THE MIXED EXPERIENCE OF ACHIEVING BUSINESS BENEFIT FROM THE INTERNET —A MULTI-DISCIPLINARY STUDY

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

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Certification

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research programme; and, any editorial work, paid or unpaid, carried out by a third party is acknowledged.

Greg Adamson

Date: February 2004

Acknowledgements

While working for Australian Associated Press as a technician in 1987, I became caught up in the enthusiasm for Asynchronous Transfer Mode technology. This promised a single all-purpose communication network to replace the diverse technologies I worked with, from X.25 to legacy valve-based baudot services. This research was conceived as a way to understand what had happened as the vision evaporated over the next seven years. Many people assisted me along this path, including Paul Petit who gave me an appreciation of engineering and Glen Smith at Australian Associated Press who gave me an enthusiasm for technology knowledge sharing and mentoring. In this thesis my supervisor Supriya Singh has been a constant source of scepticism and questioning in examining every aspect of the evidence I found and the conclusions I drew. She has been a great support over the period, as well as giving me a user-centred perspective. My second supervisor Greg Tucker has provided an invaluable regulatory and commercial perspective, and much practical advice. This research was divided between Edinburgh and Melbourne. In Edinburgh my colleagues at Fujitsu, Neil Richardson, Scott Warnock and Mark Napora, shared an e-business learning experience. In Melbourne Rob Miles provided further practical knowledge. Yinan Yang convinced me that undertaking a PhD would be a good thing. Peter Duckworth provided a sounding board for a wide range of theories. Rob Schaap at the University of Canberra helped me understand the separate disciplines involved in this study. As a part-time student the fortnightly postgraduate seminars at RMIT were invaluable. Ross Kelso was generous with his knowledge of Australian

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2.

Abstract

By 2003 the Internet had grown from a 1960s research project to a global communication medium with 600 million users. This made it a major means of early 21st century communication, alongside the telephone, press, radio, film, television and other communication media. The Internet shares many similarities with these. However, despite its commercial basis (unlike the postal system for example), commercial investors have mixed experiences in achieving business benefit. This thesis examines the basis for this difference through the research question: Why has the experience of business benefit from the Internet been so mixed, given the Internet's usefulness to hundreds of millions of people?

The research question is approached from five perspectives: the history of the Internet; the usage that is made of it as a communication medium; the technology of its architecture; the regulatory environment in which it developed; and the business aspects of its formation and development. These five areas of research are combined in a multi-disciplinary approach, based on existing literature in each of the five areas:

- The historical perspective provides an understanding of the combination of government funding, a technologist gift economy, and conversion of existing infrastructure that allowed the Internet to gain millions of users without mass commercial funding.
- The communication and media perspective focuses on the uses made of the Internet, by individuals, businesses and non-commercial organisations. It identifies the similarity of interactive use between the early research period and the late commercial period.
- The technological perspective provides an understanding of how the non-commercial origins of the Internet are reflected in its architecture, and the challenges that this

poses for commercial use, particularly as a transactional medium. In this thesis, 'transactional medium' refers to a means of communicating commercial documents or payments, including orders, invoices and electronic payments.

- The regulatory perspective helps explain the success of the Internet in the face of large entrenched commercial interests, in particular, by the controls exercised over telecommunications incumbents that allowed the Internet's success.
- The business perspective links the other four perspectives to the research question, finding that user uptake and the appropriate technical characteristics are necessary but insufficient conditions for business benefit. In addition, competitive advantage is required to ensure that commercial investors are able to capture at least part of these benefits, rather than competing them away.

The thesis concludes that the mixed experience of business benefit has resulted from the difficulty of combining usage, technical and commercial understandings of the Internet. The absence of a commercial tradition in 1995 provided warning of this. That warning was obscured by the Internet's rate of usage growth, and generally ignored in the reactive rush for market position.

This thesis addresses interests of multiple audiences. For business this thesis helps to identify those benefits that can currently or most easily be obtained from the Internet. For media and communication theorists it contributes to an understanding of the influence of usage on technology adoption and modification. For technologists it helps answer the question, why does so much technological development end up unused? This research is also a significant contribution to the development of an independent field of Internet studies, providing evidence of the value of a multi-disciplinary approach in this area.

Chapter 1

INTRODUCTION

From military beginnings the Internet evolved and grew to meet communication needs of one-tenth of the world's population, some 600 million people, by late 2002 (NUA 2002). While businesses have been among those using the Internet, they have had mixed experiences in achieving business benefit from the Internet. In the short term the Internet changed the way we communicate (e-mail, instant messaging, file sharing), but has had less effect on the way we conduct most business (such as grocery shopping or inter-company supply chain management). High levels of use of the Internet have not directly translated into commercial benefit for business.

This study examines the issues of Internet use and business benefit from multiple perspectives. For this study the US Federal Networking Council (1995) definition of the 'Internet' is adopted:

> 'Internet' refers to the global information system that:
>
> (i) is logically linked together by a globally unique address space based on the Internet Protocol (IP) or its subsequent extensions/follow-ons;

(ii) is able to support communications using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite[1] or its subsequent extensions/follow-ons, and/or other IP compatible protocols; and

(iii) provides, uses or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure described herein.

The World Wide Web is one of the applications supported by the Internet, alongside but separate from others such as e-mail, instant messaging and peer-to-peer file exchange. The World Wide Web in turn supports its own applications, such as viewing web pages and video clips, and web logging ('blogging'). While the Internet is a type of 'new media', this term also refers to other functionally similar technology-based systems introduced in the 1990s, including interactive television and mobile telephone–based non-Internet systems such as Japan's iMode.

1.1 Research question and objectives

This thesis examines the question: Why has the experience of business benefit from the Internet been so mixed, given the Internet's usefulness to hundreds of millions of people? This question addresses the difference between business benefit provided by the Internet and that gained from many other communication media technologies. Four chapters of this thesis

[1] A network is a set of communication paths, such as copper wire, optical fibre, microwave and satellite, that are linked together to allow information to be passed across them. The global telephone network is an example. TCP/IP is the Transmission Control Protocol/Internet Protocol. It is used both for the Internet and for separate private TCP/IP networks. A 'protocol' is a set of technical rules on which a network is based. TCP/IP is refered to as a 'protocol suite' because it contains many separate protocols. For example, it contains the Internet Protocol (IP) and the Transmission Control Protocol (TCP), but it also contains the Simple Mail Transfer Protocol (SMTP), the User Datagram Protocol (UDP) and others. Within the technological literature these protocols are almost universally referred to by their initials, and this practice has been copied in business and popular literature.

examine subsidiary questions. These have been selected to focus on particular aspects of the development of the Internet that may appear to influence its later commercial value.

Chapter 3 examines the question: How did the Internet become a communication medium with millions of users by the early 1990s?

Chapter 4 examines the question: Did the development of the Internet prior to 1995 shape its technical architecture in a way that limited its later business use?

Chapter 5 examines the question: Was United States government regulatory policy during the development of the Internet a major factor in its success?

Chapter 6 examines the question: Under what conditions have businesses received business benefit from the Internet? Combined with the other subsidiary questions this provides a basis for drawing conclusions regarding the research question.

Each question is examined using one or more of the perspectives of researchers from history, media and communication, technology, regulatory policy and business.

'Business benefit' is defined here as a measure of direct or indirect financial gain, following the definition of Alinean (2003): 'Business benefits: The estimated gain in company revenue and profit by implementing the solution, such as increased customer conversion, increased customer retention and reduced sales cycle duration.' This is a study of the mixed experience of achieving such benefits, rather than a quantitative study designed to measure these benefits. Section 2.2.5 considers the relationship of business benefit to the separate concept of productivity.

This thesis follows the *New Shorter Oxford English Dictionary* (1993) definition of 'useful', taken to mean 'producing or able to produce good results, advantageous, beneficial', and

applied to individual, business and government use. It is acknowledged that this approach would not be satisfactory for a broader study of technology: 'The human encounter with artificial means cannot be summarized solely (or even primarily) as a matter of "use" ' (Winner 1978, p. 194).

1.2 The significance of this research

In 1990 relatively few people were familiar with the Internet. Five years later it was the focus of mass commercial interest. Five years after that in 2000 it was derided by many as a fad. Through the decade the Internet repeatedly surprised technologists, business investors and media researchers. Historical research into earlier media makes a convincing case that the hyperbole surrounding the Internet is not new (Marvin 1988). The growth of the Internet as an interactive communication medium, however, is a significant event.

In 2003 business attitudes to the Internet remain sharply divided. For some it represents an economic success story worth $A43 billion in Australia alone (Allen Consulting Group 2002). Others dismiss its economic importance as a source of productivity or business benefit (Cassidy 2002). Still others (particularly the music distribution industry) are attempting to control its use in law courts around the world. Making sense of the unexpectedness of the Internet is still at an early stage. This thesis is a contribution to that understanding.

Widespread debate exists regarding what the Internet *should* be. This has developed around the separate positions that its development should be protected for wide use as an 'innovation commons' (Lessig 2001) or be primarily market based. Ethernet inventor Bob Metcalfe (interviewed in Petrie & Wiggins 1997, p. 7) presents a case for the latter:

> I get e-mail from people who tell me this betrays the real purpose of the Internet. 'The Internet was not built to serve the money-grubbing capitalist corporations of America.' You know, I

> was around when the Internet was built. And it doesn't matter what the original purpose of the Internet was. That's moot.

While these positions are not mutually exclusive, there is agreement that maximising the benefits of one will limit the benefits of the other. This research is an original contribution to understanding *what happened*. In particular, the failure of Metcalfe's commercial expectation cannot be attributed primarily to the strength of support for Lessig's view in the late 1990s.

The material on which this research is based is well known within individual areas of research, but generally unknown outside each of these. The multiple perspectives in this research provide the means for understanding why the Internet developed in the way that it did. It also provides an understanding of the ongoing tension between communication and commercial aspects of the Internet. For business this thesis helps to identify the conditions under which business benefit can be obtained. For media and communication theorists it contributes to an understanding of the influence of usage on technology adoption and modification. For technologists it addresses the question, why does so much technological effort end up unused?

1.3 Structure of this thesis

The first two chapters provide an introduction to the research, with the research question introduced in this chapter and the methodological approach and current knowledge examined in the next. The following four chapters each examine a separate subsidiary research question, as listed above in Section 1.2. Chapters 3 to 5 primarily focus in turn on the user experience of the Internet, the technology of the Internet, and the regulatory environment in which it emerged. In each case a multi-disciplinary approach is taken, as described in Chapter 2. Chapter 6 relates each of the three previous chapters to the business experience of using the Internet. A conclusion regarding the research question is then drawn. Chapter 7 provides a summary of the findings regarding the subsidiary questions and the main research question. It also identifies the limits of the findings and suggests further areas of research.

10.

Chapter 2

A MULTI-DISCIPLINARY STUDY

This is a multi-disciplinary study of activities, characteristics and trends that define the Internet up to August 2003. It connects history, media and communication, technology, regulatory policy, and business perspectives. It is based on historical and contemporary literature principally from these areas of research. Each provides a particular perspective on the Internet. The emphasis is on connecting these perspectives rather than a freestanding analysis of the Internet from each. The thesis uses this multi-disciplinary approach to illuminate the experiences of Internet use and business benefit.

2.1 Strengths and challenges of a multi-disciplinary study

The influence of the Internet is such that there is probably no research area, from biology to law or theology to material sciences, that could be excluded from the field of Internet research. This thesis is based on a purposive selection of literature in five areas of research: historical examinations of the Internet; sociological and media studies of communication usage; technology development; the regulatory context; and business studies of strategy and the 'Internet economy'.

While examining the Internet from these five perspectives, this thesis does not attempt to be five theses in one. Rather, it seeks to provide a multifaceted view of the Internet by examining various aspects related to the research question, using a combination of these perspectives. This combined character of the study makes the research multi-disciplinary.

The use of a multi-disciplinary approach assists in overcoming what Hexter from a historian's perspective describes as 'tunnel history', the assumption that economic results have economic causes, or technology outcomes have technology origins (cited in Fischer 1970, p. 177). Analysing the issue of Internet use and business benefit from the traditional perspective of the technology workshop, the boardroom, the user community or the government policy committee provides only part of the story. Combining these perspectives provides a richer, multi-dimensional analysis.

This thesis examines the Internet as a communication medium. Halloran (1998, p. 18) argues that 'mass communication is a field of interest, *not a discipline*. It is a field that may be illuminated from several different disciplinary positions'. McPhail (1989, p. 61) considers that, 'Communication, in its broadest form, now involves so many aspects that no one discipline can possibly understand or solve the problems'. A multi-disciplinary approach is currently applied by some Internet research institutions, including the multi-disciplinary Oxford Internet Institute established in 2001 (University of Oxford 2003), and the Association of Internet Researchers, <http://aoir.org/>.

In addition to the diversity of issues raised in Internet research, the novelty of the Internet means that broadly accepted ways of viewing it are yet to be established. Internet research sits on the border of disciplines. In the 1940s, information technology pioneer Wiener argued that the 'boundary regions' between disciplines are the most fruitful areas of research. These areas

offer the greatest opportunity because 'traditional methods simply don't work' (cited in Naughton 2000, p. 61).[2]

Multi-disciplinary research may begin from a 'meta-discipline'. For example, in geospatial studies the single common element of physical location can be used as a means of grouping botanical, geological, historical, geographic, demographic and many other types of information. Such research may comprise multi-disciplinary teams of researchers representing the separate disciplines. Alternatively multi-disciplinary research may result from research that follows a question beyond the traditional boundaries of a single discipline. Such research may remain oriented to the initial audience, but be written in a way that extends its knowledge into the separate field. DiMaggio, Hargittai, Nueman et al (2001, p. 329) point to the example of Lessig, whose work 'calls attention to the importance of studying aspects of the technology that remain invisible to most observers (and of the need for sociologists studying the Web to acquire sufficient technical expertise to address these questions)'. This may result over time in the modification of a discipline. Zelizer describes the 'New Chicago School' of law, including Lessig, where 'a group of legal analysts are rediscovering the explanatory power and policy potential of social norms and social meaning ... to reconcile sociological and economic approaches to legal issues' (Zelizer 1998).[3]

This thesis is aligned to the 'meta-discipline' approach. It follows the author's separate professional involvements, each of several years' duration, in the fields of media (print publishing), technology (data communication technology and engineering), and business

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[2] Weiner's ability to make original contributions across a range of fields from mathematics and cybernetics to prosthesis, and his contribution to information theory (Mandrekar & Masani 1997) make his work highly relevant to Internet multi-disciplinary researchers coming from a technical perspective.

[3] Some writers distinguish between 'multi-disciplinary' and 'inter-disciplinary', for example describing a multi-disciplinary clinical group practicing with awareness and tolerance for other disciplines, while an inter-disciplinary group is one assembled to represent a range of disciplines (WMAHEC 2001). For the purpose of this thesis the single term 'multi-disciplinary' is used to cover both meanings.

(national mid-level management and international consultancy). The regulatory perspective was not initially included at the commencement of the research. The need for this additional dimension became clear during the research as a means for understanding the development of new media technologies. In addition to these four areas, the author grew up in an environment where he received extensive exposure to media history. Working as a consultant in electronic business strategy provided an intimate understanding of the difficulties experienced by 'bricks and mortar' enterprises: the companies, personalities, issues and events. Most of this information is not available for use in public research. In this thesis the only material that has been used from this experience is a review of the Aberdeen-based oil and gas industry from publicly available information. For Porter (1985, p. xix) 'in-depth case studies are hard to obtain, because of the extraordinary disclosure required of participating companies.' This is despite 'the extraordinary access [Porter] has to almost any company on earth' (Trinca 2002). Apart from issues of commercial secrecy, consulting research is focused on providing company-specific solutions to identified problems. Placing these issues in an industry-wide context and analysing their causes is beyond the scope of most assignments. This thesis returns to some of the issues raised during consulting engagements, and places them in a wider context.

The combined set of the author's experiences overcomes the problem observed by Winner (1978, p. 199), that technically trained persons (described in this thesis as 'technologists') demand that one must first 'learn technology' before engaging in a cross-disciplinary discussion. He describes this as 'usually less a plea for understanding than an urging to compliance'. As a result, 'there is almost no middle ground of rational discourse, no available common language with which persons of differing backgrounds can discuss matters of technology in thoughtful, critical terms' (1978, p. 11). Halloran (1998, p. 20) describes such professional socialisation in which profession members 'take on a range of beliefs, values, basic assumptions and understandings as well as sets of occupational routines, in order to be accepted as qualified and successful'. The multi-faceted approach introduces a new potential problem, the loss of the important 'tension between the insider/outsider perspective' (Singh

1997, p. 37). Arguably, this tension resides within the author's varied experience, but an awareness of this potential problem has guided the thesis preparation.

The author found many examples of sociologists, historians, technologists and business theorists working outside of their traditional perspective, particularly in the context of technology history, user-centred design, technology philosophy and business strategy. Brown (1997) describes the multi-disciplinary perspective as 'seeing differently'. His own example begins from a technological perspective, then moving to take in the user perspective which reflects back on technological issues. This provides a technological audience with the means for understanding the limitations of their perspective. Pirsig (1974) provides an alternative perspective, an opportunity for an audience outside of the technological environment to see the technological approach. Both of these were useful to the author in moving between disciplines, each with their own language and assumptions.

Working across disciplines raises the issue of how to combine multiple sets of language specific to each. For example, 'speculation bubble' is a technical term from economics, defined by Shiller (2001, p. 5) as, 'an unsustainable increase in [stock market] prices brought on by investors' buying behavior rather than by genuine, fundamental information about value'. 'Best-effort delivery' is a technical term from data communication described by Comer as, 'Characteristic of network technologies that do not provide reliability', such as the Internet's User Datagram Protocol. 'Audience' is a contested technical term from media and communication theory which, for Barney (2000, p. 184), is produced for 'sale to manufacturers advertising their mass-produced consumer goods and services'. In each of these examples, these definitions are distinct from common usage. In some cases the same word has a distinct and different technical meaning for different areas, such as 'broadcast'. For communication media, broadcast is a style of media delivery used by radio and television. For

a data network technologist, broadcast is a method for sending data packets[4] over a network. While the networking definition originated from analogy with the media definition, the two are now completely separate. In this thesis in all cases the intended meaning is defined. Sokal and Bricmont (1999, p. ix) examine problems arising from the application of terminology from physics and mathematics outside of those fields. Their warning for multi-disciplinary study, which has assisted this research, can be summarised in the view that 'we are not against extrapolating concepts from one field to another, but only against extrapolations made without argument'.

The wealth of information provided by five areas of research is potentially overwhelming. The purposive selection of literature was guided throughout the research by the research question. This addresses an issue identified by Winner (1978, p. 177): 'The problem with allowing the inevitable flood of variables to enter a theory too early ... is that one may fail to treat the original subject of concern in its integrity'.

2.2 Issues in relation to each area of research

This section examines the primary themes of relevance to this thesis in each of the five areas of research, and the related literature.

2.2.1 History

The Internet is young in historical terms. The impetus for its development, the 1957 launch of the Soviet satellite Sputnik, is still within living memory of many people. With some notable

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[4] A 'packet' is a unit of data that could contain some words, a sound, a fragment of a picture, or part of a spreadsheet or database, transmitted across a digital network. The term 'packet' is used throughout this thesis when referring to the Internet, although the correct technical term is 'IP datagram' (Comer 1991, p. 493).

exceptions (such as Jon Postel and Donald Davies) many of the key participants during its technology development since the early 1960s are alive and professionally active at the conclusion of this study in August 2003. The main historical methodological challenge is examining issues so soon after the event when historical significance is measured in decades rather than years:

> The important effects of the printing press era were not seen clearly for more than 100 years. While things happen more quickly these days, it could be decades before the winners and losers of the information age are apparent. Even today, significant (and permanent) cultural change does not happen quickly (Dewar 2000).

This is separate from a related debate in the study of history described by Fischer (1970, p. 141), 'that a history of ongoing events ought not to be attempted, because objectivity is impossible, evidence is incomplete, and perspective is difficult to attain'. Fischer himself suggests that these same problems relate to all study of history.

It is pointless to predict what in the future will be considered significant in the events of the past three or four decades. The Internet of today may be completely transformed by 2010. Any replacement would draw on some characteristics of the existing Internet, potentially elevating currently slight or obscure aspects of the Internet development while submerging what might today be considered key features. Long-term conclusions from specific events in the later years covered by this study are avoided. This includes the state of the NASDAQ or Dow Jones stock index, or the failure of one or other company when the dot-com stock speculation bubble collapsed. (The term 'dot-com' refers to a company that uses part of its Internet 'address' in its company name, such as 'Amazon.com', pronounced 'Amazon-dot-com'.)

Problems in the study of Internet history identified during the research are:

- The Internet is political: As the Internet moves towards a global regulatory environment analogous to the world telephone or world postal system, it is facing significant problems, including control of a multilingual Domain Name System, and top level domain control (described in Chapter 4). This makes precedent and interpretation of recent events a politically significant issue.
- Secrecy: Coming out of the US Department of Defense, the history of the Internet at least partly remains the subject of government secrecy.
- History as told by leading participants: Much writing to date is provided by or based on the recollections of key technology development figures from the early years of the Internet. Evans (1997, p. 214) raises the difficulty that, 'Much if not most military history written by generals, for example, is hopelessly narrow and ignorant of the wider social, political and diplomatic aspects of the subject'. Where histories focus on the individuals involved in developing the Internet there is also a tendency to the 'heroic theory of invention' identified by Maclaurin (1971 [1947], p. 249) in his study of radio.
- Growing historic importance: In tracing a debate over origins of the Internet, described in Chapter 4, Davies (2001, p. 156) identifies a change in discussions of the Internet between 1970 and 1978: 'A set of papers in the Proceedings of the IEEE [Institute of Electrical and Electronic Engineers] in 1978 is of even greater interest because the writers were evidently conscious of the historical content of their papers.'
- The success of the Internet presented as inevitable: Outside of the Internet context Fischer (1970, p. 135) criticises this approach as 'to prune away the dead branches of the past, and to preserve the green buds and twigs which have grown into the dark forest of our contemporary world'. The assumed inevitability of later events becomes a substitute for examining the detail of the events. Geyl (1958, p. 257) writes in relation to the period before the United States Civil War, 'we cannot do justice to the pre-war years if we will see them only in the light of the war *we* know was coming.' Many histories of the Internet describe its development from the 1960s as an

inexorable growth of an inevitable idea. Internet usage over the period lends credibility to this approach. For Marvin writing in a technical context (1988, p. 154):

> We often see [history] as the process by which our ancestors looked for and gradually discovered us, rather than as a succession of distinct social visions, each with its own integrity and concerns. Assuming that the story could only have concluded with ourselves, we have banished from collective memory the variety of options a previous age saw spread before it in the pursuit of its fondest dreams ... we often see our own past as a less-developed version of ourselves.

- Loss of commercial evidence: While the events described in this thesis occurred very recently from a historical perspective, and are well documented, the effect of the 2000 stock market collapse meant that evidence of possible commercial outcomes from Internet investment was lost, as widespread financial collapse destroyed many companies, regardless of their independent value. From a commercial point of view the losses were very large. In the 12 months from 10 March 2000 the total value of companies listed on the US NASDAQ stock market fell from $US6.7 trillion to $US3.2 trillion (Cassidy 2002, p. 307). By 2001 around $US1 trillion in material investment, as opposed to stock value, was lost. In the six months to August 2001, a large telecommunications operator went bankrupt on average every six days (Roberts 2001a). Damage to telecommunications companies was shown by their level of debt compared to the value of all their stocks in the financial year 2001–02: 325 per cent for France Telecom; 163 per cent for Deutsche Telekom; 60 per cent for British Telecommunications and 66 per cent for Telefonica (Noam 2002, p. 9).[5]

[5] Such spectacular telecommunications company losses also create significant barriers to identifying the benefits that these companies gained as Internet infrastructure providers.

Several histories of the Internet were examined during this research. The Internet history by Hafner and Lyon (1998) provides an introduction to the development of the Internet. This is written in a journalistic style, providing an introduction to the topic and extensive detail. Another early writer is Abbate (1999), who provides a deeper analysis of Internet technology. Naughton (2000) extends these, writing from a European perspective. This places the Internet in a wider context, both in terms of time and in its international setting. Several key participants in the development of the Internet have contributed to writings on the subject. Gillies and Cailliau (2000) provide an insider's view of the establishment of the World Wide Web, in addition to an historical account. Berners-Lee and Fischetti (2000) focus on the Berners-Lee's development of the World Wide Web.

Several technology historians have written since the formation of the Internet on the history of earlier networks and communication technologies. Marvin (1988) provides a study of the development and influence of late 19th century technologies, particularly electricity. Standage (1999) provides a description of 19th century telegraphy. Winston (1998) makes a thorough examination of the economic and political circumstances surrounding major communication media technologies since the telegraph, although the Internet receives relatively brief mention. Clarke (2001) documents the early Australian initiatives that would become part of the Internet. One online source, 'A brief history of the Internet', appears in multiple versions including Kahn (1997) and Leiner et al (2000). These provide recollections from central participants in the development of the Internet. Cerf (2001) provides a later account of the Internet's institutionalisation. Lynch (2001) provides a timeline of the introduction of Internet-related terms and concepts. Stefik (1996) provides excerpts from some of the early proponents of an Internet-style network including Vannevar Bush.

2.2.2 Media and communication studies

Internet usage is examined from a variety of perspectives. Those of direct relevance to this research are media studies and technology usability:

- Usage surveys: Following the experience of television media research, much early Internet usage research has been based on understanding which viewers are seeing which Internet web sites. In the television context this information provides the basis for evaluating the reach of advertising, and for establishing advertising rates. The predominance of advertising as a funding mechanism for information-based web sites lends itself to a similar approach, and commercial surveys such as NUA, <http://www.nua.com>, provide this. The Australian Bureau of Statistics (2000) domestic technology use series and the Pew Internet & American Life series, <http://www.pewinternet.org>, provide Australian and United States domestic usage figures in the late 1990s and early 2000s. Zakon (2001) records the growth of Internet usage since its creation.[6]
- Audience meaning: Silverstone, Hirsch and Morley (1991) focus on 'the "actual practices" of media and information technology use' (p. 208). This changes the focus from the intentions of technology and media content producers to the experiences of consumers in their homes. While this research predates the widespread dissemination of the Internet, it was motivated by the environment from which the Internet emerged (which is described in Chapter 5 of this thesis): 'an awareness that what was becoming available in terms of new technologies, new services and new systems was likely, suddenly, to expand quite dramatically' (p. 208). The diversity of Internet content types and the absence of a single stable media delivery equivalent to broadcast television places audience research at an earlier stage than that of television. Research can be found on single areas of use, such as the review of online communities (Smith & Kollock 1999) and of online gaming experiences by Castronova (2001). Singh (2001a, p. 37) describes the changing context: 'The debate about "active" and

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[6] A completely separate area of Internet usage measurement is that of Internet 'weather maps', such as the University of California, Irvine, Internet Weather Report, <http://weather.uci.edu>. These provide vast amounts of information about traffic traversing the Internet. While such data has existed within telephone networks, there is no equivalent within electronic broadcast media.

"passive" audiences takes on a different dimension when one moves from the TV to the PC and the Internet.'

- Rate of communication technology uptake: Descriptions of the Internet and its uses often focus on the speed of growth, compared to previous media or technologies. Comparisons are difficult to establish for two reasons. First, rates of growth for pre-20th century technologies are often difficult to determine. Marvin (1988, p. 64) writes: 'Early telephone figures are difficult to find and often unreliable'. Second, a basis of comparison may be difficult to establish. Comparisons between media can be based on when a device is invented, which could refer to its prototype, a patent, a working device, or a commercial release. It could consider the launch of a medium such as the Internet or of a service provided on it such as the World Wide Web, which occurred decades later. It could consider absolute numbers, the relative rate of growth, or the proportion of the population using a service. Proportions could refer to a city, country, or the world. The figures might be provided by an industry or by an independent observer. One or many geographical markets could be considered. Potential ambiguity is typified by Barua and Whinston (2001, p. 7), who conclude that the Internet economy is 'bigger' than the Industrial Revolution: 'Starting around 1994, the Internet Economy has grown [at a] much faster pace than the Industrial Revolution that began in the 18th century.'
- The 'digital divide': Much attention given to Internet use is focused on comparing relative accessibility to the Internet for citizens. There is an analogy with widespread literacy or access to the telephone in economically developed countries: without Internet access in an increasingly connected world, an individual or community will be deprived of their ability to communicate. Critics of this approach suggests that reducing communication to the presence or absence of an Internet connection responds to a complicated social problem with a simple technology answer. Cuban (2001, p. 197), for example, argues that the current 'excessive focus on technology use in schools' is a threat to core United States ideals.

- Domestication and usability: The means by which the Internet becomes widely used, and the characteristics that cause a particular service or application to be adopted, draw on existing schools of research. Technologists Brown and Duguid (2000) link technology usage and commercial success, a perspective that is often expressed from the technological point of view, but more rarely from the user point of view, in which they succeed. Management theorist Zuboff (1988) achieves a similar success in her descriptions of how technology is actually incorporated into business usage. Sociologist Singh (2001b) examines the need for connecting technology user and provider perspectives. In addition to recognising the incompleteness of any single perspective, she argues that bridging concepts such as trust, design and effective use should form the basis of a dialogue between technology users, providers and policy-makers. Lally (2000) describes the reception of the Internet in a social context in her examination of Western Sydney families. Newstead (2000) in the Australian context draws common usage success factors from a review of six telecommunications technologies. The way in which an industry develops to support usage requirements is considered from a technology perspective by Rogers (1995), from an economic perspective by Porter (1985) and from a political economy perspective by Mosco (1996).
- The Internet's interactivity: This changes the concept of audience. Examination of this area has been a recurring theme in futuristic, technological and science fiction writings since World War II. From a technological perspective in 1947 Vannevar Bush (1996 [1945]) described the possibility of the widespread interconnection of information sources. Other writers who present a vision of the possibilities of Internet use include Dertouzous (2001) and Negroponte (1995). Sceptics include Oram (2000) who refers to 'the excessive glorification of information as the basis of our economy and society', and Orwell (1949), who presented an early image of interactive television as part of a scheme of social control. Mathematician and science fiction writer Vinge (1987), writing at the end of the 1970s, described many aspects of

cyberspace, including a computer hacking community and the use of 'avatars' (a character that a person creates to represent their appearance) in online gaming.[7] Combining economic, management and social theory approaches, Castells (2000) places the Internet at the centre of a vision of a networked world. Poster (1990) links the effects of the Internet to a post-structuralist description of the world. Many of these views of the effect of the Internet draw on long-held approaches to technology. Technology philosopher Winner (1978) addresses the question of whether a technology such as the Internet has autonomous characteristics, beyond the control of people.

- The success of the Internet: Livingstone (1999, p. 60) argues that, 'which media succeed in dominating the market (and, as a result, everyday life) depends more on their social shaping and contexts of use than on their technological capacities per se'. This suggests that the success of the Internet should be understood in a social context rather than from its technology or individual use. While most of the previous points in this section deal with the effects of the Internet's success, this point relates to the causes of its success. Both of these are addressed throughout this thesis.
- Invention and use: Examination of the relationship between technology invention and use has a long history, and comprises the key consideration within the philosophy of technology. Mary Wollstonecraft Shelley (1985 [1818]) wrote *Frankenstein: The Modern Prometheus,* which is described by Winner (1978, p. 307) as 'still the closest thing we have to a definitive modern parable about mankind's ambiguous relationship to technological creation and power'. Scharff and Dusek (2003) make available an extensive historical collection of writings on the philosophy of technology. Tenner (1997, pp. 9–11) creates a classification system for the 'revenge effects' of technology, where initial expected results are 'rearranged', 'repeated',

[7] The terms 'cyberspace' and 'avatar' with these meanings were coined by Gibson and Morningstar respectively (Gibson 1995; Morningstar & Farmer 1990).

‘recomplicated’, ‘regenerated’, or ‘recongested’. Winner (1978, p. 103) provides a separate perspective regarding the relationship between technology and its consequences. He argues that technology change creates ‘imperatives’ for society, and that focusing on ‘unintended consequences’ of technology understates this.

The medium of the Internet itself provides a poor basis for persistent references. The basic address element of a World Wide Web page is its Uniform Resource Locator (URL), such as <www.isoc.org>. Research published by the Association for Computing Machinery shows that: ‘Approximately 28% of the URLs referenced in *Computer* and [*Communications of the ACM*] articles between 1995 and 1999 were no longer accessible in 2000; the figure increased to 41% in 2002’ (Spinellis 2003, p. 77).

2.2.3 Technology

There are many themes in technological writing regarding the Internet. Most relate to the relative benefits of alternative technologies. In relation to this research, the major gap in this literature concerns the capacity of the Internet to support commercial applications, particularly as a transactional medium: A widespread technology assumption from the mid-1990s that the Internet could be modified to do so is rarely examined. Huston (1999a) and Camp (2000) are among the few writers from among Internet supporters who investigate this problem. Themes in technology literature that are relevant to this research are:

- Understanding technology: While several historians of the Internet provide an introduction to its technology, this is often more easily understood through technological writers. This is because of the purpose of an existing technology, which has been designed to do something. Technological writers are writing about technology in its own context, which may be more easily understood than a descriptive historical approach. Huston (1999a) positions his technological examination of the Internet in a business context, describing how to become an

Internet service provider. Comer (2000) provides a very detailed technical examination of TCP/IP, but at the same time this is moderately accessible to the non-technical reader attempting to understand a concept such as the Domain Name System.

- Defining the Internet: The US Federal Networking Council (1995) definition of the Internet provided in Chapter 1 is clearly technological, using 'Internet Protocol', 'globally unique address space', 'layered' services, and other technical terms in its definition. This emphasises the technological basis for Internet-based services, but also serves to obscure the Internet in non-technical discussion. For example, among networks that are not part of the Internet are those based on Japan's iMode, Wireless Application Protocol (WAP) networks, mobile telephone 'texting' and private global TCP/IP networks. The usage and business implications of these are important, but the distinction can only be described technologically. Throughout the thesis such technical detail is provided where necessary.
- The cultural separation between voice and data communication: A significant difference of perspective exists between technologists in the traditional voice telephony field and the data communication technologists who developed the Internet. In North America technologists from these two perspectives are named 'bellheads' and 'netheads' respectively. 'Bellhead' refers to technologists who were trained in the culture of the US Bell telephone system (Denton, Menard & Isenberg 2000). These differences are reflected in discussions on the relative merits of 'packet switching' and 'circuit switching' described in Chapter 4, for example. The early years of Internet usage were dominated by a haphazard and accidental evolution of technology guided by a sense of technology cooperation. This stands in contrast to the telecommunications culture of the time, including the mission of a telephone in every house and 'five nines' availability for business, service available 99.999 per cent of the time (Mills 2001). Voice communication has been a distinct area of employment throughout the late 19th and 20th centuries, both through telecommunications

companies and within large organisations. A technological and regulatory shift occurred across much of the world in the 1970s and 1980s, as private corporate telephone exchange ('PABX' or 'PBX') equipment connected to public networks. This voice-communication in-sourcing brought with it a set of telecommunications engineering practices, including a regulator-enforced focus on service quality and the ability to identify users and attribute costs. This remains true today, with telephone system accounting software typically identifying usage to an individual within an organisation (such as who is allowed to make long-distance calls and what calls they make). Data communication has existed as a separate field of major employment only since the 1970s.

- The separation of technologists from users: Technologists are trained to adopt a problem-solving perspective. When considering the various possible uses of the Internet from a technological perspective, Stefik (1996, pp. xxii-xxiii) identifies four archetypes: the keeper of knowledge or conservator, the communicator, the trader, and the adventurer. He presents these four views as collectively exhaustive, missing the technologist, and thereby providing no reflective examination of the Internet itself. The technologist sits above or outside of the world of problems to be solved. If technology is 'out of control' (in either a negative or positive sense), who better than a technologist to intercede on a business's behalf? This recalls Babbage's 19th century view of the factory with the engineer as an agent of God's order (Agre 1999). Fischer (1970, p. 151) suggests that the use of archetypes blocks the development of historical understanding. Giving priority to unchanging elements, the archetypes, prevents an understanding of the things that change, the subject of historical study.
- The separation of technologists from business: Joseph Schumpeter (1934, pp. 14–15) describes a relationship that can be seen at the end of the 20th century:

> Economic reality does not necessarily carry out the methods to their logical conclusion and with technological completeness, but subordinates the execution to economic points of view ... Economic logic prevails over the technological. And in consequence we see all around us in real life faulty ropes instead of steel hawsers,

> defective draught animals instead of show breeds, the most primitive hand labor instead of perfect machines, a clumsy money economy instead of a cheque circulation, and so forth.

The research examined large volumes of technology publishing, which are important in identifying social trends in technology. Internet standards provide a public record for review of technological issues. These are called 'RFCs' (Requests For Comment).[8] The Association for Computing Machinery (ACM) Digital Library papers dating back some decades have been searched by topic. The Institute of Electrical and Electronic Engineers (IEEE) and publications of three of its societies (the Communications Society, the Computing Society and the Society on Social Implications of Technology) are a major resource. They provide a means for understanding communication technology, and they present technological views on non-engineering subjects. These include: technological standards development; social issues affecting the success of technologies; technology history; competition between technologies; and technology usage. Several of these publications provide a valuable technological overview of issues for a technological, but not an expert, audience. *IEEE Communication* and *IEEE Network* (reviewed over the period 1993 to 2003), and *IEEE Internet Computing* (from its launch in 1997), are highly technical but include tutorials on new fields for technologist readers and some consideration of standards development. *IEEE Spectrum* (reviewed over the period 1993 to 2003) has regular theme issues, for example on electronic money, which are written in a semi-technical introductory manner in order to be accessible to readers across a wide range of engineering disciplines. *IEEE Technology and Society Magazine* (reviewed over the period 1993 to 2003) examines engineering history and implementation using engineering methodology. It also considers issues of law, history, social organisation, gender and third

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[8] A brief review of Requests For Comment shows that they are unlike an equivalent set of, for example, International Organization for Standards documents. As well as technical concepts, detailed technology proposals and performance reports, some such as Hobbes' Internet Timeline describe history, while others such as the Hyper Text Coffee Pot Control Protocol are humorous. RFCs tend to be much shorter, more practical and intelligible. They are free and published on the Internet.

world development, and provides a forum for discussion of technology philosophy and technology debate, although only a small number of articles touch on these issues.

2.2.4 Regulatory policy

The Internet originated in the United States, and for this reason the major focus of formal regulatory consideration, provided in Chapter 5, is on the United States and the US Federal Communications Commission (FCC). Two issues of importance to this thesis have received little attention. First, how regulation of the early Internet compares to early regulation of previous media. In the absence of specific regulation directed at the early Internet, little research examines indirect regulation. Winston (1998) approaches the question, but primarily focuses on non-Internet media. Second, whether late 1990s regulation of the Internet represents the continuation or a break with early 1990s regulatory activity. The 'information superhighway' term dominated discussions of network services up to 1995, but was then replaced by references to the Internet and the World Wide Web. There has been little examination of whether the Internet represents the implementation of the 'information superhighway', or a break from the commercial expectation of that approach as this thesis argues.

