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Webcasting and Convergence: Policy Implications

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WEBCASTING AND CONVERGENCE: POLICY IMPLICATIONS

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FOREWORD

This report was presented to the Working Party on Telecommunication and Information Services Policy (TISP) at its meeting in September 1997 and was recommended to be made public by the Information, Computer and Communications Policy (ICCP) Committee in November 1997.

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MAIN POINTS

Convergence between different telecommunication and broadcasting infrastructures and services is increasingly raising challenges for regulatory frameworks and may require adjustment in view of emerging services. A leading example of this phenomenon, born of convergence in the communication sector, is the group of emerging services known as webcasting. Webcasting services use the Internet to deliver content to users in ways that sometimes closely resemble other traditional communication services such as broadcasting.

Due to the fact that some webcasting services are regarded by some policy makers as "like services", there is an inclination to regulate them according to criteria stemming from broadcasting and telecommunication markets.[1] At the same time it is important that new services like webcasting should be permitted to develop, without impediments, to facilitate the growth of applications in areas such as electronic commerce, health care and education. This issue was highlighted by the Clinton Administration in its statement entitled "A Framework for Global Electronic Commerce", which noted,

> "Officials in some nations claim that "real time" services provided over the Internet are "like services" to traditionally regulated voice telephony and broadcasting, and therefore should be subject to the same regulatory restrictions that apply to those traditional services. In some countries these providers must be licensed, as a way to control both the carriage and content offered. Such an approach could hinder the development of new technologies and services."[2]

This raises the question of how policy makers can enable the tremendous potential of convergence to be applied for economic and social development, while maintaining an even handed approach toward the regulation of traditional communication services. The response to this seeming dilemma might be two-fold. As a first step an examination could be taken of the *raison d'être* for regulating traditional communication services and infrastructures against the potential of the new services. The specificities of the Internet environment should be taken into account by regulation and especially how new services such as webcasting might contribute to many of the original goals of such regulation. In this context for example, the initial indications are that webcasting holds the potential for greater pluralism and cultural diversity -- two of the traditional goals of broadcasting policy.

For a number of countries, the development of new services such as webcasting is viewed as necessitating a review over time of the regulation of traditional services to take into account the new environment. The need for such reform is likely to gather momentum because the Internet, and particularly leading edge webcasting services, are already changing the way users access information, entertainment and communication services. While webcasting services are in many ways immature relative to traditional services, in terms of quality and accessibility, the pace of technological development is such that the gap will narrow over the next several years. Indeed, many webcasting services will be seamlessly integrated into traditional infrastructures and services very rapidly. The more webcasting comes to resemble traditional services the greater the challenge will become to the existing regulatory frameworks. This implies, if technological neutrality is to be practised, that existing regulation of traditional services needs to be reviewed in this light.

At the same time, webcasting over the Internet is raising a number of issues for policy makers dealing with telecommunication. In particular these issues are concerned with interconnection between different types of networks. As long as bottlenecks exist in certain infrastructures, some ongoing telecommunication regulation aimed at ensuring conditions such as non-discrimination and transparency will be necessary as convergence progresses. On the other hand the question of how to adapt safeguards and privileges accorded to the interconnection of "like networks" to alternative communication infrastructures (i.e. different platforms such as Internet) in terms of regulation need to be addressed. Some regulatory practices, such as specifying co-location or unbundling of network elements, may need to be extended to Internet Access Providers to ensure non-discriminatory access to essential facilities.

OECD analysis, based on 'Web21' data, indicates that the most accessed Internet content originates on the West Coast of the US. In June 1997 some 40 of the most accessed 100 websites appear to be located in California. In respect to webcasting, some 37 of the most accessed 100 audio websites are in California and Washington State. Webcasting will increase the need to locate the most accessed content close to users if congestion is to be avoided. So called 'IP Multicasting', enabling the shared use of the same data stream, may address this issue in the future.[3] In the shorter term network providers will take action to minimise transmission costs, maximise network performance and avoid access congestion that may increase due to webcasting. This factor may raise a number of new issues for policy makers. These issues are largely concerned with the distribution of content such as debates over international settlements, in respect to carriage, and the storage of content in respect to caching. Some owners of intellectual property are concerned that increased commercial caching may undermine their business models for electronic commerce. On the other hand infrastructure providers would like governments to clarify their position in respect to technologies they view as essential for efficient network management and improving the Internet's responsiveness for electronic commerce applications.

In 1997 it might seem relatively easy to place webcasting on a list of issues to be dealt with in the future. The technology, while dynamic, is relatively immature and so are the services. Clearly the quality of webcasting, at the speeds most commonly accessed by dial-up Internet users, does not lend itself to the standards of broadcasting by traditional media. Nor does Internet access, both from the perspective of users connected to the Internet and for the number of users that can access the same content at the same time, yet approach access to radio and television broadcasting. On the other hand much of this is set to change relatively quickly as Internet services become further integrated into existing 'broadcasting technologies' and IP multicasting technologies are employed on a widespread basis. Indeed, leading webcasting companies are saying that the first major commercial deployment of IP multicasting will enable streaming media services to be accessed by 50 000 simultaneous users, or 10 to 15 million users on a daily basis.

WEBCASTING

Where regulation of communication markets has been deemed necessary, for reasons other than technical co-ordination (e.g. radio spectrum management), policy makers increasingly prefer to regulate services rather than technologies. This approach has many advantages over past practices because it does not attempt to prescribe the technology used to provide a particular communication service. This has the benefit of enabling communication infrastructure and service providers to select from all available technologies. It also means that regulation is not necessarily outdated by each technological innovation. However in regulating services, rather than technologies, new challenges are emerging as different technological platforms enable the provision of services with similar characteristics.

Digitalisation of content enables it to be transported over a myriad of different communication technologies. As a result of this convergence a leading question facing policy makers is what happens when a communication service, with similar characteristics to one that has been highly regulated in the past, emerges on a new platform. Should the new service be subject to the same regulatory framework as 'like services' using different technologies? If not, then the new services may have an advantage over traditional services because of an uneven regulatory playing field. On the other hand trying to regulate the new services in the same way as traditional services could well impede their development and the potential benefits they hold and undermine the original intent of the regulation.

The emerging capabilities of the Internet, particularly webcasting, provide a leading example of this phenomenon. Webcasting, sometimes known as netcasting, is the term applied to an emerging group of services that use the Internet to deliver content to users in ways that take on many of the characteristics of other traditional communication services (e.g. print media, audio-visual, telecommunication services). These services range from text and graphic services that are regularly transmitted over the Internet to subscribers (e.g. Pointcast) to so called 'streaming media' with audio or video content (e.g. Real-audio or Real-video 'broadcasting') to Internet video-conferencing (e.g. Internet telephony and Internet video-telephony).

The Internet, even in its most commonly used application for transmitting static world wide web pages, often challenges communication regulation by the nature of its content or the source of the server. Examples of this trend have been evident in recent elections in several Member countries. In France, regulation prohibiting the publication of opinion polls in the week prior to the May 1997 election was disregarded by several newspapers.[4] The Editors took the view that because the results of opinion polls were readily available on the Internet they should be able to publish the same information in their newspapers.[5] In other words they felt that the regulatory playing field penalised their media as opposed to a new media. In Mexico traditional media were similarly constrained during the July 1997 election. Although Federal electoral law prohibited the publication of opinion poll results during the week prior to the election this information was available on Internet sites. While CNN's cable television coverage of the election was blacked out on election day in Mexico, their coverage over the Internet was readily available.[6]

In the same way the Internet can be expected to increasingly challenge the regulation of traditional broadcasting services and the practicality of their implementation. For example a number of OECD countries have regulation pertaining to the type of content broadcast by radio and television stations. These might include certain language requirements or levels of domestically produced content that must be put to air. Webcasting services, such as audio services put on the Internet by radio stations, particularly when received over high speed local access infrastructure (e.g. satellite, cable modems, xDSL), may differ little from the traditional radio services.[7] This raises the question of whether 'like services' can or should be treated differently either in respect to the practicality of regulation or its goals.

The most recognisable way the Internet challenges the practicality of regulation is through foreign origination of content (i.e. origination beyond national borders and national regulatory controls). This is not the only challenge. The Internet also enables a huge increase in the number of sources of content from within national boundaries. Whereas there were relatively few sources of traditional media (i.e. in the tens or hundreds for most OECD countries), and therefore a manageable number of regulatory points of control, the Internet enables a huge increase in information sources. It would be highly impractical, if not impossible and not desirable in the case of privacy concerns, that all multi-media Internet content should be monitored or regulated by governments in the same way as traditional broadcasting media.

Applying past regulatory practices to webcasting could also hinder the development of electronic commerce. Webcasting is not just undertaken by traditional communication companies and is increasingly being applied by all types of business for internal and public communication. The Boeing Company, for example, has deployed Progressive Network's 'RealVideo' technology across its corporate Intranet providing up to 145 000 employees access to a new live and on-demand medium for training and corporate communication.[8] Other companies that have deployed either 'RealVideo' or 'Real Audio' across their corporate Intranets include Cisco, Digital Equipment Corporation, KPMG, MCI and Oracle. Business users are also increasingly using webcasting to provide information and services to their customers. For example, 'Timber & Stone' the largest supplier of antique log cabins, barns, and outbuildings in the U.S uses 'RealVideo' on its public web site.[9] The Shikoku Bank in Japan and the German Metal and Electronics Employers Association are others to use 'RealVideo' webcasting to communicate with the public.[10] In future business is also expected to be able to transact electronic commerce via 'pay-per-view' webcasting.[11] This would, for example, enable a service provider to charge users for listening or watching a webcast concert or sporting event.

Paradoxically, however, the characteristics that make it impractical to apply traditional regulation to webcast services may also make them extremely attractive in terms of meeting traditional policy goals. Rather than undermining the goals of regulation webcasting can be viewed as a tool to achieve a number of traditional objectives of communication regulation. The Internet holds tremendous potential to promote cultural diversity by linking communities of interest beyond national borders. As access expands, the Internet also holds the potential to increase pluralism in ways that traditional media regulation could not have achieved. Interestingly while a great deal of the most accessed 'new Internet content' originates from California, there is a much greater spread across the US and around the world in respect to the publication of traditional media (e.g. on-line newspaper sites) on the Internet. From the most accessed 100 News Sites on the Internet almost one in five are outside the OECD area despite there being a very low Internet access in many of these countries. Clearly a major application of the Internet is for users seeking news focused on 'home states or countries' not provided by local media (see section on mapping web content).

While, at first sight, webcasting might seem to present a dilemma for regulators, after further consideration this may not prove to be the case. The crux is that although some webcast services can clearly be regarded as 'broadcasting-like services', the initial indications are that the reasons for regulating traditional broadcasting may not apply to webcasting. Moreover, in many ways, webcasting could turn out to be a boon in terms of meeting policy objectives at the heart of traditional regulation (see section on broadcasting regulation and webcasting). What might prove a more difficult challenge for policy makers is reforming the regulation of the traditional broadcasting sector to take into account the new circumstances.

In 1997 it might seem relatively easy to place webcasting on a list of issues to be dealt with in the future. The technology, while dynamic, is relatively immature and so are the services. Clearly the quality of webcasting, at the speeds most commonly accessed by dial-up Internet users, does not lend itself to the standards of broadcasting by traditional media. Nor does Internet access, both from the perspective of users connected to the Internet and for the number of users that can access the same content at the same time, anywhere near approach access to radio and television broadcasting. On the other hand much of this is set to change relatively quickly as Internet services become further integrated into existing 'broadcasting technologies' (e.g. set top boxes for televisions, cable modems, satellite and terrestrial broadcasting of Internet content) and Internet multicasting technologies are further developed.

One example of such a technology is the 'Web-TV' set-top box product, now on sale in the US, which enables users to receive Internet content, including webcast audio, via the PSTN and their television. Other examples come from a number of approaches to upgrading access infrastructure via cable or satellite technologies. Cable services such as '@Home' are discussed later in this document. Less well publicised are terrestrial and satellite Internet broadcasting initiatives. For example Eutelsat and Com.Net, a wholly owned subsidiary of Nuova Telespazio are planning to offer the first satellite service in Europe providing access to the Internet, with speeds of up to 40 Mbit/s per transponder, based on the DVB (Digital Video Broadcasting) open standard for digital television.[12] The service aims to enable more efficient access to multimedia services via the Internet. The service is scheduled to be operational from summer 1997 and will be commercialised by Telecom Italia. The equipment required to receive the service consists of a DVB-MPEG2 card for the PC at the user's premises and a 60 cm antenna which can be the same as the one already used to receive television services. On the transmission side a normal modem and telephone line are all that are required.

The challenges of webcasting for policy makers are not confined to the field of broadcasting regulation. Convergence on Internet is raising a number of issues for policy makers dealing with telecommunication. In particular these issues are concerned with interconnection between different types of networks. Sometimes these issues seem familiar to telecommunication policy makers, such as non-discriminatory access issues. Others, such as the intellectual property issues that may emerge with increased commercial 'caching' between networks, are new and need to be discussed at national and international levels.

CONVERGENCE AND THE TRANSITION TO WEBCASTING

The term convergence can be applied to the communication industry in a number of different ways. One type of convergence is evident in the type of technologies used by infrastructure providers. For example fibre optic cable is now used as the technology of first choice by both public telecommunication operators (PTOs) and cable television companies for an ever increasing part of their core networks.[13] On the other hand a growing number of different technologies are being introduced in the connection of customers via the local loop. These technologies, such as the numerous wireline and wireless options, can also said to be converging because they aim to offer the same types of services (i.e. telecommunication, broadcast entertainment, information services etc.) over enhanced local access networks. A third type of convergence has occurred as a result of market liberalisation over the ownership of network equipment that, together with digitalisation, is driving webcasting.

Convergence between different communication platforms, and the services provided over them, has been an ongoing trend for many decades. In times past the potential impact of convergence, in terms of increasing the choice of service supplier, was limited by government regulation. For example, both satellites and undersea cables have long been used for carrying telephone calls. However this made little difference to telephone users' choice of service supplier in an era characterised by monopoly PTOs. Nevertheless every technological development of this type, which enabled a new way of carrying the same telecommunication services, raised questions about market structures that precluded the ability of new entrants to take advantage of convergence. The birth of MCI (Microwave Communications Inc.), a company wanting to utilise microwave radio to provide telecommunication services but initially prevented by regulation, is an obvious case in point.[14]

At the same time that prospective market entrants, such as MCI, were raising questions about network monopolies, the convergence between the computer and communication industry was raising the same issues at the periphery of networks. This started with the issue of who could own the equipment connected by users to the public switched telecommunication network (PSTN). The debate then extended to the provision of value added services and the connection of private networks to the PSTN. Since the 1960s this process has built increasing momentum with rapid advances in information technologies (i.e. vastly increased storage and processing capabilities). In parallel a network called the Internet was being assembled which today largely utilises capacity leased from, or internally allocated by, incumbent PTOs and new infrastructure providers.

