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Broadband Infrastructure Deployment: The Role of Government Assistance

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BROADBAND INFRASTRUCTURE DEPLOYMENT: THE ROLE OF GOVERNMENT ASSISTANCE

Atsushi Umino

Abstract

The potential economic importance of electronic commerce, and the role of broadband in supporting e-commerce, has increasingly led governments to place emphasis on facilitating access to broadband networks. To a large extent the emphasis has been on a range of policies aimed at supporting development and diffusion of high speed network capability in the local loop. Although broadband infrastructure deployment is in the process of development and the extent to which it will cover entire populations or geographic areas is still not clear, governments appear to want to accelerate the infrastructure investment.

There is a wide range of government initiatives structured in different ways and their underlying justifications are often quite different. In this context, the main concern of this paper is to examine whether these initiatives are efficient in spurring broadband deployment and to what extent governments should be involved. The paper argues that government policies should continue to emphasise the role of competition in stimulating broadband development and diffusion and should avoid direct intervention in the broadband market which risks distorting market mechanisms. Government's role should be to facilitate such developments and only intervene in areas where it has become clear that there will be no private infrastructure investment.

There is a range of other options available to governments other than direct intervention in infrastructure development. For example, policies to aggregate public demand for broadband services may help in providing sufficient incentives to the supply side. Partnerships with the private sector in cost-shared projects may be envisaged especially on the demand side. In areas where it is clearly uneconomic to provide broadband access, initiatives such as encouraging private consortia to stimulate new market entry might be appropriate. In such initiatives, care must be taken by governments not to distort market mechanisms and not to reinforce the dominant position of incumbents. It is important for governments to ensure that unnecessary regulations which may hamper market entry are removed, and to facilitate the roll-out of new infrastructure by new entrants through appropriate policies in areas such as rights of way.

DÉPLOIEMENT DE L'INFRASTRUCTURE À LARGE BANDE : LE RÔLE DE L'AIDE PUBLIQUE

Atsushi Umino

Résumé

Compte tenu du vaste potentiel économique du commerce électronique et du rôle que la large bande joue dans son développement, les pouvoirs publics s'attachent davantage à faciliter l'accès aux réseaux à large bande. L'accent est mis dans une large mesure sur le développement et la diffusion d'infrastructures haut débit dans la boucle locale. Bien que son déploiement soit toujours en cours et que l'on ignore encore dans quelle mesure elle couvrira l'ensemble de la population ou des zones géographiques, les pouvoirs publics semblent désireux d'accélérer les investissements dans l'infrastructure.

Les initiatives des pouvoirs publics sont très variées, diversement structurées, et leurs justifications sont souvent très différentes. Dans ce contexte, le présent document cherche avant tout à définir si ces initiatives parviennent réellement à accélérer le déploiement de la large bande et dans quelle mesure le gouvernement devrait intervenir. Ce document avance également l'idée que les pouvoirs publics doivent continuer à mettre l'accent sur le rôle de la concurrence en soutenant le développement et la diffusion de la large bande et doivent éviter d'intervenir directement sur ce marché, afin de ne pas en fausser le fonctionnement. Les pouvoirs publics devraient s'efforcer de faciliter de tels développements et d'intervenir seulement dans les zones où il est certain que le secteur privé ne financera pas la création d'infrastructures.

Les gouvernements disposent d'un éventail d'options en dehors d'une intervention directe dans le développement de l'infrastructure. Ainsi, le fait de regrouper la demande publique de services à large bande pourrait contribuer à stimuler suffisamment l'offre. Il est possible aussi d'envisager la création de partenariats à coûts partagés avec le secteur privé, notamment au niveau de la demande. Dans les zones où la fourniture d'accès à la large bande est incontestablement non rentable, il peut être approprié d'encourager des consortiums privés à favoriser l'arrivée de nouveaux entrants sur le marché. De telles initiatives doivent attirer l'attention des gouvernements à ne pas fausser les mécanismes du marché et à ne pas renforcer la position dominante des exploitants historiques. Il importe que les gouvernements suppriment toutes réglementations inutiles susceptibles de freiner l'arrivée de nouveaux entrants sur le marché et qu'ils facilitent le déploiement de nouvelles infrastructures par de nouveaux acteurs grâce à des politiques appropriées dans des domaines tels que l'accès aux voies publiques.

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Main points

Broadband communications provide the foundation for the development of the information society. Broadband is characterised by high speed, always-on connection and two-way capability and can support applications in e-commerce, education, health care, entertainment and e-government. Broadband is expected to have a significant impact on economic and social activities.

Despite relatively rapid growth in broadband diffusion, at present OECD countries are still in the early stages of broadband expansion. Although the availability of broadband infrastructure, in itself, will not necessarily result in the take-up of new broadband applications, the price of broadband access will play an important part, and in turn this will depend largely on infrastructure market conditions.

Market competition has played a significant role in the development of broadband infrastructure thus far, and recent policy initiatives, such as unbundling, should strengthen the role of competition in the market. Government policies should continue to emphasise the role of competition in stimulating broadband development and diffusion, and should avoid direct intervention in the broadband market which risks distorting market mechanisms.

There is concern that broadband development will be incomplete, creating a geographical digital divide, because the provision of broadband access in rural areas may not be cost effective and thus market forces may be insufficient to provide national coverage in all countries. Some have argued that this justifies proactive government involvement in infrastructure supply. However, at present levels of broadband diffusion and technological development it is difficult to identify which geographical areas would not receive broadband services via market actions. Technological developments, for example, in fixed broadband networks and satellite markets have already provided possibilities to expand the geographic reach of broadband access. The role of government should be to facilitate such developments and only intervene in areas where it has become clear that there will be no private infrastructure investment.

There is a range of other options available to governments other than direct intervention in infrastructure development. For example, policies to aggregate public demand for broadband services may help in providing sufficient incentives to the supply side. Partnerships with the private sector in cost-shared projects may be envisaged especially on the demand side. In areas where it is clearly uneconomic to provide broadband access, initiatives such as encouraging private consortia to stimulate new market entry might be appropriate. In such initiatives, care must be taken by governments not to distort market mechanisms and not to reinforce the dominant position of incumbents. It is important for governments to ensure that unnecessary regulations which may hamper market entry are removed, and to facilitate the roll-out of new infrastructure by new entrants through appropriate policies in areas such as rights of way.

