978). Outcomes from the TELECOM 2000 Report. Melbourne, Australian Telecommunications Commission (Telecom Australia)**:** 70.

Telecom (1992a). A Submission to the Senate Select Committee on Subscription Television Broadcasting Services concerning Part 7 of the Broadcasting Services Bill 1992: The Future through Australia's Telecommunications Infrastructure. Melbourne, Australian Overseas Telecommunications Corporation (Telecom Australia)**:** 16.

Telecom (1992b). Supplementary Submission to the Senate Select Committee on Subscription Television Broadcasting Services concerning Part 7 of the Broadcasting Services Bill 1992. Melbourne, Australian Overseas Telecommunications Corporation (Telecom Australia)**:** 5.

Tellis, W. (1997). "Introduction to Case Study." The Qualitative Report **3**(2): 13.

Telstra (2004a). Telstra announces next generation access technology commerical pilot. Media Release. Sydney, Telstra Corporation Limited**:** 1.

Telstra (2004b). Telstra Technology, Innovation and Products: Operational Briefing - Opening Address. Melbourne, Telstra Corporation Limited**:** 27.

Telstra (2005a). The Digital Compact & National Broadband Plan. Melbourne, Telstra Corporation Limited.

Telstra (2005b). Technology Briefing. Melbourne, Telstra Corporation Limited**:** 28.

Telstra (2005c). Transcript from Analysts Q&A session - Telstra Investor Day. Melbourne, Telstra Corporation Limited**:** 53.

Telstra (2005d). Submission to Taskforce on Reducing the Regulatory Burden on Business. Melbourne, Telstra Corporation Limited**:** 41.

Telstra (2005e). Telstra Regulatory Briefing. Melbourne, Telstra Corporation Limited.

Telstra (2005f). Fibre-to-the-node. Melbourne, Telstra Corporation Limited**:** 1.

Telstra (2006). Submission to the Australian Competition and Consumer Commission, Response to the ACCC Proposal - "A strategic review of the regulation of fixed network services". Melbourne, Telstra Corporation Limited.

Thierer, A. (2004a). "Net Neutrality" Digital Discrimnination or Regulatory Gamesmanship in Cyberspace? Policy Analysis. Washington, CATO Institute**:** 28.

Thierer, A. (2004b). "Are "Dumb Pipe" Mandates Smart Public Policy? Vertical Integration, Net Neutrality, and the Network Layers Model." Journal of Telecommunications & High Technology Law **3**(2): 27.

Thierer, A. and C. W. Crews (2003). What's Yours Is Mine: Open Access and the Rise of Infrastructure Socialism. Washington, DC, CATO Institute.

Thorne, J., P. W. Huber, et al. (1995). Federal Broadband Law, Little, Brown and Company.

TISP (2001). Working Party on Telecommunications and Information Services Policy: The Development of Broadband Access in OECD Countries. Paris, France, OECD, Directorate for Science Technology and Industry, Committee for Information Computer and Communications Policy**:** 63.

Todd, N. (2004). Telstra confirms FTTH trial. The Australian. Sydney.

TransACT Communications (1999). Introduction to the TransACT Project: A Brief Introduction to the TransAct Communications Project. About TransACT, Technical Information. Canberra, TransACT Communications Pty Limited**:** 8.

TransACT Communications (2001). Overview of the TransACT Network Architecture: Introduction to TransACT. About TransACT, Technical Information. Canberra, TransACT Communications Pty Limited**:** 26.

TransACT Communications (2004). TransACT and ActewAGL join forces in regional alliance. Media Release. Canberra, TransACT Communications Pty Limited**:** 2.

TransACT Communications (2005). Network Architecture. About TransACT, Technical Information. Canberra, TransACT Communications Pty Limited**:** 4.

TransAct Communications Project (1997a). TransAct Communications Feasibility Study. Canberra, ACTEW Corporation**:** 3.

TransAct Communications Project (1997b). TransAct Interaction - Project Update. Canberra, ACTEW Corporation**:** 5.

TransAct Communications Project (1997c). TransAct Interaction - Project Update. Canberra, ACTEW Corporation.

TransAct Communications Project (1998). TransAct Interaction - Project Update. Canberra, ACTEW Corporation**:** 8.

Tseng, E. (2001). Competition in Fiber to the Home: A Technology and Policy Assessment. Engineering Systems Division, Massachusetts Institute of Technology**:** 101.

Tseng, E. and S. E. Gillett (2000). Open Access to Cable Data Networks. Workshop on Advanced Communications Access Technologies, Cambridge, MA, Harvard Information Infrastructure Project, Kennedy School of Government, Harvard University.

Turner, G. and S. Cunningham (2000). The Australian TV book. St Leonards, NSW, Allen & Unwin.

van Schewick, B. (2005). Towards an Economic Framework for Network Neutrality Regulation. 33rd Research Conference on Communication, Information and Internet Policy (TPRC), Arlington, Virginia.

Westfield, M. (2000). The Gatekeepers: The Global Media Battle to Control Australia's Pay TV. Annandale, NSW, Pluto Press.

Whitt, R. S. (2004). "A Horizontal Leap Forward: Formulating a New Communications Public Policy Framework Based on the Network Layers Model." Federal Communications Law Journal **56**(3): 587-672.

Whittle, R. (1995/96). "The Great Cable Race." Australian Communications: 12.

Whittle, R. (1996). "The Optus Vision: Telephony, Internet and Video." Australian Communications: 61-77.

Whittle, R. (1997). "Telstra's HFC Cable Internet Hits Home - Part 1." Australian Communications: 81-88.

Windhausen, J. (2006). Good Fences make Bad Broadband - Preserving an Open Internet through Net Neutrality. White Paper. Washington, Public Knowledge.

Winegardner, K. E. (n.d.). The Case Study Method of Scholarly Research, The Graduated School of America**:** 23.

Woroch, G. A. (2002b). Local Network Competition. Handbook of Telecommunications Economics. M. Cave, S. Majumdar and I. Vogelsang, Elsevier.

Wu, T. (2003). "Network Neutrality, Broadband Discrimination." Colorado Journal of Telecommunications & High Technology Law **2**: 34.

Wu, T. (2004). "The Broadband Debate, A User's Guide." Journal on Telecommunications & High Technology Law **3**: 69-96.

Wu, T. and L. Lessig (2003). Ex Parte Submission in CS Docket No. 02-52. Federal Communications Commission. Washington**:** 17.

Yin, R. K. (1991). Case Study Research: Design and Methods. Newbury Park, SAGE Publications.

Yoo, C. S. (2004). "Would Mandating Broadband Network Neutrality Help or Hurt Competition? A Comment on the End-to-End Debate." Journal of Telecommunications & High Technology Law **3**.

Yoo, C. S. (2005). "Beyond Network Neutrality." Harvard Journal of Law & Technology **19**(1): 77.

Yoo, C. S. (2006). Promoting Broadband Through Network Diversity. White Paper. Nashville, TN, Vanderbilt University Law School**:** 56.

Yoo, C. S. and T. Wu (2006). Keeping the Internet Neutral? Debate Club, Legal Affairs, http://www.legalaffairs.org**:** 12.