While there has been only limited discussion of these issues, there are several themes in relation to regulation and the Internet:

- The regulatory environment and Internet use: This is generally discussed in its international context. Mueller (2002) provides a discussion of those mechanisms of control that do exist within the Internet, in particular the technical elements that remain the responsibility of the United States government. Several organisations monitor the regulation of Internet content, including: Electronic Frontiers Foundation, <http://www.eff.org>, which specialises in limitations on Internet content; Electronic Frontiers Australia, <http://www.efa.org.au>, which provides a resource on regulation

in Australia; Chilling Effects, <http://www.chillingeffects.org>, which records the effect of legislation on Internet innovation and freedom of speech; and the Internet Global Liberty Campaign, <http://www.iglc.org>, which provides comparative international information. The limits of content control are illustrated by Cryptome, <http://www.cryptome.org>, which provides copies of many documents which other web sites have withdrawn due to legal threats. Regulation of the Internet also takes the form of assertion of national sovereignty over the activity of national citizens. This includes restriction on information and concern about loss of taxation revenue (particularly gambling-based revenue and sales tax). The ability of this approach to succeed is contested by Barlow (1996), who suggests that the existence of cyberspace has already transformed world relations.

- Regulatory experimentation during the period of the Internet's development: This has a primarily United States focus prior to the 1980s, followed by an international discussion of issues such as deregulation. Cuilenberg and McQuail (2003) divide communication media into three regulatory periods: emerging communication industry policy up to World War II; a socio-political focus up to the 1980s; then a period of experimentation and uncertainty. While international deregulation in telecommunications developed strongly in the late 1980s and early 1990s (Sandler 1997), the basis of this had developed over decades. Melody (1987, p. 119) sees dissatisfaction with the AT&T monopoly in the United States as due to a perception of 'the growing magnitude of the potential benefits being foregone'. Schiller (1999, p. 7) writes that a business agenda for corporate use of telecommunications independent of AT&T control developed between the mid-1950s and 1970s based on banks, insurance companies, retail chains, automobile manufacturers, oil companies and aerospace firms. The United States government has yet to establish a single approach, in place of a regulated national monopoly along the AT&T model. Winston (1998, p. 288) describes an experiment in privatised regulation through the 1960s Comsat group responsible for commercial satellite communication. He attributes to this deregulated

approach a significant lost opportunity for United States commercial interests. A second experiment was division of the United State into 500 separately licensed areas for first generation mobile telephony, producing what Hundt (2000, p. 14) describes as 'the worst quality, most out-of-date cellular systems of any developed country in the world.' Following European predominance in mobile telephony technology, the later failure of a common international standard for third generation mobile telephones repeats the standards failures in the digital transmission field which resulted in the E1 and T1 standards, and in the colour television transmission field which has NTSC and PAL (Sung 1997, pp. 329–31). This experience is the background for discussion of the approach to Internet regulation.

- How regulation and technical architecture intersect: Lessig (1999) argues, through an examination of law, the market, norms and architecture, that technology may be used to establish regulatory restrictions. Lessig places major emphasis on the 'end-to-end effect' described by Saltzer, Reed and Clarke (1984). In a traditional telephone network, new services (such as call-forwarding) are provided from within the network. The Internet in contrast sits outside of the network. For example, the World Wide Web was added to the Internet without any 'approval'. This has a regulatory effect. Networks using digital technologies can either provide an unrestricted platform for new applications or they can control new applications.
- What regulation encourages electronic commerce: As a global network the Internet provides a basis for international electronic commerce. This creates potential friction between different legal traditions. These include privacy of information (specifically the difference between European and United States legislation) examined by Agre and Rotenberg (1998), who combine issues of political science, law, sociology, communication and human-computer interaction. There are also strongly opposed perspectives in relation to intellectual property rights and the Internet. One is provided most clearly by the Recording Industry Association of America,

<http://www.riaa.org>. The other is represented by the ‘digital commons’ approach led by Lawrence Lessig, <http://www.digital-commons.org>.

- What regulatory environment encourages innovation: While including an international dimension, the relationship between innovation and monopoly is vigorously debated in the United States, specifically whether the resources of large corporations or the ambitions of small companies are more conducive to innovation. Writing at the end of World War II, Maclaurin (1971 [1947]) argues that in conditions of monopoly, small competitors are unlikely to be able to afford research, including both the cost of development and cost of protecting resulting discoveries. He cites the example of a conflict between two radio patents filed in 1913 and 1914, the outcome of which was not resolved by the Supreme Court until 1934 (p. 256). Similar views were voiced at the time by Schumpeter (1939). Porter (1990), writing some decades later, finds historical evidence for Schumpeter’s view lacking, and attributes innovation to smaller firms and ‘outsiders’ (pp. 787–8). During the period of development of the Internet, the US Federal Communications Commission described its role as being: ‘to create a level playing field where telephone companies using their economic might could not unfairly enter the enhanced service provider market and destroy its competitive and innovative nature’ (Cannon 2000, p. 7). TCP/IP co-inventor Kahn (1994) suggests that active government support was required to maintain innovation in the Internet: ‘What guarantees that the same degree of vitality will be part of its future evolution if market forces alone determine what new capabilities are added to the Internet?’ (p. 11).

Regarding the activities of the US Federal Communications Commission itself, Hundt (2000) provides an account of the FCC in the 1990s. He was chairman of the FCC from 1993 to 1997. It was a significant period in regulation history, including both the adoption of the Telecommunications Act of 1996, the most significant change of regulation since 1934, and the success of the Internet as the predominant global data communication network. An FCC

perspective on Internet regulation is provided in three papers by FCC staff members: Werbach (1997), Oxman (1999) and Cannon (2000).

2.2.5 Business

Within business literature on the Internet there are a wide range of themes and debates. This section examines four themes: defining business benefit; defining and measuring the Internet economy; where the Internet fits in discussion of information technology in business; and, factors that affect clarity in the debates.

Defining 'business benefit': The term 'business benefit' is used in this thesis to capture a range of concepts including commercial value, profitability and return-on-investment (ROI). Business benefit includes these, although it is not a technical accounting term. The purpose of using the term is to identify whether the Internet has provided a financial benefit, without making any attempt to quantify that benefit. Within information technology business literature the concept of a business benefit is widely used. This thesis uses a definition of financially defined gain, described in Chapter 1. This is based on Alinean (2003), which describes itself as 'the leading developer of research, methodologies and software tools to measure and quantify the Value and ROI from Information Technology.' For Gartner Group (Young 2002), business benefit may involve efficiency, cost reductions, improved service quality, improved services or competitive agility. McKinsey Global Institute (2002c, p. 25) uses 'surplus', a related concept examined in Chapter 6. In this thesis the concept of a business benefit is contrasted to the technological concept of a solution to a problem, as this may or may not provide some type of financial value to a company employing it. The following issues were identified regarding 'business benefit'.

- Return on investment (ROI): ROI is a related concept, although it measures a *rate* of benefit. For example, if a $100,000 investment in an information technology project were shown to have produced a financial gain of $200,000, then the ROI would be

100 per cent. The term 'business benefit' rather than ROI is used to suggest that there is financial gain, without making any effort to quantify that gain.

- Relationship to profitability: Business benefit has been used in preference to the term 'profitability'. Comparing profitability of companies investing in the Internet depends on a range of accounting issues that vary within and between countries. For example, the use by Amazon.com of 'pro forma net income' rather than net income defined under Generally Accepted Accounting Principles in the first quarter 1999 resulted in a net loss of $US36.3 million, rather than $US61.7 million that most other United States companies would have reported on the same figures (Doherty 1999). The profitability of companies in Internet-related fields are also significantly affected by the allocation of share options to employees (Lea 2000).[9]
- Business use and business benefit: There is potential confusion between 'business use' and 'business benefit' due to an assumption that anything that is used by business therefore provides a business benefit. This is not necessarily the case. For example, when a corporation implements a programme to comply with legislative requirements, it is meeting a precondition for existence as a corporate entity, but it isn't achieving an identifiable and financially measurable business benefit. On the other hand, if it introduced a system that reduced the cost of such compliance, then it would be achieving a business benefit. There is no simple means for overcoming the confusion that 'use' automatically creates 'business benefit', especially when addressing multiple audiences as required of this thesis. This thesis attempts to clearly separate the two concepts, but the confusion is to a large extent due to a confusion within business itself over what the Internet is providing. While the term 'commercial value'

[9] For 2002 the stated profits of the globally most successful purely Internet-based companies were: Yahoo! Japan, $US102.4 million; University of Phoenix Online, $US85.1 million; Expedia travel agency, $US87.5 million; Hotels.com, $US77.8 million; eBay, $US306.5 million; European Internet service provider Wanadoo, $US31.1 million; Yahoo!, $US143.2 million; Overture Services search engine, $US55 million (*Business Week* 23 June 2003).

was considered, this appeared to be even more confusing, as the thesis could then be seen as arguing that the Internet often lacked 'value' for business, and was by implication 'worthless'.

- Productivity and business benefit: Economists show that there is no necessary relationship between productivity and a financially defined business benefit. 'In economic theory, corporate profits growth has no clear or unambiguous relation to productivity growth, and so it is no surprise that historical data show no such relation' Shiller (2001, p. xxviii).
- Scepticism regarding a generalised business benefit: Warren Buffett, the world's richest investor, told shareholders in Berkshire Hathaway: 'For society, the Internet is wonderful, but for capitalists, it will be a net negative. It will increase efficiency, but lots of things increase efficiency without increasing profits. It is way more likely to make American businesses less profitable than more profitable' (Tilson 2000).
- Technology vendors and business benefit: The research found that many information sources reflected the interests of Internet technology and product services vendors. Shiller (2001), Cassidy (2002) and other commentators identify the role that financial reportage played in encouraging investment during the stock market boom. When France Telecom prepared for the stock market launch of mobile telephone operator Orange in 2001 it employed '22 of the largest European and United States banks to take part in the syndicate—leaving few independent voices' (Roberts 2001d). Henry Blodget gained fame with his successful prediction in December 1998 that Amazon.com would rise from $US242 to $US400 per share (Cassidy 2002, p. 200). He was later fined $US4 million and banned from the industry as part of $US1.46 billion in compensation that US Wall Street companies agreed to pay in April 2003 for inflating stock recommendations during the speculation bubble (Whyte & Taylor). In February 2001 the global chief of stock research for investment bank Salomon Smith Barney reported that of 1,179 (primarily technology) stocks assessed to date, the research group recommended that only one was under-performing, and

had not made a single 'sell' recommendation (Smith 2003). The Cisco-funded study by the Allen Consulting Group (2002) estimated online income for Australian businesses during 2001–02 at $43 billion, nearly four times the estimate of the Australian Bureau of Statistics (2003) for the same period.[10] Enthusiasm for companies is found in corporate profiles. *Making the Cisco Connection* states in its preface (Bunnell 2000, p. xii): 'Cisco shines with a kinder, gentler image, emphasizing happy customers and employees'.

Defining and measuring the Internet economy: The following approaches were examined:

- Defining an 'Internet economy': A series of studies funded by Internet equipment manufacturer Cisco and undertaken by Barua and Whinston (1999; 2000; 2001) measure global revenues and employment by US companies with an Internet involvement. Collectively they define this as the 'Internet economy', a definition used in this thesis. There are four categories: The 'Internet infrastructure layer' includes telecommunications carriers and hardware manufactures, end user equipment manufacturers and Internet service providers. The 'applications infrastructure layer' consists of software vendors and consultants. The 'Internet intermediary layer' primarily consists of online service providers. The 'Internet commerce layer' is made up of companies selling physical products and services over the Internet. While the value that an Internet infrastructure provider places on Internet business benefits must be critically examined, the model is useful in distinguishing diverse aspects of Internet

[10] The Allen Consulting Group report (2002, p. 1) states: 'Online income [in Australia] appears to be growing at an annnualised rate of around 33 percent, currently [in 2001–02] accounting for about 6.4 percent of total revenues. Extending the database findings to the economy at large suggests that Internet Economy revenues currently have a market value of around $43 billion.' The Australian Bureau of Statistics (2003, p. 5) states: 'Internet income earned by Australian businesses increased by $1.9b from $9.4b in 2000–01 to $11.3b in 2001–02. The value of this Internet income represented 0.8% of total business income during 2001–02.'

investment that range, for example, from installing e-mail to conducting online commerce or from electronic procurement to setting up an online business.

- Establishing a basis for measurement: The Organisation for Economic Co-operation and Development (OECD) has examined the requirements of measuring electronic commerce (1999; 2002), a concept that includes, but is broader than, the Internet economy. Other international sources include the quarterly OECD Financial Market Trends, at <http://www.oecd.org>, a United Nations Conference on Trade and Development report (2002) and 'eEurope 2002 Final Report' (Commission to the Council 2002), a report to the European Parliament. The OECD (2002, p. 3) states: 'As ICT [information and communication technology] has only been recognised as a major source of economic and social change in recent years, official statistics on ICT are still under development.' In 2001 the OECD approved a 'model questionnaire on ICT usage in the business sector'. This focuses on levels of use rather than commercial and other effects of use. The questionnaire 'does not contain questions on the impact of ICT use on enterprises' organisation, production processes and skills, or quantitative questions such as investment in ICT goods and services' (pp. 87–8). This suggests that comprehensive comparative international statistics regarding Internet business benefit will not be available for a number of years. In April 2000 the OECD adopted two definitions of 'e-commerce transactions', broad and narrow. (Singh (1999, p. 754) suggests another, 'as an idiom of the future and a synonym for the online environment'.) The OECD definitions are as follows:

> Broad definition: An **electronic transaction** is the sale or purchase of goods or services, whether between businesses, households, individuals, governments, and other public or private organisations, conducted over **computer-mediated networks**. The goods and services are ordered over those networks, but the payment and the ultimate delivery of the good or service may be conducted on or off-line.

> Narrow definition: An **Internet transaction** is the sale or purchase of goods or services, whether between businesses, households, individuals, governments, and other public or private organisations, conducted over the **Internet**. The goods and services are ordered over those networks, but the payment and the ultimate delivery of the good or service may be conducted on or off-line (p. 89).

- Evidence of the Internet economy in Australia: Australian government publications provided extensive information regarding Internet use and its context within the Australian economy. Two series of surveys by the Australian Bureau of Statistics were examined: 'Household use of information technology' (2000) and 'Business use of information technology' (2003). These figures are the most current available in August 2003. Three reports on the effects of information technology investment were examined. The first was 'Productivity and organisational transformation: optimising investment in ICT [information and communication technology]' (Ovum 2003), published by the National Office for the Information Economy (NOIE). This report combines examination of productivity evidence with case studies that suggest ways in which the Internet provides benefit to business and non-commercial organisations. The second, 'eCommerce beyond 2000' (National Office for the Information Economy 2000) provides a review of expected results across the Australian economy from the uptake of electronic business. The third, 'Uptake and impacts of ICTs in the Australian economy: evidence from aggregate, sectoral and firm levels' (Gretton, Gali & Parham 2002) represents combined work by the Productivity Commission, the Australian Bureau of Statistics, the Department of Industry, Tourism and Resources, and NOIE.
- The particular character of the Internet economy: The *Financial Times* statistics editor (Briscoe 2000) identified five difficulties in measuring the electronic business industry: the industry is dominated by small firms; the industry has rapidly changing boundaries and definitions; companies specialising in the industry are more identifiable than in-house activities of other companies; there is no standard

classification system; and, frequent product changes make value and volume adjustments virtually impossible.

The Internet and discussions of information technology: This thesis argues that the Internet's character as a communication medium makes it different to other information technology investment from a business perspective. In contrast, business literature generally considers the Internet as part of broader information technology investment. The additional features of the Internet as a communication medium are described using theories of the Internet's peculiarity as a technology, such as Tapscott (2000, p. 4), for whom: 'the Internet precipitates one of those rare occasions in economic history when we must think even more broadly in order to understand how the entire infrastructure for wealth creation is changing'. This thesis therefore positions itself in relation to some technology debates that may appear to have no direct relationship to the Internet, as these arise in Internet business discussions. Notable relevant debates are the productivity paradox, competitive advantage and whether information technology investment 'matters', discussed below:

- The productivity paradox: Magrassi, Panarella and Hayward (2002) describe the origin of this debate in 1987 when Steven Roach published 'America's technology dilemma: a profile of the information economy'. Roach found that although white collar service sector computer use rose dramatically in the 1970s and 1980s, productivity of the sector had not risen. Fifteen years later, 'No one has yet made the connection between IT [information technology] investment and non-IT-producing sector MFP [multi-function productivity] growth clear and incontrovertible' (Hayward 2002). Krugman (1997, p. 127) suggests that much business restructuring of the 1980s and 1990s did not improve productivity because it did not eliminate jobs: 'it merely outsources them from large corporations that pay high wages to smaller suppliers that often pay less'. Several reports on information technology and productivity from McKinsey Global Institute (MGI) were reviewed (2001; 2002b; 2002c) . The results

of these were combined in a widely cited report, 'Whatever happened to the New Economy?' (McKinsey Global Institute 2002a). This found supporting evidence for the productivity paradox: 'At the economy-wide level, MGI found no correlation between jumps in productivity, and jumps in IT [information technology] intensity. Moreover, our sector studies revealed specific instances where IT failed to raise productivity' (p. 2).

- Competitive advantage: Chapter 6 makes reference to the work of Michael Porter, who developed a theory of competitive advantage in three key works: *Competitive strategy* (1980), *Competitive advantage* (1985) and *Competitive advantage of nations* (1990). He later applied this analysis to the Internet (2001), where he identified the difficulty of companies benefiting from the 'network effect' (the increasing value of a network, such as the telephone network, as more users join it). Each of these works is widely known within business studies, but not well known outside of that field, although his technical term 'value chain' has become part of technological marketing jargon. A comparative study of nine schools of thought in strategic management by Elfring and Volberda (1996, p. 17), identifies Porter (1980) as founder of the 'Positioning' approach, based on economics.[11] In contrast to Porter, Castells (2000) argues that, under pressure from the Internet, old-style hierarchical corporations are in crisis, and that network enterprises, made up of multiple smaller parts, would replace them: 'Under the conditions of fast technological change, networks, not firms, have become the actual operating unit' (p. 187). In a later work (2001) Castells moves away from an economic approach to suggest that, 'new economy is based ... ultimately, on the culture of hope in the future' (pp. 111–12).

[11] The study describes the other schools as based variously on psychology, political science, anthropology, biology and system theory. Some, including Schumpeter's entrepreneurial school, are given no external discipline base.

- The value of information technology investment: The 'productivity paradox' debate received fresh impetus towards the end of this period of research from Carr (2003a), basing himself on Porter (1985). For Carr, 'Little has been said about the way the technologies influence, or fail to influence, competition at the firm level' (p. 42). He suggests that the generalised availability of standard technology, especially the Internet, was reducing the capacity for information technology spending to provide competitive advantage. Within weeks of publication the article had generated responses from dozens of industry publications including *Fortune*, *Financial Times*, *Washington Post*, *New York Times*, *InfoWorld*, ZDNet, *Express Computer*, *Information Week*, *Computerworld*, *eWeek* and *Information Week*. Senior managers from Microsoft, General Motors, Cisco Systems and other major corporations had responded, along with research organisations Gartner Group and Forrester Research (Carr 2003b). The fury of responses suggests that the information technology business sector is beginning to pay more attention to economic views on the need to identify business benefits, as described in Chapter 6. This debate underlines the experience that when economists question the value of the Internet, they are generally suggesting that it is a poor destination for investment, rather than announcing an intention to disconnect e-mail or close down a company web site (no example of this was found).

Factors that affect clarity in discussion of Internet business benefits: Reviewing business discussion of the Internet between 1995 and 2000, the research found that enthusiasm for investment in Internet applications became a barrier to practical discussion of its business benefit. This enthusiasm is described in Cassidy (2002) and the popular press of the period. This enthusiasm took several forms:

- Hyperbole in technical investment: Hyperbole regarding expectations of technology success and profitability was institutionalised by the Gartner Group's 'hype cycle' (1998). Based on the religious imagery of John Bunyan's *Pilgrim's Progress* (1910

[1678]) this suggests four stages for technology uptake: the peak of inflated expectations, trough of disillusionment, slope of enlightenment and plateau of productivity. As a technology moves through these stages, its technical promise may or may not result in broad user uptake. Bronson (2000, pp. xxix–xxxi) describes the practice of inflated expectations in California's Silicon Valley (a region in California based around San Jose, known for its technology industries) just months before the stock market crash: 'One fad after another has been proven to be no more than that, but amazingly, everyone still has a job, plugging sixty-hour weeks into the next fad ... The next five years will be the Valley's greatest boom of innovation to date'. In a departure from traditional market principles, Sahlman (1999) suggested that: 'In all probability, it will not be long before companies go one step beyond free and start paying people to use products or services' (p. 102). A significant example of the effect of this on investment was the strong expectation of success for third generation (3G) mobile telephony services.[12] In a series of auctions, telecommunications companies paid €130 billion for European 3G licenses (Roberts 2001c). Forrester Research (2002) estimates that these telecommunications companies will not recover their cost of investment until 2014 or later. The hyperbole created an environment of sweeping generalisations regarding the Internet. For Rayport and Sviokla (1995): 'In the marketspace [online marketplace], many of the business axioms that have guided managers don't apply' (p. 83).

- Rapid migration of investment into Internet-related stocks: This was seen in the trend among small Australian mining companies, particularly in the nickel and gold sectors. By the dozens these began to transform themselves into technology companies, primarily Internet or telecommunications. For example, an investment of

[12] 3G mobile is distinguished from earlier mobile services by the amount of information it can send. This allows it to support video telephony (seeing the person you are talking to) and data services such as Internet web browsing.

$A2.4 million and a restructure of Golden Hills Mining resulted in the telecommunications company Davnet. In 1999 this transformation lifted shares from 2.5 cents to 33 cents for a total value of $A67 million (Hextall 1999). By January 2000 nearly 100 junior resource companies had transformed themselves into Australian technology companies (Hextall 2000), although this trend began to reverse with the collapse of the dot-com speculation bubble (Liddell 2002). In the United States venture capitalists played a major part in the creation of new companies, such as Kleiner Perkins Caufield & Byers, whose successes included Netscape Communications, Amazon.com, Juniper Networks, FreeMarkets, @Home Network and Handspring (Veverka 2002).

- Embrace of the Internet as a 'disruptive technology': Christensen (1997) provides a theory of 'disruptive technology',[13] which many companies interpreted as suggesting that they should launch separate dot-com company ventures rather than incorporate Internet technologies into their existing business. By 2001 this view had fallen out of favour. For example, a McKinsey and Company survey of 300 members of the Periodical Publishers' Association found that 80 per cent had combined previously separated offline and online enterprises as most publishers had failed to meet online profit targets (O'Connor 2001a). Christensen later revised his views, explaining in 2001 that he does not consider the Internet met his definition of a disruptive technology (Harmon 2001).

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[13] Based on examination of the computer disk drive industry, Christensen found that a major danger for established leaders was the practice of listening to their customers and delivering what they wanted. This blinded them to new industry competitors and new demands for their products, often because the new opportunities were initially less profitable than their current business. He recommended splitting off innovative parts of a company, which would otherwise be smothered by the existing structures. His term is often misunderstood to refer to dramatic technology changes, but this is not so: 'Generally disruptive innovations were technologically straightforward, consisting of off-the-shelf components put together in a product architecture that was often simpler than prior approaches' (p. 15). Schumpeter (1939, p. 216) had expressed a similar view, that 'as a rule the new does not grow out of the old but appears alongside of it and eliminates it competitively'.

- The role of technologist in business strategy: The elevation of a technological voice in the 1990s, for example through the creation of Chief Information Officer (CIO) positions, advanced the technologist as an expert expected to be able to influence the direction of technology. For Hartman (2002) they provided 'business-savvy IT [information technology] personnel to provide visibility into new technologies that can drive productivity opportunities'. For Brown and Duguid (2000, p. 77) the expectation that technologists either understand the basis of technology success (by whatever measure), or are able to discover it because of their technology training, is generally misplaced. They suggest that technologies work because the social resourcefulness of users is able to overcome inherent 'technological frailty'. By contrast, technologists generally approach the question from an assumption that 'people are unpredictable but machines are not' (p. 268).

Several sources of recent business information regarding the Internet were used. Cassidy (2002) provides a list of the 500 US dot-com companies that were publicly launched between 1995 and 2001. Webmergers (2003) provides high level estimates of Internet-related company success, while stating that 'it has been notoriously difficult to obtain reliable numbers as to the total number of Internet companies'. It estimates that at the beginning of 2000 there were between 7,000 and 10,000 'funded Internet companies' in the world. By March 2003, at least 962 'substantial Internet companies' had shut down or declared bankruptcy, and a further 3,892 or more had been acquired. These figures do not provide any indication of the number of internal company Internet projects that have been cancelled or combined, or of non-funded companies. In May 2001 a Goldman Sachs Internet analyst said, 'There was a vast number of small e-commerce companies in the US last year, both public and private, and a minute fraction of those are still trading today' (Benoit 2001). The *Business Week* 'Information Technology 100' list provides a view of commercial interest in particular Internet-related

companies.[14] This list includes the following number of Internet companies (using a narrower definition than that for the Internet economy) in each year: 15 out of 100 in 1998 (2 November), 27 in 1999 (21 June), 4 in 2002 (24 June), and 7 in 2003 (23 June).

The research has made use of the traditional financial press, particularly the London *Financial Times,* reviewed in 2000 and 2001, and the *Australian Financial Review*, reviewed from 1996 to 1999 and from 2002 to August 2003, in order to gain ongoing coverage of industry activity. These showed a greater capacity to examine Internet business issues in an independent manner than industry publications or information technology sections in other quality press (such as the *Economist*, *Times*, *Australian*, *Age*, or *Sydney Morning Herald*). As this thesis was written in Edinburgh and Melbourne, no opportunity was available to review US publications, especially the *Wall Street Journal, New York Times*, *Barron's* and *Business Week,* as events were occurring. Citation of these is based on archival searches. The author acknowledges challenges to reliability in media journalism written to a schedule of daily deadlines.

This section has described current themes, debates and literature of relevance to this research in each of the five selected research areas.

2.3 Integration of perspectives

This section describes the basis for confidence in the findings of this research.

The thesis is based on a wide-ranging purposive examination and analysis of existing knowledge within and across five areas of research. Much of this existing knowledge is unknown to researchers outside of each area. The thesis seeks to combine the knowledge from

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[14] Only a partial list was published in 2000, and the list was not produced in 2001. The selection is purposive, providing a 'best of' rather than a full listing. Conditions for inclusion change each year.

separate areas of research to achieve a result beyond that available from within a single area. The need to integrate results exists even within a single area of research. The validity of research depends 'at least in significant degree' on this process of integration (Silverstone, Hirsch & Morley 1991, p. 214). The task of integration is made more difficult by the multiple sources of research, but the challenge itself is not new.

2.3.1 Use of secondary sources

The use of secondary sources from each of the areas of research requires critical examination. It raises the question of whether an examination of secondary sources can provide the basis for original research. Within each area of research examined, a large body of knowledge already exists. The purpose of this research was not to gather original empirical data to provide the basis of new understanding. It was to compare disparities in understanding across the areas of research, which could then be reconciled and combined in a new way. The following four examples illustrate this.

Media: Within media studies it is generally recognised that the Internet is a communication medium, and that communication media follow common phases of development (described in Chapter 3). It was widely assumed that the Internet would follow a similar path to other 20th century media. I found, in contrast, that the Internet was the first 19th or 20th century medium where widespread usage preceded commercial investment. This finding is based on a combination of historical, media and commercial sources.

Technology: As described in Chapter 4, technologists know that the Internet is a technology that reflects the design activities of a wide range of technologists. It was widely assumed that the limitations of the Internet as a transactional medium would be resolved by appropriate technical design effort. I found that the Internet has proven strongly resistant to commercial technical modifications, and from a commercial service view essentially retains its pre-1995

architecture. This finding is based on a combination of technical, commercial and media usage sources.

Regulation: As described in Chapter 5, the United States regulatory community knows that throughout the 20th century each US communication technology system has been the subject of extensive regulation, including telephony, radio and television. It was widely assumed that the new interactive medium would depend on regulation for its success. I found that the Internet did depend on regulatory intervention for its success, but in an accidental way. This finding is based on a combination of historical, regulatory and technical sources.

Business: From mid-1995, widespread commercial attention to the Internet was based on an understanding that it fulfilled the expectations of a new interactive medium (described in Chapter 6). It was generally assumed that widespread use of the Internet would also meet the commercial expectations of a medium such as the 'information superhighway'. I found that the sudden transfer of commercial expectations from the promised 'information superhighway' to the Internet from 1995 was not accompanied by commercial analysis of the Internet's actual technical or usage characteristics. This finding is based on a combination of commercial, historical and technical sources.

Adopting an empirical research approach, by contrast, would again have led to the dominance of one perspective. As I have shown in my literature review in the previous section, the gap is for multiple perspectives, rather than the immersion in one perspective alone. The need is for integration, after which new lines of questioning begin to open up, which may then require empirical research.

2.3.2 The process of integration

The process of integration can be described in relation to each chapter. The following example describes the development of Chapter 6, focused on business. This was originally conceived

as a presentation of several company case studies based on the financial press, company reports, academic research and business literature. Dossiers on 14 companies were assembled,[15] with companies chosen to reflect varying levels of involvement with the Internet and varying levels of success from investment in the diverse commercial uses of the Internet. This approach is consistent with writings on business research methodology such as Saunders, Lewis and Thornhill (2000).

This approach failed to move beyond a business-based single discipline analysis, however. It did not draw a direct relationship to the Internet's communication characteristics described in Chapter 3, or architecture as described in Chapter 4. The next approach was to review the case studies for aspects that addressed the various areas of research being considered, described in the following paragraphs.

The historical perspective for the chapter arose as it became clear that none of the 14 companies originally examined had turned significant attention to the Internet prior to 1995, even though the Internet already had millions of users by that time. At the level of a single company this is obvious from an examination of infrastructure supplier Cisco, online stockbroker Schwab or online auctioneer eBay. As a combined phenomenon it helps to explain the pace of competition for limited Internet resources in the late 1990s, and the sense of reactive urgency. While business research pays most attention to the current activity of companies, a historian's perspective discovers a pattern in apparently unrelated events.

The issue of usage arose in several ways. Most importantly it addressed the question of the very poor quality of some business decisions when investing in the Internet in the late 1990s, in particular those that paid no attention to the characteristics of Internet use that had made the

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[15] Adultshop.com, Amazon.com, America Online, Berkshire Hathaway, Bertelsmann, Cisco, Covisint, eBay, Egg, Lucent, Microsoft, News Ltd, Orange, Schwab.

medium so popular. The requirement of usability was introduced into the chapter as another precondition, alongside technical suitability, for Internet business benefit. Many economic discussions of the Internet as a technology do not acknowledge that communication media have different development paths to technologies such as railways, refrigeration or electric power. In particular, measuring the impact of a communication medium by its contribution to labour productivity is a difficult task.

Regulatory issues were not considered at the commencement of this research. It became clear in examining previous commercially successful media, however, that regulation has played an important role in both encouraging commercial collaboration and controlling monopoly. Making the regulatory perspective explicit is also important because of the widespread belief among Internet investors that 'deregulation' can be equated to minimal regulatory activity.

The business chapter in turn had to provide a business perspective to a non-business audience.

Once each of these perspectives had been considered, the chapter faced another difficulty: the separate analyses were now organised in identifiable 'piles', but the result was not an integrated whole. Overcoming that problem involved two more steps. First, the chapter was rewritten to establish a clear and logical flow, which allowed each example to be tested for relevance and appropriately located. The final step standardised the structure and language of the chapter, and placed it within the framework provided by the key research findings. Each of these revisions took the form of a major recasting of the text. These proved necessary in moving to a single thematic consideration of the research question.

For each chapter a similar process of integrating perspectives took place. The findings are presented in a form that can be tested against experience in each of the five areas of research. Popper (1968) provides a theory of falsifiability that is used to guide the development of the thesis. Popper argues that objective knowledge can best be approached through propositions that could be disproven, or 'falsified'. This is based on his view that 'it must be possible for an

empirical scientific system to be refuted by experience' (p. 41). (This thesis adopts the approach suggested by Kuhn (1996, pp. 146–7), that such a refutation would result in the modification of a theory rather than its rejection, as a strict reading of Popper would require.) The key findings of this thesis are that the mixed experience of business benefit has resulted from the difficulty of combining usage, technical and commercial understandings of the Internet; the absence of commercial tradition in 1995 provided warning of this, but that warning was obscured by the Internet's rate of usage growth, and generally ignored in the reactive rush for market position. These are all measurable effects.

The findings may appear quite modest, and this in part is a result of using multiple perspectives to find a mid-point in a discussion typified by hyperbole and single-factor solutions. What is startling in retrospect is the failure of investors to examine the communication usage and technical aspects of the Internet prior to significant investment. This thesis examines why these issues were difficult for commercial investors to understand. This is in contrast to critics of the dot-com investment bubble such as Cassidy (2002) and Shiller (2000), who generally focus their criticism on the failure of the Internet to meet unrealistic promise as a technology (comparable to electric power). My analysis in contrast views the Internet as a communication medium. While media theorists have treated the Internet as an important communication medium at least since the early 1990s (as described in Chapter 3), astute observers such as Herman and McChesney (1997) generally expected commercial investment to convert the Internet into a television-style commercial medium. I identify the characteristics of the Internet that made this very difficult (and at the end of this period of research in 2003 still unfulfilled). It is these mid-range discoveries that have been previously unacknowledged.

As described the this section, the approach taken in this thesis is original in its selection and use of viewing angles, in contrast to the many one-sided views of Internet usage, technology, regulation and commercial development.

2.4 What has not been examined

This thesis does not attempt to quantify the business benefit provided by the Internet. As described above, the current knowledge regarding the business benefit from information and communication technologies in general is still at an early stage. For the Internet such empirical data, separated from the effects of the stock market speculation bubble collapse, is not available at the conclusion of the period of research in August 2003.

This thesis does not attempt to define the characteristics of technology investment that contribute to a successful business. It also does not attempt to provide a prescription for the success or failure of Internet-related business at a micro-economic level. Rather it identifies limiting factors regarding business benefits that can be provided by the Internet.

This thesis does not examine the question of whether the success of the Internet was inevitable, a type of question that can be considered metaphysical (Fischer 1970, p. 12). It does not consider whether the success of an alternative global data communication network such as the ‘information superhighway’ would have addressed the commercial limitations described in this thesis.

Chapter 3

THE PRE-COMMERCIAL INTERNET BECOMES A WIDELY USED MEDIUM

By the early 1990s the Internet, which had been developed through several non-commercial funding sources, provided communication services to millions of people. This funding basis was different to that of most other media, which relied on commercial development to gain mass use. It allowed the Internet to become a widely used medium in the absence of commercial investment. This chapter examines the research question: How did the Internet become a communication medium with millions of users by the early 1990s?

3.1 Funding sources for the Internet

Early Internet funding was government-based, initially as a United States military project, and then as an academic and research project.[16] The international technology community designed much of the Internet on a voluntary basis. Infrastructure investment requirements were minimised through the conversion of existing technology for the use by the Internet.

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[16] The earliest constituent of the Internet, called alternatively Arpanet or Darpanet, commenced operation in 1969. The name Internet only came into use in the 1980s. This thesis uses 'Internet' to refer to planning in the years leading up to 1969 and all subsequent forms of the network.

3.1.1 Government funding

United States government research programmes, initially military and later academic, provided primary development funding for the Internet from the 1960s to 1995. These funding periods provide a means for dividing the Internet history into three periods of primary use: up to 1982, military-experimental; 1983 to 1995, research-academic; 1995 onwards, commercial.

Following the October 1957 Soviet Sputnik launch, the US President's Science Advisory Committee put forward a proposal for a new approach to research funding (Rubin 1983, pp. 120–6). The subsequent reorganisation of United States research included the creation of the Defense Advanced Research Projects Agency (DARPA).[17] DARPA describes its programme through most of the 1960s as ballistic missile defence, nuclear test detection, and counter-insurgency research and development programmes, with some work on computer processing, behavioural sciences, and materials sciences (webmaster@darpa.mil 1999). One DARPA project was the creation of a network that would grow to become the Internet. This has been variously described as a decentralised network able to continue functioning in a nuclear war, and a method for connecting together incompatible computer networks (these two views are examined in Chapter 4).

Robert Taylor, director of the DARPA Information Processing Techniques Office, was the Pentagon official who initiated the project. He also had responsibility for information technology problems related to the United States war in Vietnam, and when on military business carried the rank of one-star general (Hafner & Lyon 1998, pp. 12, 152). The project achieved its first communication in 1969. This was based on packet switching technology but in many other ways lacked the features of the modern Internet. These were gradually added in

[17] DARPA changed its name from DARPA to ARPA (dropping or adding 'Defense') several times between the 1960s and 2003. Throughout this thesis DARPA is used.

the following decade. In particular, Vint Cerf and Robert Kahn in 1974 conceived of separating the networking functions from the information transfer functions. This meant that finding a destination across a network was achieved using a separate protocol to establishing end-to-end reliable sessions once the remote destination was found. This is described technically in the separation of the Transmission Control Protocol and Internet Protocol. These are the two central protocols of the TCP/IP protocol suite. The resulting protocol suite was introduced to the Internet at the beginning of 1983. Administration was transferred from DARPA (a research-based organisation) to the Pentagon's Defense Communications Agency (an operational organisation) in 1975 (Naughton 2000, p. 163). Of 62 Internet sites in 1979, 16 were at universities and 46 were in the military-industrial complex (Winston 1998, pp. 331–2). In 1983 the majority of the previously connected computers separated to form a United States military network called Milnet, described partially by Stoll (1991).

The use of United States tax dollars for research and development of Internet technologies is not unusual, according to Rubin. National Science Foundation figures show that between 1960 and 1980 US federal government funding provided 60 to 70 per cent of the cost of all basic research and 45 per cent of developmental costs (Rubin 1983, pp. 111–12). Newman (1999) argues that this is part of a wider pattern of technology development dependence on government investment. In response to critics of government involvement in economic development, he examines the history of United States government funding in what would become Silicon Valley. This began with 19th century US federal government railroad support, then included the research laboratories at both Stanford University and the University of California at Berkeley, and developed with the proliferation of defence contracts during and after World War II.

By the early 1980s the Internet had proven its value as a communication network. Its core architecture was upgraded to the TCP/IP protocol and funding for its communication links gradually moved from the Department of Defense to the National Science Foundation (NSF). The NSF provided backbone Internet services until 1995. These included the Computer

Science Research Network, initiated in 1979 (Winston 1998, p. 332). The 1980s was a period of major growth, as the Internet provided a means for academics, students and researchers to communicate, exchanging e-mails and computer files. Initially this was primarily within the United States, but by the beginning of the 1990s it linked people across many countries. Kehoe (1992) provides a comprehensive Internet user's guide which gives the flavour of Internet use prior to the arrival of the World Wide Web. Sterling (1993) describes uses of the Internet at the time as 'mail, discussion groups, long-distance computing, and file transfers'. The development of the World Wide Web in the European Centre for Nuclear Research (CERN) began in the late 1980s. The Internet that people generally think of in 2003 was completed with the release of the Netscape web browser in 1994.

The decision to pass the US backbone services from the National Science Foundation to commercial interests in 1995 appears to have been less significant than the early privatisation of the telegraph, described in Section 3.3.3, as the Internet by design can bypass any single point of control. However, it clearly defined US Internet infrastructure as privately owned rather than publicly-owned infrastructure (in contrast to the United States postal or national highway systems for example).

The early military and academic research funding of technology development was important, but not unusual. The outcome, an architecture and infrastructure, could have become one more legacy network[18] in the 1990s, if it had not continued to develop and grow on the basis of the enthusiastic contribution of an international network of communication technologists, as described in the following section.