Introduction

The development of an information society and electronic commerce has increased the demand for the development of broadband communication infrastructures and broadband Internet connections. The greatest differences between traditional narrow-band Internet access (*i.e.* dial-up access) and broadband Internet access are in the speed of access and the 'always-on' capability. Whereas, in many OECD countries, dial-up access was offered through a pricing structure developed for telephony (*i.e.* time-based charges), broadband Internet access is generally being priced on the basis of a fixed charge with no usage charges. Broadband technology clearly represents the beginning of a change for residential subscribers eventually allowing for high speed telecommunications that enable users to originate and receive data, graphics and video, and in the future, integrated voice services. The higher bandwidth capacity of broadband can support the delivery of numerous new applications which may be developed over the next few years. Because of the potential economic importance of electronic commerce, and the role of broadband in supporting e-commerce, governments have placed increasing emphasis on facilitating access to broadband networks. Such access is defined from the application side and the information technology side (for example providing schools with computers), but to a large extent the emphasis on access is in terms of the development and diffusion of high speed network capability in the local loop. For these reasons many OECD governments have placed emphasis on a range of policies aimed at supporting broadband development.

The development of broadband and its diffusion to residential subscribers are still in their early stages and the market is far from mature. Until recently, broadband technology had been only available to relatively large users of communication services through the use of leased lines. The advancement of xDSL (digital subscriber line) technology and the upgrading of cable television networks to support two-way communications through cable modems, and thus offer broadband connections, have been important technological developments. A recent OECD report on broadband indicated that by June 2001 there were 22 million broadband subscribers using DSL or cable modems in the OECD area (OECD, 2001*a*). Contrasting this number with the approximately 400 million mobile cellular subscribers in the OECD, the over 500 million standard subscriber lines in the OECD, and the approximately 150 million dial-up Internet subscribers, makes it evident that broadband is in the early days of diffusion.

If, as argued by many governments, the widespread availability of broadband access is important in order for citizens to participate in the information society, then there are two essential steps governments need to take. First, they need to inform the population of the benefits of broadband, its potential impacts on the quality of life and any general improvements in the standard of living. This would help to raise the level of understanding of the benefits of this technology, and promote its usage.

The second requirement is to ensure that all the necessary steps have been taken to increase competition in the telecommunication market, in particular at the level of the local loop. As previous OECD work has stressed the most fundamental policy available to OECD governments to boost broadband access is infrastructure competition (OECD, 2001*a*). Although governments (and regulators) have taken a number of steps to increase competition in the telecommunication market, which should help stimulate the expansion of broadband access, there is still scope for further initiatives. One area for policy change, for example, is to ensure that incumbent telecommunication operators divest their cable television holdings so as to ensure more facilities-based competition. Many OECD countries need to further refine policies on local loop unbundling, on co-location and on pricing for unbundled local loops. The availability of broadband services will not automatically translate into the take-up of such services, unless residential consumers view prices as affordable. Further measures to stimulate competition are the best way to ensure attractive pricing.

Broadband's lack of maturity is largely due to the fact that broadband infrastructure is still in the process of expansion in OECD countries. For example, only a few OECD countries had relatively high DSL population coverage by the end of 2001 (OECD, 2001*a*). On average in OECD countries, only two per 100 inhabitants were subscribed to high speed Internet service by mid-2001, and Korea, by far the leading country in terms of broadband penetration, had 14 subscribers per 100 inhabitants at that time. Therefore, one of the essential requirements at present for broadband's success is continuing development of access to broadband infrastructure.

Although broadband infrastructure deployment is still in the process of development and the extent to which it will cover entire populations is not yet clear, governments appear to want to accelerate the infrastructure investment. There are a number of points that they need to take into account:

- Governments need to clarify the extent to which DSL or cable modem coverage would be made available through the competitive process and clearly identify those areas which would definitely not be served in the short to medium term.

- Decisions regarding the necessity of high speed Internet access for consumers cannot be made without a clear identification of which services are necessary and cannot be accessed in the short term through dial-up Internet access.

- Depending on the data rate required, DSL services could currently be provided to subscribers within a range of 4-5 kilometres from a telecommunication exchange. Technological developments are expanding this range at given speeds and alternatives exist that offer lower speeds (which are nevertheless significantly higher than ISDN speeds).

- Alternative technologies also exist (other than DSL and cable modem) to provide high speed access, *e.g.* satellite and Wireless Local Loop.

- Acceleration in high speed Internet deployment would be undertaken at a quicker pace if markets in certain countries had more effective competition. For example, cross-ownership between the incumbent PSTN operator and CATV operators tends to reduce competitive pressure.

- In certain countries local loop access for high speed Internet may be sufficient but gaps exist in backhaul facilities.

In recent years, a number of public initiatives have been implemented to promote broadband infrastructure deployment in OECD countries. In particular, it is striking that not only central but also local governments have started to take action on broadband access. Many of these governments have targeted broadband as an essential economic tool, which can stimulate new business opportunities and enhance productivity. There is a wide range of government initiatives structured in different ways and their underlying justifications are often quite different. In this context, the main concern of this paper is to examine whether these initiatives are efficient in spurring broadband deployment and to what extent the government should be involved.

Definition of broadband

"Broadband" refers to the amount of capacity (or speed of data transfer) provided on a telecommunications network. Internet connections over a telephone line usually use a modem with a speed of 33.6 or 56 Kbps (kilobits per second). On the other hand, the broadband transmission rate is faster than 2 Mbps (megabits per second), according to ITU-T Recommendation I.113 (ITU, 1997). Previous OECD work defined broadband as providing downstream access of 256 Kbps (and upstream access of 128 Kbps) (OECD, 2001*a*) in that these are at present the most common speeds offered by DSL in OECD countries.