Following the retirement of the so called 'acceptable use policy' the Internet has made a transition from being a 'private network', first for the military and then for academia, to a commercially driven public network.[15] Yet while the transmission infrastructure was grafted onto the global PSTN, the routers (i.e. the Internet equivalent of PSTN switches) belong to Internet backbone and service providers. As the formerly private Internet was opened into a public Internet, the culmination of a trend that began with the liberalisation of terminal equipment occurred. In other words equipment owned by users was

performing core rather than peripheral network functions in offering services to the public. It was at this time that several business models based on proprietary systems lost ground to the Internet and by around 1995 the leading players began to alter their strategies (**Table 1**).

The first business model to be shaken by the Internet was the one for proprietary on-line services such as America On-line, Prodigy and CompuServe. The change, generated by the Internet, happened so quickly that some planned services, such as Europe-On-Line, had their initial business models disintegrate during implementation.[16] The more established players, however, were able to adapt their business models by opening gateways from their proprietary networks to the public Internet and dramatically restructuring their pricing.[17] The effect of this was to more than halve the cost of 20 hours per month for a user of an on-line service. These changes, in general, dramatically escalated the number of subscribers to on-line services, such as America On-Line, but they were now only one of many hundreds of companies offering Internet access. In 1997 the number of US customers to Internet Access Providers (IAPs) surpassed the number of US customers to the services of formerly proprietary on-line service providers.[18]

The second business model was for telecommunication and cable companies to offer interactive television services via proprietary broadband systems to the home. Unlike the on-line service model, the interactive television model was limited to a number of high profile trials, which are widely regarded as not being successful in terms of leading to commercial services. Some examples include Time Warner's trial in Orlando, Florida, which offered movies on demand, home shopping, and video games and Bell Atlantic, Nynex, and Pacific Bell's Tele-TV service trial.[19] These trials are now being wound back as telecommunication and cable companies re-orient their strategies toward xDSL, satellites and cable modems.

For telecommunication companies the new trend has definite advantages. Internet has created tremendous new demand for existing network access options such as second telephone lines, local calls and ISDN services. The various xDSL technologies offer a gradual path to further developing existing local access networks. Cable modem technology offers a similar potential for suitably upgraded cable television networks. For both telecommunication and cable companies this approach offers a more evolutionary and, compared with the interactive television model, relatively lower cost way to offer multimedia services. On the other hand the quality of the services, particularly video services, will not match the ambitious goals the interactive television model had for video on demand. The development of webcast technologies is still in its infancy and today's services are of very modest quality compared to traditional broadcasting mediums.

The key to webcasting may be that what the services lose in quality compared with traditional broadcasting systems they compensate with diversity. The Internet's ability to link communities of interest on a national and international basis in an interactive way far surpasses that of existing electronic media. In addition the ability of the Internet to offer a virtually unlimited number of information channels, more along the lines of traditional publishing than broadcasting, and make these channels readily accessible to users throughout the world is a major strength. Furthermore these channels of information can be tailored by individuals to their specific interests and delivered or webcast to their terminals via 'push technologies'. Even based on its existing services, access to the Internet is growing extremely quickly and is increasing demand for existing higher speed local access products (e.g. ISDN). Webcasting, if it is welcomed by users in spite of its immature quality of service, has the potential to add significantly to the demand for higher speed local access networks. This is one reason why incumbent PTOs are enthusiastic about webcasting. One example is the announcement by NTT and KDD that they will co-operate in a service called J-Stream which will offer media companies capacity to webcast audio and video content over the Internet.[20]

Table 1. Proprietary Models to Internet Models

	Interactive TV Model	Webcasting Model	On-line Service Provider Model	Internet Information Access Model
Circa	1994	1997	1994	1997
Business Model	Proprietary	Open Internet	Proprietary	Open Internet
Leading Providers	Time Warner, RBOCs and many other PTOs.	Progressive Networks, Web-TV and others.	America On-line, Compuserve, Prodigy, Europe On-line, NiftyServe.	NetCom, AT&T, EUnet, and more than 4000 others.
Leading Service Goal	High quality video on demand; Interactive Shopping etc. in closed on-line malls and games.	Low quality audio/video that can evolve with higher compression rates and higher speed local access networks.	Provide access to proprietary databases of news, information and other services.	Provide Internet Access.
Number of 'Information channels'	Video on demand and 500 plus channels.	Unlimited but variable quality.	Closed world of proprietary databases.	Unlimited but variable quality.
Interface	Electronic Programme Guides.	Internet browsers with streaming media 'plug-ins'.	Company proprietary interface.	Netscape and Microsoft browsers.
User equipment	TV, set-top box, remote control.	PC with PSTN, wireless or cable modem, Web-TV or Internet ready TV.	PC and modem.	PC and modem.
Infrastructure Costs	Expensive supply-driven infrastructure provision.	Lower cost-demand led infrastructure upgrades.	Major cost items are customer service, marketing and content provision.	Relatively low cost entry to IAP business. Potential cost increases depending on future of peering & interconnection.
Pricing	Pricing in trials only.	Mostly free content (advertiser supported) or pay per download of content models.	Certain number of hours included followed by measured charges. Premium pricing for some content.	Flat rate per month.
Strategy Shift	Close or dramatically scale back trials. Shift focus to cable modems, selling existing access products (ISDN, 2nd lines) and/or high speed xDSL technologies. Flat rate or volume charges for cable modems.	Work to develop Internet protocols, compression and streaming media technologies. Open Web-TV devices to be non-proprietary and incorporate more multimedia applications.	Open proprietary networks to Internet since 1995. Reinvent themselves as IAPs offering additional premium information services. Reorient pricing toward IAP model.	Incorporate 'Push' interfaces such as Pointcast. Differentiate access pricing for value-added service.

1. See also NewsCom table: http://www.news.com/SpecialFeatures/0,5,9628,00.html

Source: OECD and NewsCom

Webcasting: Push, Pull and Streaming Media Technologies

Webcasting, sometimes known as netcasting, is the term applied to an emerging group of services that use the Internet to deliver content to users in ways that take on many of the characteristics of other traditional communication services (e.g. print media, audio-visual, telecommunication services). Notwithstanding this some of these technologies clearly offer additional features not available from traditional communication mediums. Courtesy of PC Webopaedia a number of key terms are defined in **Table 2**. These services range from text and graphic services that are regularly 'pushed' over the Internet to subscribers (e.g. Pointcast) to so called 'streaming media' with on-demand or live audio or video content (e.g. real-audio or real-video 'broadcasting') to Internet video-conferencing (e.g. CU-see-Me Internet video-telephony/conferences). For convenience the term webcasting is used in this report as shorthand for all these services, as well as traditional Internet 'pull' services that have multimedia characteristics (e.g. audio-visual download for playback). Webcasting is sometimes defined more narrowly as a term encompassing 'push services', as in Table 2.

The major difference between webcasting and browsing the world wide web is that data is pushed or streamed to a user rather pulled (Refer Table 2). Nevertheless, with the possible exception of e-mail, a user wishing to receive a webcast service must take some action. This can involve requesting a streaming media service, subscribing to a push service or employing software which carries out these functions on behalf of a user. It is the characteristic of agent autonomy or independence, after the initial action, that leads to parallels with broadcasting. In the same way that a user receives a service after selecting a television or radio station, webcasting does not necessary entail additional actions by a user to receive an ongoing service. Some of the technologies enabling these services are described in **Table 3**.

Multicasting is one of the most promising ways to enable more efficient webcasting. Unlike conventional webcasting technologies, which essentially transmit on a point-to-point basis, multicasting enables webcasts on a one-to-many basis.[21] This means that instead of sending the same data to multiple recipients, users can share a data stream. This technology is being used in trials by companies like @Home, which together with Progressive Networks, are undertaking a trial in Fremont, California. @Home says the trial will deliver CD-quality audio and broadband video via multicasting by "... allowing several users to link to a single multimedia stream, in much the same way audiences receive a single, over-the-air signal."[22] The company says immediate offerings include short video clips of motion picture trailers and music videos. In future it is likely that 'pay-per view' capabilities will be incorporated into webcasting technologies to enable some services to be charged for separately from a basic Internet subscription.[23] MCI, together with Progressive Networks, has also equipped its Internet backbone to be used for IP multicasting. The new system will distribute data in a shared stream to multiple network centres from where it can be webcast to as many as 50 000 simultaneous users.[24] MCI and Progressive say that the potential audiences for such webcasts are 10 to 15 million visitors on a daily basis through a combination of live and on demand webcasts on the public Internet and private Intranets. Accessibility on this scale takes webcasting into a scale comparable to broadcasting, albeit the quality of signal reception does not yet match traditional broadcasting. This opens the way for 'pay-per-view' and events supported by advertising of significant size.

Table 2. Key terms in 'Internet broadcasting'

Term	Usage
IP Multicast	Sending out data to distributed servers on the MBone (Multicast Backbone). For large amounts of data, IP Multicast is more efficient than normal Internet transmissions because the server can broadcast a message to many recipients simultaneously. Data traveling between multicast servers moves in a stream rather than in packets to ensure timely delivery.
MBone	Short for Multicast Backbone on the Internet, MBone is an extension to the Internet to support multicasting-two-way transmission of data between multiple sites. The TCP/IP protocol used by the Internet divides messages into packets and sends each packet independently. Packets can travel different routes to their destination which means that they can arrive in any order and with sizable delays between the first and last packets. This works fine for static information, such as text and graphics, but it doesn't work for real-time audio and video. The MBone is an experiment to upgrade the Internet to handle live multimedia messages. MBone servers have special Class D IP addresses. Currently, there are only a few thousand such servers on the Internet. The Mbone was developed by Steve Deering at Xerox PARC and adopted by the Internet Engineering Task Force (IETF)in March 1992.
Pull	To request data from another program or computer. The opposite of **pull** is **push**, where data is sent without a request being made. The terms push and pull are used frequently to describe data sent over the Internet. The World Wide Web is based on pull technologies, where a page isn't delivered until a browser requests it. Increasingly, however, Information services are harnessing the Internet to broadcast information using push technologies. A prime example is the PointCast Network.
Push	In client/server applications, to send data to a client without the client requesting it. The World Wide Web is based on a **pull** technology where the client browser must request a Web page before it is sent. Broadcast media, on the other hand, are **push** technologies because they send information out regardless of whether anyone is tuned in. Increasingly, companies are using the Internet to deliver information push-style. One of the most successful examples of this is PointCast, which delivers customized news to users' desktops. Probably the oldest and most widely used **push** technology is e-mail. This is a push technology because you receive mail whether you ask for it or not -- that is, the sender pushes the message to the receiver.
Streaming	A technique for transferring data such that it can be processed as a steady and continuous stream. Streaming technologies are becoming increasingly important with the growth of the Internet because most users do not have fast enough access to download large multimedia files quickly. With streaming, the client browser or plug-in can start displaying the data before the entire file has been transmitted. For streaming to work, the client side receiving the data must be able to collect the data and send it as a steady stream to the application that is processing the data and converting it to sound or pictures. This means that if the streaming client receives the data more quickly than required, it needs to save the excess data in a buffer. If the data doesn't come quickly enough, however, the presentation of the data will not be smooth. There are a number of competing streaming technologies emerging. For audio data on the Internet, the de facto standard is Progressive Network's RealAudio.
Webcasting	Using the Internet, and the World Wide Web in particular, to broadcast information. Unlike typical surfing, which relies on a pull method of transferring Web pages, webcasting uses push technologies. The most popular webcasting service to date is PointCast, but several major companies, including Microsoft and Netscape, have announced their own webcasting products and services.

Source: Extracted from PC Webopaedia (www.pcwebopaedia.com)

Table 3. Selected Webcast Enabling Technologies

Name	Description	URL
CU-SeeMe[25]	Video conferencing software for PC and Macintosh computers.	CU-SeeMe.cornell.edu/
Electric Records	Manufacturer of software that enables songs to be bought (including billing system) on the Web, downloaded, stored and played on a PC.	www.electricrecords.com/
Fantastic Corporation	This company's Media Distribution System prepares any content for broadcast to end-users across any transport media. The system is structured around the Channel Management Center™ (CMC), a media broadcast studio containing packaging and scheduling software which screens and filters incoming content, packages it up for transmission, and then sends it on-air to subscribers. Channel Servers can be used by Media and Content Providers producing Data Channels (or services within Channels) independently. These servers process local data for subsequent integration into the CMC according to the playout schedule defined by the operator.	www.fantastic.ch/
Ituner	Ituner is the next generation RealAudio 3.0 compatible client. Features include realistic and changeable faceplates, advanced preset and scanning, detailed network statistics etc.	www.ituner.com/
Liquid Audio	Liquid Audio software suite consists of three components: mastering tools for content creation, playback tools for sampling, purchasing and publishing, and audio delivery tools to complete the client/server architecture.	www.liquidaudio.com/
Microsoft	Net Show player enables webcasting of live and on-demand audio, video, and mixed multimedia.	www.microsoft.com/netshow/about.htm
Multicast Backbone (MBone)	IP Multicasting, via the MBone network, is a standards based approach to enabling live broadcasts of audio and video.	www.mbone.com/
Progressive Networks	Manufacturer of 'real-audio' and 'real-video' software that enables webcasting. RealVideo uses a variety of data compression techniques and works with both normal IP connections as well as IP Multicast connections.	www.Realaudio.com/
VDOnet Corp.	Commercial provider of video streaming software tools including Internet video-telephone.	www.vdolive.com/
VXtreme	VXtreme developed and markets video over the Internet and corporate networks. Its Web Theater product family delivers video for news, entertainment, and promotion.	www.Vxtreme.com/
Xing Technologies	Xing's software plays live and on-demand audio and video from 'StreamWorks' servers.	www.xingtech.com/

Source: OECD

Webcasting Services

Webcasting is here used to refer to a group of emerging services that deliver content to users over the Internet. Some have similar characteristics to traditional communication services while others add new capabilities. As these services are very new, and very dynamic, it is not easy to categorise them by their characteristics or by the technologies they use. Attempting to do so would not only be complex but might also be relatively fruitless given the extremely fast rate of innovation. The grouping of webcast services in **Table 4** is not meant to be definitive. In Table 4 webcast services are grouped according to some key features to provide an overview of some leading applications. In some cases the placement of a service in one of the seven sub-groups is somewhat arbitrary in that this service may have a feature that might equally be applicable to another category.