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[18] A legacy technology is one that has been installed and is still in use, but has been superseded (for functional or support reasons), such as an SNA network or Cobol programming: a reliable workhorse still bearing a large load but to be retired as soon as possible. The difficulty and cost of supporting multiple technologies for the same purpose is often the reason for 'migrating' from the legacy technology to a currently supported one.

3.1.2 A technologists' gift economy

From a technology development perspective the early Internet network represented a 'proof of concept'. Making the original architecture robust and scalable (able to continue providing a service as it grows) required extensive modification and testing. It is usually a period of high investment risk as the future value of investment is unknown prior to user adoption. While the financial basis for development of the Internet can be identified as government funding, the intellectual activity required to develop the Internet involved more than hiring technologists. It developed through the voluntary contribution of thousands of technologists, encouraged by its non-proprietary character.

The development approach for the Internet has been that a technologist with an idea can put it forward, through a process that may result in the publication of a Request For Comment (RFC), an Internet standard. These standards are available without cost and contributed by their authors without remuneration. While firmly located within the US Department of Defense environment, the first RFC set out a 'warm and welcoming' tone (Hafner & Lyon 1998, p. 144). This collaborative approach was reflected in the 2002 decision by the World Wide Web Consortium to retain its requirement for royalty free technology in its standards (Olavsrud 2002).

The development of RFCs closely matches the 'open source' movement in programming. This was born as a formal movement with the formation of the Free Software Foundation by Richard Stallman in 1985 (Lessig 2001, p. 53). It encourages the publishing of software for use and modification by others, and is inspired by the sentiment 'information wants to be free', an Internet 'saying'. Stewart Brand, who coined the phrase in 1984, meant 'free' in the sense of cost. He posed the paradox that information is both very valuable, and very cheap to produce (cited in Quiggin 2002). In common use it came to mean both free of cost and free of control.

In addition to much of the Internet's software, open source software includes the Linux operating system, the Apache web server and Pretty Good Privacy security. This has been described as a gift economy (Naughton 2000, p. 206). Linux is based on a public licensing approach. This has precedents in the free information sharing of the public library system, established in the 19th century. Schiller and Schiller (1988, p. 146) suggest that not coincidentally the public debate between open source and proprietary software is now paralleled by attempts to privatise previously public resources in the United States library system. Critics of the gift economy suggest that this leads to 'freeloading' and term the problem a 'tragedy of the digital commons' (Adar & Huberman 2000). This phase refers to an earlier debate, the 'tragedy of the commons', which suggests that without control provided by private ownership, a commonly held area of land for grazing livestock will be destroyed by overgrazing. Shirky (2000b) among others queries whether it is possible to 'overuse' a digital resource, as its use by one person does not affect its availability for another.[19]

Gift economy cooperation is also found among corporations. Winner (1978, p. 164) describes the engineering tradition of cooperation in problem solving: 'similarly trained persons in the technostructures of different firms will cooperate in ways that enhance the effective technical arrangement of a particular branch of industry as a whole, while denying the old-fashioned mechanisms of capitalist competition'. The open source approach reflects the academic tradition of reputation based on publishing, which in the programming community is recast as the ability to write an elegant piece of programming code which is then shared with others.

In addition to the gift economy of technologists, commercial companies also provide subsidised or free products for various reasons. One is to establish an industry standard, with

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[19] While 'digital' resources (described in Section 3.1.3) may be infinitely reproducible without changes to the original, the process of reproducing them uses physical resources. In the Internet context these include facilities to host the resource and communication channels to deliver it.

an expectation of profits generated by sale of related products or services. This is the basis of the free web browser from Netscape in 1994, which established a precedent for future browser products (Naughton 2000, p. 252). Another is to participate in a market from which a company may be otherwise excluded for regulatory or commercial reasons. For example, the development of the Unix operating system by AT&T provided a cheap alternative for educational institutions to products from information technology companies. AT&T was bound by a 1956 anti-trust settlement to 'restrict its activities to the regulated business of the national telephone system and government work'. This precluded entering the computer business, and the Research UNIX Edition V was sold to educational institutions for a nominal $US150 (Naughton 2000, pp. 175–6). Most importantly the license gave users the right to change the code. IBM similarly provided significant resources for the development of the free Linux operating system, allowing the company to compete in an area dominated by Microsoft. A $US1 billion commitment announced in December 2000 made it the largest commercial supporter of the operating system (Foremski 2000). Approximately 15 per cent of IBM mainframe capacity shipped in the first half of 2002 used the Linux operating system (Kerstetter et al 2003).

Because the Internet was seen as peripheral to commercial information industry convergence in the early 1990s, this also kept down the cost of its development at a crucial time. While there were significant disagreements over standards, especially e-mail, a process of technology development and usage uptake settled these. This contrasts to the common United States technology development path, typified by the telegraph and telephone industries, of competing inventors racing to get their discoveries to a patent office. In contrast to the early Internet period, by 2003 Internet electronic commerce was embroiled in patent disputes. In two high profile cases, Amazon.com patented the idea of purchasing goods by clicking on a single button, and Open Market patented the online shopping trolley (Thurm 1999).

Torvalds and Diamond (Torvalds & Diamond 2001) describe a similar situation that assisted the development of the Linux open source operating system. In a dispute over ownership,

AT&T sued the University of California-Berkeley. AT&T was seeking to win some belated benefit from its Unix development, in a case that ended after Novell purchased Unix from AT&T. 'Meanwhile, all the legal haggling had been instrumental in giving a new kid on the block some time to mature and spread itself. Basically, it gave Linux time to take over the market' (p. 57).

In 1994, during a discussion on options for interactive digital television, Bill Gates addressed the gift economy culture of the Internet: 'Nobody can make any money on the Internet. Everything is free' (Bank 2001, p. 39).

Following widespread commercial interest in the Internet from 1995, these gift economy roots were maintained in the provision of extensive free information services, partly funded by advertising.[20] While the information was free, individual users may have invested a significant amount of money in their personal computer, modem, and the Internet access itself,

The technological gift economy played an important part in the development of Internet standards, and therefore of the Internet. This helped bring an experimental research network up to the standard required of a complex and widely used technology. In addition to helping establish the Internet without commercial investment, this gift economy created difficulties for business investment. First, for existing services it was difficult to develop commercial services that could compete with free services. Second, for new services that would not be competing with free services, there was no user expectation or technical infrastructure for payment. (This is examined in Chapter 4.) For businesses selling Internet technologies and services this is not a significant problem, but for those adopting the Internet to improve their competitive position

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[20] US Internet advertising stopped its rapid growth at the end of 1999, by which time it accounted for approximately 2.5 per cent of total US advertising spending, according to Competitive Media Reporting. By this time click-through rates (the number of viewers deciding to click on an advertisement) had fallen to below 0.5 per cent (Tomkins 2000).

in traditional industry sectors it was significant. Regardless of a willingness to embrace the 'disruptive' character of the Internet, these businesses still expected to be paid for goods or services they provided.

3.1.3 Existing technologies provide infrastructure

If the Internet had depended on dedicated transmitters and receivers such as those found in the radio and television industries, the network would probably have had to wait for large-scale commercial investment. An 'invention' is usually based on the combination of existing technologies for a new purpose. The Internet adopted not only technologies but whole technical systems and *changed their purpose*. This included the telephone, personal computer and computer operating systems.

With the telephone, the Internet turned an 'analogue' machine for enabling conversations into a 'digital' machine for carrying data.[21] The telephone system carries analogue signals (conversations) between two people. Increasingly from the 1960s the signal remained analogue only until the nearest telephone exchange, where it was converted into a digital signal, carried across the telephone network, reconverted to analogue at a remote exchange, then carried to the remote person in their home or office. In 2003, for most Internet users with a domestic personal computer, the data is converted by a modem and connected to the voice network. This creates a convoluted arrangement in which the signal leaving a personal

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[21] Most naturally occurring phenomena have continuously varying features, such as the shades of colour in a leaf. These may be directly recorded on analogue systems (such as a traditional photograph or voice recording). 'Digital' refers to discrete numbers (in the case of computers just 0s and 1s) rather than a continuous 'analogue' scale. Analogue information can be represented digitally by breaking it up into short periods or small pieces, and then matching each of these to the closest of a predetermined, digital, series of sounds or colours. For example, a photograph can be digitally recorded, or 'digitised', by dividing it into millions of small areas, and then matching each of these to a chart of 16 million colours. A sound can be digitised by breaking it into small fractions of a second, and then choosing the closest of a set of values matching the sound for that brief moment. To capture a voice for a telephone call requires less information per second than a classical music concert for a CD, but the principle is the same.

computer is converted from digital to analogue to digital, sent across the network as a digital signal, then converted to analogue for the remote phone line and back to digital at the destination computer. This convoluted arrangement shows that the Internet has changed part of the voice telephone network into a data network. By 1990 the ubiquitous modems that achieve this were already highly technically complicated (Turner 1990). This contrasted with the relative simplicity of Internet routing devices.

Lessig (2001) describes the result of using this pre-existing infrastructure, combined with the freely developed standards and software, the 'code layer'. The ownership of the telecommunications network was controlled, but the applications that these were put to were not: 'The Internet was born on a controlled physical layer; the code layer, constituted by the TCP/IP, was nonetheless free' (p. 48).

The Internet changed the 'purpose' of the personal computer.[22] Lally (2002, pp. 3–4) describes home computing in Australia in the mid-1980s as primarily a hobbyist activity. This changed into the home computer as a kind of software 'player' for the home in the late 1980s. By the 1990s, particularly for families with school age children, and people who worked with computers, consumers felt compelled to have a home computer (p. 11). Poster (1990, p. 112), writing without specific reference to the Internet, presents the view that the 'immateriality' of the personal computer is quite different to that of previous means of manuscript preparation, and mimics the immateriality of the human thought process. For Winston (1998) the early development of a small computer in Britain in the late 1940s showed a potential for distributed computing unrealised until the development of the microcomputer in the late 1970s. For Naughton (2000) the mass adoption of personal computers in the 1980s

[22] While the IBM Personal Computer, or PC, is the de facto standard for most personal computers, the two terms are not synonymous. For example, the Apple Macintosh is a 'personal computer', but not a 'PC'. For simplicity this thesis uses PC and personal computer interchangeably.

represented a democratisation of computing power. By contrast, one writer from outside the technology field calls PCs ‘typewriters and high-tech pinball machines’ (Shiller 2001, p. 20).

Without the mass availability of computing resources provided by the personal computer, the Internet would not have had one of its ingredients for success, although the French Minitel approach saw the distribution of 5 million free terminals (similar to a personal computer screen with a keyboard) between 1983 and 1991 (Organisation for Economic Co-operation and Development 1998, p. 9). This suggests that alternative paths at varying cost are possible once integrated circuits create the basis for any form of widely distributed computing. The personal computer is the basic means for accessing the Internet, and preceded the Internet’s mass growth. By contrast, for the telegraph, telephone, radio and television, users had to purchase or rent equipment manufactured specifically for the purpose before they could use the service. This meant that new media prior to the Internet depended on the development of an industry to produce their particular receiver.

The Internet was also able to build on pre-existing computer programming. One initial purpose of the Internet was to allow any computer to send data across the network to any other computer. This was done by creating a protocol that was independent of any computer operating system, and developing separate computers to handle the communication tasks. DARPA funded the provision of the TCP/IP protocol as part of the University of California at Berkeley (UCB) version of Unix from 1985. This provided a strong motivation for many educational institutions to adopt it (Naughton 2000, p. 168).

Ironically, some of the huge commercial Internet data networks also provided a ‘non-commercial’ basis for growth in Internet use. Although many companies such as Global Crossing went bankrupt in the process, they built immense networks that facilitated subsequent Internet growth.

This section has identified those sources of funding which collectively provided the means for non-commercial development of a communication medium. While each of these is widely acknowledged, the contrast to other early media development is not. The following sections of this chapter examine the role of usage in driving this success, and the contrasting historical experience of other media.

3.2 Meeting a communication need

Early Internet services were designed by technologists to meet their own interests. These turned out to be communication needs shared with the wider community and these services, particularly e-mail, were extremely popular. This sections describes how the growth of Internet use was accelerated as other networks became part of, or were replaced by, the Internet.

3.2.1 The technologist as technology user

In the absence of specific direction the early Internet evolved according to the interests and needs of technologists working on the project.

The basis of technology design and uptake is examined later in this chapter. In the absence of a clearly defined subject audience, a technologist will still base their design on some expectation of usage. In that case the perspective adopted will often be a technologist's perspective (Singh 2002, p. 2). This may be unconscious, as the technologist believes they are simply 'solving a problem'.

Technologists may show an understanding of the need to design for users. User-centred design principles described by Norman (1990) contributed to the success of public telegraph systems developed around Morse code in the 19th century, a data communication protocol that was still in use in the late 20th century. This code was distinguished from those of competitors

through its convenience of use, described by Winston (1998, p. 26) as Morse's 'crucial insight'. The code represented each letter of the alphabet with a series of short or long pulses (dots and dashes). For example, the universal call for assistance, SOS, is a particular Morse code pattern. The this code was based on printing practice, rather than arbitrary technological allocation. More common letters were represented by shorter sequences, reducing the effort of use. This came from Morse's decision to observe the frequency of type use at a printer.

The earliest mandate provided to the Internet designers in the 1960s was to create a network that gave high levels of interconnectedness and fault tolerance. The absence of an existing body of expertise for this task and the lack of interest among most business and government authorities combined to give technologists a free hand in implementing this broad mandate. Berners-Lee's original 1990 case for development of the World Wide Web was motivated by a need to retain organisational knowledge. He observed that the European research organisation CERN where he worked was 'losing information' due to the high turnover of researchers serving relatively brief assignments there (Berners-Lee & Fischetti 2000, p. 212). His approach was to preserve the links between sources of information established by one researcher in order to assist later researchers. This is related to the idea that Vannevar Bush proposed: 'Selection by association, rather than by indexing, may yet be mechanized' (1996 [1945], p. 17). This is widely described as the conceptual work behind the World Wide Web, that the trails people follow to find information have a value distinct from compiled catalogues of information. Such preservation of knowledge has provided a focus for technology developers for many years, including by pioneers such as Brown and Duguid (2000) at the Xerox PARC facility.[23]

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[23] There are significant limits to the ability of technologists to achieve knowledge preservation goals, however. Zuboff, cited in Brown and Duguid (2000, p. 30) says: 'The paradise of shared knowledge and a more egalitarian working environment ... just isn't happening. Knowledge isn't really shared because management doesn't want to share authority and power'.

Following the lead of Internet technology and research users, hundreds of millions of people began using the Internet in the late 1990s. How they have used it has been the subject of many surveys. The Australian Bureau of Statistics (2000) provides detailed information on the demographic and usage characteristics of Australian Internet users. This showed that:

> The most popular uses of the Internet at home during 2000 were to use email or chat rooms (68%), general browsing (57%) and finding information relating to work (36%). For adults accessing the Internet at work during 2000 the most popular uses were to find information relating to work (78%), to use email or chat sites (52%) and for general browsing (26%). For those adults accessing the Internet during 2000 at sites other than home or work, the most popular uses were for general browsing (46%), to use email or chat sites (41%) or to find information relating to studies (32%) (p. 17).

A 2003 United States survey asked Internet users what they thought the Internet is like: 61 per cent compared it to a library; 10 per cent each compared it to a meeting place or shopping mall; 6 per cent to a school; 2 per cent to a party; 1 per cent each to a peep show or bank; and 4 per cent to 'all of the above' (Lenhart 2003, p. 15). These suggest limited opportunity for commercial service providers. Internet use in the United States has hovered between 57 and 61 per cent of the population from October 2001 to early 2003. A sixth of these who do not use the Internet have in the past. The same survey examined why they have stopped using the Internet. In 59 per cent of cases it was for financial, technical or availability reasons (p. 22).

A 2000 survey by PricewaterhouseCoopers showed that 90 per cent of home web users said their primary reason for going online was to check e-mail or find information (Enos 2000): 'the number of surfers logging on primarily for entertainment purposes represented a mere 6 percent in the U.S., 2 percent in Australia, and 4 percent in Europe'. A 1999 Jupiter survey showed Internet users rated entertainment the last of five on a list of critical needs (Crowe 1999c).

An NUA survey for September 2002 gave the following regional figures for Internet use: Africa, 6 million; Asia/Pacific, 187 million; Europe, 191 million; Middle East, 5 million; Canada & USA, 182 million; Latin America, 33 million (NUA 2002). First language distribution of Internet users in mid-2002 was English (230 million), non-English European languages (224 million) and Asian languages (179 million) (GlobalReach 2002). This language distribution was not reflected in the language distribution of web sites, according to the global library cooperative Online Computer Library Centre (2002). In 2002, 72 per cent of sites were in English, 20 per cent were identified as in other European languages and 7 per cent were in Asian languages.

The Internet Software Consortium (2003) counts the number of Internet hosts (generally, the number of connected computers), which gives an idea of long-term Internet growth. This shows among other things that between January 2000, a few weeks before the stock market speculation bubble collapse, and January 2003, the number of hosts grew from 72 million to 171 million. Usage figures are far higher than these, as many users share a computer, or log on from an Internet cafe. Historical user statistics for the Internet show that its dramatic period of growth occurred around 1988. Prior to that, there were at most a few tens of thousands of computers connected. In the following three years the number quickly approached 1 million (Lottor 1992). This change occurred well before arrival of the World Wide Web, and as described in Section 4.3.1 was unexpected among veteran Internet technologists.

Throughout its development the designers of the Internet have taken their own communication needs as the basis for its design. This section has illustrated the wider relevance of these needs to a broad Internet user base.

3.2.2 The Internet becomes a widely used medium

From 1983 to 1995 the Internet grew from a small military research network to the predominant global data communication network. Unlike most traditional communication

media, the Internet supports a wide range of uses, including e-mail, the World Wide Web, instant messaging and peer-to-peer music exchange.

Internet use has specific differences to other 19th and 20th century communication media. The 19th century saw the development of two bi-directional electrical media, the telegraph and the telephone. Barriers of cost and technology limited use of the telegraph. Use of the telephone was initially limited by cost. Early telephone installations provided point-to-point services, and the late 19th century telephone, being restricted to the rich, 'was not a democratic medium' (Marvin 1988, p. 153). Within a century telephone provided a cheap form of one-to-one communication for a significant minority of the world's population. This bi-directional pattern was not repeated throughout most of the 20th century. For users of communication media the 20th century provided growing opportunities for consumers to receive rather than interact with information, alongside limited production opportunity. Broadcast radio dominated wireless technology use from its post-World War I emergence as a popular communication medium until the post–World War II arrival of mass television viewing. (Cable and satellite television were also based on the broadcast approach, and it was not until towards the end of the century that a new interactive technology, mobile telephony, emerged.)

The mail system has been in place as a bi-directional communication system for centuries. The arrival of electronic mail between organisations in the 1970s provided the convenience and much of the functionality of mail, but with the speed of the telegraph. This was the early usage success for the Internet, and remains its predominant application. By the early 1990s businesses and other non-campus customers were demanding access because of its usefulness. E-mail is able to provide a communication channel not fully met by the telephone. Adding to, rather than replacing, e-mail was the World Wide Web from around 1993. This greatly simplified the access to online Internet information. Users also now had their first means for mass publishing at low cost in the electronic age. A person or organisation with relatively few resources could now publish something that could potentially be seen by anyone among hundreds of millions of people.

The World Wide Web has been highly successful in creating an environment in which people can randomly follow various interests, pick up music, listen to international radio stations, join chat sessions, and wander through the mountains of trivia which fill up many web sites. The World Wide Web is the most visible aspect of the Internet, even if it is not as widely used as e-mail. Its functions include being a global library or database. This has been enabled by the 'search engine' concept. This allows users to search millions of Internet pages for particular words or phrases.

Previous attempts to develop a large, scalable network of information sources foundered on the question of how to catalogue the information (Gillies & Cailliau 2000). In 2003 extensive projects to catalogue the World Wide Web existed. However, the conceptual leap achieved by the World Wide Web in the 1990s was that an information system does not have to 'know' where it stores information, whether the information is fact or fiction, or whether it has any value to anyone. Searching through a large and unorganised mass of information produces a sufficiently meaningful result to be worth the effort. It also relates to the impossibility of ever fully cataloguing information: 'I think it self-evidently absurd to believe that information can ever be complete, true and up-to-date anywhere other than in a stone cold dead universe' (Oettinger 1990, p. 5). In some aspects Internet communication has the characteristics of an exchange of post cards, described in the tradition of Derrida as the 'presentation of a fragmented and disoriented subject' (Poster 1990, p. 126). This is an accurate description of much e-mail, chat and instant messaging communication. It also describes the effects of Internet search engines, something like flicking through a library catalogue before settling on a relatively arbitrary reference.

The World Wide Web is innately less interactive than e-mail, although Tim Berners-Lee's original concept was 'not just an interface that would provide passive viewing, but something that would allow users to create their online links even as they were reading a document' (Naughton 2000, p. 239). This interactivity is emerging in the growth of 'web logs' or 'blogs'. Each is a diary of comments. Viewers comment on the entries, creating a discussion. Quiggin

(2003) examines two blogs that had a significant impact on United States politics in the early 2000s. The first resulted in the resignation of the US Senate majority leader after researchers persistently documented his record on race relations. The other involved similarly detailed research into gun usage in the United States. Blogs provide the means for painstakingly thorough examination of the public record in exchanges that can extend over months, as 'bloggers are not subject to the constraints of column space or deadlines'.

The growth of the Internet emphasises its role as a communication medium, rather than simply a technology. In particular, interactive applications have been the most widely adopted. This has remained true throughout all periods of Internet development.

3.2.3 Other networks converge on the Internet

From 1990 Internet growth included combined streams of access. These represented a technologically and geographically diverse set of non-commercial and commercial networks.

By design the Internet has a capacity to link diverse networks. It was the linking of Arpanet to military 'packet radio' networks[24] and satellite networks that made it an 'internet' rather than simply a network (Leiner et al 1985). The development of these links took place in several ways. The Internet networking rules, TCP/IP, were widely disseminated with the Unix operating system. This meant that many of the separate networks that existed throughout the world in the late 1980s could interconnect using this protocol, and the skills required to do this were widely spread.

From an operational point of view the free Internet standards made it a popular choice outside of the corporate environment. The primary need to connect was in order to exchange e-mail

[24] Packet radio is a means of sending digital data over a traditionally analogue radio channel.

between separate systems. Application gateways provided the means for many protocols to connect. In general achieving interconnection of networks was as simple as setting up two modems or leasing a data communication line between the offices hosting the separate networks and attaching appropriate devices at each end. Because e-mail is not particularly time sensitive, a slow connection between two networks could still meet the need for interconnection. International links involved more expenditure, but were also relatively simple to connect. (Connecting different e-mail software, however, is not so simple.)

At the centre of the confluence of networks was the National Science Foundation–funded Internet, based in research and academia. A second stream was the international development of data networks, especially in Europe, funded primarily by government or academia. Academic networks existed in many countries. Typical academic networks included AARNET in Australia, funded by the Australian Vice-Chancellors' Committee (Clarke 2001), and the Indonesian Inter-University Computer Network, UNInet (Luhukay, Somali & Tedja 1986).

A third stream comprised the community of bulletin boards, including Fidonet, which commenced in 1977 and were based on increasingly sophisticated modem programmes. These were distinguished by a low cost of entry, 'owned and operated primarily by end-users and hobbyists more than by computer professionals' (Bush 1993). The role of such networks outside traditional research and academia is illustrated by the Australian Pegasus Networks, affiliated to the international Association for Progressive Communication. In 1991 the network operated an e-mail and conferencing system, which linked to networks in seven countries. It also provided e-mail gateways to Applelink, ACSNet/AARNET, BITNET, Dialcom, FIDONet, Janet, Portal and the Internet (Peter 1991). This stream brought with it a tradition of social activism, including Internet-based discussions, consumer advocacy campaigns, and international coordination of movements taking up issues of globalisation. Walch (1999) gives an Australian perspective on this, describing the relationship between early voluntary networks and community organisation.

A fourth stream was made up of the growing commercial networks, most importantly the French Minitel network, that had achieved commercial success but were essentially based in a single country. In 1990 Poster describes the Minitel experience as the 'most extensive and fascinating experiment in computer communications services for the general public' (1990, p. 119). This suggests a strong link between the user experience with Minitel and the subsequent Internet.

A fifth stream was government use, as the Open Systems Interconnect (OSI) vision disappeared. (This is described in Section 5.2.3.) By around 1993 the failure of government-endorsed standards to materialise forced many governments to adopt the Internet standards as a stopgap measure. In Australia, for example, speakers at the 1992 Government OSI Profile Conference in Canberra recommended an interim migration from proprietary to TCP/IP protocols in certain areas pending the completion of the OSI suite (recorded in the author's conference notes).

The combination of these networks to form an expanded international Internet, the expense of Asynchronous Transfer Mode (ATM) hardware for the 'information superhighway' (described in Chapter 5) and emerging business interest in e-mail, meant that the Internet gradually began to fill the global information network void. Its lack of both cost and competitors meant there were few barriers to this. The arrival of the World Wide Web Mosaic browser in 1993 took the network out of the hands of two million or so technicians and semi-skilled professional users by making it immediately and intuitively available to tens of millions more. The final part of this chapter considers this in comparison to other media.

3.3 How other communication media development compares to the Internet

The uptake of new media technologies occurs in a pattern, with common phases of growth. The major difference between the Internet and other communication media was the absence of business requirements during the Internet's development prior to 1995, despite its use as a

communication medium by millions of people. The late development of business interest from 1995 is examined in Chapter 6. This section reviews the experience of previous media.

3.3.1 Invention of communication media technologies

Each new communication medium satisfies particular user requirements. This is seen in the history of the Internet and other media technologies. The subsequent stages of growth also share common features across media.

An examination of the evolution of such media technologies as the printing press, telephone and television shows an intricate interaction between technology and society. The emphasis placed by technology historians such as Marvin (1988) on continuity with past developments is in contrast to that of contemporary reviewers such as Gleick (1999), who write that cultural changes are speeding up, and that this is having an effect on technology uptake.

Winston (1998) creates a framework for viewing the development and uptake of each media technology, including scientific, legal and commercial issues. His model addresses the question of why technology discoveries often occur virtually simultaneously, such as creating a multitude of ways for achieving voice or picture transmission that then find themselves in patent disputes. For Winston, the basis for the technology development of a medium is the existence of scientific discovery followed by 'technological performance'. The creation of a technological prototype is not possible until scientific and technical competence is in place, but it is not inevitable. The technological bases for a large number of inventions may exist for decades prior to their combination in an invention, such as the ball point pen (Brown & Duguid 2000, p. 266).

The prototype may be successful, partially successful, fail, or migrate to some other use. This will depend on what Winston calls 'supervening social necessity', a need for the prototype. For radio this was coordination of naval fleet. For telegraph it was the need to avoid train

collisions. For the Internet the primary need has been e-mail. This concept is reflected in business literature as the ‘killer application’, although this is more broadly defined to include any application that is highly successful.

The first of the modern media, electrical telegraphy, provided a means of rapid information exchange across any distance (although not to any location) around the globe. In both France and Britain early electrical telegraph advocates were unable to gain military interest despite its apparent suitability for military purposes. The concept of using electricity to send telegraphic messages (in contrast to the visual semaphore telegraph) was provided as early as 1753 in a letter signed ‘C.M.’ to *Scots’ Magazine* headed: ‘An expeditious method of conveying intelligence’ (Standage 1999, p. 19). Various prototypes were developed in the early 19th century, although its introduction was delayed by the existing semaphore system, particularly in France. The semaphore telegraph was an integral part of centralisation of the French state under Napoleon (pp. 14–15).

In the absence of initial military interest, an alternative course of development was an information network linked to the major growth industry of the time, the railways. Early railways had a single set of tracks, so head-on collisions were a significant hazard. The first telegraph lines were laid beside railway tracks, and carried messages between stations regarding approaching trains. In 1840 the first telegram of general public interest in Britain, notifying the birth of a royal heir, was carried from Windsor to London on the Great Western Railway’s telegraph line. Four years later Samuel Morse’s first telegrammed message, ‘What hath God wrought’, was carried along the side of railway tracks (Winston 1998, p. 24).

Practical tests of the first radio were undertaken at the end of the 19th century. In 1898 Gugliemo Marconi, working with the British navy, was able to send signals across 100 kilometres of water. Just as the telegraph had solved a problem for rail transport, the requirement for radio was created by the growth in size of ironclad ships:

> Their guns had a range of up to 7000 yards and to avoid collisions they needed to steam into action 800 yards apart. This meant twelve ships of the line stretched over 6 miles of sea which in turn caused a major communications problem (Winston 1998, p. 71).

Once the technological basis for a communication medium exists, and a supervening social necessity provides the need for it, the medium then develops in a series of identifiable stages. The first notable 'media technology' after the development of writing itself was printing. This is generally dated from the invention of movable type by Johann Gutenberg around 1450. Steinberg (1974) divides the subsequent history of printing into three periods:

> (1) 1450–1550, the creative century, which witnessed the invention and beginnings of practically every single feature that characterizes the modern printing piece; (2) 1550–1800, the era of consolidation which developed and refined the achievements of the preceding period in a predominantly conservative spirit; (3) 1800 to the present, the period of tremendous technical advances, which has radically changed the methods of production and distribution as well as the habits of producers and readers (p. 12).

The concept of stages of development is important in examining media, including the Internet. It provides a basis for identifying how the Internet differs from other media. The next section looks at the growth of mass audiences for new media technologies.

3.3.2 Reaching a mass audience

Successful technology dissemination involves a previously unknown technology becoming part of the daily lives of millions of people. This may be considered a reflection of the power of the technology, although this thesis argues for a more diverse set of factors as described below. For example, a technological view may see the telephone network as a network for connecting telephones, 'the largest machine ever built' (Hundt 2000, p. 39). From the point of view of use it is a global network for connecting people, a voice-based communication medium.

An example of the ‘domestication’ of technology can be seen in the radio receiver. For a 1920s household the radio represented an electronic device providing voices from across the world. While cinemas had provided images in a public location, the house remained a private place, although the radio had been preceded by the gramophone and newspaper. The early radios consisting of boxes of wires and valves were changed into items of furniture:

> The resulting designs, paradigmatically those of Gordon Russell for the manufacturer Murphy, involved radio appearing in the form of modern, if not slightly futuristic, furniture. The technology was hidden in a wooden cabinet, but the cabinet was designed in such a way as to indicate its distinctive status and function when it arrived in the living-room (Silverstone & Haddon 1996, p. 48).

Writing prior to the mass growth of the Internet, Marvin (1988, pp. 205–6) examines the ideological aspects of ‘revolutionary’ technologies:

> A useful strategy for stripping social phenomena of the power to endanger the status quo is to anchor them to safely established notions while presenting them for public consumption as revolutionary. This was the strategy that defenders of electrical progress used to fend off unwelcome challenges to the social-world-in-place from the electrical-world-in-prospect while appearing to embrace the latter world fully and fearlessly. Electricity was frequently characterized as revolutionary to compare it to the steam revolution that had preceded it. That comparison reversed the usual meaning of *revolution* as a decisive break with the past, however. The work of electricity was presented as continuing the work of the past, and the past with all its difficulties was justified as a necessary prologue to the present and the future.

Each of these technology developments shows the complicated relationship between technology discovery and uptake. This contrasts to the ‘technological determinist’ approach shown, for example, by Gates (1995, pp. 120–1):

> Gutenberg's invention of the printing press brought about the first real shift in distribution friction—it allowed information on any subject to be distributed quickly and relatively cheaply. The printing press created a mass medium because it offered low-friction duplication. The proliferation of books motivated the general public to read and write, but once people had the skills there were many other things that could be done with the written word ... Books gave literacy critical mass, so you can almost say that the printing press taught us to read.

As Gates only means to give his readers a small insight into a period of history they may have no knowledge of, the anachronism of a 'general public' deciding to pick up a book in 1450 is understandable. However, he also introduces the technological determinist view that the technology discovery itself was responsible for the subsequent effects of print media.

The development of a literate 'general public' is the course of history for the 450 years after Gutenberg's discovery. After the first 200 years, in 1650, only 20 per cent of Europe's population was literate, so there were clearly more issues involved than the production of printed literature. Literacy gradually improved over the following 150 years, with European literacy around 50 per cent at the beginning of the 19th century (Cook 1996, p. 73):

> Among the factors associated with this improvement was the growing role of reading and writing in work, especially in the trades. In fact, one of the earliest exceptions to the exclusion of literacy to all but social elites was its appearance among the trades. Reading and writing became a growing part of work as the increasing organization of society expanded the need to keep records ... Significantly, the spread of literacy to more people and more classes of people during this period (approximately 1650 to 1800) occurred alongside some rather remarkable changes in both the idea and reality of social equality.

Technology philosopher Langdon Winner describes the core views of technological determinism (1978, pp. 75–6).

> Understood in its strongest sense, technological determinism stands or falls on two hypotheses: (1) that the technical base of a society is the fundamental condition affecting all patterns of social existence and (2) that changes in technology are the single most important source of change in society.

Technological determinism is a common form of technology writing in the popular press, the idea that a new technology is invented, and then changes the way that people live their lives. This view sits at the opposite end of a spectrum from a view such as Schmookler (1966, p. 209) that invention is a routine activity produced on demand:

> Even the state of knowledge at a point in time in 'intellectually coherent fields' of technology, and therefore the inventive potential of those fields, are economic variables, for the rate at which each such field is cultivated is primarily determined by the promise it holds of yielding useful knowledge.

Freeman (1987) summarises the debate between these technology uptake theories as 'technology-push' and 'demand-pull'. Technology-push is the view that the entrepreneur in the market provides a product or service which users may then adopt.[25] For demand-pull, a market develops for a technology, which is subsequently fulfilled. This debate includes focus on the quantitative relationship between published scientific papers, patents, and investment, looking for the patterns that might show a tendency for one to follow another.

Each of these perspectives provides a means of examining the Internet. In contrast to the technological determinist view, technology was only one of several elements in the success of the Internet, as described in this and the following two chapters. In contrast to demand-pull,

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[25] A separate concept, 'push technology', refers to providing information to Internet users that they have not requested. It was poorly received by Internet users, although in 1997 it 'galvanized hope for converting the Internet into a viable commercial mass medium' (Herman & McChesney 1997, p. 125).

there was no market meeting the communication needs of users across the range of commercial computer operating systems. In the case of the Internet, a commercial market to provide services such as e-mail only emerged after the Internet's success as a communication medium. The gradual rise of non-commercial demand in the 1980s and early 1990s contrasts to the wave of business interest from 1995 described in Chapter 6.

This section has introduced views on the basis of technology usage uptake. This thesis argues that the non-commercial evolution of the Internet in response to user needs, rather than a single technology discovery or astute commercial investment, has been central to success of the Internet. This is important for understanding the failure of extensive commercial investment in the late 1990s that based itself on expectation of dramatically changing user needs due to the availability of a new technology.

3.3.3 The establishment of communication media industries

An examination of the telegraph and telephone communication media technologies shows that each achieved a mass audience following the establishment of a commercial industry, which led user uptake. This is also the case for radio and television, which are examined in Chapter 5. The business benefit achieved by each of these industries is compared to the experience of Internet investment in Chapter 6.

The development of a commercial United States telegraphy industry is well documented, and established a pattern for the subsequent commercial media industries of telephone, radio and television. Samuel Morse was voted $US30,000 by the United States Congress in 1842 to establish the first telegraph link between cities, from Washington to Baltimore, opened in 1845. Just 13 years later the first trans-Atlantic cable was laid. Already by 1852 *Scientific American* wrote:

> No invention of modern times has extended its influence so rapidly as that of the electric telegraph ... The spread of the telegraph is about as wonderful a thing as the noble invention itself (Standage 1999, p. 57).

The pattern of commercial usage for the telephone was established by the telegraph. First, telegraph usage was charged by the character. Second, by privatising the line in 1845, shortly after opening, 'a crucial privatising precedent was set in American public communications policy' (Winston 1998, p. 27). Third, the equipment used to provide the service remained the property of the telegraph company.

The invention of the telephone in the 1870s overshadowed the telegraph technologically and commercially, even if not displacing all its functions, especially data services such as stock prices and money transfers. History lists the telephone as having been invented by Alexander Bell in 1876. An examination of his key patent on which the AT&T telephone empire was subsequently built, however, shows a more complicated process. This patent identifies the discovery first as a method for sending multiple telegraph signals along a wire. No mention is made of it being used for speech. His design served well as a telephone receiver, but not as a transmitter. The core functionality of telephone as it is now known developed over subsequent years. Winston describes the contest over the discovery of the telephone, and the patent which Bell and his partners fought more than 600 legal actions to defend (Winston 1998, p. 28). He sees this as following the pattern established by privatisation of the telegraph in the United States:

> The policy of privatisation thus created was not reversed when such uses [newspapers receiving advance notice of news] made the telegraph into a commonplace a year or so later and private enterprise was creating a system racked with patent disputes, geographical dislocations and redundant duplicated wires.

Where Winston sees a question of public policy, Bellaver attributes AT&T's early aggressive commercial practices to the leadership of banker J. Pierpont Morgan. In 1906 the company was described by the corporation council of Chicago as a 'ruthless, grinding monopoly', for its policy of refusing to allow competing telephone companies to interconnect with AT&T or through to other companies, and also for buying up rivals. By not giving independents the long-distance connections they needed Morgan forced many of them to sell out to AT&T at rock-bottom prices (Bellaver 2002). This situation was resolved with the Kingsbury Commitment of 1913, nine months after Morgan's death. AT&T sold Western Union and agreed to interconnect to other carriers. Most importantly this agreement laid the basis for AT&T becoming the single United States telephone monopoly for the next seven decades.

Where the telegraph had charged for payment at the point of provision of the message (in writing) to the operator, the telephone system included an operator who was necessary to make the connection. When later systems began to automate the operator's role, a key feature was that the automated exchanges needed to be able to track all use made of the network for billing purposes.

A major challenge to commercialisation of radio for widespread use was the 'lack of privacy' of radio messages (Winston 1998, p. 101). Partly for this reason it was only after World War I that the development of radio as a communication medium occurred, based on an approach that sought to win as many listeners as possible to the message, either for commercial or government purposes, thus overcoming this privacy 'limitation'. This made radio the first broadcast communication medium, although radio programming copied telephone programming, which originated in Budapest in the 1890s (Marvin 1988, pp. 223–8). By 1896 Telefon Hirmondo was providing a daily programme over the Budapest telephone system, including stock exchange reports, a summary of the daily news, theatre and sport news, and parliamentary news. This preceded modern radio programming by a quarter of a century.

Commercial radio funding was based on advertising, although this was not as dramatically different to the telephone as might appear:

> Advertising had been introduced by AT&T who, in seeking to treat the radio as just another sort of telephone, had come up with the concept of leased time for commercial messages (Winston 1998, p. 80).

One feature of the Internet investment hyperbole was the expectation that it would replace other existing media, including books, newspapers and television. Similarly, because of the telegraph's ability to delivery critical information quickly, there were widespread predictions that the telegraph represented the end of printed newspapers. *New York Herald* editor James Gordon Bennett predicted in 1846: 'The telegraph may not affect magazine literature, but the mere newspapers must submit to destiny, and go out of existence' (Lewis 2003). A century-and-a-half later Don Logan, president of Time, Inc. was able to provide a more long-term view that 'the electronic revolution is simply one new form of communications that will find its place in the food chain of communications and will not displace or replace anything that already exists, just as television did not replace radio, just as cable did not replace network television, just as the VCR did not replace the movie theatres' (Snoddy 1997).