It is important to note, especially in the context of discussing government policies aimed at diffusing broadband technologies more rapidly, that what is regarded as "broadband" today may well be considered "narrow band" in a couple of years. On this basis, it may be better to think of broadband as a wide set of technologies that generate some minimum level of high speed bandwidth interconnection.

Benefits of broadband

Why does broadband matter? Broadband is characterised by high speed, "always on" connection and two-way capability. It is capable of supporting many applications. For example, broadband can be used to stream audio and video over the Internet at a much higher quality than narrow band. It provides a platform in which service providers have the ability to develop and deliver new content, software, and technology. Not only new applications, but also existing services, can be accessed more quickly and conveniently by virtue of broadband technologies. Faster speeds improve the overall online experience of broadband users, encouraging them to explore more applications and spend more time online (Cyberatlas, 2001a). For many, broadband has been viewed as having a significant impact on economic activity and is considered by some as being an accelerator for economic development. Although it is difficult to make an exhaustive list of broadband applications, key areas will be business and consumer e-commerce, education, health care, entertainment, and e-government.

In addition to its economic benefits, broadband may also have social implications. For example, broadband can enable subscribers to get access to content which meets their personal interests and/or obtain cultural content in their native language wherever they are. An interactive high speed connection can also be used for two-way applications such as online classrooms and health clinics, where teacher and student, or doctor and patient, can see and talk to each other through their computers.

In spite of these features, some believe that there is currently no "killer application" which can be expected to result in a surge in demand for broadband. Such an application may emerge in the future once a certain threshold in the number of customers has been attained. Nor are there applications that are viewed as essential which could therefore result in a case being made for broadband infrastructures to be included within an extended definition of universal service.

Nevertheless, the availability of a broadband infrastructure, in itself, will not necessarily result in its take-up or in the development of new applications. The price of broadband access will play an important part in stimulating its take-up, and in turn this will depend to a large extent on the conditions of competition in the infrastructure market.

E-commerce

As e-commerce is becoming an increasingly integrated part of the operation of large businesses, the most likely demand for broadband applications will be from those business users. It is expected that e-commerce will enable companies to lower costs such as procurement, production, selling and distribution, which will lead to the development of new markets and services. This process has the potential to reshape the supply chain by removing the need for intermediaries between suppliers and customers.

However, most large businesses use directly connected leased circuits for broadband applications. For small and medium-sized enterprises, technologies such as DSL and cable modems are likely to be in high demand as they represent the first opportunity these businesses have to obtain affordable, high speed and permanent connections. Broadband networks can also enable new e-commerce activities including services that are not feasible for small business over narrow-band networks, such as electronic trading communities.[1]

Education

Broadband technologies have the capabilities to enable distance learning applications, which deliver optimum real-time audio and video to the classroom. In addition to many public schools which are, or will be, connected via broadband networks, there is a growing commercial market for education services offered by private companies. Broadband can also enable online learning systems via public libraries and provide improved access to information for rural and remote areas.

Yet another use of broadband is in social education. In December 2000, for example, in collaboration with Canada's Advanced Internet Development Organisation (CANARIE), Canada's national fibre optic network, CA*net 3, linked the National Arts Centre Orchestra with a violin virtuoso and made possible a live long-distance music lesson. The benefits of broadband can be extended to the arts, and this type of usage is expected to be more and more prevalent in the future.

Health care

Broadband capabilities can be used in telemedicine applications, which require high-quality video imaging. They enable, for example, specialist doctors to provide advice to general practitioners or nurses in rural and remote areas and can be utilised for 'distant diagnosis' directly with patients. Telemedicine can potentially provide health care workers with an extensive network of specialists from whom to get support and provide patients with improved medical attention no matter where they are located.[2]

Entertainment

Entertainment is an area which may prove popular for broadband applications. For example, online games and video are often cited as potential areas for growth in broadband demand.[3]

It might be anticipated that consumers are likely to pay more for broadband connectivity when it is bundled with broadcasting services.[4] In this context, the applications with the most potential in the residential community will be non-pay TV-based video applications such as streaming video and audio services, which could be major drivers behind broadband adoption. Services such as "movie on demand" offerings by the major movie studios would be an excellent example of the next generation of technology-enabled

entertainment (Cyberatlas, 2001*a*).Most of the attention with regard to broadband entertainment has been focused on the growth of the residential market, but the large number of Internet users who have broadband at work represents another potential market for streaming audio and video providers. Radio and television broadcasters can possibly extend their brands and provide content to consumers in new ways (Cyberatlas, 2001*b*).

E-government

Broadband technology can be used to deliver government services directly to citizens, as well as business users. Such applications can reduce the costs of providing government services and can facilitate access to these services by citizens and business. Such services can range from information services, administrative documentation, renewal of a range of licences, tax submissions, etc. In geographic areas where no government offices are available such services allow for real-time dialogue with administrative officials at low cost (CIO, 2000).

Summary

Just as dial-up Internet created many new applications, such as e-mail, the broadband access environment will enable users to develop an increasing variety of applications. Simply put, as broadband infrastructure is deployed more widely, more people can access the Internet and thus there are more possibilities to create new applications. The examples of applications above show that broadband has benefits and available evidence indicates that its users will spend more time online.

Although many of the potential applications will provide user benefits, broadband is often a substitute - in most cases a much improved substitute - for an existing application. It would be difficult, however, to make a case that, in the short term, some of these services were essential. On the other hand, it is much easier to argue that broadband has the capacity to create an environment where everyone, irrespective of their geographic location, can have the same opportunities in commerce, education, health care, entertainment and government services. This, of course, would be subject to having the appropriate infrastructure throughout a country's geographic territory. In this context, broadband can help bridge some of the economic and social gaps that may exist in countries, but whether it would be the most effective way to bridge them has not been thoroughly examined.

Broadband technologies

Current technologies

Before examining the extent to which governments should be involved in infrastructure construction, it is useful to provide a brief overview of the different broadband technologies. Currently, the most common and simple way to access the Internet is a dial-up connection, which is slower than broadband services. This narrow band service has generally been charged using the local telephony charging structure, *i.e.* on the basis of time charges. Exceptions were those countries that had flat rate local calling and, over time, in a number of countries flat rate offers have been made for Internet access. Thus by August 2001 there were 11 OECD countries where dial-up customers could obtain a flat rate package for off-peak Internet usage and eight countries with a peak rate.[5] For many users, higher speed services have the advantage of being priced on the basis of flat monthly rates and of being true "always on" services.