The **first** category is providers of digital libraries of audio-visual content as on-demand services. The essential feature of these services is that they take static web pages and build multimedia capabilities into their service offerings using webcast technologies. This enables a user with a suitably equipped PC to download content on demand. For example a user might download a sound or video clip from a service which can be played in 'real time' as streaming media or for later playback. A number of start-up companies are exploring the potential use of this application for electronic commerce, including the delivery of content to users. For example 'Global Music Outlet' sells songs, at US$0.99 per song, that can be downloaded by users for later playback. Sites such as 'Sound Dogs' sell sound effects that can have applications ranging from web page creation to home movie making. There are also many hundreds of radio stations now webcasting their content over the Internet using streaming media technologies such as at the World Radio Network's site. In addition Telecom Finland's 'Mediaweb' site webcasts a Swedish radio station among others.

The **second** category, Webcasters of 'live' events using audio-visual content, is an extension of the first with the main additional feature being that these sites concentrate on live webcasts. In other words special events, such as concerts, are webcast as they occur. The **third** category, Webcasters of live events using text based services, is essentially the same as the second except that they use text services to describe 'live events' instead of transmitting sound or video. For example 'The Age' newspaper in Australia webcasts text descriptions of football matches, and running scoreboards, which are received and displayed via an Internet browser. This service also allows users around the world to send messages to others receiving this service during a webcast. Interestingly the 'live' webcast of events has prompted sporting authorities and others to raise the issue of whether the rights to events can be sold in the same way as they sell broadcast rights.[26]

The **fourth** category, providers of subscription based information services, features services using so called 'push and pull' methods of delivery. The first service available and, perhaps the most widely used, is Pointcast. Pointcast is a product that enables users to receive automatic content updates via their Internet connection (e.g. PC, Pointcast software and communication connection). It is this feature that has led to services such as Pointcast being called 'push technologies' because once users subscribe, content is automatically sent to their desk-top. An additional feature of Pointcast is that the service also acts as a 'screen saver'. In other words if a user has not used another application for a pre-specified length of time Pointcast automatically displays information. Since Pointcast was first made available in 1996 it has spawned a number of similar services with additional features. These include services where the user specifies to a greater extent the content they would like to have 'pushed' to their desk-top either by nominating 'channels' or designated Universal Resource Locators (URLs). In the case of 'channels' information services are provided by a specific content producer. This can also be at the company level via push services over Intranets. In the case of URLs, pre-designated sites are automatically downloaded so that users can have more convenient access to preferred sites conveniently

than by conventionally going from site to site. The two leading providers of Internet browsers, Netscape and Microsoft, are both incorporating these services into their standard products for navigating the world wide web.

The **fifth** category is an extension of the fourth. The different feature is these 'push and pull' services use 'intelligent agents' to add an additional layer of autonomy or independence to the process. In addition a service such as Jango uses what it defines as 'parallel pull' by which it means the software can obtain information from different sites rather than simply downloading a pre-designated site. In other words the Jango software, which aims to offer information for online shoppers, could gather the price of a good or service from 30 or more relevant sites.

The **sixth** category of webcast services encompasses providers of information services using multiple delivery platforms. The main distinguishing feature of these services is that they employ multiple technologies in the delivery or reception of service. For example 'Airmedia', webcasts Internet content via the radio spectrum allocated to paging services, to a receiver connected to a user's PC. Intercast plans similar services using spectrum allocated for television broadcasting. Since services using traditional broadcasting platforms (terrestrial and satellite), such as Intercast, broadcast content to users in one direction they employ Internet connections via the PSTN to enable users to request content. A variation under this category is a service such as Web-tv which uses a set-top box to enable Internet content received via the PSTN to be displayed on a television. In addition other services, such as 'Audible', are using the Internet for the original content delivery and then transmitting to other devices for playback (e.g. stereo, car radio).

The **seventh** category, information services providing programme guides to audio and video webcasts may not in itself be webcasting. However it is an important element in webcasting. Just as television and radio guides provide programme information and schedules these services provide the same thing for webcasting. While these services are provided separately at the moment services such as 'Net Channel' aim to bundle electronic programme guides as part of their Internet service. Like webcasting itself this area is subject to tremendous innovation and is in the process of creating new types of programme guides. CNN, for example, uses the 'Magnifi' search engine technology to organise more than 120 000 news clips which enables users to search for sound and video content.[27]

Table 4. Selected Webcasting Services

Service Name	Description	URL
1st Category: Providers of digital libraries of audio-visual content as on demand services		
CNN	Library of news story video clips.	www.cnn.com/video_vault/index.html
East-West Sounds Online	Provides a commercial library of CD and CD-Rom sounds.	www.soundsonline.com
First-tv	Site enabled with streaming media to webcast 'video' and news content on demand.	www.first-tv.com
Fox News	Provides 'video' clips of news stories.	www.foxnews.com
Global Music Outlet	GMO sells songs for US$0.99. Users can sample and download songs directly from their site.	www.GlobalMusic.com
Internet Television Network	Library of video clips updated daily.	intv.net
Medianet	Telecom Finland's webcast site including on-demand and live audio and video.	www.medianet.tele.fi
Sound Dogs	Provides a commercial on-line library of sound effects.	www.sounddogs.com
World Radio Network	WRN carries live newscast audio streams in RealAudio and StreamWorks 24 hours a day from 25 of the world's leading public and international broadcasters.	www.wrn.org
2nd Category: Webcasters of 'live' events using audio-visual content		
Audionet	Live radio webcasts and audio archives available on demand (including audio books & CDs)	www.audionet.com
itv.net	Provides webcast ('video') coverage of events (e.g. Irish Elections, Eurovision Song Contest).	www.itv.net
Liveconcerts	Live webcasts of concerts using real-audio.	www.liveconcerts.com
3rd Category: Webcasters of live events using text based services.		
the Age	Australian newspaper service that provides 'live' text based coverage of sporting events.	www.theage.com.au
4th Category: Providers of subscription based information services (so called push/pull services)		
Backweb	Users sign up to information channels that are automatically downloaded.	www.backweb.com
Desktop News	Desktop News delivers a customized news feed direct to a user in the form of an 'intelligent ticker'. Users establish specific areas of interest and Desktop News continually seeks out and delivers custom content utilizing personal News Agent software.	www.desktopnews.com
Headliner	Lanacom 'Headliner' is an online push client application that delivers and manages information from the WWW. 'Professional Headliner' enables the creation of content channels.	www.lanacom.com

Table 4. Selected Webcasting Services (cont'd)

Service Name	Description	URL
Intermind	Users sign up to information channels that are automatically downloaded.	www.intermind.com
Marimba	'Castanet' automatically distributes and maintains software applications and content within a company or across the Internet. 'Bongo' software enables users to create Castanet channels.	www.marimba.com
Microsoft	Incorporating 'push and pull technologies' into browsers.	www.microsoft.com
Netscape	Incorporating 'push and pull technologies' into browsers.	www.netcape.com
Pointcast	Provides webcast information service to subscribers.	www.pointcast.com
5th Category: Push and Pull services using 'intelligent agents'		
Amulet	InfoWizard uses intelligent agents to compile a report on IT subjects from various sources.	www.amulet.com
Autonomy	Intelligent agent software enabling off-line research, news compilation etc.	www.agentware.com
Farcast	Information service that utilises e-mail to send news to subscribers. In addition to breaking news users can employ up to 15 intelligent agents to search for specific items of interest.	www.farcast.com
Internet Financial Network	Delivers summaries of filing to the US SEC's Edgar Database using push/pull technology. User's can signal interest in a particular company, industry or type of document and the information is 'pushed' to them.	www.ifn.com
Netbot	Jango software is an intelligent agent for comparing prices over the Internet, that uses parallel pull technology to bring information from 20, 30 or more sites.	www.netbot.com
6th Category: Providers of information services using multiple delivery platforms		
Airmedia	Information service using a wireless connection that provides an ongoing stream of data to a user's computer terminal.	www.airmedia.com
Audio Highway	Listen Up Player downloads 1 hour of web audio. Trials planned for September 1997 with an advertiser supported model.	www.audiohwy.com
Audible	The AudiblePlayer enables users to download 2.5 hours of spoken audio -- either from the AudibleWords Library (pay per download) or free from the WWW -- and play it back remotely through the AudiblePlayer's own headphones or through any nearby stereo tuner or radio (including car radio).	www.audiblewords.com

Table 4. Selected Webcasting Services (cont'd)

Service Name	Description	URL
Cellular Vision	CVDN 500 is a high speed Internet access service provided by CellularVision NY. CVDN 500 provides data from the Internet to a computer at 500kps (this is about four times faster than ISDN service and almost 20 times faster than a 28.8kps modem). Backchannel provided via PSTN Internet connection. Service available now in some parts of New York.	http://www.cellularvision.com/
Fantastic Corp.	See Table 3. Porposes to deliver high speed services over satellite (or other) with backchannel provided via PSTN Internet connection. Plans to offer Media Channels which can be combined into Channel Packages, in much the same way that TV channels can be combined into bouquets. Plans European services for business in 1997 and consumers in 1998.	www.fantastic.ch/
Intercast	Industry group promoting a technology that enables equipped PCs to receive content simultaneous with television broadcasts.	www.intercast.org
WavePhore, Inc.	Data broadcaster which has announced an agreement to create a branded channel that will allow home PC users to receive free access to Time's Internet content via the Vertical Blanking Interval (VBI) of the TV broadcast signal. To receive the WaveTop service, users will need to obtain the free WaveTop software and use a computer with a TV tuner.	www.wavephore.com
Web-TV	Set-top box for TV, and subscription based Internet service via PSTN, enables users to receive Internet content (including real-audio and CD song library).	webtv.net
7th Category: Information services providing programme guides to push, audio and video webcasts		
Magnifi	Magnifi enables the automatic construction of indexes for content and allows users to search for any type of media, including text, image, sound, video, animation and virtual reality.	www.magnifi.com
Net Channel	Start-up company aiming to provide Internet-TV interface (including electronic guides for TV and Internet). Uses set-top boxes (similar concept to Web-tv) and suitably equipped TVs and PSTN.	www.netchannel.net
Phlip.net	Channel guide for push services.	www.phlip.net
Timecast	Internet 'electronic programme guide' for webcasts. Includes details on current audio and video webcasts as well as a schedule of future emissions.	www.timecast.com
Web Times	Guide to audio and video webcasts. Can also be received via Pointcast.	www.webtimes.com/main.html

Source: OECD.

CONTENT, CACHING AND CARRIAGE

There is a popular notion that distance is becoming a less important factor in terms of decisions made by communication infrastructure providers and users. This thought was initially fostered by the falling price of national long distance and international communication. The idea has been given greater currency by commonly used Internet pricing models that mean users often pay the same price to shift data, irrespective of source or destination. From the perspective of a user further weight is given to this proposition by the global access to webcasting. A user in Iceland can equally listen to the daily news service webcast by Radio Nepal, the Caribbean News Agency or any of the other hundreds of radio stations webcasting over the Internet.[28]

However, the Internet has also brought forth a countervailing trend in which distance is a very important factor in Internet economics and network management. Webcasting is likely to accentuate this trend to the extent that it generates large traffic increases of the same content. Due to the various capabilities of the different networks that make up the Internet, it is increasingly important for content to be brought closer to users. The main reasons include minimising transmission costs, maximising network performance and avoidance of congestion, such as at global Internet peak times or because large numbers of Internet users want to access the same topical content at the same time (so called hot spots or flash crowds).[29] The two most promising technological approaches for bringing content closer to users are by IP multicasting and large scale caching. In the process of bringing content closer to users the process may raise a number of new issues for policy makers. These issues are largely concerned with the distribution of content such as debates over international settlements in respect to carriage and the storage of content in respect to caching. Webcasting will also have implications for the current pricing of network services in many countries. First, however, it is necessary to get some indication of where the most accessed Internet and webcast content originates by mapping the most accessed content.

Mapping Content

Given the nature of the Internet there are few data available on the location of the content most accessed by users and the impact this factor might have on traffic patterns. Unlike the public switched telecommunication network (PSTN), for example, little information is available that indicates the balance of traffic between different regions and countries. Since the phasing out of the National Science Foundation backbone network, in 1995, few data have been available which attempt to dimension Internet traffic on a widespread basis. While the providers of Internet backbone networks and Internet Access Providers generally monitor the volume of traffic that pass over their networks, these data are not aggregated in a systematic way which might enable a picture of traffic patterns to be constructed.

The number of Internet hosts gives one indication of the relative development of the Internet in different countries but is subject to a number of caveats. While it is believed that the majority of hosts registered under top level domain names (TLDs such as .be for Belgium) are located in the country of registration there is not presently a public way to allocate generic TLDs (such as .com) across different

countries. While the address of a registrant for an individual generic TLD can be determined by interrogating the 'Whois?' database, these data are not published by Network Solutions, the existing generic TLD registrar, on an aggregated basis for each country. Even the availability of generic TLD registrations by country would not guarantee that all the hosts were located in that country. Nor would they indicate how much content was available via the Internet, the market it is aimed at, or how popular it was with users in that country or others. According to AltaVista, for example, in mid-1997 more than half the pages written in French are located outside of the .fr (France) domain.[30]

In the absence of indicators akin to the traditional analysis of telecommunication traffic patterns some analysts are turning to other methods. Search engines are being used to examine the source of Internet content which might be most accessed by users. Another approach is to examine the data generated by search engines (such as the most frequent search words and terms) in association with available traffic data, interviews with webmasters (as well as site log books) in an attempt to rank the most accessed WWW sites. This approach is followed by 'Web21', a company which ranks the top 100 web sites by the number of hits and links.[31] By taking the leading 100 sites, as ranked by Web21, and interrogating the 'Whois?' database it is possible to generate one indicator of the location of the most accessed content (**Table 5**). This analysis is predicated on the assumption that the location of content generally correlates with DNS registration addresses. This assumption may not be correct for many reasons (e.g. mirror sites etc.) but it does provide one publicly available basis for discussion of the implications.