Barr (2000, p. 156) points out: 'Paradoxically, the old media seem to be thriving and prospering in this age of new media.' Even the early 2000s craze in texting with its language of abbreviations recalls the telegram. Marvin (1988) responds to an approach to media technology history that focuses on the technology itself, the 'instrument':

> The model used here is different. Here, the focus of communication is shifted from the instrument to the drama in which existing groups perpetually negotiate power, authority, representation, and knowledge with whatever resources are available. New media intrude on these negotiations by providing new platforms on which old groups confront one another (pp. 4–5).

The expectation of communication media evolution is accompanied by an expectation that the 'old' Internet will evolve into a 'new' Internet. For Gartner Group researcher Smith (1997, p. 2): 'The Internet will evolve from a passive publishing medium to an interactive computing environment that redefines and expands beyond today's client/server computing models and into transaction processing and electronic commerce'. One of the more ambitious Internet-based alternatives to broadcast television was the failed Digital Entertainment Network, which 'set out to feed 14 to 24 year olds a stream of five-minute episodic videos and other material tailored to their short attention span and varied tastes' (Parkes 2000). While challenging the programming patterns of broadcast television (or more accurately, generalising a single pattern), the service still delivered pre-prepared content to an audience, rather than building on the Internet's interactivity.

Viewing the Internet as a communication medium, rather than as a technology, better explains its development and growth. This in turn is valuable in understanding the impact that it has had on corporate culture. There is a wide separation between this impact and any simple expectation that Internet adoption will inevitably lead to business benefit.

This section has described early events that led to the commercial communication media existing in Australia, the United States and elsewhere today. In each case the particular media technology was one part of the development, while usage, commercial and regulatory issues also contributed. The distinct difference for the Internet was its success as a communication medium prior to the development of such a commercial industry.

3.4 Summary

In this chapter I examined the origins of the Internet, providing an answer to the research question: How did the Internet become a communication medium with millions of users by the early 1990s? I identified three aspects of resourcing, and the role of usage in creating such a success. In contrast to existing literature I compared this development path to other

communication media of the past two centuries. The information provided in this chapter, however, only addresses the situation prior to 1995. If the subsequent evolution of the Internet had then followed the pattern of other commercial media, these origins would have simply been a historical footnote. The next chapter examines the technology legacy that the Internet carried with it beyond 1995. A later chapter, Chapter 6, considers the effect of these origins on business benefits provided by the Internet.

Chapter 4

INTERNET ARCHITECTURE AND BUSINESS REQUIREMENTS

The Internet in its development up to the early 1990s lacked a commercial imperative, reflecting its usage and funding basis previously described. This is evident in its architecture, which is highly useful for communication for both commercial and non-commercial users, but poorly supports business transactional requirements. In contrast to its earlier period of development the Internet has shown significant technological inertia since the early 1990s. With a few notable exceptions, by 2003 most efforts to modify its architecture have failed. This chapter examines the research question: Did the development of the Internet prior to 1995 shape its technical architecture in a way that limited its later commercial use?

4.1 Early usage and Internet architecture

The origins of the Internet mean that at no point up to the early 1990s were its commercial or transactional capabilities critical to its progress. By the beginning of its commercial period in 1995 its overall use had grown beyond the capacity of orderly technological modification, such as those required to create a business transactional medium.

4.1.1 Military usage requirements

Chapter 3 examined funding sources for early Internet development. This section considers the use that the Internet was designed to serve. The early military purpose of the Internet is either viewed as military command and control, or military administrative. In order to follow the debate between the two views of the original purpose of the Internet it is necessary to understand the role of packet switching technology in the functioning of the Internet. This debate is important for this thesis in establishing non-commercial origins, and in understanding that the Internet by design lacks mechanisms of control.

Sending information (including voice and data) across a network can be divided into two steps: firstly, identifying where the information has to go; secondly, delivering the information. These two steps can be combined or separate. In the postal network they are combined: information is packaged in a letter or parcel and an address is added to the outside. Once the package reaches this address, the information itself has been delivered. To send 10,000 letters from one organisation to another the same process is repeated 10,000 times. This example (not analogy) is packet switching. In a traditional telephone system the processes are separated. Deciding where a call should go is done during call set-up. A telephone number is hierarchical. The international code, national code, regional code and local exchange are each represented by certain digits within a telephone number. When a telephone number is dialled, these groups of numbers are used to select from among all possible destinations. Once the call has been connected, then information (a voice) is delivered between two people over a dedicated series of links joining them. These links are not separate physical wires or optical fibres, because wires and fibres carry many calls simultaneously. But the links are identifiable and reserved parts of physical connections. Whether the call lasts for five seconds or five hours, it is only set up once, and all the

information is transferred along the same path or circuit. This is circuit switching. While the traditional telephone networks use circuit switching, the Internet uses packet switching.[26]

For some writers, packet switching offers a completely new *business* (rather than technical) basis for electronic communication: Isenberg (2003, p. 38) writes, 'when AT&T was offered a leadership role in Internet development, it passed—just as Western Union passed on the telephone a century earlier'. The 19th century decision by telegraph giant Western Union not to buy the telephone patent, which resulted in its commercial demise, is described by Brown and Duguid (2000, p. 88). Hafner and Lyon (1998, p. 232) describe the decision of AT&T to decline a US Department of Defense offer to run the Internet infrastructure in the early 1970s. Whether these decisions are comparable is disputed. Roberts (2000) argues that both packet switching and circuit switching have commercial promise. Roberts played a key role in the design, initiation, planning and development of the Internet. He argues that as long as communication lines are expensive, their high utilisation (achieved by packet switching) is predominant. As communication line costs drop, converting information into packets becomes an expensive overhead. As the cost of communication lines is falling at a faster rate (halving every 12 months) than packet switching computing (halving every 20.7 months), circuit switching may once again become more cost effective than packet switching. From a telecommunications industry perspective Goeller (2000) argues that AT&T made the correct commercial decision. He points out that in 2000, nearly three decades after AT&T's decision, TCP/IP still doesn't predominate in telecommunications networks.

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[26] Circuit switching and packet switching have several fundamental differences, which require an 'intelligent network' and an 'end-to-end network' respectively. Circuit switching users are connected in 'real time'; a service is either available or engaged, connected or not connected; the network is aware of the state of all circuits. These are not required for packet switching. Each has a disadvantage. While circuit switch wastes resources by reserving a resource when it is not being used, packet switching forces information to queue beyond its useful life when more information is sent than can be immediately forwarded.

Packet switching was invented by Paul Baran in the 1960s. The two views of the purpose of DARPA's original Internet investment depend on interpretations of the role of Paul Baran with RAND, a United States research organisation with extensive military involvement. The reason for examining Baran's work is in order to identify the early reasons for Internet development, rather than to suggest that packet switching is the Internet's single technical discovery.

According to one history, 'It was from the RAND study that the false rumour started claiming that the ARPANET was somehow related to building a network resistant to nuclear war.' In this view Baran was one of many working on packet switching:

> Leonard Kleinrock at MIT published the first paper on packet switching theory in July 1961 and the first book on the subject in 1964 ... It happened that the work at MIT (1961–1967) [by Leonard Kleinrock], at RAND (1962–1965) [by Paul Baran], and at NPL (1964–1967) [by Donald Davies] had all proceeded in parallel without any of the researchers knowing about the other work (Kahn 1997).

The Institute of Electrical and Electronic Engineers (IEEE) describes Baran rather than Kleinrock as responsible for 'the discovery of packet switching' (Kieburtz & Privett 2002). Davies (2001, p. 157), who coined the term 'packet switching', reviewed this issue shortly before his death. He concluded that Kleinrock's work dealt with pre-existing message switching technology rather than packet switching:

> My contention is that the work of Kleinrock before and up to 1964 gives him no claim to have originated packet switching, the honour for which must go to Paul Baran. The passage in his book on time-sharing queue discipline, if pursued to a conclusion, might have led him to packet switching, but it did not.

Establishing the identity of the inventor of packet switching is a necessary step in identifying the original reasons for its development. The object of Baran's 1960s work was the

establishment of a fault-tolerant network based on existing infrastructure for maintaining command and control during a nuclear war.[27] While military funded, the work was published in open literature in 1964. In a 1990 interview cited by Naughton (2000, p. 105), Baran gives reasons for this:

> Not only would the US be safer with a survivable command and control system, the US would be even safer if the USSR also had a survivable command and control system as well! There was never any desire for classification of this work.

The author found no discussion of this among Internet historians, although the refusal of AT&T to acknowledge vulnerability of its network may have encouraged Baran and RAND to make the criticism public. Based on sources described in Chapter 2, the author also found no reference to either the state of Soviet command and control systems of the period, or whether Soviet researchers became aware of Baran's work.

Kleinrock was a key participant in the earliest DARPA developments, whereas Baran appears to have only become known to the DARPA group in late 1967, whereupon he was hired as a consultant (Gillies & Cailliau 2000, p. 25). Baran's work was critical to the creation of the Internet. Before Baran's work was known, the situation has been described as follows:

> … the basic topology of the network emerged. What nobody yet knew, however, was how the thing could actually be made to work. The only idea [Internet project manager] Roberts had was that the IMPs [communication devices] would be linked by ordinary 2,000 bits-per-second

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[27] Goeller (2000) points out that there is no necessary relationship between fault tolerance and packet switching. Baran (2002, p. 43) describes how he was led firstly to digital options to overcome analogue network noise when joining many network segments together. This then creates a synchronisation problem, which doesn't exist in analogue networks, and packet switching overcomes this by 'letting each link operate at its own "natural" data rate'.

> dial-up telephone lines ... but beyond that they were groping in the dark (Naughton 2000, p. 91).

Hafner and Lyon (1998, p. 42) write of the approval of the original $US1 million Internet investment without paperwork in a brief meeting. The use of battlefield ready equipment for the first Internet switches is also identified. The chief technological characteristic of the early Internet was fault tolerance, which is in line with Baran's purpose, rather than speed or cost saving. Throughout its use as a military network historians describe its low levels of use, which considering the cost of the telecommunications lines employed would make its fault tolerant design an expensive administrative overhead.

The packet switched, no-single-point-of-failure characteristic of the Internet resulted in a non-hierarchical design, a conceptual breakthrough for telecommunications. There is no reason for this according to the cost saving model, and it would appear to be counter-intuitive to the US Department of Defense as a hierarchical organisation. It was also not technologically necessary for the stated administrative purposes. From 1974, for example, IBM created the efficient and commercially successful System Network Architecture (SNA) based on a strict hierarchy of host processors, communication controllers and peripheral nodes (IBM n.d.).

4.1.2 Extended absence of commercial requirements

As the Internet moved out of the military-research environment, it took on the architecture that still defined it in 2003. It was now meeting new requirements, and subject to wider usage and development influences. None of these new influences, however, placed commercial transactional demands on the network.

Throughout the 1980s Internet traffic rose dramatically and its funding moved to an academic basis. Much academic and research funding was based on the identification of business benefits but this was not reflected in requirements of the Internet. The benefits identified for

Internet connectivity within funding proposals tended to be vaguely defined opportunity loss, the cost of opportunities lost by not being connected. In 1979 United States computer science departments not on the Internet argued that they were at a disadvantage when recruiting staff or competing for research grants (Winston 1998, p. 332).

Creation of the World Wide Web was a crucial element in establishing the modern Internet architecture. Tim Berners-Lee led this development at the European physics research centre CERN. While partially an 'official' project, the web did much more than CERN needed, and was never a central part of the organisation's theoretical physics research mandate. CERN was later quite happy to pass on responsibility for the World Wide Web.

While the World Wide Web Consortium, a subsequently developed standards body, played a commercial role, the early World Wide Web development was quite different. Berners-Lee describes its relationship with an early alternative, 'gopher'. Researchers at the University of Minnesota were working on gopher, a menu-based but functionally comparable programme for finding information on the Internet. Berners-Lee attributes the success of the World Wide Web over gopher to announced plans by the university in 1993 to charge for commercial use. He describes being 'accosted in the corridors' at an Internet Engineering Task Force conference by people asking if CERN planned to do the same:

> On April 30 [1993] Robert [Cailliau] and I received a declaration, with a CERN stamp, signed by one of the directors, saying that CERN agreed to allow anybody to use the Web protocol and code free of charge, to create a server or a browser, to give it away or sell it, without any royalty or other constraint (Berners-Lee & Fischetti 2000, p. 74).

With the benefit of hindsight the inventor of the World Wide Web described how he had spent a considerable effort encouraging companies to 'take on the Web as a product' (p. 83):

> My decision not to turn the Web into my own commercial venture was not any great act of altruism or disdain for money, of which I would later be accused (p. 85) ... The free software community was fundamental to the development of the Web, and is a source of great creativity. But it was inevitable and important that if the Web succeeded, there would be a variety of free and commercial software available (p. 107).

Tim Berners-Lee's original proposal to develop the World Wide Web's prototype shows that while commercial distribution of the World Wide Web may have become important, the requirements of commerce were absent at the beginning. Under the specification heading of 'Non Requirements' he listed 'copyright enforcement and data security' (p. 222). This is in contrast to the functional requirements of commercial data communication alternatives of the time.

The World Wide Web's development therefore continued a tradition of military and academic research: the absence of commercial requirements in its architecture. Later sections of this chapter describe in detail the specific requirements of a commercial transactional network. Before that, the following section examines some of the achievements of the Internet's architecture that make it so suitable as a communication medium.

4.1.3 Early design flexibility

By the early 1990s the Internet had incorporated several conceptual breakthroughs. These are results of the Internet's early evolving architecture:

1. Information can be delivered reliably by combining unreliable paths. This is achieved using packet switching described above.

2. Each network user is able to connect to the network with whatever capacity they have. For example, high and low speed Internet users can exchange e-mail, messages, files and telephone calls.[28]

3. A data network can be viewed at several levels of abstraction, including as a network (such as the Internet), and as applications on that network (such as the World Wide Web and e-mail). These levels of abstraction are called 'layers', and are logically independent of each other.[29] The network doesn't 'know' or 'care' whether data it carries is a conversation or an e-mail. This creates the 'end-to-end effect' described in Chapter 2.

4. Communication can be undertaken without knowing the location of the message destination. While a destination address must be included in each data packet, the physical location of that address is unimportant, and the path to that destination is separately determined when each packet is sent.

5. The network requires no central point of responsibility. In the case of the Internet, for normal operation there is no single point of control.

6. Randomly organised information can be meaningfully accessed. This is the basis of search engines such as Google, at <http://www.google.com>.

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[28] A principle of the telephone network, by contrast, is that all users within a particular telephone system (for example, all users in Australia) connect to the telephone network with an identical capacity. The Australian standard is 3.4-kiloherz bandwidth (a measure of its information-carrying capacity). While this is sufficient to support a recognisable voice conversation, it is insufficient for high fidelity music, for example.

[29] The Internet is made up of four layers: Network, Internet, Transport and Application. The Open Systems Interconnect (OSI) model is similar, but has seven layers.

These characteristics were made possible by ‘digitisation’, the common representation of text, photos, graphics, sound, video, music, speech and more as binary digits.[30] The practical application of digital technology was undertaken in the telecommunications field to improve voice traffic over networks from the 1960s and in media for new distribution methods from the 1980s. In contrast to previous systems it allows the distribution of perfect (non-degraded) copies of information over large areas. This is common to all digital computing and communication, and is a major benefit of the Internet. For some this digitisation embodies its own principles, such as open architecture and interoperability (Negroponte 1995, p. 181).

Having achieved a common form of representation with digitisation, data communication then provides a common form of delivery. Here the Internet shows a stronger similarity to the postal rather than the telephone system. An individual or small business may be able to receive only one telephone call at a time, while a large corporation may be able to receive thousands. On the other hand, either an individual or a corporation would be able to receive thousands of pieces of mail (even if the individual is unable to do anything useful with them). This aspect of the Internet reflects its ‘connectionless’ technological character. As mentioned above, this means that Internet users with a wide variety of connection types can communicate. By contrast telephones all share common connection characteristics, or else have to be connected through appropriate technological ‘gateways’ (such as are required to connect mobile to landline telephone calls).

Another important change was making Internet addresses meaningful to non-technical users. Within the Internet, information is exchanged between hosts (such as personal computers) based on their Internet address. A separate question is that of humans recognising these devices. The major change occurred with the development of the Domain Name System and

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[30] Baran’s invention of packet switching is often mistakenly equated to the invention of digitisation. Digitisation is based on mathematical work published by Nyquist in 1928 (Winston 1998, p. 134).

its name servers by Paul Mockapetris, along with Craig Partridge and Jon Postel. This was introduced to the Internet from 1985 (Gillies & Cailliau 2000, p 45). It provided the basis for English language, rather than numerical, network naming. The solution is structured. There is a set of top level domains. These may be for particular sectors, such as '.com' for company and '.edu' for educational organisation, or they may be national, such as '.au' for Australia. In a Uniform Resource Locator (URL) this top level domain is preceded by another level of organisation, such as '.com.au', for Australian companies. The organisation of categories at the top level is the responsibility of the Internet Corporation for Assigned Names and Numbers, which has no responsibility for the organisation of categories at the next level. This creates the situation where, for example, the British responsible body designates a British company as '.co.uk' while the equivalent Australian body uses '.com.au'.

The English-centric character of the Domain Name System is a complicated and potentially disruptive issue. World Wide Web pages and e-mail are rendered in many different languages and scripts around the world. But URLs must be based on English script.[31] This continues to obscure Internet use for non-English speakers.

In late 2000, one commercial organisation created an experimental environment for domain names in Chinese, Japanese and Korean (Zakon 2001). The Internet Engineering Task Force has not endorsed this. It has also been rejected by the Chinese government, which has expressed the view that registrations in Chinese are its sovereign right. The issue of multilingual registration further complicates the issue of brand names: whether the owner of a commercial name in one language is considered to have a right to that name in all languages. The Internet does not create these issues, but the Internet is drawing attention to them, perhaps

[31] While it is possible to create an equivalent table of 26 characters from another script and map them to the English language alphabet, the result is not linguistically meaningful.

for the first time. In this way the technical minutiae of the Internet's historical architecture are of unanticipated commercial interest.

The examples in this section show that the Internet continued to flexibly adapt to the needs of users throughout the 1980s. This met some requirements while leaving others such as multilingual addressing unresolved. Combined with the previous two sections, the Internet is seen to be based on a usage driven and flexible architecture. The remainder of this chapter shows that this flexibility is relative. First, the needs of a commercial transactional medium, which were not originally incorporated in the Internet's architecture, remain mostly absent in 2003. Second, while the Internet continued to adopt new forms of interactivity throughout the 1990s, large investment failed to transform its approach into that of traditional electronic broadcast media or of a commercial transactional medium.

4.2 Lack of transactional medium features in the Internet's architecture

While the Internet's architecture is useful to hundreds of millions of people, its basic architecture of the early 1990s lacked many features required of a commercial transactional medium. IBM's Leung (1999) describes TCP/IP's weaknesses as follows: best effort service; security exposures; not commercial grade; and growth outracing capabilities. This section examines five commercial transactional requirements, contrasting the Internet to other technologies that inherently support them: security of financial exchange; proof of transaction; identification of a commercial party; establishing a single meaning for a transaction; and facilitating payment.

4.2.1 Security of financial exchange

Despite its security background, the Internet's original protocol suite provides no security. Specifically it does not innately support any of the three core communication requirements for security of data: integrity, confidentiality or authentication. These are generally accepted

requirements for secure transactions (Ghosh 1998), which are also found in other security requirements. Not all are required for all transactions:

Integrity: Has the transaction been deliberately or accidentally altered? Has the figure on an order or cheque been changed? Because this is impossible to prevent (all electronic communication includes the possibility of error), the focus is on identifying whether a change has been made. Packets traversing the Internet infrastructure, which is owned by thousands of separate companies and organisations, will travel by an unspecified path that could include almost any country in the world, even when communicating between two users in the same city. By default all data is sent in a form that can be read and modified. A local or national telephone call or letter, in contrast, has a far more limited and controlled path, generally keeping within a single country.

Confidentiality: Is the transaction visible to parties other than the intended recipient? As the Internet transmits clear (unencoded) text, confidentiality is not provided by default. This is also not universally required. For example, public documents or marketing information have no requirement for confidentiality.

Authentication: Is each party to a transaction who they claim to be? This is examined in Section 4.2.3 below.

In his original work, Baran (2002, p. 45) included a discussion of the use of cryptography to protect the secrecy of communication traffic. Given that the Internet grew as a research facilitation tool, there is little mention of security in histories of the Internet listed in Chapter 2. Lack of security is found in both the technology and culture of the Internet. This requirement is often overlooked by technologists. Schneier, author of a seminal work on information technology security (1996), discusses this issue in a later work (2000):

> A colleague once told me that the world was full of bad security systems designed by people who read *Applied Cryptography*. Since writing the book, I have made a living as a cryptography consultant: designing and analyzing security systems. To my initial surprise, I found that the weak points had nothing to do with the mathematics. They were in the hardware, the software, the networks, and the people. Beautiful pieces of mathematics were made irrelevant through bad programming, a lousy operating system, or someone's bad password choice (p. xii).

This section shows that the requirements for secure communication of commercial transactions are well established. The absence of support for these on the Internet reflects their absence as requirements during development of the Internet.

4.2.2 Proving a commercial activity occurred

Financial transactions are a central aspect of business. They form the basis of payment services. A financial transaction is a discrete event. For example, a purchase is either completed or not. A single electronic transaction may have many steps, and at any one of these steps a computer may fail or a connection may disappear. At the conclusion of the process both parties to the attempted transaction need to unambiguously agree that a purchase, offer or agreement has either been made, or not, regardless of any technological problems. These requirements can be summed up as:

- atomicity: a transaction either completely fails or completely succeeds;
- consistency: relevant parties agree on the facts of the exchange;
- isolation: transactions do not interfere with each other; and
- durability, the ability to recover to the last agreed state (Camp & Sirbu 1997, p. 61).

The case of billing for services highlights the difference between the Internet and the global telecommunications network. A telecommunications company devotes a large proportion of

its technical resources to ensuring it can bill customers for services provided. This includes identifying the service and providing proof that the service was used by a customer (date, time, length of call). Historically, domestic phone calls involved only one company, and only international phone calls required the division of the charge between providers. In an increasingly fragmented market, telecommunications companies must keep track of millions of calls, and have commercial relations with other companies for the settlement of calls that use both their services. 'Settlement' is a process used by multiple parties involved in providing a telecommunications service to a user, such as a call between countries, or from one mobile network to another. Pre-agreed cost charging formulas determine how much needs to be paid between companies at some regular interval. In contrast to this telecommunications environment, early Internet usage was based on the data communication expectation that telecommunications lines will be leased and used as required, independent of the amount of traffic carried.

Huston (1999a) states that a data packet of information travelling across the Internet could traverse one or many of 60,000 networks.[32] Unlike the telephone system, the amount paid to an Internet service provider (ISP) by an Internet user is not split among the networks that forward the packet. Rather, it is kept by the ISP, who then pays other ISPs for the amount of traffic moving between them. Statistically, the payment may eventually be shared out among the providers, but this is a random result, as 'the Internet interconnection environment remains one where there are no soundly based models of financial settlement in widespread use today' (p. 573).

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[32] The process of forwarding data packets may not be cooperative. Ethernet inventor Robert Metcalfe describes 'fast exit routing' (interviewed in Petrie & Wiggins 1997, p. 15): an Internet service provider receives data packets from another ISP and uses the shortest path it can find to forward the data to another network, rather than sending it towards its destination.

The events of the transaction must leave an auditable trail. Without this a financial system would be unable to legally prove that a transaction had taken place. In this case it would be unable to enforce contracts, prove its own compliance with contracts or provide evidence of activity including governance requirements. As a result it would probably go out of business. While this may appear obvious, the case of Independent Energy in Britain illustrates the problem. The company had several dot-com characteristics, including NASDAQ stock exchange listing and co-provision of telecommunications services with a company called Future Integrated Telephony. Its 160 staff serviced 242,000 customers in a competitive energy environment. In 2000, lending banks that were owed more than £100 million refused to renew credit arrangements, and the company went into receivership. At the time it was owed £119 million by customers, but could not provide evidence of this, and so was unable to collect these accounts (Taylor & Jones 2000).

This description of financial transactions shows that transactional architecture must be deterministic: the result of the transaction in the overwhelming majority of cases has to be what was meant, and when it is not there should be evidence of what went wrong. The design of the Internet protocol suite TCP/IP is non-deterministic. It aims to achieve overall reliability in a network, not necessarily individual reliability for each segment of that network. This concept of 'best effort' is core to the Internet's design and to an understanding of the Internet's flexibility. While the telephone network will reject an attempt to connect if the destination is unavailable (a busy signal), the Internet will send information out in the hope of success, by design (best effort). There are many methods for overcoming the limitations that this creates, including within the TCP protocol itself,[33] but the design choice of 'connect if a

[33] Comer (2000) describes operation of the Internet's Transmission Control Protocol. It checks that when a group of packets are sent across the network they all arrive, requesting copies to be resent if they do not. It measures how much information the network can deliver, and the amount of congestion in the network, and modifies the volume of packets sent accordingly (pp. 209–37). This is not a simple or exact task, because the underlying Internet Protocol could be sending different packets within a group via different paths, and congestion can change from moment to moment.

full service available' or 'make every effort to get any part of the message through' remains. The original design specification states:

> [The Internet Protocol has] no mechanisms to augment end-to-end data reliability, flow control, sequencing, or other services commonly found in host-to-host protocols. The internet protocol can capitalize on the services of its supporting networks to provide various types and qualities of service (Postel 1981).

Leiner, Cerf, Clark et al (2000) describes TCP/IP co-inventor Robert Kahn's four ground rules for creation of TCP/IP: independence of each network connected; communication on a best effort basis; no information about traffic flows across the network to be stored within the network; and, no global control of the technical operation (p. 6).

Regarding payments, Camp and Sirbu (1997, p. 61) state that the Internet presents a unique challenge, as a payment may be duplicated if the protocol believes a message has been lost, or a payment message may be destroyed by network failure. These technological limitations are generally unknown to business, and the expectations of Internet-based electronic business were widely embraced by business futurists such as Gosling (1999), suggesting that the Internet would rapidly impact on all aspects of the financial transactions area.

In addition to limits imposed by the Internet's best effort character on providing a secure path for a financial transaction, it also affects the value of the Internet as a service delivery medium. To date, ISP charges are based on dial-up access time, bandwidth for permanent connections, and volumes of data in a set period. A commercial information provider could also wish to provide a range of services with appropriate tariffs based on the time of day, distance, speed of delivery, type of content or type of service (such as international telephony). The Internet's underlying architecture will not help them. Even something as simple as charging by the distance travelled would encourage inefficient delivery of information.

The technology which appears to resolve this problem is ‘differential services’. This is the term used for providing premier services on the Internet. This involves establishing a ‘quality-of-service’ concept, which could prioritise some data packets at the expense of others. Quality-of-service (QoS) can be defined as the ‘degree of conformance to user-specified service criteria’ (Lee, Hluchyj & Humblet 1995, p. 48). Ferguson and Huston (1998) of Cisco and Telstra respectively question whether this is a realistic possibility for the Internet, given that the decentralised nature of the Internet does not lend itself to generalised mechanisms for differentiating traffic. Technology writers in the field typically place the achievement of this in a future network, rather than the existing Internet. An examination of the issues by Kumar, Lakshman and Stiliadis (1998, p. 153) identifies a number of challenges in introducing QoS, including the failure of a cooperation model in the commercial environment, and the need for protection from TCP-unfriendly sources (p. 153).

Despite strong technical evidence of the incompatibility of an unregulated best effort network such as the Internet and the reliability requirements of QoS, much non-technical media and marketing coverage including Redford (1998) has suggested its imminent arrival. This is not to suggest that a multi-vendor TCP/IP environment cannot be built that will provide the requirements of a transactional medium through control and prioritisation of traffic. As Huston (1999b) points out, however, such an environment is not the Internet.

Depending on the application, the effect of best effort delivery may be a benefit or a problem. An e-mail delivered in a few minutes rather than a fraction of a second still has value, whereas users would prefer to receive an engaged or network busy signal rather than start a telephone conversation where parts of words were delivered a second or so late. This example shows the distinction between time-critical data and important data. It is critical that information for video and voice applications arrives quickly and at a steady rate. The value of the information,

however, may be low. From a corporate point of view, the loss of an e-mail message is far more important than a flicker in a videoconferencing session.[34]

This section has reviewed the relationship between the Internet's best effort architecture and the requirements of commercial communication. The discussion of quality-of-service shows that in this case the required architecture modification is so significant that the resulting network would be different from the current Internet communication medium.

4.2.3 Identifying a commercial party

The Internet by design is an anonymous network. This by itself is not a block to commercial activity. The vast majority of all commercial transactions in Australia by number (not value) are cash-based (Information Industries and Online Taskforce 1998), and therefore potentially anonymous. Security problems previously described, and the absence of a simple micro-payment method, however, make the Internet an unsuitable substitute for many currently cash-based transactions.

The process of identifying parties to a transaction is authentication, ensuring that each party is who they present themselves to be. In a contract to supply items for a period of time under particular terms and conditions this is important. When someone walks into a shop to buy a loaf of bread, it is generally not (an exception would be during a time of rationing). It may be partial, for example in the sale of cigarettes or alcohol, where age rather than identity is

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[34] As previously discussed, the replacement of a single Internet protocol with TCP/IP in 1983 created a reliable transport mechanism on top of a best effort network delivery protocol. Leiner, Cerf, Clark et al (2000, p. 7) state that following experiments with packet voice in the 1970s the User Datagram Protocol was added for those applications that needed to use the best effort Internet Protocol without reliability. For voice, and later protocols for continuous music and video, reliability is still an issue. But retransmitting a packet that gets lost does not help, because when the missing information arrives the conversation or music has passed that point. In a heavily utilised network the presence of a large proportion of UDP packets that are congestion unaware can have an impact on the network's TCP congestion management processes and traffic depending on this.

important. TCP/IP provides no mechanism to certify parties to a communication. Co-inventor Cerf (2002) identifies this as one of the key weaknesses of the protocol.

Identifying consumers is required for services that are legally or commercially limited to a geographical area, such as pharmaceutical, insurance, gambling and auction sites, and for age-limited services. Identifying a business is required for consumer protection and consumer confidence, as commercial transactions require a consumer to trust a vendor with credit card and other personal information. This makes trust and privacy necessary elements of a commercial network, elements that are not inherently provided by the Internet's architecture. Privacy has been a key concern of commercial Internet users. For example, a Consult.com survey of 19,000 Australian web users in 1998 identified it as one of users' main concerns (Davidson 1998b).

One step towards identifying a commercial party, most commonly a consumer, is to identify their geographical location, although Internet users are geographically anonymous. Location identification is used to improve delivery of online services. For example, a television-style broadcast of a concert or sporting activity will be difficult to deliver unless the source is relatively close to the viewer (such as in the same country or region). The other main reason is to identify the suitability or eligibility of a consumer for a particular service. This could include local advertising on web sites, for limiting stock prospectus distribution or for controlling access to online gambling (considered in Section 6.1.3). An examination of technological literature provides many mechanisms by which this could be tracked.[35] This can also be viewed as introducing borders to the Internet (Tedeschi 2001).

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[35] These include IP address, browser language and time setting, and more obscure technological information. Combining all of these provides only an approximate picture, due to international networks connected to the Internet, and modifications to the Internet protocol suite such as Network Address Translation and allocation of Internet addresses using Dynamic Host Control Protocol (DHCP).

Where an order based on a facsimile or letter will be accepted in normal commerce, there is no secure way to attach a person's signature to an electronic document. (An image of a signature is worse than no signature, because it can be easily copied to other documents.) The solution is an 'electronic signature'. This is a long numerical sequence which ties an individual to a document. It is considered a unique electronic signature because the result is easy for the signer to produce and difficult for anyone else to forge. Apart from the difficulty of correctly using such an approach, the main limitation is the process for establishing electronic signatures. In particular, for all the digital signatures to have meaning in the Internet commercial environment there would need to be an international 'public key authentication framework', a means for signatures from separate organisations to be recognised by each other. This is a regulatory challenge rather than a technological one, involving issues such as national sovereignty, the right of citizens to conceal secrets (recognised in some countries but not in others), and commercial liability.

By contrast the facsimile, or fax, which remains widely used in business, successfully identifies commercial parties in a 'low tech' manner. The development of the facsimile machine is a strong contrast to the development of Internet electronic business, although the facsimile and the Internet both succeeded based on non-proprietary standards (Brown & Duguid 2000, p. 257). In the mid-1990s facsimile traffic represented 50 per cent of telecommunications traffic across the Pacific and 30 per cent across the Atlantic (Negroponte 1995, p. 33). There is little about facsimile technology itself that prevented its further development. Screen-based instead of paper-based, high definition, interactive colour facsimile terminals could have provided an early alternative to aspects of the Internet. However, the most valuable thing about a faxed business order, in addition to its simplicity, is that it is fixed, and therefore moderately difficult to fake. The Internet by contrast is so sophisticated and versatile that anything it produces (especially a scanned personal signature) is inherently untrustworthy.

Once a transaction has successfully occurred, there remains a requirement to prove that this was the case. This is called 'non-repudiation', the action of 'preventing the data recipient later denying receipt of the data or the sender denying transmission' (Caelli, Longley & Shain 1994, p. 666). A dated signature on a contract is a typical means of proving this. There are also electronic means of doing this, although proving time of electronic signature can be more difficult than proving the signature itself. The Internet by default provides no proof of time, identity or content of a communication.

This section has compared the anonymity of Internet usage to the identification requirement of many commercial transactions. While many technology projects are underway to change this, each has its own difficulties. By contrast the low technology facsimile continues to provide a valuable commercial service, in part because of its more limited technical capability.

4.2.4 Single meaning of a transaction

Parties to a transaction must agree on the meaning of their communication. Here the Internet's potential flexibility places it at a disadvantage to a more structured approach, such as a paper-based order form or invoice, or the traditional electronic data interchange (EDI) approach.

The characteristics of electronic commerce have their origins in 19th century railroad developments.[36] United States railroad companies used the (electro-mechanical rather than electronic) telegraph to forward information about the contents of trains between stations (Zinn & Takac 1989). The 1980s predecessor of current electronic business was electronic data interchange. Unlike earlier data exchange systems, EDI provided a framework for the

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[36] This similarity applies to both the railroad industry itself, and investment in it. Many writers on the dot-com bubble refer to the precedent of 19th century railway investment (for example, Hof & Hamm 2002). Friedlander (1995) describes railroad companies as the first 'Big Business'. For the *Harvard Business Review* (1997), 'The railroads had introduced principles of hierarchical organization and financial control'.

exchange of data between separate organisations, to meet the requirement for multiple organisations to agree on the meaning of business messages. Because of this requirement for inter-organisation cooperation for the purpose of trade, EDI dissemination involved an enthusiastic band of advocates who collaborated to have cross-industry standards developed. The electronic data interchange campaigners from the late 1980s created a large body of literature identified by Sokol (1989). EDI met three key requirements: common meaning, common infrastructure, and security.

Common meaning: Within a single corporation, due to multiple purchasing policies, acquisitions and other reasons, by the 1980s incompatible computer systems were common. Nevertheless the possibility existed within a single organisation to resolve this, by executive instruction if all else failed. For *separate* organisations to communicate meaningful information to each other required EDI, a standardised method for conveying order forms, invoices and the hundreds of other forms which make up commercial transactions, in a mutually understood way. The major task in the implementation of EDI was development of commonly agreed definitions. The standards that emerged (UN/EDIFACT, ANSI X12 and a range of proprietary industry-based sets) represented many years of work. For example, an electronic EDIFACT certificate stating that a particular shipment of meat has passed a particular inspection for export has the same meaning in any country that has adopted this UN standard. That level of international agreement represents years of negotiation. A change of technology, for example use of the Internet, does not necessarily simplify such negotiations.

Common infrastructure: Getting an EDI message between two organisations requires a common communication infrastructure. For two organisations exchanging large amounts of information a dedicated communication link is generally the most cost effective. For organisations dealing with dozens or hundreds of other partners this is impractical. So

commercial value added networks (VANs) were created to act as switching points for EDI messages. While these provided reliable and guaranteed delivery of information, their cost for data transmission is several orders of magnitude higher than Internet data transmission costs.[37] This cost can lead to a mistaken expectation of savings through a less reliable medium. While the individual cost of an Internet-based transaction may be a few cents or a fraction of a cent, in an automated process involving thousands of transactions (per week or even per second) the cost of manually correcting one transaction in error may be hundreds of dollars. This could be required by poor data quality, ambiguous business rules and user uncertainty or error. Any transmission difficulty that increases this, such as Internet congestion, may increase rather than reduce overall costs.

Security: This is required for two reasons. First, EDI messages contain information that may be commercially sensitive. Second, two businesses linked by EDI will want to ensure that the only information they provide is the information they want the other party to see. The individual design of most EDI solutions assisted in providing security.[38]

During its heyday in the late 1980s electronic data interchange swept the business world. Sokol (1989, p. xi) begins, 'By every indicator, EDI, electronic data interchange to accomplish business transactions by transmitting and receiving machine readable data between trading partner companies, is taking the business community by storm.' EDI solutions in 2003 continue to carry the vast majority of the world's electronic commercial transactions by value. In particular the SWIFT international financial transfer system transfers millions of messages

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[37] In mid-1998, for example, Internet service provider connect.com imposed punitive charges of 4 cents per megabyte on certain users (Davidson 1998e). At the same time the minimum Telstra charge for data on their EDI network was $A10 per megabyte, and for small messages began at 17 cents per kilobyte, or $A170 per megabyte (e-mail to the author from Telstra, 28 October 1998).

[38] 'A review of the EDIFACT EDI format standards shows that it is not difficult to augment the existing standards to provide at least a basic level of support for authentication, integrity, and non-repudiation' (Caelli, Longley & Shain 1994, p. 684).

worth trillions of dollars per day, both on its traditional EDI network and over its private TCP/IP network SWIFTNet (Society for Worldwide Interchange of Financial Transactions 2001). The total volume of privately carried transactions is vastly greater than that carried by the public Internet. While a simple examination of financial transaction channels shows this to be self-evident, this is widely misunderstood within the technology community. Many electronic business infrastructure discussions also confuse the Internet and private TCP/IP-based networks, which are similar in technology but are completely separate in operation, and do not directly connect to the Internet. For example, it takes a close reading of the following quotation to realise that the authors are *not* stating that SWIFTNet is part of the Internet, but is rather a private Internet Protocol–based network:

> Several Internet-based initiatives were launched in the last two years. Probably the most significant move in the wholesale banking adoption of the Internet was the decision in December 2000 of SWIFT, a core element of the global payment infrastructure, to migrate to a new IP-based network, SWIFTNet. SWIFT's clearly stated ambition is for SWIFTNet to become the infrastructure of choice for [a] new generation of payment systems and related services (Goldfinger, Hayim & Trauscht 2002, p. 3).

In 2003 commercial use of EDI remains strong. Ericson (2002) describes where user priorities lie, with reference to the eXtensible Markup Language (XML) Internet technology considered in Chapter 6. (XML is a variation on the World Wide Web's HyperText Markup Language that can be read by computers):

> 'Most of the vendors tell me almost 100 percent [of customers] are using EDI', says Ken Vollmer, research director at Giga Information Group. Likewise, says Rabin, whose accounts at eB2B Commerce include Disney, Verizon, Rite-Aid and Toys 'R Us. 'We have a full XML capability, and of all our clients, there's been only one that's asked for XML,' he says. 'Of 750,000 transactions per quarter we process, less than 1 percent is something other than EDI'.