It is very important to emphasise that broadband networks are relatively new in terms of deployment and still subject to development. The likelihood that we will see important improvement in broadband technologies in the future is very high in view of the telecommunication development process so far.

Digital Subscriber Line (DSL)

One of the most popular broadband technologies is the digital subscriber line. This technology converts standard twisted copper pair telephone lines into high speed digital lines with installation of a special modem both at the user's premises and at the network operator's switches. At the switch, digital subscriber line access multiplexers (DSLAMs) are required in order to separate the voice-frequency signals from the high speed data traffic.

A DSL uses the existing telephone line and does not require an additional one. DSL speeds vary according to the subscriber's distance from the local switching office and the degree of symmetry of the traffic flow. While this technology has a number of variations, the term "xDSL" is normally used with the acronym DSL to describe all of them.

Asymmetric Digital Subscriber Line (ADSL)

The ADSL would be the most common form of DSL service for residential and small business users as it shares a single copper wire pair with a telephone line. It is called "asymmetric" since most of its two-way bandwidth is devoted to the downstream direction, sending data to the user, whereas only a small portion of bandwidth is available for upstream or user-interaction messages. The data rate for ADSL is shown in Chart 1. This rate changes when interactive applications are being used. Unlike similar services over cable modem, ADSL will not be competing for bandwidth with other users in the service area.[6]

Chart 1. ADSL data rates as a function of wire size and distance

Data rate (Mbps)	Wire size (mm)	Distance (km)
1.5–2.0	0.5	5.5
1.5–2.0	0.4	4.6
6.1	0.5	3.7
6.1	0.4	2.7

Source: International Engineering Consortium.

G.Lite

G.Lite, also known as ADSL Lite, is a slower ADSL that does not need line-splitting at the user end but filters traffic at the telephone company's facilities. It officially provides a data rate of up to 1.5 Mbps for downstream and from 32 Kbps to 512 Kbps for upstream (ITU, 2001).

High Data Rate DSL (HDSL)

The HDSL is used within a corporate site and between the telephone company and a user. The main feature is its symmetrical bandwidth, which means that an equal amount of traffic flow is available in both upstream and downstream directions. Therefore, the maximum data rate, which is approximately 2.3 Mbps, is lower than ADSL.

IDSL

In spite of its name, the ISDN DSL (IDSL) would not be in the category of broadband technology since it is closer to ISDN data rates at 128 Kbps. This technology is also symmetrical like HDSL.

Rate-Adaptive DSL (RADSL)

The RADSL is an ADSL technology which automatically adjusts the access speed based on the condition of the line.[7]

Symmetric DSL (SDSL)

The SDSL is the same technology as HDSL with a single line, offering 1.5 Mbps (United States and Canada) or 2 Mbps (Europe) of data in each direction on a duplex line. As it cannot share the line with analogue signals, this technology is ideal for small and medium-sized companies that have an equal need to download and upload data over the Internet.

Very High Data Rate DSL (VDSL)

The VDSL is a developing technology that promises much higher data rates but with a very limited range. It will enable transmission between 51 and 55 Mbps over lines up to 300 meters in length. It is anticipated that VDSL may emerge and co-exist with ADSL after the ADSL is widely deployed and co-exist with it.[8]

DSL technologies have a number of advantages. They can provide "always-on" service, which does not require dialling up and enables simultaneous access to both the Internet and voice or fax services. In addition, since DSL uses the dedicated local loop line from the central switch to an individual customer, it is not shared with other users and therefore line performance is more stable. The greatest disadvantage at present is that DSL can extend only about five kilometres from a telephone company's switching office (Leighton, 2001). However, some analysts argue that DSL is just a bridging and short-term technology between narrow band and fibre-to-the-home (FTTH) technologies. For example, the European Commission in a recent report argues that ADSL is only a transitory technology, which will be overtaken by fibre within 10 years (EC, 2001).

Cable modem

It is possible to provide broadband service via access lines for cable television. Although traditional cable TV networks require upgrading in order to enable interactive communication such as Internet access or cable telephony, it is technically possible to use the same coaxial cable for both television and telecommunications applications by using cable modems and a switched network architecture (ITU, 2001). The advantages of this technology are, like DSL, always-on service and simultaneous access to both the Internet and cable television. Unlike DSL, the effectiveness of this technology is not limited to a five-kilometre range from switching offices. It provides an average home with an extra two-way connection, with speeds ranging from 1 Mbps to 10 Mbps. However, as cable modems use networks that link groups of nearby subscribers to an Internet connection, slower speeds may result when many users transmit data simultaneously.

Fibre optic cable

Fibre optic technology allows for transmission speeds of 10 Gbps (gigabites per second), which is much higher than DSL technologies. Fibre optic cable is currently being used in places of high density of demand, such as large volume users in the business market. Complete replacement of the existing copper-wire loop with fibre optic cable is unlikely in view of the time and cost required. Thus, fibre optic cables are usually planned to be rolled out up to the feeder point and subscribers use traditional copper wire line for the last few meters which connect that point and their home. Fibre optic cables can also be used from the local switching offices to more remote feeder points to shorten the length of the copperwire loop, which may enable DSL services.[9] If FTTH technology is provided, it will be used not only for the Internet but also for broadcasting and cable television, and in due course will enable the next generation's Internet and interactive video-telephone services. The main disadvantage of this technology is the high cost. However, according to a UK industry conference report, recent developments have reduced the cost of FTTH to little more than ADSL over copper.[10]

The capacity of fibre optics has increased significantly in the past few years. One of the leading technologies is the Dense Wave Division Multiplexing (DWDM), which carries multiple wavelength of optic-signal in a fibre. Through DWDM, an optical beam on a single fibre strand is divided into its component colours, each of which can be made to carry as much information as the original fibre. Normally, DWDM can be installed on existing fibre and its cost is a fraction of that of installing new fibre. This means that network providers can ensure that a large amount of data capacity can be made available in a relatively short time and at low cost via existing fibre optic cable.[11]

Fixed Wireless Access (FWA)

Fixed wireless access includes technologies such as Local Multipoint Distribution Services (LMDS). This technology can ideally bridge the gap between the fibre backbone and end users without last-mile bottlenecks. One disadvantage is that it may suffer from the high cost associated with new technologies. Bandwidth is shared between users so that the actual bandwidth available to them may decline when there are a large number of users online. There is a trade-off between bandwidth and distance from base stations and customers. The requirement for line-of-sight may limit usage in some areas. In Europe, LMDS have been licensed in a number of countries over the last year.