The results indicate that by far the majority of the most accessed sites are in the US. This result is to be expected in that around two thirds of all Internet hosts are located in the US. However, within the US a great deal of the origination of Internet content would appear to be concentrated in the states of California and New York. In particular, California has by far the most accessed sites using webcasting technology (i.e. audio sites). California also appears to be the location of the most accessed shopping and adult sites. These categories, along with finance sites, increasingly use webcast technologies.

What, of course, is not known is a breakdown of the locations from where this content is most requested. If these sites are in great demand from users spread across the US, and beyond, then Internet backbone providers face the possibility of having to increase their carriage capacity to these destinations or to bring the most requested content closer to users. Based on the assumption that US users are primarily responsible for these rankings it is interesting to note that in the more narrow categories foreign sites, on average, make up one in five. Given the lower quality of webcast audio and video, compared with traditional media, it is fairly clear that one of the leading applications is users seeking content from locations beyond traditional broadcasting. One possible indicator of this trend is the fact that the greatest number of sites outside the US, in the categories surveyed, are for News and Sport.

While it is true that the bulk of content currently on the Internet is in English the balance appears to be changing in line with growing access to the Internet throughout the OECD area. According to Digital Equipment Corporation, the operators of the Alta Vista search engine, an estimated 25 per cent of all web content is written in languages other than English.[32] This correlates almost exactly with the number of hosts under the top level domain names for countries where English is not the first language of the majority of the population (**Table 6**). One reason for the shifting balance, as noted by the European Ministerial Conference in Bonn, is that the Internet lowers the barriers of entry for the creation and dissemination of content in different languages.[33]

In respect to web sites outside the US the two most obvious factors explaining the inclusion of sites in certain countries would appear to be low entry barriers for global dissemination to overseas communities of interest. While India and Thailand have relatively low levels of Internet access, compared

to OECD countries, they have a significant number of the most accessed News Sites (i.e. eight of the leading 100). Presumably the popularity of sites in these countries is due to expatriate communities in countries with higher levels of Internet access. However it is Canada, followed by the UK, from where the most accessed content originates from outside the US. Publication in English no doubt contributes to the accessibility of this content with many Canadian sites having the additional benefit of being published in French.

Webcasting has also opened up a new way to deliver many radio services aimed at international audiences. Services originating in OECD countries but aimed at audiences elsewhere in the OECD area and beyond increasingly use audio webcasting (**Table 7)**. A survey by the OECD reveals that in 20 Member countries the leading 'public services' aimed at international audiences are using audio webcasting. In July 1997 these services were offered in more than 20 languages. Many of these services are publicly funded. It should be noted that an even greater number of purely commercial stations are using audio webcasting. Accordingly while Table 7 aims to show leading 'public services' aimed at international audiences many commercial stations are also webcasting to this market. For example Turkey has more than 40 stations being webcast over the Internet.[34] The Timecast services lists 470 stations that webcast live and 650 that webcast radio in a far from exhaustive list.[35] Interestingly many of these services are webcast in foreign languages. Among these include, 'Apna Sangeet Radio Network Inc', an Indian radio station broadcasting in North America with music and news from around the world; 'Armenian Nor Serount Radio Internet Program', an Armenian traditional and modern music online webcaster in Sydney Australia; and 'The Vietnamese Canadian Broadcasting Group', webcasting audio content in Vietnamese from Toronto, Canada.[36]

Table 5. Location of Most Accessed WWW Sites

Location(1)	Leading Sites (2)	Live Audio	Shopping	Finance	News	Children	Sport	Adult
US	94	78	85	75	67	88	79	79
Non-US	6	20	14	25	33	12	34	21
Number of sites	100	98	99	100	100	100	113	100
Breakdown of the location of the most accessed WWW sites by US State:								
California	40	29	18	15	13	33	23	21
New York	16	8	14	17	11	8	12	6
Washington State	4	8	7	1	3	7	2	9
Texas	3	6	4	2	4	2	7	3
Massachusetts	4	5	5	5	1	2	3	2
Florida	3	2	5	3	1	0	6	7
Other US States	24	20	32	32	34	36	26	31
Breakdown of the most accessed WWW sites outside the US:								
Canada	2	4	6	6	5	7	8	10
UK	2	3	2	5	6	1	8	2
Germany		4	1	1	2		2	1
China (3)	1	2	2	2	1			1
France				2	1		3	
Japan		2		1		1		2
India					5			
Israel				1	2		2	
Korea		3	1			1		
Australia					2	1		1
Thailand					3			1
Italy			1	1			2	
Netherlands	1						2	1
Ireland			1	2				
Sweden								2
Spain							2	
Singapore					2			
Switzerland							2	
Taiwan				1	1			
South Africa				1			1	
Norway		1					1	
Indonesia					1			
Denmark						1		
Philippines					1			
Russia				1				
Mexico				1				
Luxembourg							1	
Brazil					1			
Malaysia		1						

1. Location by domain name registration.
2. This is the leading 100 websites in all categories for June 1997 (excluding adult sites and IAPs) while other categories are for July 1997. The list of sites in this category is included here as Table 15 in the Appendix.
3. China includes sites registered in Hong Kong.

Source: Web 21, Whois.

Table 6. Internet Hosts attributed to OECD Countries with English as a Primary Language

	Jul-91	Jul-92	Jul-93	Jul-94	Jul-95	Jul-96	Jul-97
Hosts in OECD countries with English as a first language (000)	476	861	1505	2474	5084	9725	14293
Hosts in OECD countries where English is not a first language (000)	91	195	384	679	1396	2719	4459
Share in OECD Hosts in countries where English is a first language	83.9	81.6	79.7	78.5	78.5	78.1	76.2
Share in OECD Hosts in countries where English is not a first language	16.1	18.4	20.3	21.5	21.5	21.9	23.8

1. As the number of hosts under certain gTLDs, registered by users outside the US, can not be determined from publicly available data, these numbers tend to over state the hosts in countries with English is a first language and understate the number in other OECD countries.

Source: OECD, Network Wizards

Table 7. Selected International Webcasting from OECD Countries

Country	Name	Audio Webcast Languages (1)	URL
Stations audio webcasting from 'home site' or the World Radio Network: http://www.wrn.org			
Australia	Radio Australia	English	www.abc.net.au/ra/
Austria	Radio Austria International	German	www.orf.at/roi/
Belgium	Radio Vlaanderen	Dutch, English	www.brtn.be/rvi/
Canada	Radio Canada International	English, French, Spanish, Arabic, Chinese, Russian, Ukranian	www.rcinet.ca/realaude.htm
Czech Republic	Radio Prague	Czech, English, German, Spanish, French.	www.radio.cz/
Denmark	Radio Denmark	Danish, English	www.dr.dk/rdk/
Finland	Radio Finland	Finnish, Swedish, English, Russian, French, German	www.yle.fi/fbc/radiofin.html
France	Radio France International	French, English, Spanish, Portuguese, Chinese	www.francelink.com/radio_stations/rfi/
Germany	Deutsche Welle	German, English	www.dmc.net
Greece	Voice of Greece	N/A (Does not appear to be audio webcasting)	http://alpha.servicenet.ariadne-t.gr/Docs/Era5_1.html
Hungary	Radio Budapest	Hungarian, English, German, Russian.	www.eunet.hu:80/radio/
Iceland	RUV	Icelandic	www.ruv.is/english/ and this.is/ruv/
Ireland	RTE	Irish, English	www.rte.ie/
Italy	RAI	N/A (Does not appear to be audio webcasting)	www.mix.it/raiinternational/

Table 7. Selected International Webcasting from OECD Countries (cont'd)

Country	Name	Audio Webcast Languages (1)	URL
Japan	Radio Japan	N/A (Does not appear to be audio webcasting)	www.nhk.or.jp/rjnet/
Korea	Radio Korea International	RKI broadcasts in 10 languages	kbsnt.kbs.co.kr/rki/rki.html
Luxembourg	CLT	N/A (Does not appear to be audio webcasting)	N/A
Mexico	Radio Mexico Internacional	N/A (Does not appear to be audio webcasting)	N/A
Netherlands	Radio Netherlands	Dutch, English, Spanish, Indonesian	www.rnw.nl/
New Zealand	Radio NZ International	N/A (Does not appear to be audio webcasting)	www.actrix.gen.nz/biz/rnzi/
Norway	Radio Norway International	N/A (Does not appear to be audio webcasting)	www.nrk.no/radionorway/
Poland	Polish Radio	Polish, English	apollo.radio.com.pl/piatka/index.html
Portugal	RDP	N/A (Does not appear to be audio webcasting)	N/A
Spain	REE	Spanish, Catalan, Galician and Basque. English, French, Arabic, Russian, German and Sephardic, as well as a daily programme for Equatorial Guinea	www.rtve.es/rtve/_rne/_radios/_ree/radioe00.htm
Sweden	Radio Sweden	Swedish, English, German, Estonian, Latvian, Russian	www.sr.se/rs/realaudi.htm
Switzerland	Swiss Radio International	English, Portuguese	www.srg-ssr.ch/SRI/
Turkey	TRT	N/A (Does not appear to be audio webcasting)	N/A
UK	BBC World Service	English	www.bbc.co.uk/worldservice/
USA	Voice of America	Multiple	www.voa.gov/

1. This category is for languages that are webcast rather than broadcast. Most of these stations broadcast many more languages (e.g. the BBC broadcasts in 45 languages) and the languages listed are only those webcast.

Source: OECD

Caching Content

The most accessed content on the Internet appears to be highly concentrated and this may lead to local access congestion. In as much as this problem may be accentuated by webcasting, the question arises of how to minimise congestion. In other words, prior to the widespread deployment of IP multicasting, how can network operators minimise transmitting the same content over and over again. Several technologies are being used to bring content closer to users such as mirror sites and network caches.[37] Mirror site is the term given to the establishment of servers with similar content in different

parts of the world. Mirror sites are generally established by service providers facing the greatest demand in terms of accesses on their world wide web site. For example Digital Equipment's 'Altavista Search Engine' has mirror sites in Australia and Sweden, respectively hosted by Telstra and Telia. While mirror sites sometimes contain additional content or capabilities, such as additional languages or country specific applications, the main advantage is their ability to bring services nearer to users. For example, France's annual 'Fete de la Musique', which was webcast using VDOLive's streaming media software, had sites mirrored between France and the US.[38]

Caching has a broadly similar goal to the establishment of mirror sites, in bringing content closer to users, but there are significant differences. Caching involves the replication and storing of data by users or network providers rather than 'original content providers', as in the case of mirror sites. Caching can occur at various levels commencing with a user of an Internet browser caching requested material on their PC and progressing through to caches operated as part of local area networks (LAN). At higher levels commercial caching is also undertaken by Internet Access Providers (IAPs) and increasingly network operators. Caching at the level of a user with a PC is sometimes referred to as 'client caching' while caching by a LAN operator or IAP is referred to as 'proxy caching'.

The main feature of client caching is that it enables an Internet browser to retrieve data from a PC's hard drive rather than having to retrieve data from a distant site. The aim of proxy caching is broadly similar with one important difference. Proxy caching, by a LAN operator or IAP, enables users requesting the same data to retrieve it from a site that is generally located nearer to them than to the source of the material. In other words if a user in France requested data from a site in Japan these data could be cached by the French user's IAP. These same data can then be retrieved, by other customers of that IAP, from that operator's cache in France rather than the originating site in Japan (**Box 1**).

The benefits of caching are readily apparent for users as well as IAPs and other network operators. From the perspective of a user caching has the potential to enable a faster response time from when data are requested and to when it is received on their terminal. Apart from offering a speedier service to their customers, often identified as a barrier to electronic commerce on the Internet, caching has tremendous potential to reduce the costs of IAPs leasing capacity from PTOs. This is because much data requested by users over the world wide web is repetitive. For the same reason, caching benefits IAPs through the potential to reduce transit or 'interconnect' payments, in the absence of peering arrangements, to other IAPs.

From the perspective of content providers caching may be seen as a mixed blessing. While it is of advantage to content providers if users gain more efficient access to their material on the world wide web, caching raises a number of complex issues in relation to intellectual property rights (IPR) and certain models of financing content production. These issues are taken up in the following sections devoted to the 'infrastructure benefits' and the IPR questions they pose. The process of convergence between different communication platforms in providing Internet services is going to make these issues even more complex. Indeed much of the potential enabled by utilising new infrastructures for the delivery of Internet services, such as via cable or satellite, and their pricing very much rely on caching. Moreover the delivery of multi-media like services via streaming media is going to initially demand far greater caching if widely used. IP multicasting may alleviate some of this demand but it will take some time to implement this technology. These factors are likely to generate new IPR issues, or reconsideration of existing issues from new perspectives, as caching takes place on a far larger scale and more commercial basis. The potential benefits and drawbacks of caching have been well summarised by Lisa Sanger (refer **Table 8**).

Table 8. Caching's Potential Benefits and Drawbacks for Electronic Commerce

Potential Benefits	Potential Drawbacks
1) caching expedites user access time	1) caching inhibits websites' ability to calculate hits and page impressions
2) caching decreases the amount of bandwidth each user uses	2) caching may result in promulgation of stale documents
3) caching decreases bandwidth used on the Internet generally	3) caching may constitute copyright infringement
4) caching decreases bandwidth used on network servers	
5) caching decreases bandwidth used on remote servers	

Source: Lisa Sanger: "Caching on the Internet", http://seamless.com/eric/cache.html

Box 1: **Frequently Asked Questions on Caches**
(Source: Mirror Image http://www.mirror-image.com/FAQ.htm)

What is caching?

Caching is used by Internet service providers and network administrators to avoid the delays of Internet bottlenecks and to save valuable bandwidth. Caching means copying files from the Internet traffic to a memory more close to the users than the original site. The next time an already copied file is requested, the copy is delivered directly from this nearby cache memory.

What is mirroring?

Mirroring is used by content providers to give better distribution to their sites, enhancing the user's possibilities to access that site fast and trouble-free. It is a publisher-driven act of storing copies of Internet files locally. Mirroring means copying a whole or parts of a web site to a mirror server, positioned closer to a group of users.

Don't ISPs and consumers already utilize caching techniques?

Many ISPs and LAN operators are using (proxy-) caching for the reasons of better economy and net performance. These efforts are however often crippled by the lack of scale. To really make a difference to both the ISP and it's customers, a cache has to be of a substantial size. Today caches very seldom are, due to: 1. The difficulty of getting the normal Internet user to configure his browser correctly, typically resulting in less than 25 per cent using the cache. 2. The use of unsophisticated methods for reducing the risk of obsolete data. 3. The end user base of each cache being too small to capture a large enough portion of the ever expanding Web.