EDI uptake figures appear insignificant compared to the number of Internet users. This is deceptive, because all major global commercial organisations use EDI in some format, while only a tiny proportion of small and medium enterprises outside particular industries use it. From a financial point of view EDI can be counted as a success, while from a dissemination view it is a failure. This causes problems for large enterprises attempting to electronically connect to their suppliers. The smaller suppliers in general have no access to EDI due to barriers of cost, difficulty of use, and expertise. While large corporations are able to adopt EDI for communication between each other, they still have to cope with the cost of manual or semi-manual communication with suppliers.

From the mid-1990s a body of literature emerged which focuses on potential business benefits that can be achieved using the Internet rather than dedicated data services. Willaert (2001), in a sympathetic explanation of the benefits that EDI can bring to XML through the 'ebXML' framework, identifies the following shortcomings of EDI:

> Since the Internet was not yet commercially available when these EDI standards were developed, they define not only message formats, but also communication protocols and even certain hardware requirements. This renders implementation more complicated, and requires expensive Value Added Networks (VANs). In turn, it entails the use of a compact syntax which is difficult to understand. EDI is based on detailed agreements between all parties, both on business and technical aspects. This makes the agreement process lengthy and thus more expensive, while preventing short-term relationships from being established. Moreover, it means that the number of partners must be relatively small. The message specifications themselves are very rigid, with business rules embedded into them. They are meant to be applicable to nearly all industries and businesses, taking into account the particularities of *each* of them. This results in elaborate, complicated specifications, difficult to understand and taking very long to implement. At the same time however, each industry has its own implementation guidelines. This especially forms a problem for companies interacting with several industries. The mere fact that there are *two* major standards, X12 and EDIFACT, causes problems for companies that do business with both American and non-American companies (p. 79).

Each of these criticisms contains an XML promise that has not been met by 2003, five years after XML's launch: value added networks in one form or another survive in the Internet business-to-business (B2B) world; broad B2B ventures are being replaced with dedicated company-to-company business relationships; many industries have seen two or more major and separate B2B initiatives; and XML standards remain a field of contention. The emergence of the Internet XML technology in the late 1990s led many to mark the whole EDI development as a legacy technology. Understanding how to make money out of electronic business in part involves understanding what EDI still does better than Internet-based alternatives. Some of these issues are examined from a business perspective in Chapter 6.

4.2.5 Payment mechanisms

From a business benefit perspective the Internet suffers from a tradition that information is provided for free. A separate technical difficulty is that when a user can be convinced to pay for information, there are no mechanisms for billing. This is in contrast to the telephone system, were users are regularly charged a few cents or tens of cents in their local currency for services.

Security for the purpose of financial exchange has been a central factor of some commercial networks since the telegraphy industry a century before the Internet. Standage describes the introduction of a secure cash transfer system for up to $US100 established by Western Union in 1872, including the following steps which resemble the functional description of modern electronic payment systems:

> The system worked by dividing the company's network into 20 districts, each of which had its own superintendent. A telegram from the sender's office to the district superintendent confirmed that the money had been deposited; the superintendent would then send another telegram to the recipient's office authorising the payment. Both of these messages used a code based on numbered code books. Each telegraph office had one of these books, with pages

> containing hundreds of words. But the numbers next to these words varied from office to office; and only the district superintendent had copies of each office's uniquely numbered book. A running count was kept for each book, and each time a money transfer telegram was sent, the next word in its unique numerical order was sent as one of the words of the message (p. 113).

Not all transactions involve or require electronic payment methods. Cash-on-delivery is a settlement option used by Internet companies in India (Donald 2000). The postal service, like the Internet, lacks the ability to support secure transactions (because a letter could be stolen from a letterbox, for example), so methods of payment such as postal orders and non-negotiable checks have been developed that overcome this. When the Internet is used to replace other remote purchasing channels, such as the telephone or mail-order catalogue, a non-Internet payment system will already be in place.

Problems occur when there is no convenient alternative means for receiving payment. For Internet purchases of between several dollars and a few thousand dollars, based on the Secure Sockets Layer (SSL) security, a credit or debit card can be used, although credit card use is generally restricted to business-to-consumer sales to adults. Many of the information services provided on the Internet have a value too low to fall into this range, especially for single or intermittent purchases, and are provided internationally. This is where the lack of a broad and uniform micro-payment system, particularly in the range from a few cents to a few dollars, is seen. Micropayment systems proposed generally underestimate the flexibility of physical money, which they attempt to replace. One possibility is collecting payments through a user's telephone bill, and in 2003 Australia's Telstra was trialing the purchase of soft drinks from dispensing machines linked to mobile phones.

One of the most successful commercial uses of the Internet is eBay's online auctions. Here the personal cheque provided access to just part of the Internet's reach (its US audience). Once

established, eBay then adopted the Paypal financial settlement system, initially in US dollars, but later covering a small number of other currencies.

The characteristics described in the previous five sections were lacking at the time that investment began to flood into Internet electronic business from 1995. Where these deficiencies were identified, particularly in the area of security, technological approaches were developed to correct the problems. As described below these were only rarely adopted. The primary effect of these limitations on the Internet as a transactional medium was not to prevent commercial investment, but to make this investment more difficult and expensive than expected.

4.3 The Internet's technological inertia

The success of the Internet is largely due to its flexibility in evolving to meet user needs and be shaped by these needs, particularly up to the early 1990s. Yet describing the Internet as technologically flexible blurs two distinct issues: first the capacity of the Internet's fixed and static architecture to rapidly grow; second, the flexibility with which the Internet architecture changes to meet new user requirements. The first addresses how the Internet scales; the second, how the architecture changes. At the end of this period of research, while the Internet continues to grow, its architecture has changed little from the early 1990s.

4.3.1 Attempts at commercial modification

By the early 1990s two things had become clear to the technological community: the Internet had major shortcomings with regard to business; and, something had to be done about it, because user uptake meant that the Internet was about to become the predominant global data communication network. This section explains why these technology initiatives were generally unsuccessful in the short term.

Towards the end of the 1980s there was a view within the Internet's technology community that the Internet was a legacy network. In contrast to the sense of the historical purpose of the Internet provided by its 1990s historians, participants at the time in general failed to anticipate the future importance of the Internet itself. They directed their energies into the networks that were expected to supersede the Internet. TCP/IP co-inventor Robert Kahn, through the Corporation for National Research Initiatives (CNRI), played an important role in development of the 'information superhighway' programme of the late 1980s as a successor to the Internet (Corporation for National Research Initiatives 2001). This alternative network is described in Chapter 5. Other veterans of Internet development often express surprise at the success of the Internet. For Vint Cerf the 'first hint' of coming success was in 1989 (Hafner & Lyon 1998, p. 253). This was still commercial interest in the Internet as an academic network, rather than commercial interest for its use in the commercial world. It was only in 1991 that the Internet was reorganised, through the formation of the Internet Society, 'under the auspices of Kahn's Corporation for National Research Initiatives (CNRI) and the leadership of Cerf, then with CNRI' (Leiner et al 2000). The beginning of commercial interest in commercial (not Internet-based) e-mail was not seen until a similar time. According to Cerf, 'it would take from 1983 to 1992 before email became a widely appreciated service in the business world' (Cerf 2002). The mass use of the Internet after the development of the World Wide Web came as a major surprise.

In response to the Internet's continued growth, a flurry of activity occurred within the technology community in the early 1990s. This included IPv6 (Internet Protocol version 6)[39] and the RSVP protocol for broadcasting (in the media, not data communication sense) over

[39] Also called IPng for 'Internet Protocol next generation', IPv6 is a 1994 initiative of the Internet Engineering Task Force responding to several design issues, in particular the limitation on the size of the Internet and security. Other issues, including multilingual support, are not addressed by IPv6. IPv6 is a different technology to the current Internet, and the two are incompatible.

the Internet. A major focus of these was to introduce quality-of-service as described earlier in this chapter.

Following these technology initiatives, the late 1990s saw a series of commercial initiatives, generally devoted to moving functions and usage between electronic media. The Wireless Application Protocol (WAP) sought to move Internet interest to the mobile telephone to establish what was called 'm-commerce' (mobile commerce). Interactive digital television was promoted around the expectation that most people using the Internet would use it to order goods or services, or gamble, through the television set.[40] Voice-over-IP (VoIP) technology provided the possibility for information technology companies to seize markets from telecommunications equipment manufacturers.[41] (Discussion of the benefits of Internet telephony thoroughly mixes two separate debates: how to provide low cost voice calls using the infrastructure and technology of the Internet, and whether the Internet's technology is inherently better for voice communication.[42]) When the WAP was introduced in the late 1990s it was criticised from within the technology community for unnecessarily modifying the TCP/IP protocol:

> WAP Forum and its major backer claim that handheld Internet access is not about surfing, and so have eschewed generic approaches in favor of custom applications hosted by the carrier. There isn't even an escape hatch—standard HTML pages do not map directly onto WML [Wireless Markup Language]. Claiming that 'wireless is different,' WAP 1.1 rewrites almost

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[40] A telecommunications vision of interactive television is provided by Bryan (1999). 'By drawing on the interactivity enabled by the internet, the act of watching TV is set to become a far less passive pursuit. Interactive TV guides, for example, will remind consumers when they are missing their favourite show and they can search for programs that relate to their own special interests.'

[41] Voice-over-IP is one part of a broader area of 'Internet telephony', which includes other technologies.

[42] Oltsik (2003) suggests that as VoIP equipment requires upgrading every three or four years compared to 12 years for traditional private exchange equipment, savings are unclear. According to Gartner, VoIP migration actually declined between 2000 and 2001 (Breidenbach 2002). Cisco's strong advocacy ensures VoIP's continuing development, while lack of support among telecommunications carriers prevents its rapid success (Ryan 2003).

> every Web standard in the book. All its smarts are built into the WAP Gateway on the carrier's premises. To the public Internet, that gateway becomes the termination point; from there to the device, WAP Forum's standards take over (Khare 1999).

WAP was based on the model of consumers paying for information provided by a controlled commercial market. WAP's subsequent commercial difficulties can be contrasted to the low speed Japanese iMode service. By 2003 this text-based service had attracted more than 30 million subscribers in just a few years of operation. It has no technological similarity to the Internet, although it is functionally similar in its provision of e-mail and the availability of tens of thousands of official and unofficial services (Nakamoto & Roberts 2000). WAP on the other hand attempted to be technologically similar to the Internet but functionally distinct. By 2001 the expected boom in mobile data services had arrived as texting.

In 2003 interactive digital television, VoIP and WAP are each struggling to make their presence felt as global technologies, in contrast to their early promise. Regardless of their future evolution, they have each shown the difficulty of modifying the Internet's 'shortcomings'. Widely successful modifications in the late 1990s most often either extended existing functionality without resolving any underlying limitations such as the shortage of computer addresses,[43] or they increased the Internet's interactivity for users. Notable here are instant messaging which identifies whether a selected party is online, peer-to-peer file exchange which doesn't depend on a single central data holding and therefore has no single point of service failure, and web logs or blogs.

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[43] Multiple changes in the addressing schemes included: subnetting, a means for dividing up one large network into many smaller ones; Network Address Translation, which allows a network of thousands of computers to appear on the Internet as just a few addresses; and Dynamic Host Control Protocol, which only provides addresses at the moment a user connects to the Internet (Comer 2000). Kruse Yurcik and Lessig (2000) describe the way in which some of these, and other changes, breach the original architectural integrity of the Internet.

The examples in this section have illustrated the difficulty of transforming the Internet's architecture for commercial purposes. Some of the major proposed changes have been briefly examined. The simplest way to verify this difficulty is to consider the primary usage for the Internet in the late 1990s. No commercial application has matched the widespread interest of the early 1990s non-commercial applications, even as the Internet has grown from millions to hundreds of millions of users.

4.3.2 Rapid growth of an unchanging design

From 1995 the Internet ceased to be a prospective network of networks, and became the predominant global data communication network. Once this success was clear, all investment in competing approaches moved to it. The subsequent growth of the Internet from a few million to hundreds of millions of users occurred around a relatively static architecture, in contrast to the technology changes of the 1970s and 1980s. The role of usage was central to this.

When first developed the Internet provided a protocol that was independent of the operating systems of diverse computers that needed to be connected. Later on the name 'Internet' was chosen to reflect the idea that it would interconnect a wide diversity of networks that developed in the 1970s and early 1980s. Vinge (1987, p. 93) writing between 1979 and 1980 describes this viewpoint in a futuristic fictional examination of networks. The Internet of the mid-21st century is presented as a small and narrow US government–based information network, linked to a gamut of powerful commercial networks. This remained an apparently universal expectation among the Internet community to the end of the 1980s. In the years after the Internet concept emerged with the first development of TCP/IP in the mid-1970s this was a logical expectation. A diversity of military networks had been developed. The Internet promised to interconnect these networks.

By the early 1990s, however, the convenience of using TCP/IP protocols to interconnect was leading to a generalised acceptance of these protocols. The Simple Mail Transfer Protocol (SMTP) displaced proprietary protocols and the X.400 International Organization for Standards e-mail standard. The network monitoring Simple Network Management Protocol (SNMP) became a convenient standard for collecting event and performance statistics from diverse proprietary equipment, much of which was then redesigned to directly support SNMP. Private wide-area networks (WANs) began to adopt TCP/IP as the protocol of choice to simplify equipment purchase and technological training requirements. For example, in 1992 the Australian Quarantine and Inspection Service had several wide-area network protocols in place including: SNA for its mainframe applications; XNS for its Xerox computers; and X.25 for one of its service networks. When it connected its local-area networks nationally in the following year, TCP/IP was the automatic choice, and migration of other protocols to TCP/IP became a priority.

By 1995 the Internet's predominance and the commercial success of Netscape proved two possibilities simultaneously: First, there was a market for a single interactive global information medium that would deliver diverse services to tens or hundreds of millions of people. Second, the Internet would fulfill this possibility. By the early 1990s the great majority of late 1990s uses of the Internet were already supported. As mentioned in the previous section, many further modifications were proposed, but the Internet for various reasons remained unchanged by these. In this, the prototype described in Section 3.1.1 became the successful technology. This created a precedent. The Internet became a success based on usage needs, without associated commercial controls or commitments. This then increased the difficulty for investors, who focused on developing commercial features to add to the Internet's free useful features.

User habits may be quite rigid. Netscape browser design team leader Marc Andreessen described the process of early design and the expectation that 'a much more sophisticated way of navigating' would emerge. He gives the example of the 'back' and 'forward' buttons for

moving between pages: ‘we never intended that to be a permanent part of the interface … You have to be careful with the metaphors you put in front of people because once they click onto one, that’s it’ (Glasner 2003). (This reflects a widespread expectation among technologists that they are or should be able to control the way that users adopt technology.)

While generally believing that ‘more could be done’, the technology community appears broadly unaware how little it has been able to influence the Internet and online technology generally since the early 1990s. This reflects the observation by Winner (1978, p. 128) from a non-technological perspective that: ‘Technological society ... has never shown any great commitment to self-reflection, self-criticism, or the study of its own history’. From the engineering community Gong and Sandhu (2000) are rare in seeking an understanding of the poor uptake of security technologies. There are many add-on security programmes available for the Internet to solve its security limitations. However, over a period of three decades they report that only four or possibly five ‘effective security technologies’ out of thousands have been broadly adopted: anti-virus software; one-time passwords; firewalls; Secure Sockets Layer (SSL); and possibly Java security mechanisms. The question Why? is rarely asked:

> The focus on deployment reflects the frustration, shared by the majority of the computer security research community, over the glaring gap between state-of-the-art security research and state-of-the-art security practice ... Why such a gap exists is a mystery, and to attempt an analysis is beyond the scope of this article. Our emphasis on deployment for this special issue is a small effort towards narrowing this gap. In the end, we failed to attract articles that explain why certain security technologies are adopted while others are not—Any historians out there reading this?—but succeeded in getting articles that dissect and discover problems with a few emerging security standards (pp. 38–9).

Christensen (1997, p. xv) describes the phenomenon that ‘the pace of technological progress can, and often does, outstrip what markets need’. Commercial modifications of the Internet may fall into this category. In 2003, 600 million Internet users are engaged to a large extent in

the same activities as the five million users in 1993. This section suggests that these users' information communication needs appear, for the most part, satisfied. A successful information technology company such as Microsoft may expend considerable effort to overcome this resistance to further technological development. Bank (2001, p. 58) quotes Microsoft insider Adam Bosworth who explains: 'The idea that something is simple is not regarded as a good thing'.

4.4 Summary

In this chapter I have linked the Internet's non-commercial early usage to its later development. I have shown that the features that supported this early usage are clearly found in the Internet's continuing architecture. Its poor support for commercial transactions is a reflection of that. I have shown that while this is a relative rather than an absolute limitation, it represents a challenge for all Internet electronic business approaches. Contrary to widespread belief, my comparison of XML-based Internet commerce and traditional electronic data interchange identifies some of the business limitations of Internet electronic business. I have also identified that by the end of this study in August 2003 the Internet has grown immensely, but its architecture has proven far less amenable to the transactional needs of commerce than its early responsiveness to the communication needs of users. The following chapter examines the situation from a separate perspective, the activity of regulators while the Internet was developing. Chapter 6 then examines the practical implications of the findings of this chapter for later 1990s investment.

Chapter 5

REGULATORY INFLUENCES ON THE INTERNET'S DEVELOPMENT

As the Internet was developing in the 1980s and early 1990s, communication media regulatory focus in the United States was on convergence of the telecommunications, information technology and media industries which would provide 'a major force for change in the growth of the new media' (Barr 2000, p. 22). This was in preparation for what was variously described as 'convergence', 'multimedia' or the 'information superhighway'. In the resulting competitive environment the Internet, a previously 'invisible' competitor, was the unexpected winner. Regulatory bodies in market economies had played a major role in the formation of media industries throughout the 20th century. The US Federal Communications Commission in 1939, for example, saw its aim in relation to the television industry as helping to develop 'a new and important industry logically and on sound economic principles' (quoted in Burns 1998, p. 562). This role often took the form of encouraging a competitive environment for existing corporations by preventing early monopolisation of the new medium. Coming from a non-commercial background the Internet was not an expected candidate for establishing such an industry. Since 1995, the Internet has gained the attention of regulators around the world. Various measures have been taken which broadly fit within the purpose of regulation through the 20th century: protection of national interests, and seeking to establish the basis for a stable commercial communications media industry. This chapter examines the research question: Was United States government regulatory policy during the development of the Internet a major factor in its success?

5.1 The Internet and traditional regulation

United States communication media regulation throughout the 20th century has been based on two related purposes: the national interest, and the requirement to regulate monopolies in order to encourage innovation. Regulation includes both direct controls and indirect influence. This includes regulation of the new media itself, and regulation of existing industries to allow the new media to develop. Regulation is based on particular media characteristics that facilitate control, management or influence. An examination of the Internet shows that for various reasons these characteristics are generally absent.

5.1.1 The regulatory invisibility of the Internet

Ganley and Ganley (1989, p. 240) provide late 1980s advice regarding communication and information policy. They predicted that no new technologies were likely to impact these areas of policy between the time of writing and the mid-1990s. The writers failed to see that an old technology (the Internet) was about to overturn many aspects of that policy.

There were several aspects of the Internet that kept its growing success out of public and regulatory sight, so that things seemed to 'just happen'. One group of reasons relates to established areas of regulation:

- Spectrum requirements: Using traditional broadcasting techniques, each broadcaster is allocated a particular range of frequencies. This means that only a limited number of radio and television stations can be fitted in to all the available space without interfering with each other's broadcasts.[44] While the number of licenses for radio and

[44] Spread spectrum' technologies such as CDMA used for third generation mobile telephony do not have this restriction, as they use a range of frequencies rather than a predetermined frequency band. These are based on a 1942 patent by actor Hedy Lamarr and musician George Antheil entitled 'Secret Communications System' (Malik, 2003).

television may bear no relation to technological capacity, the existence of a theoretical limit is described in the United States as 'a deeply held assumption at the core of our jurisprudence governing broadcasting technologies' (Lessig 1999, p. 182). The introduction of cable television partly undermined this approach, but the Internet complete supersedes it, as it is designed to use any available infrastructure to deliver information. The Internet can use telephone, television, cable, mobile telephone and other wireless devices.

- Patent litigation: Because the Internet's commercial potential was not clear until the Netscape stock launch in 1995, there was little commercial interest in developing a portfolio of 'Internet patents' to compete with the free Internet Request For Comment (RFC) standards. This in turn meant no initial patent litigation to attract the interest of regulators.
- Telephone data services: High Internet usage changes the character of telephone networks (for example by extending the length of the average call). As described below, United States regulators had already established the principle that data services should have open access to the telephone network prior to mass growth of the Internet. The Internet was simply one more application.

A second group concerned the management of new media and technologies. Programmes were in place that had little meaning for the Internet:

- Regulatory forums: The Internet technological standards model sits outside of direct governmental or international standards body approaches. There is no requirement for a regulator to send delegates or establish policy positions. Scott Bradner (interviewed in Gillmor 2002) identifies the rejection of TCP/IP by international telecommunications standards bodies as an important basis for the Internet's success.
- Content control: Barr (2000, p. 143) argues that 'there are no direct equivalents to the "gatekeepers" of content and form which characterised the major media of the past

few decades, the press and broadcasting'. Unlike broadcasting, for example, there were no 'Internet licences'.

- Industry policy: During its first period of major usage growth in the late 1980s the Internet was essentially restricted to an academic environment. Changed work practices there were less visible than in manufacturing where, for example, a sudden uptake in a technology such as bar coding would be more commercially prominent.

A third group of issues arose from the fast-moving and fragmented character of the Internet:

- Technology policy: Reusing existing technological infrastructure the Internet lacks the obvious sophistication of a telephone or television network where the introduction of a new technology such as High definition television is a highly visible activity.
- Speed of development: Once the importance of the Internet became clear, the speed of technology development among innovators provided a barrier to regulatory understanding. World Wide Web inventor Berners-Lee (2000, p. 92) described his standards development approach: 'I wanted the [World Wide Web] consortium to run on an open process like the [Internet Engineering Task Force's], but one that was quicker and more efficient, because we would have to move fast'. Napster has been described as the fastest growing 'business' in history, gathering more than 65 million users in 18 months (Harding 2001).
- Low commercial barriers to entry: The Internet creates the possibility of mass participation of non-profit, non-commercial and small commercial entities (McChesney 1999). This is a characteristic of the low barriers to entry for Internet activities, resulting in a wide diversity of participants. By contrast, traditional communication media regulation deals with a relatively small number of content publishers.

These difficulties occurred in a wider context of challenge to traditional regulation. Noam and Wolfson (1997, p. xxi) identify several areas in which friction between new industry and the regulatory approach typical of mid-20th century regulation could be found. The list includes: pricing, investment, content policy, privacy and security, quality, employment, and standards.

These differences give an understanding of the difficulty facing regulators. Chapters 3 and 4 have described the causes of these differences. Some of the effects of these differences are examined in this chapter.

5.1.2 Methods of regulatory influence and control

Government regulation of the development of new communication media takes many forms, both direct and indirect. 'Deregulation' itself is a form of regulation. In Australia, Barr (2000, p. 174) points to 81 national government reviews, reports or inquiries into communication policy in the years leading up to 1995. 'Paradoxically, at a time when virtually every government in developed countries is embarking upon greater privatisation, deregulation and liberalisation of their communications industry, and withdrawal from many of their traditional roles, most governments have been constructing national communications development strategy plans' (p. 169). For Werbach (1997, p. v):

> Government may influence the evolution of the Internet in many ways, including directly regulating, participating in technical standards development, providing funding, restricting anti-competitive behavior by dominant firms, facilitating industry cooperation otherwise prohibited by antitrust laws, promoting new technologies, encouraging cooperation between private parties, representing the United States in international intergovernmental bodies, and large-scale purchasing of services.

Regulation and market economics are often presented as two ends of a spectrum. Ellul (1967) writes of advanced technology (which he calls 'techniques'): 'The basic effect of state action on techniques is to co-ordinate the whole complex. The state possesses the power of

unification, since it is the planning power par excellence in society.' Such an approach is often considered irrelevant to a market economy. The 'unregulated market' view is presented in a typical form by McKenna and Poole (1998) in relation to the 1996 US Telecommunications Act:

> Particularly in the world of data communications, where everything is new, regulators should strive to reduce regulatory burdens in order that the market forces which new technologies are unleashing can bring benefits to the entire public (p. 96).

This view is not supported by United States government practice in relation to media or other major infrastructure in the 20th century. For example, the United States federal roads system was developed and owned by the US government after World War II. Here the high cost of infrastructure and the need for coordination functions created a candidate for government investment in a market economy. Sawhney (2001, p. 40) examines how the large sums required for creation of an advanced telecommunications infrastructure can be justified. He considers the experience of large infrastructure investment and the successful experience of 19th century canal construction in Canada. 'An initial underestimation of the cost and technological difficulty was therefore necessary for getting the project started'. Such uncertainty lends itself to government funding, where resources and political will can be mobilised for large projects.

Having reviewed communication policy in seven developed countries, Snow (1986) describes a requirement of communication which goes beyond the interests of the industry itself. With the emergence of the modern nation state, 'the evolution of international banking, modern accounting techniques, and state trading companies, communications was as important as transportation to emerging national governments' (p. 7). Its strategic role re-emerged in the last third of the 20th century as part of the 'information society'.

The absence of technology leadership by government may contribute to drawn out and destructive battles between alternative standards interests. An example of this has been the case in the development of multi-purpose smartcards, where competition including legal disputes between contenders has contributed to minimal progress in their implementation from the early 1990s. One long-running implementation has been the New South Wales government 1999 tender for supply of public transport smartcards as a ticketing system (Rogers 1999). Legal disputes delayed the contract signing with the winning company, ERG, until early 2003. This delay contributed to $A244 million losses for ERG in 2002, and an auditor's warning regarding uncertainty that ERG could continue as a going concern (Bryan 2003b). This experience threatened to be repeated as competitor Schlumberger criticised the process involved in ERG's successful $A50 million proposal for a ticketing system for Stockholm (Bryan 2003c). While such disputes are a standard feature of business, they represent a significant threat for commercialisation of technology. Where this is seen to undermine national interests, governments may intervene. The British government in 2001 illustrated the difficulty. The government 'e-envoy' blamed the lack of smartcard standardisation, along with slow uptake of digital signatures, for delays in implementing e-government initiatives (Timmins 2001).

In this thesis the United States circumstances are studied in detail for three reasons: the Internet first emerged in a United States regulatory context; there is a widespread belief that government regulation is not a major aspect of United States industry development; and the United States market approach to media and industry regulation has been followed internationally during the period of the Internet's success. The United States experience in regulation is quite different to the European and Australian tradition, which tended to acknowledge a more active role for government. These traditions are each couched in terms of meeting people's needs, with the difference based on whether a market or governmental model achieves this best. (Barr (2000, p. 96) describes this in the Australian context.)

This section provides the basis for a more general examination of media regulation issues in the following section. This section has introduced a discussion of regulation in a market economy. The next section examines the role of national interest in more detail.

5.1.3 Protecting national interests

Throughout the 20th century, government regulation played a dual role in relation to national interest. First, it oversees activities within its own country. Second it represents these interests in the international arena. These two are examined in this section.

AT&T represented an enduring monopoly for most of the 20th century. Reilly (1994, p. 31) observes that it was the de facto United States telecommunications standards developer prior to its splitting by US government order in 1984. Former Federal Communications Commission (FCC) chairman Reed Hundt (2000, pp. 38–9) provides a description of the extent of the relationship between AT&T and government:

> It was true that when Theodore Vail had assembled the AT&T monopoly, he purposely sought government regulation. In return for price regulation AT&T obtained protection from competition and a guaranteed return on investment in construction and maintenance of the Public Switched Telephone Network (PSTN), the largest machine ever built. State and federal regulatory commissions were acolytes to this communications machine that carried the world's voice and fax traffic; they guaranteed that precisely the right amount of money oiled the gears. Hundreds of pages of regulation in each state and at the FCC memorialized this regulatory deal.

Within the telecommunications field international standards bodies historically consisted of national delegates representing a national government and a national telecommunications industry, especially the government or monopoly telecommunication carrier. In 1932 the International Telecommunication Union (ITU) published the first set of separate regulations for telephony, to accompany earlier telegraphy regulations. At the time the US government

refused to sign both regulations, giving as reason that its telegraph and later telephone systems were privately owned. It eventually agreed to be bound by both these regulations in 1973 (Codding, 1984).

The International Telecommunication Union was originally formed (as the International Telegraph Union) in 1865 to coordinate cross-border communication between European states. Prior to this, international telegrams were transcribed by a clerk at the border, handed over in paper format, then rekeyed by another clerk in the same office (Standage, p. 67). The ITU's coverage was extended to include radio based on the issue of marine safety, after the Marconi Wireless Telegraph Company ordered its operators not to communicate with any radio stations using non-Marconi apparatus (Codding 1984, p. 7). In Britain itself, Marconi was sued by shipping insurer Lloyds (Winston 1998, p. 72).

The major media technologies that followed the telephone were radio and film. Maclaurin (1971 [1947]) provides an examination of the development of the radio industry. Three large United States companies were involved in radio during the World War I: AT&T, General Electric and Westinghouse. Through their research, and purchase of third party patents, each built up a large holding of patents related to radio technology. Wartime measures allowed any United States manufacturer of military equipment to use any United States patent (p. 99). At the conclusion of the war this created a significant problem of patent interference (legal disputes between similar competing patents). Maclaurin points to 20 important disputes between the patents of General Electric and AT&T from 1912 to 1926 (pp. 97–8), and expresses the view regarding AT&T that: 'Although the company did not, itself, dominate the radio industry, it was in a strong enough position to prevent any other company from doing so' (p. 93). A 1919 US Navy memorandum cited by Maclaurin stated that a patent investigation 'found that there was not a single company among those making radio sets for the Navy which possessed basic patents sufficient to enable them to supply, without infringement ... a complete transmitter or receiver' (p. 105).

After World War I, the radio industry was seen as a national priority. General Electric's Owen Young describes a meeting he had with Admiral Bullard, Director of Naval Communications:

> When Admiral Bullard arrived in my office, he said that the President, whom he had just seen in Paris, was concerned about the post-war international position of the United States and had concluded that three of the key areas on which international influence would be based were shipping, petroleum and radio. In shipping, England was supreme and the United States could not rival her position. On the other hand, in petroleum, England could not challenge America's position. But in radio, the British were now dominant and the United States, with her technical proficiency, had an opportunity to achieve at least a position of equality (cited in Maclaurin, 1971 [1947], p. 101).

Bullard describes his focus at the time: 'I had continually in mind the cable situation, and its control by foreign [British] interests and was determined that if possible this new form of international communication should remain in the hands of American citizens' (p. 101). This had been a sore point since Britain cut United States cable access to Germany in 1914, three years before the United States entered the war. After the war, under threat of further United States government control of its US interests, the British Marconi company agreed to terms of a sale: 'Stimulated by the Navy, Young persuaded the directors of the General Electric Company to purchase a controlling interest in American Marconi' (p. 103). General Electric invested more than $US3 million to establish the new company, called the Radio Company of America (RCA). Without all the patents necessary to develop a radio industry, General Electric drew in investment from AT&T and Westinghouse. AT&T purchased $US2.5 million in RCA shares in 1920. Westinghouse joined a year later, alongside the United Fruit Company and Wireless Specialty Apparatus. This US Navy sponsored approach fitted Owen Young's desire for an 'orderly and stabilized' industry (pp. 105–7). The tight-knit arrangement is described as follows:

> All current and future radio patents [of General Electric and AT&T] were to be available to each other, royalty free, for ten years. AT&T was given exclusive licenses in wire telegraphy and telephony and certain rights to radio telephony in conjunction with the telephone network. In its turn GE was granted wireless telegraphy ... Westinghouse joined the 'radio group' on June 30, 1921. Thereafter, RCA was to purchase 40 per cent of its radio apparatus from Westinghouse and 60 per cent from General Electric. As a result of these and other agreements, RCA obtained rights to over 2,000 issued patents, including practically all the patents of importance in the radio science of that day ... The position of RCA in 1923 was described by the Federal Trade Commission in the following terms: '... the Radio Corporation has acquired all the high-power stations in this country with the exception of those owned by the government, and it has practically no competition in the radio communication field' (Maclaurin 1971 [1947], pp. 105–8).

In these circumstances, the desire of the United States President and Navy for US influence in international radio was achieved through the facilitation of a single radio company balancing the interests of the most important corporations of the time in the field. Following the precedent of the 1913 agreement with AT&T establishing a telephone company monopoly that would survive more than seven decades, industry stability led to creation of an industry monopoly, although of shorter duration.[45]

In 1926 Zenith Radio Corporation successfully challenged the authority held by the US Secretary of Commerce since 1912 to issue radio broadcast licenses. This created a brief period of broader access and technical confusion among broadcasters (Maclaurin 1971 [1947], pp. 225–6). Congress responded by establishing the Federal Radio Commission in 1927, which became the Federal Communications Commission under the Communications Act of

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[45] RCA, or Radio as it was commonly known, was the glamour stock of the 1920s. From 1921 it rose from a low of $US1.50 a share to a high of $US570, allowing for stock splits, in April 1929. It lost 75 per cent of its value in the 1929 stock market crash, and took until 1964 to recover its April 1929 level (Cassidy 2002, p. 70).

1934. That legislation combined telegraph, telephone and radio regulation, and guided regulation until the 1990s. Within Britain antitrust regulation also focused on radio, where the Radio Industry Council, formed in 1943, brought together four autonomous manufacturing associations representing 95 per cent of production (Mercer 1995, p. 190).

The early 20th century experience of telephone and radio shows a major role for government regulation, arguably in an increasingly sophisticated form. The experience of television is examined next.

5.1.4 Establishing an industry on 'sound economic principles'

US government regulatory policy towards television in the 1930s had a similar but different focus, to achieve a stable industry, but without leading to the creation of a single monopolising company such as RCA. The long arm of existing industry was making itself felt well before the establishment of commercial television. AT&T, which exercised considerable control within the film industry through its Westrex sound system, in the late 1920s contractually banned studios using this system from selling sound movies to television (Winston 1998, p. 115).

Early television followed two distinct paths, based on mechanical and electronic technologies. It was also initially unclear whether viewers would watch television in their homes (using the radio analogy) or in community areas (using the cinema analogy). By 1929 the US Federal Radio Commission had licensed 22 radio stations to transmit pictures based on mechanical scanning, although in the 1930s the approach was superseded by electronic television systems (Winston 1998, p. 95).

Vladimir Zworykin patented a complete electrical television system including camera in 1923.[46] Winston writes that 'every basic aspect of modern television systems conforms to Zworykin's original patent description' (p. 106). Maclaurin (1971 [1947]) suggests that: 'if we had decided in 1928 to press forward in television research and development with the same all-out energy that we put into radar [during World War II] it would have been technically possible to advance as far in two or three years as we have gone in twenty years' (p. 265).

Winston (1998) points to two separate causes of delay. First, until the appearance of excess United States industrial capacity following World War II, there was no compelling economic need for a television equipment industry. Second, from a content perspective, the US FCC delayed the introduction of television licensing in order to give existing industries time to position themselves. In April 1939 FCC Commissioner Craven presented this view:

> If the television development means a limited amount of channels, who, considered on a broad public basis, is entitled to them—the existing broadcasting industry, the moving picture industry or the newspapers? They are all vitally interested. Despite great pressure exerted upon the commission's [television] committee to launch the television industry and still beyond that, pressure brought to bear for the adoption of certain standards, the FCC's watchword is 'caution' in the public interest (Burns 1998, p. 558).

The FCC announced that its aim was to develop 'a new and important industry logically and on sound economic principles' (Burns 1998, p. 562). While the FCC was concerned about representing the interests of three media sectors, film, radio and print media, pressure to move quickly came from RCA and the Radio Manufacturers Association (RMA), which it dominated. David Sarnoff led the RCA campaign. Originally from American Marconi, he was

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[46] Zworykin migrated to the United States after studying with Boris Rozing in St Petersburg. While television had many 'inventors', Rozing in 1911 was the first to transmit a distinct image using an electronic system (Winston, p. 101).

later to play a major role in commercial television. Within the FCC itself there was division between those who thought RCA should be rewarded for having developed a set of workable technology standards, and other members who were 'antagonistic to RCA for trying to monopolize television by securing the adoption of standards on which it had most of the patents' (Maclaurin 1971 [1947], p. 236). Having identified the divisions between industries and within the radio industry over suitable standards, the FCC adopted a position that placed pressure on RCA to reach a compromise position with smaller radio companies, through the National Television System Committee (NTSC) standards committee:

> As soon as the engineering opinion of the industry is prepared to approve any one of the competing systems of broadcasting as the standard system, the Commission will consider the authorisation of full commercialisation (cited in Burns 1998, p. 563).

In the late 1930s, from a regulatory perspective the film industry was focused on defending itself from investigation for monopolistic distribution practices, which may have limited its capacity to respond to the opportunity of television. When the television industry emerged, it was owned by radio interests. Radio was considerably less affected by the arrival of television than the film industry, although Hollywood remained a major production centre (Winston 1998, p. 119). One film response was the introduction of a new film screen aspect ratio (shape), incompatible with the proportions of a television screen. According to Negroponte (1995, p. 112), this is due to an early 1950s movie industry change 'in order to undermine early television distribution'.

Once the commercial television industry took off in earnest, growth was rapid. United States television set ownership among families rose from 3 per cent in 1948 to 76 per cent in 1955 (Shiller 2001, p. 108). The owners of the first 108 television stations emerged from the radio industry (Winston 1998, p. 122). In the early 1950s television also arrived in force in Canada, and across Europe in Italy, Germany and France: '... in every nation, the arrival did not displace whatever interested parties pre-existed the "invention". Everywhere, radio

manufacturers and producing entities switched to television. There were no casualties. There were few new faces' (Winston 1998, p. 125).

In Australia the same pattern of new media technologies being taken up by existing media interests can be seen. Barr (2000, p. 11) identifies the continuity between newspaper, radio and television station ownership between the 1930s and the 1950s creating, 'a media ownership pattern which essentially gave the major television licences to the same big press/radio oligopoly, resulting in Australia having levels of concentration of media ownership unprecedented in the Western world'.

The examples of early radio and television industry development in the United States show that the government played a major role in the form that new media industries took, ensuring that the interests of existing businesses would remain a high priority if they were willing to help develop the new medium. The same approach can be seen in the period in which the Internet developed.

5.2 Regulation during the period of the Internet's development

From the 1960s to the 1990s a vision of electronically connected neighborhoods provided a focus for new media regulation. Some of these projects were implemented at considerable cost. While not commercially successful, they provided a basis for understanding how a new commercial interactive medium might work. Regulation during the period focused on preventing the incumbent telecommunication monopoly from blocking commercial new media development. Mass Internet usage proved the unexpected outcome from this approach.

5.2.1 The online vision

Beginning with the first of the Computer Inquiries in 1966 (Cannon 2000), the US Federal Communications Commission played an active role in encouraging a competitive environment

for the anticipated new communication medium. The form of this was not clear, but some development of the television medium was expected. While television was a one-way broadcast, technology development in the telecommunications and cable industries established the possibility of interactivity, and the information technology industry created the basis for sophisticated home-based machines, allowing viewers to order goods and receive digital products such as videos. A regulatory approach that involved telecommunication, information technology, and media industries was therefore required.