Satellite

Satellite technologies could be promising for providing broadband service. Satellites are capable of filling the gap of broadband deployment between urban and rural areas, as they have the obvious advantage of not requiring the local terrestrial communications infrastructure to be upgraded.[12] Accordingly, satellite is most likely to be used for subscriber access networks in rural and remote areas in the future. However, investment costs are high for two-way broadband satellite systems, and the market is still at very early stages of development. Another disadvantage of satellite is its susceptibility to disruption in bad weather. In addition, without a satellite transmitter to send information back, customers of this service must use a conventional copper-wire line or cable service for upstream connections.

Mobile wireless

While mobile phones had been limited to narrow-band service, the IMT-2000 (International Mobile Telecommunication 2000), or the third generation mobile (UMTS), is offering 384 Kbps of data and will enable 2 Mbps data communications when the subscriber is not moving. However, the roll-out of this

technology is slowing and given the uncertainty about the pricing structure to access multimedia content it is difficult to make predictions on the growth of this market.

Power lines

Technologies have been developed which use existing electrical power networks to deliver bandwidth of between 1-2 Mbps upstream and downstream. The widespread availability of power lines could mean that this is a potentially competitive technology. However, a number of technical problems need to be resolved before proceeding with this technology. There is presently no widespread commercial offer of residential broadband service via electricity power lines, although there have been small scale deployments in Iceland and Germany.

Future technological development

Judging from the current situation of broadband development in OECD countries, it can be anticipated that DSL and cable modems will be the primary technologies for the short term. These two technologies will provide the leading platforms for the competitive delivery of services although in most countries both are expected to have geographical limitations in terms of coverage.

However, the role that technological development may play in providing new improved services should not be underestimated. DSL, for example, surfaced very quickly as a technology, which allowed for broadband access over existing local loops. For instance, the Canadian Broadband report stressed "that we are likely to see rapid development of broadband technology, services and applications over the next few years in response to consumer demand and user requirements…."[13]

It is important to note that many observers expect multiple technologies. Although it could be that one technology will become predominant over time, it is likely that all these technologies will co-exist on the market as they meet potentially different consumer demands. Like public transportation, where different means of urban transport co-exist and compete, multiple technologies should be encouraged in view of the fact that not all technologies will be available to everyone. For instance, some rural areas will be too far from a telephone switching office to provide DSL service but within easy reach by satellite.

Moreover, different technologies will allow users to choose between broadband options according to their needs. As broadband technologies are still only nascent, it is difficult to focus on a specific technology in examining infrastructure deployment issues. At present, it is hard to predict the broadband market trend because it is consumers who decide the technologies to be adopted. In other words, no one currently knows which technology will best provide broadband.

Government concerns for broadband technologies

Most OECD countries have stressed the importance of broadband networks, often viewing them as playing an important role in boosting economic activity. Many countries have also commissioned reports to provide arguments as to why broadband matters (Table 1). The initiatives of a few OECD countries can be cited by way of examples. The UK government predicts that broadband services, offering higher connectivity and entirely new sorts of value added services, will be a significant factor in determining national competitiveness over the coming years.[14] From this perspective, it established the Broadband Stakeholders Group in March 2001 to advise on development and implementation of broadband strategy.

In Canada, the National Broadband Task Force was established in January 2001 by the Minister of Industry for the purpose of mapping out a strategy for ensuring that broadband services are available to businesses and residents in every Canadian community by 2004.[15] The Task Force maintains that "over the next 10 or 20 years, the development of broadband networks, services and applications will have a profound effect on all aspects of Canadian life."[16] The Canadian report lays stress on the importance of broadband because it is extending beyond a technology only for large private or public intra-organisational use, to use by all levels of government to provide external services and to individual households and small businesses.[17]

The Swedish government maintains that "broadband services make higher demands on quality, and require higher capacity than is available today" and that "the need for broadband is increasing."[18] The government asked a local government commissioner to look at funding issues in a report known as the Broadband Study. The task also involved a review of how an infrastructure programme would function, and the extent of state involvement.[19]

Other OECD countries are also keen on broadband policy. In Italy, for example, the "Document for Economic-Financial Planning (DPEF) 2002-2006" sets out a national action plan for the development of broadband telecommunications infrastructures across the country. Consequently, the Minister of Communications and the Minister for Innovation and Technologies[20] established a joint task force in September 2001.[21] In Japan, the year 2001 is considered the "first year of broadband"[22] and the Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT) established the National Broadband Initiative in October 2001.[23]

Government initiatives for broadband infrastructure deployment

What should government policy be with respect to broadband infrastructure deployment? On the one hand there are policies to enhance competition, open telecommunication markets and promote access to infrastructures. These policies - such as unbundling, line sharing, interconnection and so forth - put into place by national regulatory authorities are not the subject of this paper. Universal service-type policies could also come into play for broadband if and when governments decide that existing definitions of universal service should be expanded.

Rather, the type of policies examined in this paper deal with those government actions taken outside of the regulatory context aimed at directly or indirectly assisting in the build-out of broadband networks. The extent to which governments are engaged in deployment of broadband infrastructures varies according to policy makers' strategies, along with their budgetary situation. In some cases policy makers seem to feel the necessity for proactive involvement by the government whereas others make minimum commitments. This section attempts to identify a variety of government initiatives for deployment of broadband infrastructure. As already noted, the focus is placed on the infrastructure and thus this section is not concerned with initiatives that emphasise broadband applications and use. However it should be noted that there are a number of initiatives being taken in this area as well.