What is the Mirror Image differentiator?

The number one Mirror Image differentiator is the intelligent Interceptor at the ISPs premises, delivering high-hit-rate caching benefits for 100 per cent of the ISPs customers from day one. Without any connected user needing to do anything - but surf. Mirror Image is also unique in offering a total caching and mirroring service to many ISPs, each benefiting from the size of the joint large cache at the Mirror Image Terabyte Server. This service replaces, or delays, expensive and risky investments in extra transmission capacity with a monthly fee at a fraction of the instantly produced savings. Mirror Image cache hit rates thus average as high as 75 per cent, twice the yield of ordinary proxy caching.

Why is the size of the cache so important?

Size is what makes a cache useful -- the more users that are connected to a cache, the more use the cache produces to each individual user (and ISP). The probability that you will find a cached copy of what you are requesting is higher when there are more users and more traffic going through your cache. Size is also what makes costs for validating and refreshing a cache from stale data affordable, as costs are split on more hands. Thus, caching at its prime should be performed by third party suppliers such as Mirror Image, delivering the caching service to as many ISPs as possible. To get all of an ISPs traffic into the caching system, caching should be performed automatically to the end user, connecting 100 per cent of an ISP's customers to the cache from day one. This is only possible with the Interceptor.

How does an Interceptor differ from a proxy server?

Both perform essentially the same task, they cache web files. The proxy server requires the end user to specify a proxy setting in his browser. The Interceptor does not. The Interceptor is therefore called a transparent cache, meaning that the end user does not see it, or is not even aware of its existence. The great benefit of this is that all of the ISPs customers will benefit from the Interceptors caching service. For a traditional proxy software, the need to involve end users in setting their browsers correctly seldom results in more than 25 per cent of the users being connected over time.

Transmission Costs and Caching

The rapid growth in access to the Internet, and the growing use of webcasting technologies, is generating very large traffic growth. While there are no longer global statistics available, individual telecommunication carriers are reporting large increases in the amount of capacity they are making available for Internet and concomitant traffic growth. In the US MCI has reported traffic growth on the order of 15 per cent per month, compounded monthly, in its domestic Internet backbone network.[39] In Japan KDD has stated that the trans-Pacific circuit capacity allocated to Internet grew from 80 Mbit/s to 536 Mbit/s in the twelve month period ending March 1997.[40] Telstra's Internet capacity requirement to the US has grown ten-fold in the past 18 months, and along with much of the rest of the world, is now growing at 10 per cent per month, or trebling each year.[41] Some studies now put the rate of growth of construction of international network capacity for the Internet at three times that for voice traffic.[42]

Traffic growth on such an unprecedented scale represents opportunities and challenges for telecommunication carriers. On the one hand increased demand from IAPs for domestic and international leased lines is a growing source of revenue. In the US one commentator has reported that T1 (1.5 Mbit/s) leased line take up is currently growing by 40 per cent per annum.[43] On the other hand the extremely rapid nature of the growth raises technological challenges for carriers to meet demand. In addition the payment models for infrastructure costs between carriers, specifically international infrastructure costs, have evolved along different lines from the public switch telecommunication networks (PSTN).

Whereas carriers share the costs of international half circuit for PSTN services, current Internet practices mean that one carrier or IAP may be meeting the full cost of an international circuit (**Box 2**). While these carriers or IAPs are not losing money the current system raises their costs which must be passed on to their customers. In other words it is in the interest of IAPs (and most PTOs are now offering Internet services to the public) to bring the most requested content from international sites to national locations. One method is the creation of mirror sites but while these site are aimed at giving users a better service they may also generate incoming requests from foreign users.[44] Ironically mirror sites may generate more international traffic as users try to gain benefits in terms of faster response time by accessing offshore sites. Another strategy, following the MCI example on its US Internet backbone network, is to deploy IP multicasting on international routes for the most accessed content.

While having a number of goals, caching by LAN operators and IAPs of popular material is unambiguous in trying to reduce transmission costs. In 1997 caching is moving from being undertaken on a relatively small scale to the establishment of major commercial caches. Accordingly little data are available on the national or international impact of caching on traffic flows. Several studies have been undertaken by academic researchers. At the University of Troms initial experiments showed that a cache of 500 MB could absorb up to 30 per cent of information requests from a population of 1500 users and significantly reduce network costs.[45] Similarly, in the UK, simulations based on the log files collected at HENSA Unix show us that an institution, even with only a relatively small cache, 500 MB of disk, can reduce the load placed on the national facility by as much as 40 per cent.[46]

Mirror Image Inc., a company based in Stockholm, has launched a product to cache data on a widespread scale (Refer Box 1).[47] Mirror Image aims to provide intelligent techniques and services for distributed storage of data on the Internet. The company supplies a service on a monthly basis, with a modular cost structure that varies with the size of the IAP. An Interceptor Web cache with file verification (giving about 50% yield of Web traffic) is priced at US$2 500 per month per 1 000 modems (circa 10 000 end users). In other words an IAP with 3 000 modems and/or 30 000 end users pays US$7 500 per month and requires three Interceptors for the service. Mirror Image also runs an Exchange Point Cache, the charges for which work out at less than US$10 per GByte used. According to Mirror Image

the company typically expects to save IAPs at least 60 per cent and probably 80 per cent on their bandwidth costs, as the full service will yield around 75 per cent of current Web traffic needs from their service. By way of example the OECD has constructed the hypothetical case in **Table 9** using leased line charges and Mirror Image prices. While this is somewhat simplistic, in that it only considers two elements of cost, the magnitude of savings indicates that caching could be a significant factor in reducing bandwidth costs for IAPs.

Table 9. Cache and Capacity Costs (UK Domestic and UK-US International)

	Interceptor 1.0		Interceptor + File verif.	
Price per month (US$)	1500		2500	
Capacity Saving (Mbit/s)	1.0		1.5	
Price per 2 Mbit/s Saved (US$)	3000		3333	
Cost of leased line	Half Circuit	Both Ends	Half Circuit	Both Ends
National 2 Mbit/s (US$)	6246	12492	6246	12492
Estimated Saving (%)	52	76	47	73
International 2 Mbit/s (US$)	33249	66498	33249	66498
Estimated Saving (%)	91	95	90	95
Mixture (Assuming 75% domestic and 25% international traffic split, US$)	12997	25997	12997	25994
Estimated Saving (%)	77	88	74	87

1. Additional storage is assumed to be zero for the two options shown. Should the additional storage needed exceed Interceptor capacity then the Exchange Point cache price would be in the order of US$10 per 1 Gbyte. (Source: Mirror Image)
2. National circuits are for 2 Mbit/s at 250 kilometres and International for 2 Mbit/s between UK and US (Source: Tarifica, March 1997. Prices are based on a one year contract).

Source: OECD

Box 2: **Peering, settlements and caching**

The Internet has emerged from a US military and academic network into a public network with connections in all OECD countries. According to the National Science Foundation (NSF), network managers outside the US wanted to be connected to the NSF backbone network for two reasons. The first reason was that the US was the location of 'so many of the Internet resources' and initial Internet infrastructure.[48] The second reason was the pricing on international circuits. According to the NSF's Steve Goldstein, the earlier introduction of competition in the US made that country's international links much less expensive than most other countries. This meant that network managers had an incentive to connect to the NSF backbone network rather than directly to another country.

Traditionally IAPs have exchanged traffic between themselves using a different model to PTOs. Whereas a system of settlements, sometimes know as the accounting rate system, developed for PSTN traffic, large IAPs have exchanged traffic under a system known as 'peering'. While other methods of interconnection payment exist amongst IAPs, peering still accounts for the bulk of traffic exchange. In effect this means that individual IAPs generally pay the full cost of the circuits connecting their networks to the points of peering exchange. This has led to some discontent amongst some IAPs outside the US, because unlike half circuit pricing, they are paying the full cost of connection to the US without a contribution from users at the US end.[49] Both KDD of Japan and Telstra from Australia have argued that the costs of infrastructure should be met jointly. KDD says that in Asia many carriers share the cost between themselves.

On the other hand the available evidence indicates the most accessed international content originates in the US (e.g. Table 5). This tends to lend weight to the argument that those making most use of the international links to content should pay the bulk of the cost. Telstra estimates the flow is in the order of 70:30 U.S.-to-Australia versus Australia-to-U.S, but it is not clear whether this includes traffic that transits through the US. However, Australia probably has a greater number of the most accessed sites than many other countries (refer Table 5). For example, in July 1997, one children's site in Australia was said to be the eighth most accessed on the Internet in that category.[50] Nevertheless as the growth of Internet traffic continues the current system for payment of international links, or the introduction of interconnection rates based on usage between non-peering IAPs, is going to create incentives for IAPs to act in certain ways. First, the creation of attractive content at the national level or IAP level would place IAPs in a stronger position to negotiate joint sharing of infrastructure costs. Second, there is a growing incentive to use caching technologies at a national or IAP level to reduce the amount of international and national bandwidth required and therefore produce a lower cost. Third is for IAPs, that are not presently PTOs, to examine construction of their own infrastructure. According to one example given in *Communications Week International* owning cable infrastructure is considerably less expensive than leasing capacity.[51] According to one commentator, leasing a 2-Mbps circuit between the U.S. mainland and Australia from two PTOs would typically cost US$98 000 a month. A 2-Mbps link, known as a Minimum Investment Unit (MIU), for the same route would cost only $12 638 per month -- an 87 per cent discount.[52] Fourth could be the deployment of IP multicasting on an international basis for the most access audio and video content.

Network Performance, Caching and Carriage Pricing

Saving on bandwidth costs are not the only reason that IAPs cache content. The growing array of local access technologies, aimed at increasing the speed at which users can access the public Internet, are all limited by one factor. It is an axiom of the Internet that performance is only as good as the 'best effort' capability of any part of the network. If a user requests data from another site on the Internet the rate at which that data can be transported depends on the capabilities of every link between the user's site and the source of the requested content.

For a network infrastructure provider, wanting to increase the responsiveness of the Internet for users, this leads to several possible strategies. First an infrastructure provider can increase available backbone capacity through network expansion and allocate sufficient bandwidth to give some guarantee of levels of service quality. This is essentially what IAPs do when they create Intranets, the private network equivalent of the public Internet, or price consumer dial-up services at a different rate in return for initiatives aimed at higher performance. Second an infrastructure provider can aim to bypass existing bandwidth bottlenecks by using alternative network platforms or upgrading existing local access technologies. The obvious problem, given the nature of the public Internet, is that the effectiveness of these initiatives will count for little if the content most demanded by users relies on 'best effort' links that underperform 'best capability' links. The corollary for IAPs is to bring content closer to users so that, to the maximum extent possible, content is only transported over best capability links.

Once content is cached the full potential benefits of new access technologies, such as cable modems, can be captured. These advantages are well illustrated in comparisons of the time its takes to download amounts of data from a cache to a consumer at different speeds (**Table 10**). For example the potential difference in the time it takes to download 32 Mbytes ranges from one and a half minutes using a cable modem to two and half hours using a 28.8 kbit/s modem. However the performance of the cable modem would in most cases not be sustained at best capability levels if the content was not available on a local cache.

Due to the fact that network providers are pricing Internet access via cable modems at a premium, based on improved service capability, it is imperative that they cache the most popularly requested content. The higher bandwidth and router demands resulting from webcasting will multiply the tension between best effort and best capability network components and the need for caching. If service providers want to sustain best capability performance levels and price for that service then popular 'webcast content' will need to be locally cached or housed on mirror sites connected to the same network provider's local server.

Examples of the initial pricing of high speed access via alternative infrastructure are given in **Table 11** and **Table 12**. In the US the pricing of cable services such as @Home or wireless access via 'CellularVision' are priced to be competitive with PSTN access plus an additional charge for the benefit of a high speed connection. At US$40 to US$45, @Home pricing is about US$10 more expensive than a combined IAP charge and PSTN line rental with unmeasured local call rates. CellularVision's pricing for its wireless Internet access is similarly priced for residential users (as it includes the IAP charge via the PSTN). Both these services are operating in markets where other IAP pricing is generally at a flat rate for unlimited service in the US. By way of contrast Telstra's cable modem pricing is usage sensitive. A user of Telstra's cable modem service can leave the system permanently connected to the Internet but pays a

measured rate for sending or receiving content beyond an initial amount included in the fixed price. Telstra, while itself providing flat rate PSTN local calls, operates in an environment where the majority of IAPs, including itself, have measured pricing.

It will be interesting to follow the relative success of these pricing models with consumers as some webcasting services, and their pricing, clearly entail users having different usage patterns. With @Home's or CellularVision's service a user wanting to listen to a radio station webcast on the Internet could stay tuned in for an unlimited time without incurring an additional cost.

For the Telstra cable customer, 100 Mbytes per month would enable them to stay tuned for a maximum 7 hours 43 minutes to a radio station being webcast at 28.8 kbit/s before they incurred additional charges.[53] This, of course, assumes they only used their cable service for this single application.[54] In other words a Telstra user, in this example, could listen to the webcast radio station for around 15 minutes per day per month before incurring additional charges. When it is considered that a user will probably want a mixture of multi-media services Telstra's pricing would clearly influence their usage patterns in ways that are different to accessing radio via traditional communication mediums.

Another example of this might be a user wanting to download audio content over the Internet. For example a user downloading a CD quality audio file (MP3), for a five minute song for playback needs to download 5 MBytes.[55] In other words, at this quality a user could download 20 such songs per month before they incurred additional charges using Telstra's service. After the first 20 songs each additional 5 MByte song would cost US$1.30. The transport of an additional 10 songs would cost US$13.00. This raises the question of how the price of this transport compares with other forms of delivery despite the difference in delivery time. The US based Music Boulevard ships compact discs to all OECD countries by airmail or DHL Express at the rates listed in **Table 13**. At the prices listed it would less expensive for the Australian consumer to have an order of three compact discs delivered by air-mail, or DHL, than downloading the same content via Telstra's cable modem service. By way of contrast a US user could download the same content from an Australian site, using the @Home service, without any additional transport charges over and above their monthly rate.

As electronic commerce grows it will be interesting to observe how the different pricing structures for local access infrastructure impact on international traffic patterns and trade. The different pricing structures for local calls are already having a large impact on the cost of using the PSTN in different ways throughout the OECD area. A dial-up Internet user in Austria would pay six times as much as an equivalent user in Canada to listen or view 20 hours of webcast content per month.[56] New access infrastructures, such as terrestrial wireless or satellite delivery, promise to bypass the PSTN and introduce pricing practices more appropriate for streaming audio and video over the Internet. However it will take some time before most users have a choice of access infrastructure and some options will continue to use the PSTN to provide a back-link.