A vision of such a converged medium for cable in the early 1970s is provided by Smith (cited by Meehan 1988, p. 169). In this 'vision of a wired nation, cable would replace newspapers, broadcast television, telephony, shopping trips, mail, and banking'. Meehan then reviews an implementation of such a vision, the experimental interactive cable station QUBE. This was a partnership of Warner and American Express from 1979 to 1985. Rather than resulting in a diversity of channels and programmes, the interactivity became a means of pilot evaluation and cost minimisation[47].

In the late 1980s High definition television (HDTV) appeared to crystallise the future promise. Niblock (1991) provides a European perspective:

> HDTV is not a product but a system: an entirely new system for the production, transmission and reception of television pictures. As such it has far-reaching implications, not only for the TV viewer, but across the whole gamut of economic interests concerned with the creation and broadcasting of television, as well as with the non-broadcast delivery of audiovisual software (p. 1).

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[47] A 'pilot' project is one in which a particularly technology service is tested on a small scale.

According to technology advocates in the United States legislature, HDTV was key to United States economic strategy. In 1988, Telecommunications and Finance Committee Chair Edward Markey told an industry conference:

> HDTV will impact far more than just America's broadcast, cable, and direct broadcast satellite industries ... We have learned that HDTV may represent the convergence of the television, computer, and telephone industries (Frenkel 1989, p. 1303).

Together these industries represent a major portion of modern production. In 1994 the International Telecommunication Union valued the combined 'info-communications' sector at almost $US1.5 trillion, made up of telecommunications (46 per cent), computers (33 per cent) and media (21 per cent) (Herman & McChesney 1997, p. 108). For Northfield (1999, pp. 16–17), any regulation in the field had to take account of the separate regulatory traditions of each:

> Historically the computing industry has been highly competitive with limited regulation, while the print media has been protected by notions of freedom of the press and has also been distanced from rules or obligations. In contrast, the broadcasting sector has been regulated based on the principle of channel and radio frequency scarcity with public interest policies supporting community access to content. Telecommunications has been dominated by monopoly, often government owned, carriers and has also been highly regulated, although more in terms of carriage than content. The computing, print media, broadcasting and telecommunications sectors have all been subject to cross-media ownership regulation.

The 'information superhighway' approach (described in the next section) represented more than interactive television. Reed Hundt chaired the US Federal Communications Commission (FCC) from 1993 to 1997. He describes the following 1994 exchange between Ray Smith of Bell Atlantic, a telecommunications company formed in the divestiture of AT&T, and Ralph Roberts of Comcast Cable. This contrasts two views of convergence, between infrastructure providers and between technology and media companies. While the basis of convergence is

technological, its form is economic, as separate industry participants position themselves for a future converged environment:

> The conversation turned to the status of investment in the so-called information highway ... 'It is too expensive to build two or more routes to the household,' [Smith] pronounced. 'One lane on the information highway with multiple channels. That's the only cost effective way to connect the pipe to every home. We have the engineers. We have the switches and the intelligent network. We will build it.' (In Smith's view, convergence meant new combinations of capital.)
>
> Ralph Roberts, proprietor of the cable systems that occupy the mid-Atlantic heart of Smith's Bell Atlantic system, asked modestly, 'I wonder if cable has a place in your vision. What happens to our network?' 'Forget about it,' said Smith buoyantly, 'it's cheaper to let us carry your channels for you.' ... Roberts responded, 'I would prefer to carry my own programs on my own network.' (For him, convergence meant the combination of content and conduit under one corporate roof.) (2000, pp. 54–5).

Another source of concern was the public service potential of the new environment. Branscomb contrasts two visions. One was the Internet, with 'exciting, innovative information distribution and retrieval services, many in support of the public interest'. The second:

> ... arises from a totally different series of events—the emergence of new broad-band and interactive services into the home. New means for home access to video-on-demand—direct broadcast satellite, interactive cable TV, compressed video on telephone cable, CD ROM diskettes—seem likely to expand dramatically access to home-shopping and TV movies. Billions of dollars of capital are being invested in the new business combinations to exploit this consumer information market; the dollars completely swamp the modest investments being made in bringing public services to citizens and public institutions (Branscomb 1995, p. 27).

These examples describe the expectation for new media from the 1960s to the early 1990s. It was a period of competing, but generally commercial, visions.

5.2.2 Creating a level playing field

Significant advances in computing and media technologies were achieved in the 1980s. Until the late 1980s, however, it was unclear how they would converge. Some precautions were taken to prevent early control over the future services. Notably, the US Federal Communications Commission in 1984 prevented local telephone companies from charging for data network access, in contrast to local access charges for long distance voice communication (Hundt 2000, p. 134). Lessig (2001) describes the control exercised over the Bell Operating Companies (BOCs or 'Baby Bells') that provide local services throughout the United States:

> The Baby Bells were required to unbundle the services they offered and make it possible for others to compete directly with them. If you wanted to start an ISP [Internet service provider], you could connect your service into the telephone company's office. Their wires in a sense became your wires. The important point was preserving and defending neutrality. This imposed neutrality had an unintended effect on the Internet and its growth ... They did not imagine the birth of the Internet as a product of their accidental regulation. But that is precisely what their regulation produced. This imposed neutrality about how the wires would be used left the field open for others to use the wires in ways no one ever expected. The Internet was one such way (p. 149).

Barr (2000, p. 22) examines the Australian relationship between the key sectors of media and telecommunication, given the weaker position of information technology within the Australian economy. For Barr, :

> Broadcasting and telecommunications have historically been distinct, both as processes of communication and in terms of the institutions responsible for those services. Television was a

broadcast medium, run by television networks, or by ABC-TV, and Telecom, the telephone company, carried voice calls.

Frenkel (1989) describes United States hearings held by Al Gore for the Subcommittee on Science, Technology and Space in 1988, 'on a National Technology Strategy for HDTV and on Supercomputing and an Information Superhighway' (p. 1307). HDTV in its original form was based on analogue rather than digital technologies. In 1991 in the course of a few months the US HDTV focus shifted to digital television (Negroponte 1995, p. 39).[48]

The 'information superhighway' metaphor for high speed data connection was proposed by US Senator Al Gore and had both national interest and commercial dimensions. The National Information Infrastructure (NII) launched by the US Clinton Administration in 1993, which provided the infrastructure for the 'information superhighway' approach, created the (unfulfilled) possibility of government investment. It echoed the Federal Aid Highway Act of 1956 sponsored by Gore's father. There are obvious consumption implications in the 'information superhighway' approach. Within the United States (and Australia) car spending is one of the major personal expenditures. By grouping and extending connectivity services, this approach suggests that communication can become a similarly central consumer focus. Many believed video-on-demand would be the 'killer application' to finance the 'information superhighway' (Negroponte 1995, p. 172).

As late as 1994 this expectation of an 'information superhighway' was considered far more credible than the Internet, although the Internet as a peripheral legacy service was always

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[48] By the late 1990s television interest had shifted to interactive digital television. Technically this can be delivered by cable, broadband Internet, or television (terrestrial and satellite) with appropriate return paths such as landline telephones or SMS mobile telephone messaging (by which the viewer 'interacts'). Interactive product sales can be achieved by products within a program, separate shops on a channel, or separate channels. Industry leaders could potentially emerge from among cable, television, telecommunications or IT companies.

present in the ‘information superhighway’ vision. In a typical undergraduate engineering text, Tomasi (1994) describes the Asynchronous Transfer Mode protocol of the ‘information superhighway’ but does not mention the Internet or TCP/IP.

The most ambitious test of the ‘information superhighway’ was the Full Service Network built by Time Warner in Orlando Florida. This promised video-on-demand, games and online shopping, initially to 4,000 homes but with a potential of 14 million in five years. The fate of the pilot was as follows (Cassidy 2002, p. 50):

> The set-top boxes and the network server didn’t work properly together, and the launch date was postponed from the beginning until the end of 1994. When the experiment did finally get up and running, only a handful of viewers were online. In the middle of 1995, there were still fewer than fifty homes on the network, and many of the promised services, such as news on demand, online banking, and home delivery of fast food, remained unavailable. Finally, at the start of 1996, four thousand homes were connected, and viewers were given the option to order pizza. Even then, things didn’t go as planned. Video-on-demand proved popular, but other services languished, and technical problems continued. Time Warner started to distance itself from the Full Service Network, describing it as just one of several options for interactive television that the firm was pursuing. In May 1997, when the Orlando network had been fully operational for little more than a year, Time Warner announced its closure.

By the early 1990s, the ‘information superhighway’, the National Information Infrastructure and its international equivalent Global Information Infrastructure, and convergence were under review by regulatory bodies throughout the world. The participating industries in the new medium had been identified as information technology, telecommunications and media. A regulatory environment was being established to ensure that each of these had an opportunity to innovate and participate in the new medium. The next section examines how this approach fell apart.

5.2.3 The unexpected outcome

By 1994 the ‘information superhighway’ approach to convergence and the creation of a new communication medium appeared assured. A more regulated government service-oriented Open Systems Interconnect (OSI) approach was limited to particular applications such as government and banking. The first large-scale commercial online services were being tested. Even the growth of Internet services was seen to be proof of the ‘information superhighway’ vision, which appeared to have succeeded by the early 1990s (Negroponte 1995). The ‘information superhighway’ then disappeared, and is mentioned only rarely outside government policy examination after 1994. Kahin (1995) shows the brief overlap between it and the Internet. Technological and commercial problems and delays for the ‘information superhighway’ finally left the success of the Internet universally visible, a non-commercial success in territory created by the regulatory environment for commercial competitors.

The ‘information superhighway’ was one of several competitors in the data communication world. Where it focused on delivering services to domestic users, others looked at more structured requirements, particularly for government. There the attraction was a service that would provide ubiquitous connectivity between organisations that handled and exchanged large volumes of structured data. In particular, research, military, infrastructure and traditional government activities were important. The leading approach, in Europe, Australia and standards-oriented sections of the United States, such as the Department of Defense, was Open Systems Interconnect (OSI). This included the X.25 protocol suite, which was equivalent to part of TCP/IP, and specific applications standards such as X.400 for e-mail and X.500 for directory services. OSI was accepted as a highly reliable protocol (used by banks for connecting automatic teller machines, and by governments for secure diplomatic correspondence among others), and managed by the International Organization for Standards

(ISO).[49] Hafner and Lyon (1998, pp. 246–8) describe the attitude to OSI of the TCP/IP community, that it was overly complicated and that it was a design rather than a working network to be tested and modified. Its four-year revision cycle placed it at a severe disadvantage to the ad hoc modification approach of the Internet technology community. (This is not to suggest, however, that speed is desirable in standards development. If this is achieved at the cost of agreement, and leads to myriad and incompatible technologies built around the same standard, the value of the entire standards development process may be lost.)

OSI's problem was typified at the European advanced physics research institute CERN, where Tim Berners-Lee developed key aspects of the World Wide Web. The institute supported the use of OSI protocols, when they arrived. One major initiative based at CERN was the European Committee for Future Accelerators (ECFA):

> By 1986, those who looked closely enough could begin to see the writing on the wall for OSI. ECFA published another report reiterating its 1982 endorsement of X.25 and also recommending that ISO protocols be adopted in the USA ... had the OSI delivered, the Internet crowd might well have complied (Gillies & Cailliau 2000, p. 85).

While OSI was meeting some requirements while failing to fulfil others, the US government was waiting for a global information infrastructure to emerge, funded by private investment. In 1994 US Vice President Al Gore painted a picture of a 'planetary information network'. His reference to 'different technologies' makes it clear that he is not describing the Internet: '... it will consist of hundreds of different networks, run by different companies and using different technologies, all connected together in a giant network of networks, providing telephone and interactive digital video to almost every American' (quoted in Barr 2000, p. 170).

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[49] The similarity of initials between the International Organization for Standards (ISO) and its Open Systems Interconnect (OSI) adds a minor source of confusion to discussion in this area.

Up until 1995 the Internet remained a (growing) minor disturbance for policy makers. Australian policy for online service development was set out in *Networking Australia's Future* (Broadband Services Expert Group 1994, p. v):

> The exact shape of future technologies is far from clear. What services will be sent down the 'pipes'—and be paid for by consumers—is even more unclear ... The spectacular growth of the Internet and commercial on-line services is evidence of strong demand for new communications services. We can build on that demand now to create an on-line services industry that will enable creators, large or small, to make interactive content for the new medium.

For the authors of this report the Internet's extraordinary growth is evident. Nevertheless the solution is to encourage a content industry modelled on broadcast media. Throughout the report there is no suggestion that the government has any role in relation to the Internet's development. Regulators and commercial interests would spend several more years trying to come to terms with the commercial inadequacy of the Internet, an inadequacy normally addressed prior to the success of a regulated communication media. Dutton (1998) presented IBM's view: 'ATM is the "Super Highway": Internet is only a dirt track!'

For Cassidy (2002, p. 39) the 'information superhighway' was always a vague concept, promising different things to different political or economic groups. This vagueness then contributed to the difficulty of defining value in the subsequent Internet speculation bubble. Whether or not this is the case, the Internet in the late 1990s was held to incorporate these earlier promises, if not the architecture to deliver them. In particular that meant those companies planning to invest in the 'information superhighway', interactive digital television, or any of the other earlier models changed those plans from 1995 onwards. They redirected that investment into the Internet, without an examination or understanding of whether the Internet could meet these earlier promises. This experience is described in Chapter 6.

5.3 Establishing a regulatory environment for the Internet

The success of the Internet in 1995 surprised regulatory and commercial expectations. It created a challenge for market economy regulators: how to protect national interests and introduce 'sound economic principles' to a communication medium that had already developed without controls. Despite its non-commercial origins the Internet showed considerable commercial promise. Regulators therefore focused on achieving those missing elements necessary for a commercial environment, particularly intellectual property rights, privacy requirements and security. Coming after the Internet's success, however, these activities faced scepticism, a widespread belief that regulatory controls are an unnecessary hindrance rather than a requirement for the continuing success of the Internet.

5.3.1 National sovereignty and the Internet

From 1995 government regulatory bodies began to acknowledge the arrival of the Internet as the predominant global data communication network. Policies for the first time addressed the Internet. Many of these sought to facilitate online commerce through recognition of electronic signatures, international agreement over taxation and other elements. At the same time a large number of measures created barriers to the industry's commercial development. (Referring to the problems of regulating technology, Clarke (1997) suggests that 'The law has failed dismally in its attempts to cope with the first fifty years of information technology ... even *within individual jurisdictions*, cases involving information technology are largely a lottery'.)

Among comparable countries Australia has been distinct in its adoption of an anti-pornography legislative approach with the *Broadcasting Services Amendment (Online Services) Act 1999* (Electronic Frontiers Australia 2002). By the end of 2002 this had been used to seek the withdrawal of around 100 sites, a small proportion of the millions available to an Internet viewer. A French court ruled in 2000 that Yahoo! should not allow French citizens to access Nazi memorabilia on its United States sites (Eaglesham & Graham 2000). As this is

technically not possible based on the Internet's underlying architecture, meeting requirements such as this would see the Internet's existing structure gradually broken up along national borders. The Chinese government maintains firewalls between Chinese users and the rest of the Internet, targeted at particular media sites (Zittrain & Edelman 2003). In addition it regulates national Internet usage. Nevertheless, an extensive and diverse range of opinions still permeate the Internet in China (McGregor 2000). Many other countries have similarly unsuccessful regulation of Internet usage, often finding themselves on the defensive. In 1999 the Singapore Home Affairs Ministry, responsible for police and internal security, scanned the PC hard drives of 200,000 Internet users who subscribed through SingNet, the country's largest Internet service provider. SingNet subsequently apologised to subscribers, stating that it had requested the action in order to eliminate a computer virus (Australian Associated Press 1999).

The Internet has also become a point of discussion in international trade negotiations. In 2001 US Commerce Secretary Don Evans told Latin American trade ministers that in order to benefit from electronic commerce they should streamline customs operations and develop an infrastructure to 'expedite express shipments' (Mahoney 2001). Such an approach would presumably both provide export opportunities and open the Latin American market for external suppliers.

One of the major technological hindrances to Internet electronic business up until 1999 was the ambivalence of the US government towards the use of encryption to protect the privacy of commercial transactions. The US government had adopted the approach that cryptography was a 'munition', and therefore subject to export controls. A key report to the European Parliament states, 'The use of strong encryption which ensures the confidentiality of both sensitive commercial and of personal data is one of the foundation stones of electronic commerce' (E-Commerce Commission 1997, p. 4). The right to encrypt transmitted data was established in Europe with the creation of the International Telegraph Union in 1865 (Standage 1999, pp. 105–6). Due to the cost structure of telegrams, and their handling by

many people, complicated abbreviation codes and commercial secrecy codes were established.[50] This remained the status quo until the 1970s, when computational power and conceptual mathematical breakthroughs created the possibility of codes that were cheap to use and impossibly resource intensive to break. The relationship between the cost of protection and the effort to overcome protection was gone. In December 1998 Australia was among 33 countries to sign the Wassenaar convention, initiated by the United States, that restricted the export of effective encryption technologies (Davidson 1998c). The result of this was twofold, to encourage development of commercial non-US cryptography industries, and to limit the usefulness of international electronic business outside of specialised areas such as banking, where effective encryption was permitted.[51] The technology used to encrypt data is closely related to the technology used to create a digital signature, another central requirement of electronic commerce. As governments considered limiting encryption while promoting digital signatures, Davidson (1997) quotes Caelli suggesting that it is technologically impossible to separate these technology applications.

This situation was reversed when a US appellate court ruled in 1999 that encryption algorithms were covered under the US Constitution as a form of speech, and their export could not be blocked (Gilbert 2002). While United States government security organisations continue to have concerns about this decision, the central dilemma remains: the United States government can promote secure electronic business, or restricted access to cryptography, but not both. Key escrow approaches such as that used in France, which provide a government with keys for all encrypted transactions, are generally not acceptable for corporations operating in an international environment.

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[50] Coded telegrams were also a feature of international diplomacy, for example in the infamous frame-up of French military officer Alfred Dreyfus in the 1890s (Chapman 1972).

[51] Phil Zimmerman, creator of the encryption-based Pretty Good Privacy system, argues that the potential for criminality provided by unbreakable cryptography does not outweigh its value as a protector of privacy, as ‘governments have killed more people than criminals have’ (Davidson 1999).

The national regulation of Internet architecture and usage creates a dilemma for commercial Internet development. Internet use for commercial transactions is one of the weakest aspects of the Internet, as described in Chapter 4. It has been shown to be sensitive to restrictions on content access, cryptography access or assertions of national sovereignty over taxation. The Internet's capacity for commercial activity is far more easily damaged than its capacity for communication.

5.3.2 Property rights in cyberspace

The major focus of regulatory control over the Internet since 1995 has been in the establishment of intellectual property rights, creating the legislation and legal precedents that will determine property rights in cyberspace.

Gibbons (cited in O'Connell 1999, p. 7) has described the Internet as a 'seamless web of contractual rights, duties and enforcement mechanisms that would build the community and avoid difficult issues of jurisdiction, international law, comity and sovereignty'. However, national jurisdictional influence has been strongly visible in the context of intellectual property rights (IPR) and the Internet.

The Internet is primarily used for exchanging information, unlike traditional broadcast viewing with its highly controlled content. Nevertheless, increasingly global holdings of intellectual property still provide a basis for placing pressure on the Internet's structures. The most visible area of dispute has been the exchange of music over the Internet. In the late 1990s Napster provided a 'peer-to-peer' (P2P) means of finding and downloading music files.[52] The Recording Industry Association of America (RIAA) pursued Napster in the United States

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[52] Napster 'is not peer-to-peer in the strictest sense, because it uses a centralized server to store pointers and resolve addresses' (Shirky 2000a).

courts, accusing the company of promoting illegal copyright violations. RIAA represented five music companies, EMI of Britain, Sony of Japan, BMG of Germany, Time Warner of the United States and Vivendi Universal of France. The legal action was widely criticised within the financial press because the music recording industry had developed no viable approach for charging customers. A similar standoff had occurred in the 1930s according to Harry Fenik of US Zona Research:

> In the 1930s, the music industry successfully managed to use legal means to stop radio broadcasters from playing copyrighted songs. For two years, they couldn't broadcast any copyrighted songs until they reached a settlement in which radio companies paid a royalty (quoted in Foremski & Heavens 2000).

The music industry attack on Napster was based on claimed losses. Figures in this area are disputed. Vivendi lost a combined €36.9 billion in 2001 and 2002 for a variety of reasons (Carreyrou 2003). However, in 2000 a drop of 63 million in singles sales was offset by an increase in CD sales of 61 million (O'Connor 2001b). The dispute involves prominent performers on both sides, with some bands, including Metallica, campaigning against Internet file sharing while others, including Limp Bizkit, supported it (Harding 2000). Concern is greater among the 'content-publishing community' than the 'content-creating community' (Dyson 1998, p. 170). Performer Janice Ian (2002) identifies previous services and technologies which the recording industry had warned would have disastrous consequences: reel-to-reel home tape recorders, cassettes, Digital Audio Tapes, minidiscs, VHS video, BETA video, music videos and MTV. While joining the prosecution in the Napster dispute, Sony had previously been a defendant in similar circumstances when introducing home video products.

Napster's legal difficulties led to a strategic alliance with Bertelsmann in October 2000, based around plans for a paid monthly subscription service (Grimes & Harding 2000). A court defeat in February 2001 prompted Napster to approach the music giants with a profit sharing scheme, but it had little success (Rigby 2001). It ceased operations that year. (In contrast, a US District

Court ruled in 2003 that music swapping services Grokster and StreamCast were no more breaking copyright than a photocopier manufacturer (Wolf 2003).)

The US government's major steps in support of intellectual property rights have been the Copyright Term Extension Act (1996) and the Digital Millennium Copyright Act (1998), which 'made it a felony to write and sell software that circumvents copyright management schemes' (Lessig 1999, p. 49). The ability to circumvent some schemes may be protected under Australian law, because they allow users to play games and music bought overseas that do not work in Australia because of 'region coding', a technical scheme for controlling the source of purchasing. The Australian Competition and Consumer Commission has said the practice of region-coding might itself be illegal (Davidson 2003).

Mosco and Wasko (1988) analysed earlier computer technologies from a political economy perspective. They examined the business issues of pay-per-view, which remain complicated in 2003. In the absence of traditional content ownership controls on the Internet, the legal dimension of data and intellectual property ownership has grown in importance. Lessig (1999) presents a legal view based on the principle of a public commons, which he argues is enshrined in the United States Constitution. According to this view, which is strongly contested by the content publishing industry, people historically have a right to some free information access, both at some period after publication, and under the 'fair use' principle. According to Lessig the proportion of information available this way will tend to be reduced if the issue is left to the market and technology to resolve.

One technological view sees the market as providing a poor basis for responding to user demands. For Cowan (1999, p. 202) 'the landscape of American technical history is littered with the remains of abandoned machines'. Cowan illustrates this by examining the silent gas refrigerator, defeated in the market by its noisy electrical alternative:

> Consumer ‘preference’ can only be expressed for whatever is, in fact, available for purchase ... Consumers do not get to choose among everything that they might like to have, but only among those things that manufacturers and financiers believe can be sold at a good profit (p. 215).

The 1999 judgement in a Microsoft monopoly case expressed a similar view: ‘The ultimate result is that some innovations that would truly benefit consumers never occur for the sole reason that they do not coincide with Microsoft’s self-interest’ (quoted in Crowe 1999b). This echoed an earlier ruling on monopoly. US Supreme Court Chief Justice White in a 1911 ruling on the US Standard Oil monopoly described the effect of Standard Oil’s commercial ‘genius’ as being to ‘drive others from the field and exclude them from their right to trade’ (Sampson, pp. 33–34). For the Internet, by contrast, users were not dependent on choices made by commercial investors. The requirement for business benefit is a late addition, and the user is presented with billions of alternative web pages and hundreds of millions of e-mail enabled users.

There is a vigorous debate and large literature on the issues raised in this section. It is important to the commercial future of the Internet. However, it is only briefly examined in this thesis because, as of mid-2003, the control of intellectual property rights has not yet provided the basis for a stable commercial industry. While the project of legally limiting content distribution is well advanced, it is proving considerably more difficult that expected, for reasons examined in the following section.

5.3.3 Issues for Internet regulation enforcement

In 1934 Brookings Institute’s Walter Hale Hamilton stated that: ‘Business succeeds rather better than the state in imposing restraints upon individuals, because its imperatives are disguised as choices’ (cited in Herman & McChesney 1997, p. 191). Modern writers have

echoed Hamilton's view on the role of business in establishing control. Lessig (1999) argues this view in great detail. Dyson (1998, p. 155) provides a similar perspective:

> Overall, the United States is trying to push as much of world governance as possible into the realm of commerce, since commercial law arouses much less emotion than other kinds. The more you can make things a matter of contracts and market bargaining, the less government—and the less agreement among governments—you need in the first place.

In the early 2000s such a business-based approach to Internet regulation had shown limitations in three areas: First, in the face of widespread discussion, the business-based approach had lost some of its apparent neutrality. Second, as the Internet existed prior to business involvement in 1995, this weakens the suggestion that a market model of media technology development for the Internet was necessary. The establishment of a commercial Internet on sound economic principles becomes an option, rather than a necessary precondition for the Internet's existence. Well before the success of the Internet, Winner (1978, p. 241) predicts this possibility: 'the original purpose may serve as a troublesome obstacle to the elaboration of the network toward a higher level of development'. This is not a widely examined problem, because the requirement of commercial investment is generally a precondition for the emergence of a particular product or service. Third, while the content publishing industry has a tradition of limiting technology in order to enforce regional media distribution agreements, the information technology industry has no such tradition.

The activities of regulation during the period of the Internet's development were consistent with the earlier goals of an 'orderly and stabilized' radio industry, and a television industry based on 'sound economic principles'. The FCC in the 1930s was concerned that the interests of print, film and radio media be considered in television licenses. In the 1990s the FCC had consideration for broadcast, cable, satellite, wired telephony and wireless telephony, the five lanes of the 'information superhighway' (Hundt 2000, p. 83).

For a contrasting regulatory approach, John Perry Barlow (1996) issued a Declaration of Independence of Cyberspace:

> Governments of the Industrial World, you weary giants of flesh and steel, I come from Cyberspace, the new home of Mind. On behalf of the future, I ask you of the past to leave us alone. You are not welcome among us. You have no sovereignty where we gather. We have no elected government, nor are we likely to have one, so I address you with no greater authority than that with which liberty itself always speaks. I declare the global social space we are building to be naturally independent of the tyrannies you seek to impose on us. You have no moral right to rule us nor do you possess any methods of enforcement we have true reason to fear.

Barlow does not counterpose the use of the Internet to the possibility of stable commercial investment. His view could be consistent with Whittle (1997, p. 416): 'Cyberspace would become an enormous free market of goods, services, and information.' But Barlow does contest the primary importance of a stable industry, and the role of government regulation in achieving it.

A Global Internet Liberty Campaign report (2001, p. 4) identifies three forms of governmental control over the Internet: laws prohibiting certain content; establishing technical blocks to certain information being available within a country; and enlisting Internet service providers to 'self-regulate'. The report suggests that 'self-regulation' is a misnomer, because the ISPs are regulating the activities of their customers rather than themselves (Global Internet Liberty Campaign, p. 26). This points to a difference between the Internet and film, for example. 'Self-regulation' in the film industry will affect what an audience sees, whereas 'self-regulation' by an ISP will affect what an individual can say, through their web site for example.

By the early 2000s the debate had become public. In addition to the activism of people such as Lessig, the US Federal Bureau of Investigation arrested Dmitry Sklyarov for breach of the Digital Millennium Copyright Act. Sklyarov had presented a research paper on accessing 'electronic books' to a conference in the United States. Sklyarov spent some weeks in prison, and was eventually cleared of the charge several months later (Richtel 2002). The belligerence of the United States music recording industry was shown by attempted criminalisation of file swapping, which is undertaken by tens of millions of young people. RIAA president Cary Sherman announced that: 'We're going to begin taking names and preparing lawsuits against peer-to-peer network users who are illegally making available a substantial number of music files to millions of other computer users' (BBC News 2003). The Recording Industry Association of America and other organisations also threatened Princeton University's Felten with legal action if he presented a conference paper on research regarding the security effectiveness of a publicly released digital watermarking system. In a statement presented to the conference in its place Felten (2001) said:

> We remain committed to free speech and to the value of scientific debate to our country and the world. We believe that people benefit from learning the truth about the products they are asked to buy. We will continue to fight for these values, and for the right to publish our paper. We look forward to the day when we can present the results of our research to you, our colleagues, through the normal scientific publication process, so that you can judge our work for yourselves.

These and other issues have led to an environment of political conflict in the commercial arena not found in an examination of radio or television-based legislation previously described. Controversy surrounding earlier media focused on the extent of public access in media production and distribution.

By attempting to apply the most restrictive rules of the converging industries of telecommunications, information technology and media (that of the music industry), late

1990s Internet regulation has created an adversarial situation. For Stanford University professor Lessig (1999, p. 167) the issue has become one of 'freedom':

> The first-generation Internet might well have breached walls of control. But there is no reason to believe that architects of the second generation will do so, or not to expect a second generation to build in control. There is no reason to think, in other words, that this initial flash of freedom will not be short-lived.

While the Internet is nominally independent of control it remains under the ultimate direction of the US Department of Commerce. This department is responsible for the late 1990s Internet Corporation for Assigned Names and Numbers (ICANN) experiment. ICANN is responsible for the Internet's 'root', its central addressing standard. ICANN's incorporation in California makes its subject to both United States legislation and United States litigation. Mueller (2002) examines the obscure intersection of technology and regulation:

> The root is the point of centralization in the Internet's otherwise thoroughly decentralized architecture. The root stands at the top of the hierarchical distribution of responsibility that makes the Internet work. It is the beginning point in a long chain of contracts and cooperation governing how Internet service providers and end users acquire and utilize the addresses and names that make it possible for data packets to find their destinations (p. 6).

The strongly contrasting traditions of the Internet's technology development and the music industry's control of intellectual property has made the regulation of the Internet a volatile subject. The media controls are a late addition to an already developed Internet. The threat or prosecution of security technology researchers has brought issues of intellectual freedom into the debate. Combined, these issues show the difficulty of integrating the separate usage, commercial and regulatory interests that the Internet represents.

This section has identified the main themes of Internet regulation. Each of these has been applied to the Internet only following the Internet's commercial success in 1995. In August

2003 they therefore remain in early stages of development. The common experience in these early years is that commercial applications on the Internet are more vulnerable than general communications. This supports the finding of earlier chapters, that commercial Internet use depends on additional technical requirements such as security and non-technical requirements such as trust, but that traditional Internet communication activities are much more easily supported by the Internet's existing architecture.

5.4 Summary

In this chapter I have examined three aspects of regulation, primarily in the United States: the Internet's absence of regulatory controls in contrast to earlier communication media; the role of regulation during the Internet's development; and the difficulties caused by imposition of Internet regulation after its success. These points, while apparently obvious, are each only partially recognised in existing literature. This leads to my conclusion that the Internet *is* a product of the United States regulatory environment, but an unexpected one. Without regulatory restriction on AT&T, the Internet would have faced serious obstacles to its growth. In its success the Internet met the convergence expectations of many investors. In 1995 at the point of the Internet's commercial emergence, it suddenly became the focus of these expectations. The outcome of this commercial interest is examined in the next chapter.

Chapter 6

THE MIXED EXPERIENCES OF BUSINESS INTERNET INVESTMENT AND USE

This chapter builds on the arguments in the three preceding chapters. Chapter 3 identified the basis of Internet mass use prior to commercial investment. This created an expectation that the Internet's growth would lead to mass consumption via the Internet. Chapter 4 described the technological limitations of the Internet as a transactional medium. These limitations were not widely recognised within business. Their effect is found in both positive and negative experiences of Internet investment. Chapter 5 described difficulties with regulatory attempts to establish a stable basis for commercial Internet investment after mass Internet uptake. The absence of such a stable destination for investment, and particularly the low barriers to entry for Internet business investment, resulted in challenges for achieving business benefits through Internet investment. This chapter furthers the argument by considering the final subsidiary question: Under what conditions have businesses received business benefit from the Internet? Three necessary conditions are identified: making use of the communication characteristics of the Internet; matching the Internet's technical architecture; and, achieving the result in a way that does not compete away the business benefits.

6.1 Understanding the Internet as a communication medium

Chapter 3 described the development of the Internet as a communication medium. This creates a more complicated challenge for investment than in other technologies. Each of the communication media has particular characteristics that have attracted an audience, and this imposes constraints in the commercial development of that medium. In the case of the Internet, these characteristics include interactivity, a low-cost method of publishing and easy international reach. The growth of the Internet's user base to tens and then hundreds of millions of people led to the assumption within business that the Internet could become the preferred consumption medium of these users. While overestimating the short-term interest of Internet users in becoming online consumers, a second difficulty for companies was an underestimation of the ways in which the Internet would challenge existing organisational practices. Understanding both the external and internal business challenges created by the Internet as a communication medium was a necessary first step in achieving business benefit.

6.1.1 Mass use creates the expectation of commercial consumption

The unrestrained enthusiasm for all aspects of Internet opportunity was an important aspect of commercial Internet development in the late 1990s. The belief at the centre of this enthusiasm was that as millions of Internet users became hundreds of millions, their activities would create the basis for mass commercial opportunity along the lines of the commercial network experiments described in Chapter 5.

Such a view can be seen in the Ericsson Microsoft Mobile Venture announced in 2000. This presented the expectation that e-mail would provide the basis for a mass commercial data service:

> [Ericsson] predicts the number of mobile phones and mobile devices will surpass the number of consumer PCs by the end of 2003 and that there will be 1bn [billion] mobile internet

> subscribers by 2005. There are already 435m [million] e-mail boxes in use today (Brown-Humes 2000).

This example argues as follows: Internet users like using computers for e-mail; within a few years there will be more Internet-enabled mobile phones than any other Internet-connected device; once that happens the mobile phone will be the primary means of accessing the Internet; e-mail will then be primarily accessed through the mobile phone. The commercial basis for this hope is that the rates charged for mobile data are many times greater than those charged for non-mobile Internet traffic accessed from a personal computer. This is a convincing argument for the commercial desirability of mass mobile Internet e-mail use. However, it fails to acknowledge a critical usage issue, that mobile telephones are poorly suited for handling e-mail. They have poor display, limits on length, no support for e-mail attachments, and are difficult to use for composing e-mail. This provides an example of companies that fail to match their approach to the communication characteristics of the Internet.

Commercial investment plans focused on expectations that online users would lose interest in communication and information exchange, and become online buyers, in both the consumer and business markets. Herman and McChesney (1997, pp. 128–9) describe the ambitious commercialisation plans at the beginning of the period:

> ‘The Web will be a lot more like a great retail experience,’ the head of AT&T’s Internet access service stated in 1995: ‘If it’s done well, you won’t feel there’s any tension between the consumerism and the entertainment’ ...
>
> ‘Anything that can help the Web look, feel and act more like TV will provide a quantum leap for the advertising community in its acceptance of the Web,’ one advertising executive observed, ‘since TV video experience is the gold standard’.

Writing in the same period Microsoft CEO Bill Gates (1995, p. 6) urged his audience to 'imagine a marketplace or an exchange' when they hear the phrase 'information highway'. Schiller (1999, pp. 99, 101) describes the promised investment opportunity:

> The Web platform ... comprises a venue that is perfectly matched to the diversified entertainment conglomerates that have been assembled during the past fifteen years ... Through their strivings, on this sprawling and untidy landscape, an Internet consumer medium was born.

Widely used services promised large profits. Within the United States telecommunications industry, the number of service users is 'an excellent predictor of profitability' according to Noam (2002, p. 5), writing of mobile telephony. The expected value of Internet users as consumers was shown by America Online (AOL), with around half the US consumer Internet market. By late 1999 the company's market capitalisation had passed $US100 billion, valuing each member at $US5,260, an average of 22 years' income from each (Crowe 1999a). Such a valuation suggested the expectation of increased revenue from subscribers, through the extension of services provided. This high value laid the basis for the subsequent purchase of the world's largest media organisation, Time Warner, announced in January 2000 and completed in January 2001. At $US181.6 billion this was more than twice the next largest global merger or acquisition in this period (Thomson Financial 2001, p. 10), and the only cross-sector merger or acquisition among the largest 20.[53]

The problems experienced by many companies in gaining uptake for their Internet investments is not reflected in use of the Internet itself. Figures for Internet use following the dot-com

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[53] The 'horizontal' tendency of mergers or acquisitions to consolidate similar companies in a sector is a general phenomenon. 'Almost all of the merger activity that has taken place in the United States since the passage of the 1996 Telecommunications Act has been in horizontal segments of the market' (Mueller 1999).

speculation bubble collapse in March 2000 show a consistent pattern of growth in countries where majority uptake had not already been achieved. Between March 2000 and November 2002, Internet connectivity among members of the European Union rose from 18 to 43 per cent (Commission to the Council 2002, p. 6). Among those users the proportion purchasing online frequently or occasionally increased slightly from 18.5 to 23 per cent (p. 14).

This section has provided examples of the simple mid-1990s expectation that the Internet would become a medium for consumption. In other communication media, mass uptake has been a strong measure of business benefit from an investment. This chapter describes further conditions required for Internet business benefit. The next section shows that the Internet's communication medium characteristics may not match the internal approach of a company.

6.1.2 Communication implications within a company

In addition to the mixed experience of business benefit from Internet investment, some aspects such as e-mail and web-based business development may provide both benefits and create significant disruption to existing business processes. The examples of e-mail, digital content distribution, and sales channel competition are considered here.

E-mail has provided a new way for businesses to relate to each other. It provides a medium of communication that has the convenience of the telephone while going some way towards meeting the formality of previous written communication. It provides the added benefit of connecting people across time: the sender and receiver do not need to engage in the communication at the same time.

While facilitating corporate communication, it has some drawbacks. These include the problem of unwanted e-mail, and the physical limits for a person in dealing with a continually rising level of e-mail. Most importantly, significant challenges occur at an organisational

level. E-mail has had an important part in many legal disputes and regulatory investigations since the mid-1990s. This stems from its character as a medium of record as well as of communication. Bank (2001) develops a detailed analysis of the US Justice Department case against Microsoft for monopolistic practices based on e-mails provided during that case. One business industry report states:

> Witness the disturbing case that New York State Attorney General Eliot Spitzer is building against Merrill Lynch, the largest brokerage and investment bank in the U.S. Spitzer's probers have uncovered scads of e-mail implying that Merrill employees, including star Internet analyst Henry Blodget, privately disparaged companies they were publicly promoting. Blodget called at least two of the companies a 'piece of sh-t' at the same time that Merrill was recommending them to investors (Salkever 2002).

A US Securities and Exchange Commission investigation of Credit Suisse First Boston provided the following exchange:

> 'Okay, we got another screaming deal and I weaseled you guys some stock … We've yet to see any leverage out of you guys for the free dough-re-me. Does it make sense for me to continue to feed your guys with deal stock? Or should I take the stock to someone who will pay us direct for the allocation?' Another broker e-mailed, 'Basically, I told [client] that he was very far behind in commissions and that we expect a 65 per cent return on all money that we make him' (Cahill 2002).

Well before the spread of corporate e-mail, Zuboff (1988, p. 9) had warned of the dual character of information technology for business, contrasting it to the introduction of a machine that produces objects (such as in a factory): 'Information technology ... introduces an additional dimension of reflexivity: it makes its contribution to the product ... It provides a deeper level of transparency to activities that had been either partially or completely opaque.'