The types of initiatives governments are taking are diversified and sometimes reflect the extent to which countries place emphasis on the role of the private sector in broadband deployment. It is possible to roughly classify government initiatives as follows:

1. Financially supporting telecommunications providers.

2. Owning the infrastructure and leasing it to telecommunications providers or end users.

3. Allowing the private market mechanism to work.

These policy alternatives have pros and cons respectively. The first two initiatives take the form of proactive involvement by governments. Arguments for proactive involvement by governments are usually structured as follows:

Pros

- In certain geographic areas there is little financial incentive for companies to invest in providing broadband access to residential customers since costs are high relative to revenues. Government involvement, it is argued, is therefore necessary.

- If the municipal government owns a broadband infrastructure, it could lease capacity on this network to all new entrants at non-discriminatory terms while ensuring that municipal streets are not excavated by utilising the existing network and duct.

- Regions and/or municipalities, where investment by telecommunication operators in upgrading the network would take several years to arrive because they are less financially attractive than major urban areas, could invest by themselves or subsidise private sector investment in order to obtain broadband early and ensure that employment and other economic opportunities are leveraged as quickly as possible.

- Governments need to act in the public interest and take decisions on broadband even if there is no existing effective demand.

Cons

There are also a number of arguments against government initiatives at this stage of infrastructure deployment:

- The development of broadband infrastructure is still at an early stage and it is not evident which geographic areas would not be able to receive DSL or other technologies, *i.e.* areas where access problems are a result of technological constraints.

- Similarly, it is too early to clearly define which areas may not be served because they are not commercial.

- National regulatory authorities are taking a number of initiatives to increase competition in the telecommunication market, and in particular the local loop market. Distortion of private investment decisions by government financing can also distort the competitive landscape and slow the development of private sector competition.

- Municipal networks can result in the recreation of local monopolies and can have negative implications for industry innovation and efficiency.

- Although there may be good reasons to provide direct funding to public institutions (schools, libraries, hospitals, etc.) in order that they can invest in equipment and pay network connection charges, government investment in network infrastructure is harder to justify except in exceptional circumstances.

A key government consideration before any initiatives are taken in infrastructure investment and subsidising infrastructure roll-out is to assess what the impact will be on competition in the market and whether such subsidies will create any market distortions. All OECD governments have now accepted that competition is an essential requirement for the development of the telecommunication sector to ensure efficient provision of services and technological innovation. Many have put much effort in setting up a framework for the creation of appropriate conditions of competition so that any action that may distort such a framework should be examined carefully.

Governments need to carefully reflect on what types of actions are appropriate and what kind of government involvement, if any, is needed. In order to examine these questions, it is useful to understand how OECD countries set their goals for broadband deployment and what kind of initiatives they take to realise the goals.

Establishment of goals

A number of governments have set goals for broadband deployment. While it might be useful to differentiate business users from residential users in setting goals, most goals seem to put more emphasis on residential rather than business broadband usage. Moreover, these goals are more or less concrete, but it is questionable whether it is advisable to have such specific goals without clearer information on the use of broadband and on the technical and economic details of its deployment. Certainly giving signals to the private sector and users on the importance of broadband is important, but whether specific target dates (see Table 2) are required, especially at such an early stage of broadband development, is not evident.

When some of the stated goals are looked at in the international context, rather than on a purely national level, they are self-contradictory – for example, several countries want to be "the most connected" or have the "most competitive broadband market". In light of the fact that the future stages of broadband development are unclear, setting planning goals with 2004 or 2005 as completion dates for broadband deployment is also not advisable.

While it may be advisable for governments to have a goal for broadband deployment, they are invariably required to recognise the importance of the following: The rationale behind the goal should be clarified and explained to telecommunications providers as well as users. Although a number of countries set a specific date for broadband completion, the reasons for adopting such timeframes have not been fully explained so far.

The separation of roles between the public and private sectors

Most countries have recognised that the key players for infrastructure deployment are in the private sector (Table 3). For example, the Canadian government maintains that "the private sector should play a leadership role in the development and operation of broadband networks and services" and that "governments should facilitate the deployment of broadband networks, services and content through policies and regulations that favour private sector investment, competition and innovation."[24] The Japanese government also mentioned in its e-Japan Priority Policy Programme that "the private sector is to play the leading role in the area of IT" and that the government's role is "to implement an environment where markets function smoothly through the promotion of fair competition and revision of regulations."[25] Despite such statements, however, it is noteworthy that some of these countries seem to take rather proactive steps regarding government involvement.

On the other hand, some countries attach more importance on the government role for delivering broadband infrastructure. For example, the Swedish IT Bill of 2000 emphasises that broadband

infrastructure deployment "is primarily to be achieved through market channels" but the central government "has the overall responsibility for ensuring that IT infrastructure with a high transfer capacity is available nationwide." (Granholm, 1996). On the basis of this principle, the Swedish government is attempting to create fairly proactive policy initiatives in this field.

In both cases, it is striking that most OECD countries clearly recognise the necessity to separate the roles of the public and private sectors. The government could mislead the private sector if its own policies are misguided. Thus, the greater the degree of government involvement in infrastructure development, the more likely it is to reduce private sector initiatives.

Market mechanism

The introduction of competition in telecommunication markets has played a significant role in the development of telecommunications. It is essentially the existence of competition that has helped stimulate the development and diffusion of DSL and cable modem technologies and provided the incentive to reduce prices. Broadband provides an important market for incumbents and new entrants: many incumbents view the advent of broadband as a way to expand beyond the telephony market which is providing little growth and lower margins in a competitive environment. Governments should not risk distorting this market in its early stages of development, especially as it is one area where competition is expected to be strong.

Some countries are explicitly leaving broadband deployment to market mechanisms with minimum government involvement. The United Kingdom is one example. The British government believes that it should "continue to drive forward its pro-competitive approach to broadband" and pursue neither financial support to telecommunications providers nor ownership of infrastructure by themselves.[26] Similarly, the Danish government is expected to leave infrastructure deployment to the private market and focus investment on content. The Swiss government, having established the Information Society Project in Switzerland in 1998, has also explicitly refused to fund broadband infrastructure development (OECD, 2001*b*).