Table 10. Download Speed Comparison (Telstra Cache to Customer)

File Size	28.8kbit/s	56kbit/s	64kbit/s	Cable Modem(1)
150kbytes	42 seconds	21 seconds	19 seconds	0.42 seconds
8Mbytes	42 minutes	19 minutes	17 minutes	22 seconds
32Mbytes	2 hours 28 minutes	1 hour 16 minutes	1 hour 6 minutes	1 minute 28 seconds

1. Assumes data is cached on local Telstra server.

Source: Telstra

Table 11. Telstra and @Home Cable Internet Pricing, May 1997

	Telstra	@Home
Monthly fee	US$48 per month (100 Mbytes per month included)	US$39.95 - $44.95 (Unlimited access included in monthly fee)
Additional Usage Charges	US$0.26 per Mbyte (Applies to data transfer over and above 100 Mbytes per month)	US$0.00
Installation/Connection Fee	US$22	US$150
Cable Modem	US$450	Included in monthly rental

Source: Telstra and @Home

Table 12. Cellular Vision Internet Access Pricing

	Business	Residential
Monthly fee	US$79.95	$49.95
Additional Usage Charges	0.00	0.00
Installation/Connection Fee	US$229	$199
PC Modem and local telephone calls, for backchannel, where prices for usage exist.	Variable	Variable

Source: Cellular Vision

Table 13. Music Boulevard Charges for Shipping Compact Discs (US$)

US to:	US Air Mail (7 to 10 days)						DHL Worlwide Express (2 to 4 days)	
	First three items:		Additional items:				First three items:	Additional items:
Canada	2.99		0.50				17.99	2.00
Mexico	8.99		1.75				20.99	2.25
OECD Europe	6.99		1.50				20.99	2.25
OECD Asia/Pacific	8.99		1.75				20.99	2.25
	US Mail (Number of items)						FedEx (1 to 8 items)	
	1st	2nd	3rd	4th	5th	6th	2Days	OverNight
US (1)	2.49	2.98	3.47	3.96	4.45	4.94	4.94	6.99

1. In July 1997 Music Boulevard was offering free delivery within the US.

Source: Music Boulevard: http://mb1.musicblvd.com/

POLICY DISCUSSION ITEMS

Convergence and Interconnection

To date most policy discussions on interconnection have focused on the linking of telecommunication networks owned by different PTOs. In the majority of cases these networks provided the same types of telecommunication services even when this involved different transmission technologies (e.g. satellite, fibre optic cable, microwave radio). In other words interconnection ensured that the customer of one network provider could communicate with the customer of another (e.g. telephone). Until relatively recently interconnection between networks offering different types of services was not common in OECD countries because most infrastructure and services were reserved for monopoly PTOs. Following the liberalisation of these markets, and the rapid expansion of services such as Internet access, cross platform interconnection issues are becoming more commonly debated.

Earlier liberalisation in some countries brought these issues to the fore sooner than other OECD countries. In 1983, one early initiative was the decision by the US courts that the local exchange carriers would provide equal access to all inter-exchange carriers and information service providers after the divestiture of AT&T. Today new issues are emerging in relation to interconnection between the providers of different types of services to end users. For the Internet this issue has first emerged in relation to the different usage patterns than for traditional telecommunication services (e.g. telephony, fax). Simply put, dial-up users of Internet services stay on-line for much longer periods of time per session than users of telephony services. This has led to debates over pricing and local access regulation in a growing number of OECD countries.

It is this level of the current interconnection discussions in relation to the Internet, that is the focus in this section. Parallel debates are ongoing in the Internet community in relation to interconnection between IAPs. These discussion have been less of concern to policy makers because they are occurring in a sector of the communication industry much less encumbered by regulation than for PSTNs. By way of contrast the inheritance from monopoly provision of local networks means that 99.9 per cent of PSTN customers have their local access lines provided by an incumbent PTO. It is over these lines that by far the majority of users access their IAP. Propitiously, at the beginning of 1998, more than two thirds of OECD countries will permit infrastructure competition in local PSTN access. Nevertheless it will take a number of years before a significant proportion of users can exercise a choice of network provider because of the time it takes to roll out alternative infrastructure. A number of issues arise with the desire of IAPs to interconnect. In a purely competitive environment, equally positioned firms are usually able to reach ‘unbiased’ agreement. However, if firms are asymmetrically positioned it raises the question of whether it is appropriate for governments to intervene in the open market to ‘level’ the playing field. The current trend in a growing number of countries is to allow competition to occur in telecommunication markets, but to create rules to help in the transition in telephony from monopoly suppliers to competitive suppliers by regulating interconnection.

A select number of key interconnection issues, and the respective positions of IAPs and PTOs is summarised in **Table 14**. By necessity these positions are somewhat simplified and there would be differences between different IAPs and PTOs on these issues which would vary from one OECD country to another. They are presented in this form merely to provide items for discussion in relation to webcasting developments. The **first** item, regulatory designation, has additional importance in terms of streaming media services. The question IAPs raise here is whether they need a certain designation before they can obtain certain types of interconnection arrangements for services such as Internet telephony. Some PTOs take the position that IAPs, as opposed to other telecommunication carriers, have no rights in matters such as co-location because these rights have only been conferred by regulators to designated telecommunication carriers.[57]

Under the **second** item, the question is raised whether webcasting services might lead to new patterns of use from the initial Internet applications. Little evidence is available today as to whether webcasting will lead to longer or shorter sessions but it would be more efficient if this traffic was not routed via PSTN exchanges designed primarily for telephony. In the words of the out-going chairman of the US Federal Communications Commission, Reed Hundt "We need a data network that can easily carry voice, instead what we have today is a voice network struggling to carry data.[58]" In the mean time a number of companies are developing technologies to deal with this phenomenon. For example Northern Telecom says its Internet Thruway technology allows telephone companies to move Internet users off their voice networks and onto a more optimal data network, providing fewer busy signals for subscribers, and value-added services for Internet Service Providers.[59]

The **third** item relates to what IAPs view as unfair bundling of products and services by PTOs. An example could be a PTO bundling a telecommunication and Internet service that can not be matched by IAPs without non-discriminatory access to the same service components. [60] In the US, the Commercial Internet Exchange (CIX) the largest association of Internet Access providers, has argued that Southwestern Bell proposed to bundle services in a way that would violate equal access regulation of bottleneck facilities. [61]

The **fourth** item has particular importance for some IAPs in relation to webcasting. For those IAPs that do not plan to build their own alternative access infrastructure (e.g. satellite, cable modem, terrestrial wireless) some would like to offer their own highspeed xDSL service via an unbundled copper loop. This would enable them to compete with IAPs with their own access infrastructure on more equal terms. Related to this, under the **fifth** item, IAPs would like to be able to co-locate equipment with the PSTN facilities. Apart from the familiar reasons for wanting to co-locate, such as reducing leased line costs, IAPs would be at a disadvantage to the subsidiary IAPs of PTOs if they could not co-locate in relation to the provision of xDSL. One of the requirements for feasible xDSL is that the customer be within approximately four kilometres of the IAP's facilities. Accordingly the radius of customers that can be served is reduced without physical co-location at the PTOs local exchange.[62] In other words if an IAPs facilities are located two kilometres from the PTO's local exchange the customer must be within two kilometres from that exchange. On the other hand an IAP subsidiary with co-location could serve customers within a four kilometre radius.

Under item **six**, IAPs would like greater access to so called 'dark fibre'. They believe their need for capacity will increase due to the greater use of webcasting. The **seventh** item relates to IAPs request for equal access to network information so they can plan their own service development and in some cases this relates to key facilities necessary for webcasting.

Table 14. Summary of Key Interconnection and Convergence Issues

	'Typical' IAP Perspective	'Typical' PTO Perspective
1. Regulatory Designation	IAPs say they would like the same rights as PTOs, in areas such as interconnection, but that they do not want to be designated as PTOs by regulators.	PTOs have certain obligations imposed by regulators (e.g. universal service requirements) and, some say that where others are offering 'like services' (e.g. Internet telephony) this should be taken into account by policy makers.
2. Usage Patterns	IAPs in countries with relatively high measured local charges are concerned that this acts as a barrier to on-line use. IAPs in countries with unmeasured local rates question the extent of congestion in local networks. If it does exist they contend the problem should be addressed via the introduction of new technology, revised pricing of higher speed access facilities and new interconnection arrangements between IAPs and local PTOs.	Generally the PTO's position on this issue can be split into two main groups. PTOs with measured local calls welcome users staying on-line for longer periods of time. PTOs with unmeasured or flat rate local calls have raised concerns that these pricing structures generate congestion in local networks designed for traditional usage patterns and that they do not provide appropriate investment incentives.
3. Bundling	IAPs contend that some PTOs are given to joining together services in such a way that requires a customer buying one product to purchase an additional product.	PTOs are keen to take advantage of their different product offerings to offer customers convenience and economies.
4. Unbundling	IAPs would like to purchase unbundled facilities -- such as 'raw copper' (that is end to end metallic continuity without added electronics) to supply their own xDSL services to users.	PTOs would prefer to sell products and services that they define rather than network elements defined by another party.
5. Co-location	As with new entrants to the telecommunication market, IAPs would like to co-locate facilities on the premises of PTOs. IAPs point out that if subsidiaries of PTOs can co-locate they should have an equal right.	PTOs generally prefer to commercially negotiate interconnection using leased lines. Security issues are raised by PTOs.
6. Dark Fibre	IAPs would like access to 'dark fibre' which PTOs often lay, for economic or other reasons, in advance of their own requirements. They are concerned that the IAP subsidiaries of PTOs have access to this capacity in advance of independent operators.	PTOs say they are not in the construction business and prefer to sell existing products and services (e.g. capacity via leased lines).
7. Network Information	IAPs also say they do not have the same access to network planning information as PTO subsidiaries. In some cases, they say, this information is available to other telecommunication operators. Some IAPs say they have difficulty in learning where (i.e. in which area) some unbundled services are available from PTOs.	PTOs say their network plans constitute proprietary and confidential information for their business.

Source: OECD

Caching and IPR issues

A full consideration of the IPR issues concerned with caching and copyright issues, in each Member country and internationally, goes beyond the scope of this paper which merely aims to flag the issue for policy makers.[63] The World Intellectual Property Organisation provides the best forum for discussion of these issues at the international level. By its very nature parts of the Internet and users make copies of files when they access content. Webcasting will tend to increase this trend because of the need to take bandwidth intensive traffic closer to users. Even webcast services that aim to bypass current bandwidth bottlenecks, by providing new 'local access' infrastructure (e.g. cable modem, satellite, terrestrial wireless) will still need to cache certain content to guarantee performance levels. In the short term the available evidence indicates that use of mirror sites and caching is set to continue for reasons of network efficiency, cost savings and user convenience.

Due to the fact that mirror sites are essentially publisher driven they do not raise IPR issues in the same way as might occur with large scale commercial caching by IAPs. The leading concern of the IPR owners is that they will lose control over the distribution of their content. This may in some circumstances weaken some business models for electronic commerce. For example some IPR owners place content on the world wide web and sell advertising based on the number of requests for that file. However if a cache intervenes between the source of content and users there is no way for IPR owners to know how many times their content was accessed. [64] One commentator has dubbed this the "cache-22" in that the more popular a site becomes the more likely it is to be cached but owners can not bill for what they can't record.[65]

A similar problem may arise with caching time critical information and third party 'content gateways'. At issue here is the practice of some service providers constructing web sites that merely provide links to selected content on other web sites. Some users find such services useful because, instead of scanning a number of web sites devoted to a certain subject, they can use the 'hypertext headlines' to go directly to the content of most interest. This raises the question of what would happen if a News service was cached but a 'hypertext headline' provider was not cached -- or both services were updated at the cache at different intervals. In other words could News generated by one service provider break first on the website of another.

There are of course several options open to content providers but they may not be in line with their business models. One option is to require site access to be via a password or 'cookie' recognition. Cookies are software agents that are downloaded onto a users PC and then enable webmasters to track how users navigate through their web site or to automatically supply a password for a subscription-only site.[66] The main drawback here is that this may deter some users from regularly accessing a site containing elements protected by literary and artistic property rights or that they may be blocked from convenient access by their company firewall accepting 'cookie recognition'. Another alternative is to employ so called 'cache busting' techniques either on an ongoing basis or for periods of time to sample use to extrapolate for advertising sales. One such cache busting technique for proxy servers is to code a web site to expire every hour. In other words if the proxy site believes the site has expired it will re-cache it on a more regular basis. It is not known how effective this technique is but one web master was reported to have doubled traffic after employing such a technique.[67]

Fortunately, technological developments may provide answers to these problems. First, IP multicasting may over the longer term relieve some of the traffic growth that will occur with increased use of webcasting. This may offset the need for some local caching or mirroring of content. Second the Internet Engineering Task Force has proposals for Web standards that would enable proxy caches to send reports to web sites with information on how many times files were accessed by users.[68]

In the mean time infrastructure providers would like policy makers to clarify national positions in relation to this issue. Some owners of intellectual property are concerned that increased commercial caching may undermine their business models for electronic commerce. On the other hand infrastructure providers would like governments to clarify their position in respect to technologies they view as essential for efficient network management and improving the Internet's responsiveness for electronic commerce applications. It is clearly necessary to encourage the signing, ratification and implementation of treaties at the national level and in the framework of intergovernmental organisations for economic integration, and that the specialised forums should work towards a clear definition of the relevant legal provisions owing to the importance of this question. In Geneva, on 20th December, 1996, the WIPO Diplomatic Conference on Certain Copyright and Neighbouring Rights Questions adopted two Treaties, namely the WIPO Copyright Treaty and the WIPO Performances and Phonograms Treaty.[69] Any member State of WIPO may accede to those Treaties. WIPO discussions bear on the treatment of caching and were reported on in the following terms:

> "Both Treaties include provisions which offer responses to the challenges of digital technology, particularly the Internet. They provide an exclusive right for authors, performers and producers of phonograms to authorise the making available of their works, performances and phonograms, respectively, to the public, by wire or wireless means, in such a way that members of the public may access them from a place and at a time individually chosen by them (language which covers on-demand, interactive transmissions in the Internet.) In relation to that right, and the rights of communication to the public, in general, the Conference adopted an agreed statement expressing the understanding that the mere provision of physical facilities for enabling or making a communication does not itself amount to communication. The Treaties contain provisions on obligations concerning technological measures of protection and electronic rights management information, indispensable for an efficient exercise of rights in digital environment. The Conference also discussed whether or not specific provisions are needed concerning the application of the right of reproduction concerning some temporary, transient, incidental reproductions, but did not adopt any such provisions since it considered that those issues may be appropriately handled on the basis of the existing international norms on the right of reproduction, and the possible exceptions to it, particularly under Article 9 of the Berne Convention."[70]

Some believe nothing in the WIPO treaties requires any change in the definitions of rights and exceptions under national copyright law, including in regard to caching. On the other hand one group of infrastructure providers who believe these issues clarified are the members of the Ad Hoc Copyright Coalition. This group advocated at the WIPO conference that legal liability for material on the Internet should be linked to those that create it rather than network infrastructure providers.[71] One of the concerns of this group was that the viewing of copyright material without prior permission, via for example a cached copy, could constitute an infringement. In July 1997, MCI, one of the members of the Ad Hoc Copyright Coalition released a policy document which stated:

> "... the treaties and their accompanying statements are still blemished by ambiguous language that not only creates serious legal uncertainties, but could also threaten the Internet as much as the original treaties. A loose interpretation of this language could actually make Internet and online service providers liable for every potential copyright-infringing communication on the Internet, regardless of whether they had knowledge of such violations. Even the vast number of routine, temporary copies automatically made daily to facilitate Internet transmissions could be deemed illegal .... Service providers must not be held liable for any copyright infringements when they serve as mere transmitters of copyrighted material."[72]

Broadcasting Regulation and Webcasting

The reasons given for regulating traditional broadcasting services have included scarcity of the radio spectrum, pluralism, quality and diversity, universal service, cable television pricing, consumer protection, cultural concerns and community standards. As webcasting grows to resemble traditional audio-visual services, it raises the question as to how many of these concerns are relevant to this medium. This question is raised here not to enter into a discussion of the traditional reasons for regulation of broadcasting services but to discuss their relevance to webcasting. What such a phenomenon might mean for the practicality of existing broadcasting regulation over the longer term is however a moot point worthy of further analysis. As the quality and accessibility of webcasting improves the existing regulation of traditional broadcasting will clearly face greater challenges.

Radio Spectrum

Traditionally the numbers of broadcasters (radio and television) has been highly regulated because radio spectrum was scarce (i.e. necessitating a limitation on the number of broadcasting licences) and allocation needed technical co-ordination. Currently, because webcasting predominantly uses wireline networks (largely PSTN but an increasing number of cable network offerings) it does not impact on questions of radio spectrum allocation. While some Webcasting services do make use of the radio spectrum they generally use parts of the radio spectrum that have already been allocated to service providers.[73] AirMedia's service is transmitted over wireless paging networks. Other Internet delivery technologies, such as Intercast or Eutelsat's satellite delivered Internet services plan to use spectrum already allocated for broadcasters in the same manner as teletext services. All these services rely on the PSTN to provide interactivity.

Even as digitalisation of traditional broadcasting media promises to create an unprecedented increase in the number of audio-visual channels (e.g. digital systems with 500 channels are often discussed) the Internet holds out the potential to create a virtually unlimited number of information channels. The Internet potentially shifts OECD countries to a position of abundance for new services, such as webcasting, on wireline networks in contrast to radio spectrum scarcity with traditional broadcasting media.

Pluralism

Much of the justification for regulating traditional broadcasting media has been to safeguard the existence of a variety of sources of information and opinion. The rationale for this has largely been that a high degree of ownership concentration may adversely impact on pluralism. Sometimes this was an adjunct to placing limits on the number of market players because of spectrum limitations. In other words because regulation, rather than market forces, determined the number of broadcasters, policy makers wanted to encourage pluralism among available licences. In other cases it was because policy makers aimed to foster pluralism amongst all media sectors, of which broadcasting was just one part, such as in the case of cross media ownership or 'share of voice' regulation.[74]

Webcasting over the Internet adds new sources of information and plurality. Accordingly policies should encourage webcasting as a tool to increase pluralism.

Universal Service

Traditional broadcasting regulation has sometimes imposed infrastructure requirements on licensees in terms of territorial coverage and quality of service within that area (i.e. a certain level of reception quality). Webcasting is a service that is not network specific.

In other words because webcasting uses a variety of networks it is inappropriate to think of it in the same way as traditional broadcasting media in terms of territorial coverage. In fact precisely because webcasters use existing networks the roll out of service extends to all areas of existing coverage. For example, because AirMedia uses existing paging networks service can be extended to all areas covered by existing paging networks. According to AirMedia their service, which commenced in 1996, can be potentially received by over 90 per cent of the population in the United States, with coverage in over 98.5 per cent of major metropolitan areas. Using the same logic a service such as Pointcast can be used by anyone with Internet access (e.g. Internet account, PC with modem and PSTN connection) anywhere reached by the global PSTN. To the extent that infrastructure questions could arise it would be in relation to network quality. However in these cases the issues would relate to the network infrastructure provider rather than the service provider (i.e. the webcaster). At the same time it is necessary to recognise that webcasting is an immature technology, reliant on a 'best effort' network, in which quality is often poor compared to traditional broadcast media.

Accordingly, because webcasting is not specific to any infrastructure platform, it should not be drawn into existing regulation concerning universal service in terms of broadcasting infrastructure coverage and reception quality. Rather regulatory frameworks should encourage the development of networks with improved performance.

Pricing

Regulation of traditional broadcasting media has generally not dealt with pricing. The exceptions have been in those cases where subscription prices for basic cable television service were regulated or where the annual level of fees for public broadcasters needed to be approved by policy makers. Neither case is currently applicable to a webcasting service which operates in an open and competitive marketplace. Currently webcasting services are mostly advertiser supported or still largely funded by companies willing to experiment with a new communication technology. Airmedia is one of the few webcasters with a subscription pricing model. The cost of the service is US$71.40 per annum. Excluding the cost of the consumer equipment necessary to receive the service, AirMedia is relatively inexpensive compared to the cost of a daily newspaper.[75] An annual subscription to USA Today is US$119.

The initial indications are that the traditional concerns with pricing of some 'monopoly' broadcasting infrastructures and their regulatory implications may not apply to webcasting.

Content Quality and Diversity

Governments in many OECD countries have funded public broadcasting based on the rationale that a purely commercial service, in an environment of limited available licenses, would not provide enough programme diversity to cater for all sectors of the community. For similar reasons governments have sometimes limited the number of commercial broadcasting licences, even if spectrum was available for new players, because of their assessment of the commercial viability of additional licences and their economic impact on existing licensees. In other words the argument was put that additional players would disaggregate the advertising market causing less money to be available for high quality programme production. Irrespective of the merits or otherwise of these policy approaches they do not seem very relevant to webcasting. Accordingly, there would seem to be little justification for regulating webcasting based on concerns with content quality and diversity in traditional broadcasting. As well one of the main advantages of the Internet is its ability to link communities of interest, however small, in a way traditional broadcasting could never be expected to achieve.

Cultural and Linguistic Issues

Broadcasting policy and regulation have traditionally been very much concerned with national and regional cultural and linguistic issues. This has led to many different policy approaches in OECD countries that go well beyond the scope of this report. As was recognised in the Global Information Infrastructure-Global Information Society (GII-GIS) report convergence of communication technologies raises many new issues in relation to the practicality of enforcing some traditional regulatory approaches. Regulation aimed at content production and broadcast, such as in terms of quantity or linguistic content, which can be readily monitored via traditional broadcasting media becomes almost impossible for webcasting.

In the new environment users will be free to select audio-visual content from any source on the public Internet. If this market grows to be significant, relative to traditional media, regulation may need to be adjusted. For example a radio station webcasting over the Internet may have an unfair advantage over a station using the radio spectrum, because of the different regulatory playing field, although both are delivering a ‘like service’. On the other hand there are still major differences in the delivery of both services, not least of which are the differences in the cost of users equipment (i.e. inexpensive radio versus PC with modem and appropriate software), pricing (i.e. free to air radio versus Internet access and PSTN charges for dial-up users) and quality of reception.

At the same time it is necessary to recognise the potential benefits that new technologies, such as webcasting, can provide in terms of cultural and linguistic diversity. To the extent that the Internet may enable lower production and distribution costs of cultural or linguistic material, and empower large and small communities of interest to be linked in ways not possible with traditional media, it has a very positive role to play. One alternative to applying past regulatory models to webcasting, would be for governments to encourage content production and Internet access via a dynamic and competitive environment consistent with GII-GIS recommendations.

Consumer Protection, Privacy and Community Standards

Broadcasting policy and regulation have traditionally been very much concerned with community standards and consumer protection issues. These issues are currently being discussed in relation to the Internet at a national and international level, including ongoing work at the OECD. Given the scope and subject matter of this report, and that these issues are being dealt with elsewhere, only these issues in relation to webcasting are briefly raised. Webcasting technologies, particularly the audio-visual capabilities, potentially enable illegal and harmful material to be transmitted across the Internet in ways that may be of greater concern than text or static content. To the extent that such practices contravene national laws they will be dealt with accordingly.[76]

A more complex problem facing communication policy makers is related to the traditional concerns with broadcasting legal content. For example webcasting technologies may heighten growing concern among parents in respect to children accessing content aimed at adults. Currently the producers of sexually explicit content are among the largest users of webcasting technologies, with one estimate from Forrester research projecting a market size of US$250 million within three years.[77] Past broadcasting regulatory practices, such as time of day watersheds for adult oriented material, simply don't make sense with the global Internet. As a result filtering technologies and rating systems designed for the Internet are being developed and deployed as one way to deal with this problem. One adult industry group has also proposed the use of **.xxx** instead of the more universal **.com** as an easy to block Internet domain name.[78] While most filtering technologies and ratings systems are not aimed at webcasting services they may prove just as effective because the 'streaming media' service is generally launched from a standard world wide web page.

There are several clear differences between webcasting and traditional broadcasting in relation to the potential for interactivity and the number of actors involved in the carriage of content. To date, traditional broadcasting services have been far less interactive than webcasting. At the same time many actors provide different elements of the necessary hardware and software used by this medium in contrast to traditional broadcasting. In times past regulation could more easily be applied, or complied with, at a single point of origination. On the other hand certain Internet technologies such as filtering and rating might empower parents and educators to exercise greater choice in the type of material accessed by children than other communication mediums.

Webcasting can also raise privacy issues in novel ways. This was highlighted in May 1997 when a Norwegian group, aiming to make a statement about privacy, focused a camera attached to a PC on the entrance to a brothel and webcast the results on the Internet.[79] On the other hand the same technology is being applied in ways that many would regard as being beneficial. For example some day care centres in the US are now using cameras attached to PCs to webcast images of children to parents over the Internet. One centre has cameras in all rooms, as well as the playground, allowing parents or grandparents to log in with passwords from remote sites (e.g. home, office or virtually any other location with a laptop and modem). In another example of a positive application a number of companies have begun to webcast shareholder meetings.[80]

ANNEX

Table 15 shows the most accessed Internet WWW Sites for June 1997 as ranked by Web21. An updated version of this list is maintained at www.100hot.com/ In June the Web21 methodology excluded the pages of the leading providers of network browsers. This was later changed and Netscape was the number one site in July 1997.

Table 15. Most Accessed Internet World Wide Web Sites (June 1997)

		URL	State/ Province	Country	Service Type
1	Geocities	www.geocities.com/	CA	US	Provides free web pages in themed areas and e-mail accounts to more than 600 000 users
2	Yahoo and Yahooligans, Yahoo Sports and My Yahoo	www.yahoo.com/	CA	US	Information Directory
3	Starwave Corporation - Where More People Click	www.starwave.com/	WA	US	News, Sport & Entertainment service
4	Excite, Magellan and City.Net	www.excite.com/	CA	US	Search Engine
5	PathFinder, and Time/Warner and CNN sites: Warner Bros., HBO, DC Comics, Extra TV, Babylon5, CNN, CNN Financial Network and AllPolitics	www.pathfinder.com	NY	US	Entry page for Time/Warner & CNN sites
6	AltaVista Search Engine	www.altavista.digital.com/	CA	US	Search Engine
7	Member Home Pages	members.aol.com/	Virginia	US	America On-line
8	CNET, Search.Com, News.Com and Download.com	www.cnet.com/	CA	US	Internet News & Information Service
9	The New York Times on the Web	www.nytimes.com/	NY	US	Newspaper Information Service
10	Ziff Davis and HotFiles	www3.zdnet.com/	MA	US	IT information service
11	Kasparov vs. Deep Blue	www.chess.ibm.com/	NY	US	IBM Chess Site
12	USA TODAY	www.usatoday.com/	MD	US	Newspaper Information Service

Table 15. Most Accessed Internet World Wide Web Sites (June 1997) (continued)

		URL	State/ Province	Country	Service Type
13	Macromedia	www.macromedia.com/index.html	CA	US	Software company site
14	Progressive Networks	www.real.com/	WA	US	The Home of RealAudio & RealVideo
15	Hotwired and HotBot	www.hotwired.com/	CA	US	Magazine Information Service & Search Engine
16	Sun MicroSystems and Sun's Java Site	www.sun.com/	CA	US	IT company site
17	Sony, Sony Music, Sony Interactive Entertainment, Sony Computer Entertainment	www.sony.com/	NJ	US	Sony's US site
18	Lycos Search Engine and Point	www.lycos.com/	PA	US	Search Engine
19	Disney Entertainment	www.disney.com/	CA	US	Entertainment
20	Happy Puppy and Games Domain	www.happypuppy.com/	FL	US	Games
21	CBS SportsLine - Sports News, Sports Scores, Sports Statistics, Sports Memorabilia and Fantasy Sports	www.sportsline.com/	FL	US	Sport information
22	.MTV Online	www.mtv.com/	NY	US	Entertainment
23	Windows95.com	www.windows95.com/	UT	US	Microsoft information
24	CompuServe	world.compuserve.com/	OH	US	On-line service provider
25	Kabalarians Philosophy	www.kabalarians.com/	British Columbia	Canada	Index of names
26	Net@ddress	netaddress.usa.net/	CO	US	E-mail service
27	Adbot: The Auction Market for Internet Advertising	adbot.com/	IL	US	Aggregates sites for and selss advertising
28	Hewlett Packard	hpcc920.external.hp.com/	CA	US	IT company site
29	IBM Corporation	www.ibm.com/	NY	US	IT company site
30	Imagine and their sites: TheNet, PCGamer, Ultra GamePlayers, MacAddict, Next Generation, and BootNet	www.thenet-usa.com/	CA	US	Games
31	Welcome to Intel	www.intel.com/	CA	US	IT company site
32	Day Traders Online	www.daytraders.com/	CA	US	Stockmarket service
33	The Internet Movie Database and the UK Edition	www.imdb.com/	Middlesex	UK	Motion picture information
34	Apple Computers	www.apple.com/	CA	US	IT company site
35	Amazon.com	www.amazon.com	WA	US	Book sales
36	Opening Screen	www.nasa.com/	NY	US	Live camera feeds
37	LinkExchange	www.linkexchange.com/	CA	US	Advertising network