Apart from e-mail, another effect that the Internet may produce is enabling the combination and reuse of existing digital assets. This was shown in the ambitious restructuring plans of German-based Bertelsmann, one of the global media giants. From 1998 under CEO Thomas Middelhoff the company was involved in two related transformations: the centralisation of company management and a move into online media services. [54] Its huge content holdings potentially provide a major source of income through new media channels, although not without internal reorganisation: 'Breaking the culture of decentralised management has been crucial to the development of such combined offerings' (Dempsey 2001). These ambitious restructure plans were not completed, however. Instead, the removal of Middelhoff in mid-2002 was expected to be accompanied by reversal of this centralisation (Rose 2002).

'Cannabalising' existing sales is a further possible effect of the Internet, and is a widely observed reason for avoiding Internet investment. This is the situation when a company provides a lower cost substitute that competes with one of its own existing profitable services. The threat may be either real, or imaginary as described by Christensen (1997). An example is The Farmshed, an Australian agricultural portal.[55] The project was established in 2000 by rural corporations Wesfarmers Landmark and Rural Press Ltd, and joined by National Australia Bank and stockbrokers JB Were. Originally a defensive strategy in the face of potential alternative exchanges, the portal had information, software and online trading aspects. Prior to its sale in October 2002 it had cost between $A10 and $A20 million of $A40 million committed and had 30,000 subscribers. Electronic trading, however, had not succeeded. For

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[54] Bertelsmann has investments in magazine and book publishing, music, television stations and media production, and is in a league with AOL Time Warner, News Ltd and Disney. Some of its well-known divisions include BMG music (with Whitney Houston and Britney Spears), CDNow online music sales, RTL television and production (including Big Brother and Baywatch) and the largest English-language book publisher, Random House.

[55] A 'portal' provides a diverse range of services from a single Web site, for example selling additional services such as insurance to users of a core service such as farming information.

users, it was primarily an information source (Bolt 2002a). The financial press described the business conflict that had developed at the centre of this Internet-based project:

> The shareholders have argued the business model did not work, but outsiders claim Wesfarmers and Rural Press, which have written off most or all of their investment, were reluctant to vigorously pursue developments that might have a cannabilising and price discounting impact on their main businesses (Bolt 2002b).

Both Wesfarmers and Rural Press had alternative business opportunities. Wesfarmers in 2001 had acquired part of Melbourne-based rural goods distributor and retailer IAMA Ltd. Wesfarmers planned to limit its own Internet trading to suppliers rather than to customers (Bryan 2003a). Rural Press had concerns for its print advertising and classified business. The Farmshed's managing director Angus Taylor described this as 'a continuing set of conflicts of interest between shareholders and between the company and shareholders' (Taggart 2002). The success of business-to-business marketplaces in this case was seen as incompatible with the interests of the key partners.

A similar situation is the negative reaction to online business auctions, which can be contrasted to the positive experience of the consumer-to-consumer auction company eBay described later in this chapter, a company that has been able to tie its approach to the Internet's interactive communication characteristics. eBay provides a traditional 'highest bidder gets to purchase' auction. This provides a seller with a means to maximise value. Within business-to-business auctions the predominant mechanism is reverse action, where products or services offered for the lowest price win. This is a buyer's cost reduction mechanism, and is rejected by many product and service providers. In the hotel industry, for example, the Internet may be used to auction off spare capacity, on the principle that occupied rooms are better than empty rooms. On the other hand, Hilton hotel operations president Dieter Huckestein states the effect of reverse auction on a corporation making its hotel

bookings is ‘to drive down prices’. For this reason, individual Hilton hotel managers have been instructed not to participate in reverse auctions (DeFoe 2002).

These examples introduce some ways in which outcomes from Internet investment may be different to expected results.

6.1.3 Alternatives to Internet investment

This section describes the difficulty of one particular industry sector, media, in relation to Internet investment. Media organisations, along with business in general, have widely embraced the Internet for business practices such as e-mail. For media organisations to replace traditional channels, or even place significant focus on the Internet, however, is a more difficult proposition. The example provided here focuses on News Ltd, whose Internet investments remain relatively small and experimental. This is in contrast to the experience of Bertelsmann, previously described, and Time Warner, described below.

One of the most significant business implications of the Internet is in the area of free information. The technological basis of this is the distributed and interactive nature of the Internet. While an Internet web site visited by millions of people a day is still expensive to run, providing a site visible around the world can be achieved for thousands rather than millions of dollars. This represents a low ‘barrier to entry’ for publishing on the Internet. By contrast, Kohler (2002) describes the access cost alone of operating a television channel on the Australian Foxtel cable network. Following a substantial reduction, in 2002 this was $A750,000 per year.

This creates a dilemma for traditional media organisations, which receive an income from the information they distribute. A new media and broadcasting conference in March 2002 was described by its sponsor, the *Financial Times,* as ‘the death-knell of the internet as a commercial media vehicle’ (Pesola 2002). News Ltd chief operating officer Peter Chernin told

the conference that there is 'no viable business model that works for the internet'. He later expanded his view: 'Where did [we] get our grandiose ideas the media business was on the way to complete and utter reinvention?' (Tourtellotte 2002).[56]

In contrast to the majority of major media companies, Rupert Murdoch's News Ltd invested relatively little in the Internet sector.[57] The *Economist* (3 July 1999) expressed the view that the company's chief executive officer Rupert Murdoch had missed significant investment opportunities by focusing on a global satellite-based television network rather than new media. One Australian commentator described the News Ltd strategy as based on the 'apparently mistaken dismissal of convergence, the belief that all media are converging towards an internet-based service' (Chenoweth 1999a). An early News Ltd investment described by Cassidy (2002, p. 114) was Delphi Internet Services, a science and research-focused Internet service provider, in September 1993. This was sold back to its founders in 1996. Cassidy also describes News Ltd's unsuccessful attempt to set up an online guide, I-Guide, based on its *TV Guide*. This included the employment of hundreds of people. By the time of its launch in February 1996 portals and search engines were already providing these services for free. (By 2002 leaders Yahoo! and Google were showing substantial profits, as identified elsewhere, but competitors have had a difficult time.) Later activity was similarly limited.

New Ltd did devote considerable resources to other new media, particularly interactive digital television through its 37.5 per cent share in BSkyB, the British satellite pay television

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[56] Chernin has a record of understanding how to make money from media. Under his management Twentieth Century Fox produced three of the five biggest box office successes to that time, *Titanic*, *The Phantom Menace*, and *Independence Day* (Chenoweth 1999a).

[57] There was some family involvement. Rupert Murdoch's daughter Elisabeth had an involvement with Oxygen Holdings, an Internet fund (Daniel 2000). Son Lachlan had a central role in the 'new economy' telecommunication company One.Tel, alongside Australian media owner Kerry Packer's son James (Donnan 2001).

operator. In 2000 BSkyB announced a £250 million investment in new media and electronic commerce. These included stakes in several companies including Streets Online, Gameplay and Toyzone. A director of new media, John Swingewood, was recruited from British Telecommunications to lead the move. BSkyB launched an interactive service, Open. BSkyB's own migration from an analogue to a digital network for its 5 million subscribers had been highly successful, driven by the free distribution of television set-top boxes (Ward 2001; Ward & Harding 2001). An aggressive acquisition approach resulted in about £350 million invested in Internet retailers. By 2001 these plans had been reversed. BSkyB later reduced the value of its holdings in Internet companies to nil and made Open part of the broader company. For interactive digital television from a consumer point of view this means that instead of a full interactive Internet-style 'browsing' experience, a buyer would just be given the option of selecting the offer presented on the screen. The nine months that the service was offered cost BSkyB £158 million (Hargreaves 2001).

Hargreaves reports that the outstanding success of the project was online betting, which drew £55 million out of a total income for the period of £60 million. This points to an important difference between interactive digital television and the Internet: in the former there is complete control over who is using what service. This ensures that issues of international jurisdiction do not arise. In the Internet, by contrast, resources must be devoted to ensuring that national regulations on gambling are not breached. Gambling is often cited as a major commercial success on the Internet, although this depends on the development of a stable regulatory environment (in particular establishment of the principal of legality, and trust among consumers). In Australia both Canbet and Lasseters have each achieved betting levels of more than $A400 million per year, 'but have struggled to generate profits' (Crowe 2003). This reflects high setup costs, particularly in security. Lasseters reduced losses for 2002 to $A4.8 million, down from $A18.4 million the previous year. Canbet posted its first net profit of $A0.3 million in 2002. The closure of the Australian owned, Vanuatu-based, online CrownGames in May 2003 with losses of more than $A25 million was attributed to regulators outside Vanuatu 'cracking down on offshore casinos in a bid to protect tax revenue' (Power &

Nicholas 2003). Legality of operation is a serious concern for gambling site operators throughout the world. In 2000 an Antigua-based gambling operator was sentenced to 21 months imprisonment in the US for providing services to US gamblers (Sanghera, Daneshkhu & Garrahan 2000).

News Ltd's approach to the Internet has been to acknowledge the difficulty of achieving business benefit, and to focus on alternative commercial media avenues. For a large media corporation this has to date proven a successful approach.

This section has examined the business aspects of events described in Chapter 3. It has identified a mistaken expectation that Internet usage would simply transfer to Internet-based consumption. For most Internet-focused companies, this was followed by the extensive and well-documented commercial losses referred to in Chapter 2. In addition, the communication characteristics of the Internet have challenged existing corporate processes, particularly the permanent record of activity provided by e-mail. The difficulty of achieving business benefit is partially acknowledged by the example of one major media organisation refraining from extensive participation in the area. For those companies who are able to match their approach to the communication characteristics of the Internet, there are further requirements for achieving business benefit, outlined in the next two sections.

6.2 Matching investment to the Internet's architecture

Chapter 4 describes the technical limitations of the Internet as a *transactional* medium. This limitation is based on five aspects of the Internet's architecture: lack of security; absence of proof of a transaction; inability to identify a participant; no basis for establishing common meaning for a transaction; and the absence of payment mechanisms. While this limitation doesn't prevent commercial use of the Internet as a *communication* medium, it does impose limitations on the breadth of commercial activity that can be undertaken over the Internet. Successful Internet business use can generally be shown to reflect a match between the

Internet's architecture and a company's products or services. Features of the Internet's architecture, particularly its ubiquity,[58] anonymity and fragmentation, provide new commercial opportunities. For commercial interaction between large corporations the limitations of the Internet are more severe than those between large and medium-sized, or among medium-sized and small companies, where previously unavailable services now exist. On the other hand, the Internet's architecture does not appear to establish the basis for the replacement of large companies by networks of small companies. While the Internet's architecture provides both limitations and opportunities for commercial Internet investment, these architectural features rarely relate in a simple way to the success or failure of business Internet investment. The relationship is more general: understanding the negative and positive aspects of the Internet's architecture for commercial applications is the second necessary step in achieving business benefit from the Internet.

6.2.1 Providing customer products and services

For some commercial applications, the Internet's technology provides a means to deliver previously unavailable services, or to deliver a pre-existing service in a new and effective way. The examples selected here are based on categorisation by Pettersen (cited in Crowe 2002b). They show both the commercial opportunity provided by the Internet, and architectural limits on that opportunity. This section examines Internet architecture features that facilitate its use as a business-to-consumer commercial medium.

Anonymity: The flexibility of the Internet's architecture is shown in the success of online pornography. Within discussions of Internet electronic business it is widely suggested that the Internet closely matches the requirement of consumers for anonymity (Barker 2001).

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[58] Ubiquity here is used to refer to the widespread dispersion of Internet access in urban centres throughout the world. It is not meant to suggest universal availability of a reliable service.

Anonymity is provided by the domestic provision of data services, allowing material to be received by an individual without public purchase. The Internet is the first widespread network to provide this data service to consumers. While this anonymity is often more apparent than real, the perception of anonymity exists. The material consequence of failure of privacy in this area is exemplified by the US Video Privacy Protection Act (1988), passed after a US Supreme Court nominee was rejected following the publication of his video rental record (Lessig 1999, p. 274). The role of pornography in advancing Internet-related technology (such as high speed access, credit card payment security and watermarking for identification of image origin) is not accidental, but a recurring feature of media technology development according to one study (Coopersmith 2000):

> Pornography has had a significant role in the promotion and diffusion of new communication technologies. New technologies have also altered the nature of pornography in the last few decades. These technologies include VCRs, camcorders, Minitel, computers, and the Internet. Pornographic products have served to stimulate interest in these new technologies, despite their higher initial costs. The attractions include greater perceived privacy and easier access. As each of these technologies matures and prices drop, the importance of pornographic products diminishes relatively, but not absolutely (p. 27).

In the case of AdultShop.com, a highly successful business can be seen to benefit from anonymity. Its business strategy is viable even though only one in 300 visitors decides to pay money to become a member (Nicholas 2002a). By 2002 it had 287,500 customers, revenue of $A117.3 million and net profit of $A5.7 million for the financial year. The company announced in May 2002 that the subsequent profit would rise to $A11.6 million. Four months later this was revised to become an expected loss. Shares that had jumped from 21 cents to 43.5 cents fell below 10 cents. Adultshop.com was experiencing a payments difficulty related to the Internet's poor support for transactions, specifically related to credit card processing. Credit card use over the Internet is considered a 'customer not present' purchase. A customer on reviewing the credit card statement has a varying length of time (depending on the country)

to declare if they did not make a purchase. The credit card company then recovers the payment from the merchant. AdultShop.com experienced a rising cost from fraudulent credit card use. It responded by outsourcing the credit card verification process. What it had not expected was that a more stringent examination of its subscriber membership would result in 60 per cent of customers being blocked as credit card fraud risks, including many valid customers. Membership fell to 115,000 (Nicholas 2002b; Klinger 2002). In this case, the service offering was supported by the Internet's architecture for content delivery, but the Internet's weakness as a payment channel added unexpected cost for the service operator.

Ubiquity: Many high profile Internet businesses in the late 1990s were well established in their own industry sector prior to the Internet's mass commercial growth, as shown by stockbroker Schwab. Charles Schwab founded Schwab as a discount stock brokerage in 1973. The company provided a series of services that cut traditional trading fees, and took advantage of the 1975 end to fixed-rate commissions, a change that sent many traditional firms out of business. In 1996 the company launched online trading (Lee & Thornton 2002). This used the Internet as a ubiquitous data network for the business strategy Schwab had been developing for two decades, and seized an opportunity ignored by traditional brokerage houses. 'The aristocratic brokerage house Merrill Lynch, for example, treated online traders as if they were dumpster scavengers' (Brown & Duguid 2000, p. 148). In April 1999, just before the stock market mini-crash that foreshadowed the speculative bubble collapse 12 months later, the stock price of Schwab grew 40 per cent in a week. This valued the company at $US61 billion, more than the combined value of Wall Street stalwarts Merrill Lynch, Lehman Brothers, Paine Webber and Bear Stearns (Wyatt 1999). E*Trade, another prominent online brokerage, also preceded the Internet, being founded in 1982 as TradePlus. In 1992 it adopted its later name and began offering accounts through CompuServe and America Online. It was only in February 1996 that E*Trade moved to the Internet (Cassidy 2002, p. 126). These examples show that the investment requirement to make Internet transactions reliable in a narrow and regulated environment can enable business benefit. In the case of share trading, the ubiquity of

the Internet has been able to eliminate the significant cost of private network infrastructure for previous electronic share trading.

The online games market represents a growing Internet commercial application.[59] This has its origins in the mid-1980s. One of the first online 'worlds', launched in 1985, was Lucasfilm's Habitat (Morningstar & Farmer 1990), a world in which players could 'communicate, play games, go on adventures, fall in love, get married, get divorced, start businesses, found religions, wage wars, protest against them, and experiment with self-government'. Turkle (1995) examines some of the gender issues that arise in this environment. It was initially designed for 20,000 users and inspired by the novel *True Names* (Vinge 1987). The game was designed as a commercial product for the online service QuantumLink.[60] In 2001 a similar concept based on vastly more sophisticated technology is used as an Internet-based commercial subscription service by at least 800,000 people, and has global revenue forecasts of $US1.5 billion for 2004 (Castronova 2001, p. 3), with Sony's Everquest holding nearly half that market. Early developers Morningstar and Farmer (1990), focus on the communication and community-building aspect of these games rather than their technology, as 'cyberspace is defined more by the interactions among the actors within it than by the technology with which it is implemented'. In the games field the Internet architecture provides a common basis for service access. The Internet's ubiquity overcomes the patchwork of earlier commercial networks used in the 1980s and 1990s to deliver commercial online games.

Fragmentation: The fragmented character of the Internet creates new intermediary opportunities. Online auction leader eBay has a business strategy that is specifically matched

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[59] The terms 'games' and 'gaming' are ambiguous in the Internet context as they may alternatively refer to gambling or to online computer games. In this thesis the latter definition is used.

[60] Technical requirements for playing were a Commodore 64 and a 300-baud modem connection to a data packet network that introduced delays of between one-tenth of a second and five seconds (Morningstar & Farmer 1990).

to the many-to-many character of the Internet. Adapting the approach of the garage sale and classified advertisement, this provides a new intermediary financial service: registration and certification (in a semi-formal sense) of sellers. As described in Chapter 4, eBay initially dealt with payment based on the use of personal cheques. This limited its use to the United States. As it expanded internationally it adopted the PayPal service, supporting first the US dollar and later euro and British pound. The intermediary structure is also successful for individual and small business professional trading. eBay is one of a small percentage of dot-com companies to show a profit. Core income is based on a flat fee and a commission depending on size of transaction, paid by the seller. Between the third quarter 1998 and the same period the following year, profits rose from $US461,000 to $US1.35 million (Bloomberg 1999). By 2002 it had reached $US306.5 million (*Business Week* 23 June 2002). Cassidy (2002, p. 193), a sceptic regarding electronic business strategies, describes eBay as follows: 'EBay was one of the few online ventures that exploited the Internet to provide a service that couldn't otherwise have been provided'.

The eBay corporate message focuses heavily on trust, taking a non-technological approach, in contrast to the technological approach most other online industries take, including financial services organisations. Trust of sellers is based on viewing a seller's feedback ratings. Trust of eBay itself is built through close attention to customer relationships. Company marketing focuses heavily on building online relationships:

> Trust, in turn, creates a community, as a growing number of stories show. Cathi Rogers, known on eBay as 'Apricot', disappeared from an 'eBay Cafe' for surgery. She received 52 get-well cards from fellow members. Another eBay member wrote that she was losing her computer in a divorce settlement. eBay members got together to buy her a new one. A Virginia man couldn't afford to fix his trailer or buy a new furnace. eBay friends, who had never met him in person, journeyed hundreds of miles to repair his rotting floor while others took up a collection to buy him a new furnace (Clancy & Miniter 1999).

Referring to print media, Ogilvy (1995, p. 82) describes this type of advertising as 'testimonial': 'If you include a testimonial in your copy, you make it more credible. Readers find the endorsements of fellow consumers more persuasive than the puffery of anonymous copywriters.' eBay's success has been based on its ability to intermediate dispersed online traders. While matching the Internet's architecture, success in this role depends on an ongoing ability to retain trust in the face of fraud and other threats.

Applications that respond to the three characteristics of anonymity, ubiquity and fragmentation each match the Internet's architecture. In each case the service offered is more than simple cost reduction. One further example illustrates the difficulty of the Internet, however. Amazon.com became the best known of the late 1990s electronic businesses, with high market capitalisation, huge debts, and had not achieved a year of profitable trading at the time of completion of this research. It began trading as an online bookseller in July 1995,[61] and diversified into CDs, pet supplies, toys and electronics by 2000 (Cassidy 2002, p. 139). Its online sales provided a completely different experience to existing book distribution, whether shop-based or catalogue-based: visitors to the Amazon.com web site could compare reviewers' comments on books, and provide their own. They could browse a massive catalogue of books at their own convenience, a catalogue that became a significant resource for researchers. They could see what other books Amazon.com said had been purchased by those buying a particular author. Amazon.com, like eBay, provides an experience matched to the capabilities of the Internet: ubiquitous access to non-proprietary information that gained value with the rising number of users (the 'network effect'). In the view of CEO Jeff Bezos, the company does not sell books, it sells information about books (Davidson 1998a). If it had just been selling information, it would have escaped continual difficulties related to the

[61] Book sales rose 825 per cent in 1997 from a low base, but each subsequent year the growth rate was less than one-third that of the previous year (260 per cent in 1998, under 90 per cent in 1999), leading to early predictions that its book selling rate of growth would rapidly drop to industry standards (Doherty 1999; Edgecliffe-Johnson 2000).

provision of its off-line goods. Rather than profitability the company achieved high rates of growth and high market capitalisation in its early years. In June 2000 a Lehman Brothers analyst reported that Amazon had a 'weak balance sheet, poor working capital management and massive negative cashflow—the financial characteristics that have driven innumerable retailers to disaster throughout history' (Edgecliffe-Johnson, Silverman & Grimes 2000). By the start of 2001 the company had combined losses of $US2.3 billion for its five-and-a-half years of trading and had $US2.1 billion in debt (Edgecliffe-Johnson 2001). By this time the arrival on the Internet of traditional booksellers such as Barnes and Noble with their widely dispersed supply sources placed pressure on Amazon to match their physical warehousing, if it wished to provide services such as overnight delivery at no extra charge. This had a major effect on Amazon:

> No longer can the company sell a book, receive payment for it on the same day and then stuff the cash in interest-bearing securities for 30 days until it must pay the wholesaler for that book … Amazon will be joining the real world, where bookstores place their orders months in advance, long before they take in customers' cash (Doherty 1999).

Whether Amazon.com's economies of scale and brand leadership will ensure its long-term survival is an open question in 2003.

These examples show that in the business-to-consumer (B2C) area there are a number of 'positive' aspects of the Internet's architecture, including its anonymity, ubiquity and fragmentation, that contribute to business benefit. While they do not eliminate the commercially negative aspects of the Internet's architecture, they establish the possibility of business benefit. The next section considers the business-to-business commercial environment.

6.2.2 Inter-business transactions: the example of the oil and gas industry

Internet-based electronic business dealings between companies have several aspects. These include business-to-business (B2B) exchanges (providing an electronic environment in which a company can undertake transactions with many other companies, both buying and selling), information distribution channels, service enablement, and many more. This section provides a brief introduction to B2B exchanges, and then takes a broader view of how the various forms of Internet-based electronic business could be applied in the oil and gas industry. As described in Chapter 2, because of the early stage of development of Internet electronic business, there is only limited quantitative information on profitability or other measures of business benefit from Internet electronic business. The discussion in this section is for the purpose of examining issues that may affect business benefits, rather than to prove their existence or otherwise for a particular industry.

During the late 1990s, public business-to-business exchanges were a widely expected benefit of the Internet (Timmers 1999). By 2000, Day, Fein and Ruppersberger (2002) suggested that the only on-line markets to survive would be 'the handful of applications that could not have been realized without the Internet'. The highest profile exchange has been Covisint, a major B2B exchange designed to service the automotive industry. Despite commitment from major automotive manufacturers the exchange experienced several problems in its first years, including higher than expected losses, a change of leadership and lack of direction. The balance between cooperation and competition was also an ongoing issue. At the time of the Covisint launch, Ford announced that most of its steel would be ordered through a separate exchange, E-Steel (Bowe & Tait 2000). Covisint particularly experienced confusion regarding whether it was meant to serve the interests of its owners, or of all participants (Murphy 2002). This made it potentially unattractive to major suppliers. In the view of a vice-president for computer chip manufacturer Motorola regarding Covisint in 2000: 'So much of the talk is about auctions and cutting costs' (Welch 2000). In addition to using the interactivity and ubiquity of the Internet, these trading exchanges represent an arena for redefining current

commercial relationships between buyers and sellers. The success or failure of public business-to-business exchanges in the medium term affects only one area of Internet electronic inter-business relations. A review of the North Sea oil field, operationally based in Aberdeen, Scotland, identified a series of possible activities, and some issues related to these:

Information exchange: The ability to source or provide information and communication. This is enabled by both the availability of a standard form of communication, and the ubiquitous spread of Internet access. This is particularly important when a company's various sites are spread across the globe, often in remote locations and various time zones.

A typical example of the information value of the Internet for the oil and gas industry is the Digital Energy Atlas and Library, located at < http://www.ukdeal.co.uk/>, which provides a library of geo-scientific information on the UK Continental Shelf. It has been developed by a subsidiary of the UK Offshore Operators Association (UKOOA) in conjunction with the British Geological Survey (BGS). It provides data on wells, three-dimensional seismic surveys, pipelines and umbilicals, field outlines, coastlines, licenses and international boundaries, plus a catalogue of geological and geophysical data products, and an access point to other data repositories. It also assists in the relations between this and other industries, providing the core data used for FishSafe, an electronic underwater hazard service for the fishing industry.

Procurement and trading: A large fraction of these tasks is the exchange of information: catalogues, standards, commodity pricing, price comparisons, terms and conditions and bill presentment. The Internet lends itself to these. Gaining benefits from these opportunities depends on the businesses involved. While large oil and gas corporations have the resources for a wide range of interests, small and medium enterprises will more often depend on external infrastructure options available. To consider one example, LOGIC is an electronic business facilitation organisation sponsored by the British government, based in Aberdeen. In the late 1990s LOGIC had evaluated the requirements of the oil and gas industry, and planned to

commission an industry extranet from GE eXchange Systems (GEXS) for simple electronic messaging with the options of further future offerings.[62] The emergence of business-to-business marketplaces towards the end of the 1990s led LOGIC to reconsider its plans. It engaged Cap Gemini Ernst and Young (2000) to undertake an evaluation report. The subsequent report recommended scrapping the extranet plan, as each of the proposed facilities was more fully supported in a global context by two separate marketplaces. Where LOGIC's original proposal provided a single way forward for companies based in the UK North Sea, for online trading the new approach required companies to choose between competing exclusive exchanges.

Workflow management: The ebb and flow of oil exploration has led many companies with engineering skills to diversify into other areas of industry in the 1990s, often in widely separated areas of the globe. The Internet provides infrastructure for such multi-industry companies, in contrast to the past when each industrial sector had its own proprietary information technology standards and practices. It also enables workflow collaboration. The Internet is well suited for document and schedule management spread over time. An actual or virtual work-team spread across the globe can work on projects such as tender preparation and management or engineering design. In addition, collaboration can be enabled by near universal accessibility to the Internet by businesses around the world. These examples apply to day-to-day operational activity. The role of online collaboration for longer-term relationship building is more complicated, introducing issues such as the development of community in cyberspace (Smith & Kollock 1999).

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[62] An 'extranet' is a network that offers its geographically dispersed participants a sense of a private network, but achieves this using the Internet or some other network. For example, an industry organisation's extranet might connect all its members, providing information which non-members cannot access.

The business-to-business environment for the oil and gas industry quickly became a crowded field. A review by the author in early 2001 identified the following as a sample of the initiatives. While some had ceased operation by August 2003, they are included for historical comparison.

- Intercontinental Exchange: a business-to-business (B2B) marketplace for trading oil and gas, power and precious metals, whose partners include BP Amoco and Royal Dutch/Shell, at <http://www.intcx.com/home.htm/>.
- PetroCosm: a B2B marketplace for energy industry trading, whose partners include Chevron Corp and Texaco Inc., since ceased operation (Barlas 2001)
- Houston Street Exchange: a B2B marketplace for wholesale energy trading, at <http://www.houstonstreet.com/>.
- Altra Energy Technologies: this provided B2B marketplaces for oil, gas and other energy related commodities, since acquired by Caminus Corporation, at <http://www.caminus.com/>
- Trade-Ranger: a B2B marketplace for materials and services across the energy industry supply chain, whose partners include Royal Dutch/Shell and BP Amoco, at <http://www.trade-ranger.com/>.
- NetworkOil: a B2B marketplace for surplus oilfield equipment, which in February 2001 signed an agreement to be the exclusive supplier in its field for the PetroCosm marketplace, at <http://www.networkintl.com/>.
- Oil & Gas Journal Exchange: a B2B marketplace for surplus oilfield equipment, at <http://www.ogjexchange.com/>.
- FreeMarkets: this provides private B2B marketplaces for large companies such as BP Amoco to source internal supplies, at <http://www.freemarkets.com/>.
- VerticalNet: this provides dozens of industry-based B2B marketplaces, including for the energy sector, also providing targeted industry news and information, advertising and other links, at <http://www.verticalnet.com/>.

- Transport4: this is a membership-based site for pipeline services, at the opposite end of the spectrum to VerticalNet, providing no public information, advertising or links (except to its owning partners), at <https://www.transport4.com/>.

Large corporations may be participants in a range of electronic business activities. BP Amoco for example has developed an extensive relationship with FreeMarkets for purchasing goods and services for global operations; has a 3 per cent interest in Altra Energy Technologies; a stake in the chemical marketplace ChemConnect; a major role in the Intercontinental Exchange; and a partnership with Excelergy, providing customer information and transaction management to the retail energy market (Sharp 2000). For a small to medium enterprise, limited resources require commitment to one of several competing approaches. (Issues regarding small and medium enterprises are discussed in the next section.)

This brief examination of opportunities in the business-to-business area illustrates the potential of the Internet's architecture to support a wide range of services that may provide business benefit. The next section reviews a theory that these benefits are so immediate and significant that they are transforming the character of early 21st century business.

6.2.3 The networked company

As a business channel the Internet provides an important benefit over other digital networks: its ubiquity. For small and medium enterprises (SMEs)[63] it offers the first access to a data network. Much research on electronic business focuses on the opportunity offered to SMEs.

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[63] Definitions of this economic and regulatory category (pronounced 'smee') varies widely, with some limiting it to companies with up to 100 employees, while others include organisations with 1000 staff and $A1 billion turnover as 'medium'. It is not to be confused with 'subject matter expert', also abbreviated as SME (although not in this thesis).

Castells (2000) has generalised this into a theory of a ‘networked company’, with Cisco Systems as his model.

Descriptions of Cisco’s approach are widespread. For Bunnell (2000, p. 147):

> By using networked applications to integrate suppliers, Cisco in effect created a *single enterprise*. Manufacturers act like adjunct Cisco manufacturing sites as they respond to customer orders without the time-consumer hierarchical system of receiving orders from the mother company.

Cisco is the leading supplier of the infrastructure equipment that keeps the Internet running. As with other Internet-related companies described later in this chapter, Cisco was a late convert to the Internet. It was only in 1997 that Cisco began to ensure that all its products were Internet Protocol enabled (Slater 2003, p. 175). When Cisco CEO Chambers speaks of using network applications to build ‘networked virtual organisations’, he is referring to the outsourcing of manufacturing activities (Morrison 2001). While networking with its manufacturing contractors, Cisco’s primary approach to smaller technology competitors has been to purchase them.

Cisco’s technology is able to provide it with a high level of technical control and production information. However, it does not eliminate potential conflicting commercial interests between itself and its outsourcing suppliers. In early 2001 Cisco wrote off $US2.5 billion of $US4.1 billion inventories on its books (Abrahams 2001). This stock build-up followed earlier three-month delays in delivery, which customers responded to by ordering the same equipment two or three times (Slater 2003, p. 59). This failure to manage inventory is examined in detail by Lakenan, Boyd and Frey (2001), who reviewed eight major contract equipment manufacturers (CEMs) who provide outsourced services to Cisco, Sony, Apple, Philips and other original equipment manufacturers (OEMs). The research finds the greatest problem in this relationship is that it doesn’t scale. While it works well for fixed or gradually

changing levels of production, it cannot cope with rapid changes in production levels. In particular it doesn't provide the flexibility of vertical integration, where a single company has complete control of its production and can dedicate it to a single purpose. For OEMs and CEMs, 'when times go bad, their different techniques for fixing problems are incompatible' (p. 7).

Castells generalises his description of Cisco's networking relations to small and medium enterprises:

> With the generalization of the Internet, Intranets, and Extranets, on the basis of broad-band, fast communication networks, companies, large and small, could easily relate with each other, and with their client, in a flexible, interactive pattern. As a result, everybody was technologically able to adopt the networking form of organization, provided the firm was capable of managerial innovation (p. 187).

A difficulty for companies attempting to apply this theory is that they can easily relate to each other and their clients, but only with e-mail, which is an insufficient basis for inter-organisation relations. Once these organisations need to trade or establish other commercial links between each other, they then require rigid and strict agreement on what they are doing. Chapter 4 described large corporations' use of electronic data interchange (EDI) for this purpose. The failure of EDI to reach SMEs was a common topic of discussions of EDI throughout the 1990s. However, by the early 2000s this problem was joined by evidence of the failure of Internet-based electronic business to transform SME practice outside of particular industry locations or sectors.

The problem of small and medium enterprise uptake is widely identified, including in a report on eEurope 2002 (Commission to the Council 2002, p. 18). Based on examination of SMEs in the United States, Singapore, Hong Kong and South Korea, Pereira and Fife (2001, p. 10), attribute slow electronic business uptake to, 'the lack of capital and skilled personnel, the

significant and often under-stated cost of such e-commerce applications and solutions, and the core structure of SMEs'. This suggests that the problem is based on a more general difficulty of technology uptake for small and medium enterprises. This broader view is provided in an Australian context in 'E-business Report: The online experience of small and medium enterprises' (Yellow Pages Business Index 2002). Lumpkin, Droege and Dess (2002) address another generally overlooked aspect of bringing small businesses online. While small businesses may gain global reach, their own traditional customers can now be reached by larger competitors: 'An incumbent firm that thought a niche market was not worth the effort in the past may now use Internet technologies to enter that segment at lower cost' (p. 335).

The dilemma is illustrated by the evolution of XML, the eXtensible Markup Language. Vaughan-Nichols (2003, p. 14) describes the early motivation for work on XML by the World Wide Web Consortium seeking to provide data interoperability across the Internet. Begun in 1996 its first version was approved in 1998: 'A key factor that drove the standard's development was increased Internet and network usage requiring companies on different platforms to be able to communicate with each other.' He cites Gartner Group research identifying business requirements driving XML uptake. The same message was provided by the Organisation for the Advancement of Structured Information Standards (OASIS). XML would 'provide a simple infrastructure for people and machines to communicate and exchange documents. That's pretty important to the new economy and the way business is going to be done in the next century' (Butler 1999).

XML has proven a major boost for scientific and research fields and organisations, which are currently developing thousands of research sector-specific global standards. At the same time, within business sectors XML implementation has become bogged down in disputes over which among competing sets of standards should be adopted, as separate companies individually seek to lead the sector. For example, in early 2003 there are four separate business process approaches: from IBM, Microsoft, OASIS and the Business Process

Management Institute. For Lawton (2002), a company unable to set schema specifications to customers ‘could end up building multiple versions of its Web services for different schemas’.

A brief examination of Cisco Systems suggests that there is no simple aspect of the Internet architecture that automatically solves the business coordination problems faced by small and medium enterprises. While the Internet’s ubiquity places it within reach of millions of such companies, many of whom can easily adopt e-mail and the World Wide Web, transactional relations are more difficult, regardless of the networking technology available.

This section has reviewed business benefits provided by the Internet in the light of the Internet’s architecture examined in Chapter 4. It has considered factors that both assist and hinder business-to-consumer and business-to-business relationships. It has also examined some issues related to small and medium enterprises, a common subject of electronic business projects. This examination shows that the Internet’s architecture is an important issue affecting the achievement of business benefit from Internet investment. However, the effect is not a simple relationship between a particular commercial limitation, such as best effort delivery, and the success or failure of a specific company. Rather, the technical architecture tends to place limitations on the ways in which the Internet may provide business benefit.

Alongside the requirement to match the Internet’s character as a communication medium and to address its commercial technical limitations, the next section considers business preconditions for business benefit from the Internet.

6.3 Capturing the ‘surplus’ as a business benefit

Chapter 5 described the differences between regulatory controls placed on the earlier media of radio and television, and the development of the Internet. A major result of this difference was the highly competitive character of the commercial Internet environment. For those investments in Internet technologies or Internet customer channels that meet the requirements

of use and technical architecture already described in this chapter, the challenge of business benefit remains. The initial basis of investment in the Internet was reactive, as companies from 1995 sought to be part of the Internet's success, particularly dot-com companies and information and communication technology companies. By the late 1990s other sectors were becoming involved. In order to gain business benefit these companies needed to achieve competitive advantage (Porter 1985), which goes beyond simply providing additional benefits to customers. The example of retail banking shows the difficulty of capturing the 'surplus', a concept introduced in Chapter 2 and expanded in this section. Competitive advantage is the third requirement for achieving business benefit.

6.3.1 The relevance of competitive advantage

The Internet has shown that unlike mobile telephony, for example, it is not enough to have a popular product used by millions of people in order to achieve a business benefit. If that product is provided for free, or if every major company in a sector is providing a similar product without gaining extra income, then the result may be to reduce overall industry profitability.

This is examined in the theory of competitive advantage (Porter 1985). Porter argues that 'Competitive strategy must grow out of a sophisticated understanding of the rules of competition that determine an industry's attractiveness' (p. 4). In this, technology can play an important part:

> Many of today's great firms grew out of technological changes that they were able to exploit. Of all the things that can change the rules of competition, technological change is among the most prominent. Despite its importance, however, the relationship between technological change and competition is widely misunderstood. Technological change tends to be viewed as valuable for its own sake—any technological modification a firm can pioneer is believed to be good (p. 164).

This is an activity-based view of industries, which suggests that a company strategy should be built on a set of activities that a competitor will duplicate only with difficulty. According to this theory, activities such as 'benchmarking' can only identify problems. (Benchmarking involves reviewing what others are doing in an industry). It cannot provide competitive advantage. For Porter competitive advantage is important because it provides the basis of ongoing profitability. For business users, the Internet represents an external source of technology:

> Where important sources of technology are external to an industry, sustaining a technological lead is generally more difficult. External technology sources decouple a firm's access to technology from its technological skills and R&D spending rate, because many companies can get access to external developments. Hence external technological changes act as an equalizer among competitors. Technological leaders in industries with key external sources of technology must capture the best of those sources through coalitions or exclusive arrangements in order to sustain their lead, or have a superior ability to adapt externally developed technology to the industry (p. 183).

Porter emphasises the commercial importance of maintaining a technological lead. 'Successful technological leaders are aggressive in trying to slow down diffusion', including by patenting, secrecy, in-house development, vertical integration and retention of employees (p. 186).

Rather than aiming for competitive advantage, Internet investment hyperbole suggested that user uptake will inevitably mean business benefit. Yet some technologies provide little business benefit even over long periods. Warren Buffett cites the airlines industry:

> As of 1992, in fact—though the picture would have improved since then—the money made since the dawn of aviation by all of this country's airline companies is zero ... the key to investing is not assessing how much an industry is going to affect society, or how much it will grow, but rather determining the competitive advantage of any given company and, above all, the durability of that advantage (quoted in Loomis 1999).

Shiller (2001, p. 21) points to the difficulty that low barriers to entry create for achieving business benefit (making it relatively easy for companies to join a particular area). He asks whether companies without a monopoly on new technology will experience a rise in value from using that technology. He cites several studies that show this may not be the case, as new capital will 'compete away any extra profits that a technological advance might generate for existing capital' (p. 237).

While many technology-based dot-com companies focused on growth without profitability, Schumpeter (1939, p. 105) among others expects profit from technological advantage to emerge early in the implementation cycle. The entrepreneur has been able to create a product or service at a lower cost due to technological improvement, but sells in a market dominated by older and less efficient technology. This produces the 'Entrepreneurs' Profit'. 'It is the premium put upon successful innovation in capitalist society and is temporary by nature: it will vanish in the subsequent process of competition and adaptation', a process he calls 'creative destruction'.