Behind these policies lies the consideration that the broadband market is so embryonic that government intervention will distort it. Indeed, the British government maintains that the broadband market is "at a very early stage in its development" and that "consumers will take a lead" in deciding which services will succeed.[27] It is essential that market forces, which reflect consumer needs, determine what technology is appropriate for the provision of a particular service in view of the possibility of broadband technological transformation. Only in this manner can consumers receive full benefits from broadband.

On the other hand, there are some cases in which governments are attempting to decide what kind of broadband technology should be adopted. For example, the Japanese government's policy to deploy fibre optic cable across the country by providing financial support to companies laying the fibre, as early as 1991, was quite premature and it did not appear to put the country in the lead for broadband or DSL when compared with the United States and Korea.

Basically, governments are not in a position to decide beforehand where private companies should invest or what kind of consumer needs may emerge. The government should ensure the widespread availability of broadband infrastructure by ensuring that the appropriate market framework is in place and without creating any deterrents to the future upgrading of broadband technologies. Currently, markets are at a stage where technological innovation and uncertainty about demand for broadband somewhat curtail the process of investment.

The lack of competition in the marketplace is in some countries the greatest constraint in broadband supply. In such markets where the dominant carrier is the only potential provider of broadband

infrastructure, there is the risk of a higher price for broadband service as well as the creation of disincentives to develop new services.[28] In this context, government action for creating conditions to encourage telecommunications providers to make desired investments on a competitive basis increases its importance.

For this purpose, the government is required to ensure 'the freedom of new entry', which would promote substitution of new and alternative broadband infrastructure. In other words, the role of the government is to remove barriers that impede efficient capital market investment. In the United Kingdom, for example, only one cable operator was able to provide broadband service via cable modem in each franchise area until January 2001, which seems to have delayed roll-out of broadband services (IEA, 2001). This type of legislation should be repealed in order to promote competition. It is also important to ensure price competition, and where it does not exist to a sufficient degree, it may be necessary to take regulatory action.

At the same time, it should be noted that countries that attach importance to market competition also feel some necessity for government involvement to stimulate private investment in broadband networks. For instance, the UK government perceives that market action alone may not deliver optimal results, especially in rural areas.[29] The US has expressed concern that the market might not work at the same pace in all areas, particularly in rural and certain urban areas.[30]

The argument often put forward is that there could be 'market failure' so that total reliance cannot be placed on the market mechanism. If this is correct, then the danger would be that broadband networks might remain unavailable in some areas for many years without government proactive involvement.

Geographical digital divide

Provision of broadband networks to unpopulated, rural and remote areas may not occur because investment in infrastructure may be unprofitable in those regions. In these regions subscribers tend to rely on a single telecommunications provider which tends to be reluctant to invest in upgrading networks. From the demand side, subscribers in areas with low population densities may not generate sufficient demand to allow for profitable broadband deployment.

A number of OECD countries appear to believe that some policy initiatives, especially financial incentives, are imperative in order to narrow the geographical "digital divide" and deploy broadband services to rural communities. For example, the Italian government "now envisages the possibility of public intervention to create broadband infrastructure in rural areas and recognises the need for specific action in disadvantaged areas".[31] The Japanese government suggested in its study group report that the deployment of fibre optic networks by public investment would be desirable for the unpopulated areas where private investment would not occur.[32] The Swedish government also claims that sparsely populated areas "are the main parts of Sweden where the market will not be able to fund the expansion without assistance".[33]

It is important to note, however, that the future technological improvement might reduce or eliminate existing perceived digital divides. Extension of DSL technologies to cater to subscribers more than five kilometres from a local exchange, for example, could play an important part in reducing this divide. As noted earlier, other technologies are emerging which may also enhance the ability to provide broadband to rural and remote areas. Internet access via interactive two-way satellite services (*i.e.* not reliant on the PSTN for upstream connectivity) only became available in 2001.

Moreover, as many unpopulated areas, *i.e.* high cost areas, usually have only one infrastructure provider (the incumbent), any government initiatives to provide broadband networks tend to work with the incumbent and create or reinforce a *de facto* local monopoly. In light of these factors, governments should

fundamentally allow market mechanisms to work as much as possible for the time being. Government involvement should be limited to the areas where it is clear that the market might not work.

There are several policy options that the government could take when promoting broadband infrastructure deployment. The following sections of this paper discuss policy alternatives that OECD countries could, or do, pursue (Tables 4 and 5).

Universal service obligations

A potential policy to encourage investment in basic broadband services to subscribers in high cost areas (usually rural and remote regions) could be to redefine universal service obligations to include broadband services.[34] Such obligations, often with the help of a universal service fund, have supported the maintenance of voice telephone services at affordable rates to high cost rural areas, and all telephone users eventually help subsidise the cost of providing such a basic service to those areas.

The first question is whether broadband is so essential that its provision needs to be mandatory. In some countries the cost of providing normal telephony services is quite high, especially in those countries that have not yet fully rebalanced prices. The cost of providing telephony services is also high because in most countries there is geographic averaging of prices for fixed subscriber lines. A requirement to provide national coverage of broadband in the context of a universal service framework would result in a high cost burden being imposed on the industry, unless direct government funds were used to ensure access. It could also result in strengthening the incumbent since at present it is only the incumbent that would have the possibility to provide broadband on a national basis. Although the inclusion of broadband as part of universal service needs further investigation, there is, *a priori*, sufficient doubt that it is an essential service. In addition, the fact that there is widespread availability of dial-up Internet access across most countries reduces any urgency in designating broadband access as essential.

In practice, no OECD countries have yet taken steps to include broadband access as part of universal service[35], although the United States included some broadband service, specifically connecting schools and libraries and advanced telecommunications services for rural health care services (OECD, 2001*b*). But in the United States Congress-mandated report of February 1999, the FCC stated that it could not draw any definitive conclusions about whether, if present trends continue, broadband services will ultimately be deployed to "all Americans" (Forbes, 1999). In such a situation where the market is too immature to assess the necessity of demand for universal broadband, intervention to supply it could lead to market distortions.