Table 15. Most Accessed Internet World Wide Web Sites (June 1997) (continued)

		URL	State/ Province	Country	Service Type
38	United Media	www.unitedmedia.com/	NY	US	Cartoons
39	AltaVista Technology, Inc.	www.altavista.com/	CA	US	Search Engine
40	Intellicast	www.intellicast.com/	MA	US	Weather news
41	MSNBC Cover Page	www.msnbc.com	WA	US	On-line news service
42	Jumbo	www.jumbo.com/	NY	US	Site for downloading software
43	Walnut Creek CDROM	www.cdrom.com/	CA	US	CD-Rom sales
44	Adobe Systems Incorporated	www.adobe.com/	CA	US	Software company site
45	Virtual Hospital Home Page	www.vh.org/	IA	US	Medical and health site
46	Infoseek Search Engine	www.infoseek.com/	CA	US	Search engine
47	Panasonic	www.panasonic.com/	NJ	US	IT company
48	Macfee Mall and Macfee	www.mcafeemall.com/	CA	US	Software shopping site
49	NBC	www.nbc.com/	NY	US	US broadcaster
50	W3C - The World Wide Web Consortium	www.w3.org/	MA	US	Internet protocol development consortium
51	Welcome to WhoWhere?	www.whowhere.com/	CA	US	E-mail address search engine
52	U.S.Robotics	www.usr.com/	IL	US	IT company site
53	Prodigy Internet: Main Page	www.prodigy.com/	NY	US	Online service provider site
54	Hollywood Online	www.hollywood.com/	CA	US	Motion picture information
55	RocketMail - your free web-based e-mail	www.rocketmail.com/	CA	US	E-mail service
56	Official Star Wars Web Site	www.starwars.com/	CA	US	Site devoted to movie
57	Welcome to AMD	www.amd.com/	CA	US	IT company
58	WebCom	www.webcom.com/	OR	US	Web Site Host Service
59	SiliconSurf, Reality, SiliconStudios and VRML	www.sgi.com/	CA	US	Software company
60	WebChat Broadcasting System	www.wbs.net/	NY	US	Online chat site
61	Stat Trax Professional Main Page	www.stattrax.com/	CA	US	Web page usage tracking service
62	Welcome to Westwood Studios	www.westwood.com/	NV	US	Publisher of games and entertainment software
63	GameSpot	www.gamespot.com/	CA	US	Games
64	Zeus Server	adex3.flycast.com/	CA	US	High-performance Internet Server design. Refer also www.zeus.co.uk/
65	Deja News	www.dejanews.com/	TX	US	Usenet search engine
66	Welcome to GlobalCenter	www.primenet.com/	AZ	US	Web hosting/access

Table 15. Most Accessed Internet World Wide Web Sites (June 1997) (continued)

		URL	State/ Province	Country	Service Type
67	Symantec Corporation	www.symantec.com/	CA	US	Software company
68	Welcome to the Creative Zone!	www.creaf.com/	CA	US	Games and multimedia
69	CricInfo, Cricket Home Page	www.cricket.org:8004/	TX	US	Cricket information
70	100hot	www.100hot.com/	CA	US	Producers of this list
71	Gamelan	www.gamelan.com/	NY	US	Games for Java software
72	MindSpring Enterprises Inc.	www.mindspring.com/	GA	US	Web hosting/access
73	The Nando Times	www.nando.net/	NC	US	Newspaper site
74	Electronic Arts and EASports, Origin, Jane's Combat Simulations, BullFrog	www.ea.com/ and www.bullfrog.co.uk/	CA and UK	US and UK	Games
75	The Weather Channel	www.weather.com/twc/homepage.twc	GA	US	Meteorological information
76	The Broadcast Network on the Internet	www.audionet.com/	TX	US	Webcasting
77	Global Partners	www.onewebstreet.com/	MD	US	Internet business page
78	Riddler's Games	www.riddler.com/home.html	NY	US	Games.
79	Matrox Group	www.matrox.com/	Quebec	Canada	Software company
80	Cybercity HongKong	www.cybercity.hko.net/	NA	Hong Kong	Web hosting
81	The Lost World: Site B	www.lost-world.com/	CA	US	Site devoted to movie
82	Internet Count Registration	icount.com/	OR	US	Web usage tracking
83	Washington Post	www.washingtonpost.com/	VA	US	Newspaper site
84	HoTMaiL - The World's FREE Web-Based Email	www.hotmail.com/	CA	US	E-mail service
85	Webpage Home Page	www.webpage.com/	CA	US	Web hosting/on-linechat
86	LucasArts Entertainment Company	www.lucasarts.com/	CA	US	Multimedia company
87	NGS - National Geographic Online	www.nationalgeographic.com/	Washington, DC	US	Magazine site
88	Stomped	www.stomped.com/	MN	US	Games
89	TechWeb -- The Technology Super Site	www.techweb.com/	NY	US	IT information
90	Novell Networking, Novell Support and Novell Netware	www.novell.com/	UT	US	IT company
91	The STACK World Wide Web server	www.stack.nl/stackpages.html	Noord-Braband	Nether-lands	University association with miscelaneous information
92	National Hockey League Official Web Site	www.nhl.com/	NY	US	Site devoted to the sport
93	Borland Online	www.borland.com/	CA	US	IT company

Table 15. Most Accessed Internet World Wide Web Sites (June 1997) (continued)

		URL	State/ Province	Country	Service Type
94	HealthGate home page	www.healthgate.com/	MA	US	Health and Medical information
95	TV GUIDE ENTERTAINMENT NETWORK	www.tvguide.com/	PA	US	US television guide
96	Macmillan Publishing USA	www.mcp.com/	IN	US	Book Publisher
97	Motorola	www.mot.com/	IL	US	IT company
98	KoreaLink	www.korealink.com/	CA	US	Korean information
99	GamePen.Com	www.gamepen.com/	Maryland	US	Games and Game Information
100	Miss Universe L.P., LLLP	www.missuniverse.com/	CA	US	Site devoted to contest

Source: OECD, Web21, Whois.

NOTES

[1] Internet telephony developments are considered in DSTI/ICCP/TISP(97)3.

[2] The White House, "A Framework for Global Electronic Commerce', Washington, 1st July 1997. p 23.

[3] Multicasting also raises issues for network managers in terms of allocation of resources and so called 'tunnelling' leading to over redundancy. Refer T. Munzner, K. Claffy, B. Fenner and E. Hoffman, "Planet Mutlicast: visualization of the Mbone", 1996. http://www.nlanr.net/Viz/Mbone/

[4] Matthew Gledhill, "Internet Big Winner in French Vote", Associated Press, 31 May, 1997.

[5] Similar questions have been raised in other countries in relation to the status of material published on web pages prior to elections, by political parties, during so called 'cooling off periods' (e.g status relative to advertising limits immediately prior to elections).

[6] Ron Mader, "Bypassing the power structure", *Forbes*, July 1997.
http://www.forbes.com/tool/html/97/july/sphere0724/power.htm

[7] xDSL refers collectively to all types of digital subscriber lines, the two main categories being ADSL and SDSL.

[8] Progressive Networks, "Boeing Deploys Progressive Networks' RealVideo Across Corporate Intranet" Press Release, 6 May, 1997. http://www.real.com/prognet/pr/boeing.html

[9] Refer: http://www.timberandstone.com/

[10] Refer: http://www.shikokubank.co.jp/ and http://www.gesamtmetall.de/html/ausbilng/berufe.htm

[11] Niall McKay, "Progressive Networks to introduce I-commerce in Version 5.0", *InfoWorld Electric*, 1 August 1997. http://www.infoworld.com/cgi-bin/displayStory.pl?97081.wprog.htm

[12] Nuova Telespazio is part of STET / Telecom Italia. Refer Eutelsat press release announcing this service. Paris, May 29, 1997. http://www.eutelsat.org/press/release/press20.html

[13] PTOs are here defined as those entities offering switched telecommunication services to the public. In this sense the term 'public' does not indicate ownership status.

[14] Philip L. Cantelon, "The History of MCI: The Early Years 1968-1988", Hertigae Press, Dallas, 1993.

[15] Here public and private are not used to connote ownership status bit whether services are offered to the public or limited to private communities (e.g. academic, military).

[16] Europe Online reivented itself as an Internet gateway. See http://www.europeonline.com/

[17] OECD "Information Infrastructure Convergence and Pricing: The Internet", OCDE/GD(96)73, http://www.oecd.org/dsti/sti_ict.html

[18] "Use of ISPs rises dramaticaly in US overtaking on-line services", Internet IT Informer, 18 June 1997. http://www.mmp.co.uk/mmp/informer/netnews/HTM/618n1l.htm

[19] Jeff Pelline, "Time Warner to shutter ITV effort", *NewsCom*, 1 May 1997. http://www.news.com/News/Item/0,4,10264,00.html

[20] Jeremy Scott-Joynt, "NTT and KDD to Offer 'Netcasting", *TotalTele*, 18 June 1997. http://www.totaltele.com

[21] This approach may also have pitfalls that require action by network managers. Refer, Munzner, *et. al. Op.cit.*

[22] @Home, "@Home and Progressive Networks Announce First Consumer Trial of Broadband Multicast Services", Press Release, 28 July 1997. http://www.home.net/

[23] McKay, *Op.cit.*

[24] Progressive Networks, "MCI and Progressive Networks Launch First Internet Broadcast Network Designed to Reach Large-Scale Audiences", Press Release, 5 August 1997. http://www.real.com/prognet/pr/rn.html

[25] Mike Tanner, "Baseball Trying to Get Control of Netcasts", *Wired News*, 25 April 1997. http://www.wired.com/news/news/business/story/3439.html

[26] Jon Swartz, "Search is on for sounds, pictures on the Web", San Francisco Chronicle, 28 July 1997. http://www.herald.com/business/digdocs/014682.htm

[27] For other OECD work on CU-SeeMe refer OECD "Information technology Outlook 1997", Paris, 1997.

[28] http://www.catmando.com/news/radio-nepal/radionp.htm and http://www.wrn.org/stations/cana.html

[29] Refer for example the W3C statement on this issue at http://www.w3.org/pub/WWW/Propagation/Activity.html where they say, "There is an urgent need for making the Web more mature in order to scale to a number of at least 100 times the current size and robust enough for mission and life critical applications. Network hot spots (or "flash crowds") often appear in the internet when particular information has large topical interest, causing major problems both to end users (poor response) and denial of service to users of the network near the hot spot (due to the resulting congestion in nearby parts of the Internet). Efficient techniques for replication and caching is a corner stone in achieving the goals of scale and robustness as well as responsiveness; how much bandwidth a good caching and replication system could save is currently an open research question."

[30] Lois Monier, Chief Technical Officer for AltaVista, quoted in "AltaVista Serach Provides First Multilingual Search Capabilities on the Internet", Source Digital Equipment Corporation via PR Newswire, 26 June, 1997.

[31] Refer to Web21's site at: http://www.100hot.com/ for additional commentary on their methodology.

[32] Monier, Op.cit.

[33] Refer Ministerial Declaration, European Ministerial Conference, Bonn 6-8 July 1997. p 1

[34] Refer http://www.creatonic.com/tronline/ and http://www.ozemail.com.au/~ngcs and http://www.vncb.com

[35] Refer http://yahoo.timecast.com/livestations_frame.html

[36] http://www.apnasangeet.com

[37] For an excellent overview of caching see Lisa Sanger "Caching on the Internet", Spring 1996. Article available at: http://seamless.com/eric/cache.html

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[43] Charles Ferguson, "The Internet, Economic Growth and Telecommunications Policy", MIT, 14 April 1997. http://www-eecs.mit.edu:80/people/ferguson/telecom/

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[47] Mirror Image Internet was founded in Stockholm, Sweden in 1996, as a privately held company, with subsidiaries in the USA and the UK. http://www.mirror-image.com/home.html

[48] Interview with Steve Goldstein, Cook Report, January 1995. http://cookreport.com/icm.html

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[51] Camille Mendler, "Subsea cables make waves: New entrants climb on board..." CWI News Listing for Issue 186, Monday, 2 June 1997.

[52] *Ibid*., This would assume an upfront payment of US$1.3 million spread over the cable's expected 15-year lifespan - US$7 222 per month over 180 months.

[53] A customer of Telstra could use an ordinary telephone line and pay US$0.19 per call at unmeasured rates but the throughput of a 28.8 kbit/s modem is in practice not at the maximum level.

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[55] Larry Lange, "Strong Compression Making Web Pirates Happy", Tech Wire, 22 July 1997. http://192.215.107.71/wire/news/jul/0721music.html

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[60] See for example CIX filing on Southwestern Bell CEI Plan, July 1997 at http://www.cix.org/swbt.html

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[73] This does not imply policy makers will not need to look at spectrum management in terms of enabling high speed wireless Internet access. Initiatives in this field are underway in a number of countries including Canada, Korea, the UK and US. Refer, "Sheridan Nye, "UK Gives Third Generation Go-Ahead", *Total Telecom*", 1 August 1997. and Jeremy Scott-Joynt, "US Operators on the Blocks for Wireless LMDS Rollout", *Total Telecom*, 1 August 1997. http://www.totaltele.com/

[74] Share of voice concepts endeavour to calculate market share based on things such as audience reach or newspaper readership.

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[76] By way of example refer to "The Cyberspace is not a No Law Land", a report commissioned by Industry Canada at http://strategis.ic.gc.ca/SSG/it03117e_pr115.sgml

[77] Reid Kanaley, “Internet red-light districts seeing plenty of green”, The Philadelphia Inquirer, 22 June, 1997.

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[80] Suzanne Galante, “Webcast meets Wall Street”, NewsCom, 24 June, 1997. http://www.news.com/News/Item/0,4,11837,00.html?dtn.head