Porter (2001) revisits his theory of competitive advantage in the light of Internet commerce with its new economy theories. In the case of the Internet, 'capturing' the publicly available technology is not a possibility. Where the Internet provides a common benefit for many or all business, such as e-mail, Porter argues that there is no particular service to any business. While it may lower the cost of production, it may also lead to a generalised decline in profitability for the reasons argued by Shiller. In addition, for Porter, 'anything that a company can access over distance is almost never going to be a competitive edge: if you can buy machines from Germany, so can anyone else' (Trinca 2002, p. 39). He is critical of the general approach to Internet electronic business:

> Instead of emphasizing the Internet's ability to support convenience, service, specialization, customization, and other forms of value that justify attractive prices, companies have turned

> competition into a race to the bottom. Once competition is defined this way, it is very difficult to turn back (Porter 2001, p. 72).

Tapscott (2000) vigorously contested this approach in the Internet context based on a theory of 'business webs', which make new forms of business possible. His argument was weakened with his presentation of soon-to-fail Enron as his star example. After Enron's failure, through which investors lost tens of billions of dollars, Tapscott remained optimistic: 'My view is that there was nothing inherently wrong with the core Enron business model' (quoted in Pawle 2002, p. 24).

The theory of competitive advantage provides a basis for understanding the possible absence of business benefit, even when other conditions of usage and technological adequacy have been met. This is considered in the context of retail banking later in this section.

6.3.2 The trigger for business investment in the Internet

The expectation of commercial opportunity created by the rapid growth in Internet use resulted in a business reorientation of new media investment towards the Internet from 1995. This included both technology companies seeking to take advantage of this opportunity, and investors with limited interest in the Internet itself seeking speculative opportunity.

The beginning of the Internet stock boom can be dated from the success of Netscape on 14 August 1995, although there were other strong indicators of this potential throughout that year. Floated at $US28 a share, the stock hit a high of $US71 that day.

> The following day a slightly stunned Wall Street Journal commented that, while it had taken General Dynamics forty-three years to become a corporation worth $[US]2.7 billion, Netscape Communications had achieved the same thing in about a minute (Naughton 2000, p. 254).

While Netscape was later overwhelmed by Microsoft as a browser provider, this stock market debut was a significant business event that brought the Internet to the attention of investors, technology vendors, and business information technology users. This result and other evidence of the growing importance of the Internet led many companies in the information technology sector to turn their attention to the Internet. In the early 1990s several major organisations were providing online information and services that were not part of the Internet. These included broad service-focused organisations, particularly America Online, Compuserve and Prodigy, and narrow financial service providers such as Reuters. Of these, America Online was the most successful as the Internet replaced proprietary networks. It became an Internet service provider with tens of millions of subscribers. CompuServe had been in business since 1969, servicing primarily business users. Prodigy was launched by IBM and Sears in 1990, and in the early 1990s ran through hundreds of millions of dollars (Cassidy 2002, p. 77). For Cassidy a major advantage held by AOL was its willingness to support sexually explicit chat sessions and services (p. 110). This suggests a parallel between AOL and the French Minitel service. Even after becoming an Internet service provider, AOL continued to provide a partially private experience to its subscribers, many of whom never venture beyond the purely AOL offerings including information, online auction, instant messaging and e-mail.

Microsoft was well established prior to the Internet's commercial period, and only began to show interest in the Internet in 1995. The reorientation can be seen in the writings of Bill Gates. Gates (1995) described his vision of the networked future in *The Road Ahead*. In this he describes the Internet as the legacy network that made the vision of the future possible. In May 1995 his 'tidal wave' e-mail identified the commercial importance of the Internet for Microsoft (Cassidy 2002, p. 105). Gates (1996) then released *The Road Ahead, Updated and Revised*. From the outside the two books appear almost identical. The content has been extensively rewritten. Now the future is completely embedded in the Internet. At the same time Microsoft commenced its push for leadership of the Internet browser market, against browser pioneer Netscape.

Prior to 1995, Microsoft had sought to develop an online service to compete with America Online, CompuServe and Prodigy, known as Microsoft Network (MSN), providing proprietary information from press and television media, and consumer and business product information (Gleick 2002, p. 103). This approach continued in a modified form after 1995, when MSN became part of Microsoft's Internet strategy. In 2000, for example, MSN acquired exclusive Internet broadcast rights for a London concert by Madonna (O'Connor 2000). By 2002 MSN still lagged behind America Online, with nearly 9 million subscribers, compared to AOL's 36 million. However, it was able to draw on Microsoft's extensive commercial interests. For example, Microsoft used its investment in two telecommunication companies to match an AOL agreement for Internet consumer critical broadband services: [64]

> [Microsoft] poured $US1 billion into Comcast Corp in 1997 and $US5 billion into AT&T Corp in 1999. When Comcast agreed to buy AT&T's cable division, Microsoft got it to agree to provide it with high-speed internet access on the same terms as anyone else. Result: when America Online, after long negotiations, struck a broadband-service deal with AT&T and Comcast this year, Microsoft automatically won the right to the same terms (Angwin 2002).

The reorientation of information technology companies to a networking environment in general, and from 1995 to the Internet specifically, was an important success factor. Microsoft is often criticised for using its PC operating system monopoly to quickly dominate the browser 'market' (not literally a market because the software is provided free). However, this would not have been possible without a close alignment between the PC and the Internet. Microsoft's core PC business may have had far less relevance in the late 1990s if an alternative path of convergence, such as around interactive television, had occurred. For Malone (1999, p. 429)

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[64] 'Broadband' refers to the speed of a data connection. While a dial-up Internet service might allow the transmission of 56,000 data bits per second (a bit is either a '1' or a '0'), a broadband connection might allow 10 to 40 times this number. The number of bits per second is a measure of 'bandwidth'. Broadband supports high bandwidth applications such as television, medical imaging (such as sending x-ray images), interactive gaming, and large file exchange.

the inability to achieve a realignment was a contributing factor in the marginalisation of Microsoft competitor Apple.

The wave of Internet investment began in 1995, reaching the telecommunications sector in the following years, as described by Roberts (Roberts 2001b):

> Each of the three largest [telecommunications companies] had a new chief executive fresh from the computing industry and anxious to spend money. Mike Armstrong jumped from International Business Machines to AT&T, Sir Peter Bonfield went from ICL to BT [British Telecommunications] and Ron Sommer arrived from Sony to run a privatised Deutsche Telekom. The combination of ambitious new executives, powerful balance sheets, weak corporate governance and myopic middle management was to have some disastrous results as all three companies fell over each other to make expensive investments at the height of the boom.

Between 1999 and 2001 alone, United States telecommunications companies borrowed more than $US320 billion (Noam 2002, p. 10). Schiller (1999, p. 28) describes telecommunications companies: ‘Scrambling to find points of entry in the white-hot Internet market during 1997’.

The rapidity of the Internet economy’s development is underlined by the narrowness of many of its key sectors. For example, during the Christmas 1998 sales period, 10 Internet retail sites accounted for more than half total global online revenue (Davidson 1998d). Often just one company dominates a segment. Andreessen (interviewed in Ostrom 2003) identified the difficulty with this, that the success of one company providing a unique service may provide no help to other companies looking for areas of activity. He places Google, a search engine with significant advertising revenue, in this category. The privately held Google is an infrastructure company (comparable in position to other profitable companies such as Microsoft and Cisco). Markoff and Zachary (2003) estimate that revenue will grow from $US300 million in 2002 to $US750 million in 2003 with 30 per cent margins.

In Australia just three companies, ecorp, LibertyOne and One.Tel, dominated the stock market Internet sector (based on a narrow definition of Internet companies, similar to the *Business Week* survey cited in Section 2.2.5). These were the chief beneficiaries of $A5 billion stock gains in the late 1990s (Chenoweth 1999b). This narrowness does not necessary reflect the early success of key companies in a competitive market, however. Both LibertyOne and One.Tel went bankrupt in subsequent years, and ecorp ceased operation as an independent company in 2002 (Crowe 2002a). Leading Internet service provider America Online in the United States faced similar difficulties. Following its acquisition of Time Warner, the company suffered a loss of $US98.7 billion for 2002 (Collins 2003). By late 2002, some analysts believed that 'investors are now assigning no value to America Online' (Shook 2002).

The commercial reorientation to the Internet occurred after it already had millions of users, as described in Chapter 3, and was in this sense reactive, unlike previous new media investment. This helped to reduce focus on and confuse the issue of business benefit among investors. It was only in subsequent years that the commercial effect of many of these investments began to be examined.

6.3.3 The experience of retail banking

By the late 1990s the continuing growth of the Internet encouraged 'bricks and mortar' companies to adopt it as a new 'channel', or means of reaching their customers. This section uses the case of retail banking in order to examine that experience. [65]

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[65] 'Channel' is a business term that refers to the ways in which customers receive service. For a bank, channels include the local bank branch, the automatic teller machine (ATM), a call centre for telephone banking, and the Internet for online banking. Retail banking is the branch of banking that provides services for individual customers such as payment transactions, savings accounts, personal loans and personal real estate loans. It can be distinguished from other banking areas such as corporate banking, for business customers. A bank may specialise in retail banking, or offer this as one of several services.

The initial response within retail banking to the Internet is presented by Roderick Carr, deputy governor of the Reserve Bank of New Zealand and a former payments strategy architect for the National Australia Bank. He told the *Australian Financial Review,* 'Show me someone who is making money out of internet banking. We don't need a product out there yet' (Cornell 1998). By that year banks were beginning to take a different view. An Ernst & Young survey reported that financial institutions in 1998 expected to channel the majority of their information technology budgets into Internet services over the following three years. Globally, 57 per cent of the institutions listed the Internet as their top information technology priority (Leeuwen 1998). A survey of banks in Britain in 1998 showed that only one-third were confident that they had the right mix of branches, telephone and Internet services. By 1999 this dropped further, to one in six, with nearly half planning to have Internet banking in place by 2000, alongside other 'new media' channels (Mackintosh 2000a). In 2000, European expectations of Internet banking potential passed those in the United States. A quarter of all transactions were expected to occur over the Internet by 2003, compared to a 12 per cent expectation in the United States, according to a Cap Gemini Ernst & Young survey (Mackintosh 2000b).

Gosling (1999) compares the cost of traditional and Internet-based transactions: through a bank teller, $US1.07, through a telephone call centre 52 cents, via a cash machine, 27 cents, but just 1 cent through the Internet (p. 17).[66] In Australia in 2003 these are reflected in the average charge for each channel, from $A2.50 for a counter withdrawal to $A0.25 for an Internet transaction (Reserve Bank of Australia 2003). Along with the encouragement of cheap Internet transactions was the threat of new financial service competition from 'Internet service providers, utility corporations, television stations, the print media and major retailers' (Gosling 1999, p. 30). Banks do not appear to have yet been able to realise these savings.

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[66] Willman (2001) shows, however, that bank after-tax return on equity is affected by many issues other than reducing cost as a proportion of income.

Three separate reasons for this are described in the following paragraphs: the high cost of developing Internet-based banking; the demand for multiple channels of service and the cost of supporting these multiple channels as banks are unable to close existing channels.

The high cost of Internet-based banking: Figures promising low marginal transaction costs (the cost of a transaction once the system is in place) conceal the expense of establishing an online banking presence. There are several available examples of separate online banking initiatives (where public identification of cost is more easily seen than in internal banking projects). In Europe these included Dublin-based First-e and Banque d'Escompe of France (each at a cost of $US200 million), and Y-O-U bank in Switzerland (at a similar cost, leading to the sacking of the head of Switzerland's second largest private bank, the project sponsor). Each of these initiatives failed. SEB of Sweden and Alliance & Leicester of Britain cancelled before launch, but after significant cost. Some of those that survived had made large investments by 2001: £415 million for Egg, £120 million for Cahoot, £228 for Intelligent Finance (Mackintosh 2001a).

One early online initiative was British Internet and telephone bank Egg, launched by Prudential Insurance. Floated as a separate company, its fortunes show both the strengths and weaknesses of the online approach. In its first six months of operation the bank won 500,000 customers with £5 billion of deposits. Egg originally focused on telephone banking, but then moved its emphasis to Internet banking (Gosling 1999, p. 17). The bank's early success surprised Prudential, although it offered a preferential interest rate and emerged in a market with little initial competition. Egg floated in June 2000. At the time it had nearly a million customers, £7.3 billion in deposits and total loans of £2.5 billion. Nearly two-thirds of all transactions were over the Internet (Mackintosh 2000c). The shares floated at 160 pence and quickly rose to 190 pence before falling to as low as half that in the following year. At this point the difficulties of developing an online bank became clear. A mid-2000 survey showed banking industry optimism in the Internet at only 5 per cent compared to 67 per cent three months earlier (Mackintosh 2000d). Within four weeks of its float, Egg had lost 20 per cent of

its stock value as customers withdrew funds in response to a cut in savings interest rates and it reported half-year losses of £80 million. Blaming the customer, chief executive officer Mike Harris said that it was mostly older, less 'Internet savvy' customers who were leaving, a group that the bank had not targeted (Mackintosh 2000e). By November a further similar drop had occurred, and a new strategy was now proposed: there would be a greater emphasis on telephone banking, and the bank talked about opening a network of branches (Jenkins 2000).

The demand for multiple channels: An Organisation for Economic Co-operation and Development (OECD) report (cited in Davis 2002) found that Internet-only electronic finance business strategies had achieved little success. At the same time the number of people in OECD countries using the Internet for financial transactions had nearly doubled every year from the mid-1990s, to between 40 and 50 million people.

> Even in the fastest-growing segments of e-finance business, only a limited number of companies have been able to establish themselves in the market, and on recent evidence they are comparatively less profitable. On the whole the apparently 'winning formula' has been the setting up of e-finance activities that are integrated with an established brand identity.

Some researchers have found that bank users may want a physical location they can turn to when they have a problem (Labate & Silverman 2000). Coltman et al (2002, p. 71), addressing a technological audience, suggest that 'for every domain where cost savings can be identified, countervailing areas exist where additional costs have been incurred'. For Singh (1999) the situation reflects a problem of perspective in technology implementation:

> Instead of focusing on the replacement of paper-based payments instruments and over-the-counter transactions by electronic forms of payment, the users' perspective reveals that a person uses a *mix* of payment instruments and transaction modes (p. 758).

The willingness of customers to use the new Internet services while continuing to use other channels may relate to earlier bank service changes that created a difficult user environment. Zuboff (1988, p. 172) describes the inability of companies 'to respond to the technological presence other than as an occasion for decreasing their dependence on human talent, ignoring the opportunities to gain value from the technology in a qualitatively different way'. The introduction of Internet self-service functionality has given customers a means to address this, solving an existing service problem rather than creating the basis for new service cost reductions. There is evidence that banks have found some technology-based service changes unsatisfactory. In September 2001, as part of the integration of systems with National Westminster, the Royal Bank of Scotland announced that it would create 6,000 new full-time call centre positions to replace an unpopular automated telephone service. The bank stated that 'levels of complaints about the NatWest telephone service were very high even though it kept winning awards for cutting costs' (Mackintosh 2001b).

The cost of supporting multiple channels: A report on information technology in the retail banking sector (McKinsey Global Institute 2002c) examined the United States experience of banking transaction costs. While the cost per transaction declined from $US1.10 to $US0.96 between 1985 and 1998, the average number of transactions for each household rose, from 75 to 167. As a result, the total cost of serving each household had risen from $US83 to $US160 over the same period. The report identifies four trends that contribute to this problem: product proliferation; channel proliferation; the willingness to retain customers 'at all costs'; and poor information technology implementation: 'As customers captured surplus benefits, banks' profits were further limited' (p. 25).

Mackintosh (2001a) describes a similar phenomenon in Europe, that Internet customers tend to continue using telephone banking and branches as well as the Internet. He suggests that in 2001 without Internet services a bank would lose customers who want to use that channel, but calls it 'another layer of costs'.

The case of retail banking illustrates the difficulty for bricks and mortar companies of achieving business benefit: online banking met a real need, and is now used by tens of millions of customers; technical solutions to problems of the Internet's architecture were developed, particularly in the area of security; yet the continuing use of other customer channels has limited the capacity of retail banks to realise their expected 'surplus', for example by closing branches or automatic teller machines. At the same time, common adoption of online services across most banks has prevented any gaining a competitive advantage and winning larger market share based solely on their provision of online service. In the early 2000s the Internet has become another layer of cost.

This section has examined the importance of competitive advantage in ensuring that those services that achieve mass uptake and are able to meet commercial requirements provide a business benefit to the companies providing them. It also identifies a lack of examination of this due to the rapid pace with which companies commenced Internet investment. The regulatory environment in which the Internet developed, described in Chapter 5, contributed to this by encouraging the expectation of a converged new media opportunity, without establishing the basis for an industry on 'sound economic principles'.

6.4 Combining the perspectives

In addressing the final subsidiary question this chapter has linked the results of each of the previous three chapters. In doing this it has provided a multi-disciplinary perspective. This section provides an overview of this perspective. While the full argument is reviewed in Chapter 7, this section identifies the key discoveries of this thesis.

Following an examination of existing knowledge across the research areas of history, media and communication, technology, regulation and business in Chapter 2, the following three chapters provided the building blocks for this thesis.

In Chapter 3 I combined historical and media usage perspectives to produce two key outcomes. The Internet was able to develop as a widely used medium in the absence of commercial investment due to three non-commercial funding sources: government investment, a gift economy of technologists, and the reuse of existing infrastructure (particularly the telephone network and the personal computer). Furthermore, it was the first major 20th century communication medium to do so, by definition creating an unprecedented situation for subsequent commercial development.

In Chapter 4 I examined the Internet's architecture and identified two important aspects. First, there was no commercial imperative for the Internet during its period of development. Second, this is reflected in the architecture of the Internet, which poorly supports commercial requirements, especially those characteristic of a transactional medium. This is in contrast to the telegraph, facsimile or electronic data interchange (EDI), for example.

In Chapter 5 I considered the regulatory context in which the Internet developed. I found that the United States regulatory approach of the 1980s and early 1990s in preparation for a new converged communication medium was consistent with the regulatory role played in the development of commercial radio and television industries in the early 1920s and late 1930s respectively. I also found that the regulatory activities, particularly those that limited the influence of incumbent telecommunications carriers, were important in assisting the success of the Internet, even though the apparent goal of this regulation was the development of an alternative commercial model such as the 'information superhighway'.

These separate aspects of the Internet were examined from a multi-disciplinary perspective. The relationship of both historical origins and usage to architecture was established. The further relationships between non-commercial usage and architecture in the early 1990s and the business expectations from 1995 were also established. A business understanding of the Internet was built based on each of the other areas of research, and how these affected the traditional commercial requirements that would be placed on a communication medium. Some

of these relationships were more complicated than others. The relationship between the mass growth of Internet use as a communication medium and expectations of mass Internet-based consumption was clear. The relationship between the particular architectural limitations of the Internet for commercial transactions and the subsequent difficulties of companies was less clear. Rather than a characteristic such as security directly causing a poorly planned business to fail, the technical architecture of the Internet appears to have made many commercial ventures more technically difficult than expected.

I found that both communication medium and architecture aspects contributed a critical requirement to gaining business benefit from the Internet. The first requirement is to match existing popular uses of the Internet. No organisation is able to control the use or direction of the Internet, and attempts to achieve this (for example to convert it into a television-style broadcast medium) have been unsuccessful. Therefore commercial organisations have to examine what the Internet does as a medium, for example its interactivity, and incorporate these characteristics into commercial adoption of the Internet. The second requirement is to ensure that the technical architecture of the Internet supports the commercial requirement. The Internet's technical architecture has changed little since the early 1990s, particularly in a way that would overcome many of its limitations as a transactional medium. A commercial service on or using the Internet will provide no benefit if a business is unable to charge customers in some way. Similarly, the best cost reduction strategy based on the Internet is worthless if it relies on the Internet to be something that it is not, such as provide a secure, reliable network. These communication and technical requirements appear obvious, even if they are often ignored.

I then identified a third requirement for achieving business benefit, a commercial one: a company must be able to achieve something from the Internet that is not easily available to competitors, in order to achieve a business benefit. The alternative, when the Internet makes it easier for many competitors to provide an identical service, can lead to an overall reduction in profitability throughout an industry, and a general absence of business benefit from whatever

has been introduced. While this third requirement is widely understood in the traditional business area, it is counterintuitive for technologists, who define benefit as the functional success of a technology. This is not to suggest that companies won't continue to increase their use of Internet technologies such as e-mail and the World Wide Web, but by themselves these may become costs of engaging in business rather than sources of business benefit.

I have reviewed three preconditions for business benefit against a range of examples throughout this chapter. While by no means comprehensive, these were a representative, not incidental, set of examples.

6.5 Summary

In this chapter I have provided a business perspective on the preceding chapters regarding use, technology and control. From this it can be seen that the process of achieving business benefit has three separate sequential requirements. First, the Internet provides functionality that is not available from other communication media. Any application (such as an information service or electronic marketplace) that is going to provide business benefit through reduced costs or increased sales should be based on this functionality, for example the Internet's interactivity. Second, the technology of the particular service must meet relevant business requirements. These may be security, the ability to collect payments, or to reliably deliver information. This match is found in each successful business reviewed. Third, in highly competitive conditions the resulting service may represent an additional layer of cost if the business is unable to develop a position of competitive advantage. Depending on the industry, a business may still be compelled to undertake this investment. My research for the first time identifies the contribution of these three requirements as a result of applying multiple perspectives. I have shown that difficulties in each of these three requirements relate directly or indirectly to the late arrival of a commercial Internet sector, after the establishment of the Internet as a widely used communication medium.

Chapter 7

CONCLUSION

This chapter summarises the findings to address the research question: Why has the experience of business benefit from the Internet been so mixed, given the Internet's usefulness to hundreds of millions of people? It does this by summarising the conclusions of the four subsidiary questions. It describes the significance of the study and identifies further areas of research.

7.1 Research findings

7.1.1 Widespread communication use preceded commercial interest

The research question posed in Chapter 3 was: How did the Internet become a communication medium with millions of users by the early 1990s? I examined the question from the views of infrastructure funding and user uptake, and compared this to other media experiences to identify similarities and differences.

I identified the criticality of three separate coincidental non-commercial sources of funding. The first of these is a widely observed government investment, initially in the military, and later in academic research, as responsibility for the Internet moved from the US Department of Defense to the US National Science Foundation. The funding was not exclusively from the

United States. The European CERN project provided the resource basis of the World Wide Web.

The second area of funding is the voluntary development of the Internet's technology, by a globally distributed community of thousands of technologists. This is identified as a gift economy, closely allied to the open source software development community. This contribution was enabled by the Request For Comment (RFC) standards development approach, the absence of commercial patents and the Internet's own core technological imperative to achieve survivability by having no single point of failure (a reflection of its military origin).

The third area of funding was the existence of what would become Internet infrastructure elements. These included most importantly the global telephone network, the personal computer and the Unix operating system.

The early Internet's main users were the technology community dispersed across sites that it connected. The applications that they developed were interactive: e-mail and the swapping of files. Later, as the network grew, a means of randomly linking information stores and preserving previous information search results became the World Wide Web.

Millions and later hundreds of millions of people then broadly adopted these services developed by technologists to meet their own communication needs. The ability of the Internet to grow rapidly, its international reach in the 1980s, and its character as a free service gave the Internet a strong advantage over other networks. This encouraged many similar initiatives, both non-commercial and commercial, to interconnect with the Internet in the late 1980s and early 1990s. By this time the Internet had achieved a mass base of users, prior to significant commercial investment.

This experience can be contrasted to other communication media in print, telegraph, telephone, radio and television in the United States, where the Internet developed. Key similarities include the role of usage in successful media technology uptake, and the stages of media technology, which have similarities across all media. The major contrast is in the area of commercial investment. Since the development of the telegraph, the early period of each new medium has been surrounded by significant patent disputes or other legal battles. The resolution of these is accompanied by the rise in each major national market of a definable industry with a restricted core of key companies (or a national monopoly).

The Internet in contrast achieved global success in the absence of legal disputes, and outside the bounds of traditional media ownership. By the time of its success it neither had an identifiable industry in the traditional media sense, nor a generally successful business strategy (comparable to commercial broadcast television or pay television, for example).

7.1.2 Internet architecture did not prioritise business requirements

The research question posed in Chapter 4 was: Did the Internet's development prior to 1995 shape its technological architecture in a way that limited its commercial use? I found that commercial requirements were absent during the development period, and this can be seen in the resulting architecture. Other transactional media, including electronic data interchange, are quite different from the Internet. I identified the cause of the Internet's technological inertia as the Internet's early 1990s success in generally meeting the communication needs of users.

The early design purpose of the Internet focused on survivability rather than cost efficiency. While there is a vigorous debate over the Internet's original purpose, its architecture is closely aligned to the purposes envisaged by packet switching inventor Paul Baran. Whether due to intent or accident, the military period of the Internet's development provided it with none of the requirements of a commercial, administrative or transactional medium.

This situation continued in its academic period. While an individual educational institution's need for Internet access was often commercially based, the primary approach of such a case was typically 'opportunity loss': an institution without the Internet was at a disadvantage in recruitment and when competing for grants. Such a case placed pressure on the Internet to continue providing existing communication services, rather than to meet commercial transactional media requirements. The original proposal in which World Wide Web funding was requested specifically excludes copyright and security considerations.

This lack of commercial or transactional support is exacerbated by the structure of the Internet. While it is relatively simple to solve the Internet's transactional shortcomings within a controlled environment, the Internet by design and definition is uncontrolled.

I compared five requirements of a transactional network to the Internet's architecture. In the first, security of financial exchange, the Internet lacks the capacity of the 19th century telegraph. The second, proof of a commercial activity, requires a deterministic network, where information arrives once, in the order in which it was sent. The Internet is non-deterministic. The third, identification of a commercial party, is far more easily achieved using the facsimile network than the essentially anonymous Internet. The fourth is establishment of a single meaning for a transaction. The systems developed by electronic data interchange standardisation continue to carry the vast majority of global transactions by value over proprietary networks, not the Internet. The fifth, support for payments, particularly in the range of a few cents to a few dollars such as provided by an itemised telephone bill, remains an underdeveloped area. Each of these aspects introduces a level of difficulty in the use of the Internet as a transactional medium.

These commercial limitations were generally overlooked as investors rushed to the Internet from 1995. While this investment was much greater than the original cost of establishing the Internet, its effect on the Internet's architecture was minimal. Neither the technologist-led redesign proposed in IPv6 nor the many thousands of proposed commercial modifications

have been able to turn the Internet into a reliable transactional medium. While the Internet remained technologically flexible in its capacity to grow and provide services, I found that its early 1990s architecture was to some extent 'frozen'.

7.1.3 Regulatory influences assisted development of the Internet

Chapter 5 addressed the research question: Was United States government regulatory policy during the development of the Internet a major factor in its success?

I identified several areas in which the characteristics of the Internet differ from previous communication media. These differences created two challenges for regulation. First, they kept the Internet's growth 'hidden' from national regulation during the Internet's early growth. Second, they nullify many of the methods of influence that regulatory organisations such as the US Federal Communications Commission have for implementing policy.

Previous US new media regulation focused on two related themes: a national interest, and the desirability of developing stable industries 'on sound principles'. These themes are found to continue throughout 20th century policy, regardless of other changes in approach. In radio the US Navy, prompted by the US President, encouraged General Electric to create the Radio Corporation of America, based on purchasing American Marconi and involving the other key radio patent holders AT&T and Westinghouse. This government encouragement resulted in the establishment of a radio monopoly. The early regulation of television involved a modification to this approach. From 1934 the Federal Communications Commission held regulatory power over communication technologies. The FCC spent several years in the late 1930s and early 1940s ensuring that the interests of several commercial concerns, including print media, films, the RCA monopoly and radio industry outsiders such as Zenith, had an opportunity to be represented in the commercial television sector. Once the cross-company technological group NTSC reached agreement in 1941, approval to proceed with commercial television was granted.

While the United States and global telecommunication environments of the 1990s were commonly described as ‘deregulated’, a high level of regulatory control was found in relation to the Internet. In particular this was based on limiting the capacity of incumbent telecommunications companies to dominate the new media area during its early period of development. This was highlighted in the three Computer Inquiries of the FCC from the 1960s. The new media area was characterised by its interactivity and an expectation that it would represent a development of television. It went under various names including high definition television, an ‘information superhighway’ based on video-on-demand, interactive digital television and convergence.

Following the commercial success of the Internet in 1995, regulatory focus for the Internet was on issues of national sovereignty and the requirements of a viable commercial industry. This has focused on intellectual property rights, a concept most established in the media content distribution industry. This has resulted in a high profile for normally obscure issues of commercial law. An alternative ‘digital commons’ approach more closely matches the traditions of Internet openness and innovation. The regulatory approach of tightened intellectual property controls in new media areas is still being elaborated at the conclusion of the research in 2003. I suggested that national controls over the Internet, whether based on government policy or taxation requirements, have a greater inhibiting effect on commercial Internet applications than on use of the Internet for traditional communication activities.

7.1.4 Usage, architecture and competitive advantage required for business benefit

The research question posed in Chapter 6 was: Under what conditions have businesses received business benefit from the Internet? I examined this by drawing on the discoveries of Chapters 3 to 5, and relating them to the experience of commercial organisations seeking business benefit from Internet investment.

My first area of consideration was that of the Internet as a communication medium. Media theory provides a basis for understanding the particular character of such media. This knowledge is ignored if the Internet is examined primarily as a technology. A major difference is the persistence of media over time, as they continue to meet particular user needs, despite the arrival of new media. In the case of the Internet, its large user base was seen as a significant commercial opportunity because online communication habits were expected to be rapidly replaced by online consumption habits.

Companies also underestimated the disruptive effects of the introduction of a new communication medium into their internal operations. The introduction of e-mail as a medium of record, not just of communication, has been an extreme example of this.

While much Internet investment was poorly planned, there were significant examples where companies were able to adapt the Internet's communication characteristics, particularly its interactivity, to their commercial requirements. Another apparently successful approach was to acknowledge the difficulty of achieving business benefit through the Internet as a medium and to focus on pre-existing delivery channels.

My second area of consideration was the effect of the Internet's architecture on the success of commercial Internet applications. This examined the Internet as a transactional medium. While several architectural characteristics identified in Chapter 4 made it difficult to use the Internet as a transactional medium, three characteristics were identified that assisted commercial use of the Internet for relations between businesses and consumers: its anonymity, ubiquity and the fragmentation of users (which creates new opportunities for intermediation).

For relations between companies, the Internet appears to promise considerable benefits for small and medium sized enterprises (SMEs) based on the Internet's ubiquity. While this benefit was found to be simple in the case of e-mail and use of the World Wide Web, more ambitious requirements for the development of 'networked' companies do not currently

appear to be easily supported. In this sense the expectation that SMEs would rapidly use the Internet to gain the benefits of electronic data interchange (EDI) previously achieved by large corporations appears unfounded. Despite the availability of the Internet, non-technical issues related to technology uptake by SMEs remained unresolved.

The effect of the Internet's architecture on business possibilities was generally not a simple and direct relationship, for example that a particular company found problems because of the Internet's lack of security. Rather, the architectural limits tended to make investment more complicated, while those companies that have succeeded showed their ability to match their approach to the Internet's architecture.

My third area concerned the inability of regulatory controls to establish an industry on 'sound economic principles'. Rather, from 1995 there was a reactive wave of investment seeking to seize the opportunity of the Internet's mass user base. In these circumstances, rapid user uptake and a match to the Internet's technical architecture were found to be insufficient for the achievement of business benefit. Working with the concept of 'competitive advantage' (Porter 1985) I found that there was no necessary business benefit outcome from the first two measure of success. The case of retail banking was examined. Here the Internet promised a significant reduction in the cost of transaction processing. However, the investment in an online banking service at a time when most banks were undertaking similar development has not provided banks with a current business benefit. Rather, it has added an extra layer of cost to bank operations. This is because customers have continued to use other channels, as well as adopting online banking, preventing banks from realising the 'surplus' from their investment. Among economists this is a well-known problem where companies are unable to prevent others from simultaneously introducing new technologies.

Based on these three sections I showed that three sequential conditions are necessary for achieving business benefit: first, the application must make use of the communication characteristics of the Internet; second, the Internet's technical architecture should support the

commercial purpose; and third, the investment must be planned in a way that avoids competing away the desired business benefits.

7.2 Research conclusion

These findings provide the basis for addressing the primary research question: Why has the experience of business benefit from the Internet been so mixed, given the Internet's usefulness to hundreds of millions of people?

I showed that the Internet was the first 20th century medium to develop free of commercial imperatives. It achieved mass uptake before the development of a commercial basis of the industry had been established. This is in contrast to the traditional technology diffusion cycle. Three non-commercial funding sources allowed this to happen: early government military research investment; the contribution of a technologists' gift economy; and the reuse of existing technology, particularly the telephone network and the personal computer.

The effects of this were found in the absence of support for the requirements of commercial transactions, such as security and reliability. In contrast to an alternative early 1990s project, the 'information superhighway', it lacked the primary characteristic of commercial communication media, the ability to measure and charge for services. The Internet also lacked the characteristics by which other communication media are regulated in the United States, for example dependence on use of a controled frequency spectrum, such as used by television and radio.

While general use grew rapidly in the late 1990s, for business a contradiction developed between use of the Internet and business benefits gained from investment in the Internet. This was hidden by the expectation and hyperbole that rapid Internet growth would inevitably lead to business benefits, as measured by profitability or some other financial means. Key infrastructure suppliers and some companies whose requirements were aligned to the

interactive architecture of the Internet were able to achieve such benefits. For others, such as retail banking, however, Internet services were used by customers but resulted in an additional layer of cost in the short term.

Through the findings I suggested that there are three requirements for achieving business benefits through the Internet. First, the application has to take advantage of the Internet's character as a useful communication medium. Many Internet initiatives are poorly matched to Internet use, while competing services such as swapping music files gained millions of users. Second, the technology of the Internet should support the commercial requirements of the application. A free information service may be popular, but generate no revenue. These two conditions are necessary but insufficient bases for achieving business benefit. In addition, a company must establish a position of competitive advantage in order to be able to capture at least some of the service value as a business benefit. This competitive advantage will be based on characteristics of the company and industry in which the Internet is being applied, rather than from the Internet itself, where benefits are quickly distributed among all participants.

In summary, I concluded that the mixed experience of business benefit has resulted from the difficulty of combining usage, technical and commercial understandings of the Internet. The absence of commercial tradition in 1995 provided warning of this. That warning was obscured by the Internet's rate of usage growth, and generally ignored in the reactive rush for market position.

7.2.1 Limits of these findings

I have examined why commercial use and investment in the Internet has had mixed experiences in achieving business benefit. This is not to suggest that these conclusions are relevant to other industries where business benefit is also difficult to achieve.

This study has focused primarily on the United States, and to a lesser extent on Australia and Europe. This is due to the focus on the origins of the Internet's commercial relationships, which have been primarily determined by United States corporations, courts and regulatory bodies. Therefore this study does not suggest that non-US Internet commercial use will proceed in the way described here, although that use could expect to be influenced by similar factors or United States precedents.

7.3 Significance

Three areas of significance are identified in Chapter 1 of this study. The results for each of these are now examined.

7.3.1 Making sense of the unexpectedness of the Internet

The Internet had become a feature of daily life for hundreds of millions of people by the early 21st century, but 10 years earlier it was virtually unknown. I focused on three unexpected aspects: the initial success of the Internet; the absence of a rapid development of subsequent mass consumption via the Internet; and the difficulty for business in gaining business benefit from the Internet.

As described in Chapter 3, the Internet's usage success was unexpected even among technologists involved in its development. The Internet's non-commercial growth was unprecedented among other electronic communication media. While others might have had early non-commercial roots, they required commercial investment to reach a mass audience. The Internet's reuse of existing technologies overcame that requirement. As described in Chapter 5, this also contributed to the Internet's low regulatory profile. At the same time, the usage that shaped the Internet's architecture was found to meet the needs of hundreds of millions of people. The Internet itself was not 'repurposed' when it moved to a commercial basis in 1995.

Once the Internet had reached a mass audience there was widespread expectation that this would provide the basis for mass online consumption, as previously promised for the 'information superhighway'. Instead the Internet generally provided commercial success only where it enabled useful and previously unavailable applications, such as online personal auctions. In other ways the assumption that the Internet would take on the characteristics of a commercial medium, overcoming its non-commercial origins, proved misplaced. Chapter 4 in particular identifies several architectural hindrances to one type of commercial application, as a transactional medium. These hindrances generally persisted in the Internet in 2003.

A third unexpected aspect of the Internet was the difficulty of achieving business benefit when the Internet was used in a way that did match its communication characteristics and architecture. Chapter 6 describes the commercial basis of this difficulty, the requirement for competitive advantage. This commercial requirement was not well known by a technological audience, which had expectations that mass usage and technical suitability are sufficient conditions for commercial success.

These unexpected features of the Internet during the 1990s contributed to widespread ongoing confusion regarding the Internet. In each case my research has provided a basis for understanding the source and reason for the confusion.

7.3.2 Combining multiple perspectives

At the beginning of this research I identified the requirement to examine the research question from a multi-disciplinary perspective. This is described in Chapter 2. The requirement had two outcomes as described below. Firstly, it provided an effective means for examining the research question. Second, the results of my research suggests that without a multi-disciplinary approach the key findings of the research could not have been made.

The combined perspective can be seen in the development of the research conclusion described in Section 6.4. From Chapter 3, each subsequent chapter was able to build on the previous chapters by adding a new perspective. In addition to this, the findings of each chapter are made possible by a combination of perspectives. For example, in Chapter 5 the regulatory perspective is strengthened by an understanding of those aspects of Internet history, use and technology that made it 'invisible' to regulators until 1995. At the outset of the research it was unclear to me whether the key findings would still reflect the separate areas of research. The result clearly does: the three conditions for achieving business benefit clearly relate to the communication usage, technology and business areas of research. History and regulatory issues are less directly visible, although their influence can be found in the reasoning behind these key findings.

The second aspect of this multidisciplinary approach relates to whether this outcome could have been achieved from the perspective of a single discipline. From my research this would not appear to have been possible, as the key concepts of the Internet as a communication medium, the non-transactional character of its architecture, and the requirement of competitive advantage for business benefit are each generally understood only within single fields of research.

7.4 Further questions

The research limited itself to an examination of factors contributing to business benefit from the Internet. The results of this research provide a basis for investigating other issues regarding Internet usage and Internet commercial development.

From a usage perspective, the identified rapid growth of the Internet from the early 1990s based around a limited set of primarily interactive communication uses is now reaching a turning point. With the majority of Internet users no longer English-speaking (as described in Section 3.2.1), will the early 1990s patterns of usage continue as the Internet reaches one

billion or more users in coming years? What multi-lingual and cross-cultural issues will emerge? Within large organisations as e-mail and web uses begin to reach their current limits, what new models of use will emerge and predominate?

From a business benefits perspective, will the Internet develop a cohesive industry comparable to the television or print media industries, where the industry itself begins to change the character of Internet usage? Such an industry could include telecommunication carriers, World Wide Web service providers, commercial information service providers, and many others. Or will the Internet remain a subsidiary area of investment for other industries? For commercial users of the Internet, what payments framework will resolve issues such as micropayments and multi-currency challenges, and how will this meet the user concept of trust?

Finally, will the Internet become such a common part of our lives that it joins electricity and the telephone as ‘invisible’ technologies, or will its commercial limitations result in the development of additional networks meeting separate varied information networking needs?

With global Internet use now reaching one person in 10, and with no end to growth in sight, these questions become both timely and significant.

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