Direct financial support to carriers

Recent government initiatives show that more and more OECD countries are providing direct financial support to telecommunications providers in order to develop broadband. Many government-sponsored reports recommend that broadband infrastructure be assisted by access to capital, *e.g.* through tax incentives, low interest loans, and subsidies. In this context they are indirectly supporting the notion of broadband as a universal service.

Clearly, direct financial support to telecommunications operators can have a direct impact by accelerating broadband deployment as well as reducing a potential geographical digital divide in the short term. A company that did not have any intention to invest in broadband deployment in less lucrative areas may commit itself to invest in the business with the help of governmental support. The impact of direct government financing is probably healthier than the situation where the government builds the infrastructure on its own.

There were few examples of direct financial support to broadband operators within OECD countries during the 1990s. For example, the Korean government was in a 'minority' in providing low interest loans to telecommunications providers for the deployment of high speed public access lines.[36] Japan was also one of the few countries that had a low interest financing system available to carriers establishing broadband infrastructure through the Development Bank of Japan and the Telecommunications Advancement Organisation, both of which are largely funded by the government.

Strikingly, however, an increasing number of OECD countries have recently begun to consider this funding arrangement. For example, the Irish Minister for Public Enterprise announced funding of EUR 75 million for the extension of broadband facilities to the less developed parts of Ireland in January 2001.[37] The Spanish Minister of Science and Technology explained in April 2001 that the government is studying a new fiscal and legal framework to support the development of broadband infrastructure and services.[38]

Other governments have taken the view that such financial support is unnecessary. In the United Kingdom, for example, the government made it clear that it would offer no new tax breaks for the roll-out of broadband access in its new budget in February 2002. This policy appears to have intended to avoid excessive government involvement in infrastructure deployment as well as to promote existing tax breaks which allow content developers to offset the purchase of broadband development.

Box 1. Funding arrangements in the United States

The FCC has stated that market investments "will lead, in the near future, to greater competition in the broadband market and to greater deployment of this capability in a manner that is more efficient and more inclusive."[39] Emphasis has basically been put on easing restrictions and requirements on incumbent telephone companies as well as examining whether cable companies should be compelled to provide open access to Internet service providers. However, government financial initiatives to promote broadband access in rural and some urban areas have been developed by a number of government departments.

For example, the Economic Development Administration (EDA), an agency of the Department of Commerce, provides grants to support technology-driven projects, one of which is a fibre deployment project to create a distance learning network.[40] The Rural Utilities Service (RUS) is also implementing a loan programme to finance the construction of broadband services in rural America. The Broadband Deployment Act of 2001, introduced in January 2001, provides tax credits for five years to companies investing in broadband equipment to serve low-income areas and a 10% tax credit for broadband service delivery.[41]

In addition, there are two bills in the House of Representatives that would provide USD 3 billion for loans to broadband service providers to encourage them to deliver broadband services to rural and underserved areas. One of the bills stipulates USD 100 million to be made available in loans for broadband telecommunications providers. The Senate bill also proposes USD 25 million in funding for broadband and dial-up Internet access for rural Americans, half of which would be available as low interest loans. These bills are currently under deliberation in Congress.

The impact of such initiatives needs to be carefully examined. First, they could distort investment and may strengthen incumbents as well as create disincentives to new market entrants. In turn this could have negative impacts on the development of private sector competition. Second, such initiatives may tend to provide a disincentive to new technological developments.

Such initiatives might also subsidise broadband provision that might otherwise have developed through market action.[42] Although it is at present unclear whether the market mechanism will succeed in providing affordable broadband services to all regions, it is nonetheless necessary to wait until there is an evident market failure.

Indirect financial support

Financial support by the government is not necessarily limited to telecommunications providers. There are some ongoing initiatives to fund municipalities as well as end users for the purpose of stimulating demand for broadband access.

Financial support to municipalities

Funding municipalities to assist in the development of regional broadband networks has grown in significance. Such assistance normally takes the form of either grants or low interest loans. In the United States, for example, the Economic Development Administration (EDA) grants fund to local government, as well as to community groups, for their broadband deployment. In Sweden, a new law was introduced in January 2001 allowing municipalities in sparsely populated areas to receive funding to arrange broadband for their inhabitants.[43] The municipalities must have completed the networks by 2004 in order to receive the grant. In Japan, the Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT) plans to financially support municipalities investing in local public broadband networks with a budget of USD 60 million, based on the concept that public infrastructure improvement is required to narrow the digital divide in less favoured areas where infrastructure deployment by private companies is not progressing. The Ministry's 'National Broadband Initiative' maintains that it is desirable to utilise regional public networks deployed by municipalities.[44] In the Netherlands, the government recently introduced a subsidy scheme of EUR 6 million to city governments for projects focusing on the development of instruments to promote the construction of broadband links.

Perhaps one of the underpinnings of such initiatives is the perception that state support to private companies may distort market competition by favouring certain companies. In other words, a network under the control of municipalities would create less distortion than a mechanism offering direct financial support.

However, such initiatives can have negative implications. Municipality ownership of networks can lead to the creation of local monopolies and discourage private companies from entering the market. Even where municipalities do not own the network, there is a danger that such initiatives will effectively close the market to new entrants.

Financial support to end users

In certain countries, state financial incentives are provided to end users of broadband networks. The Netherlands provides a leading example of such initiatives. The Kenniswijk Initiative has been established under the Dutch Ministry of Transport, Public Works and Water Management. Kenniswijk is aimed at developing and testing broadband infrastructure and innovative services at one location in close collaboration with the private and public sectors for the purpose of stimulating broadband facilities and services for consumers.[45] It will examine which business models are the most viable for offering fibre-to-the-home. The government announced that it will provide USD 42 million to fund Kenniswijk, and give subsidies to the homeowners (end users) who will take part in this project.

In a similar vein, Sweden also introduced a new law in January 2001 on tax reductions for property owners (private homes as well as businesses) for connection to broadband.[46] The driving force behind this initiative is the perception that the government should not distort market competition in the deployment of broadband infrastructure. The Swedish government says that:[47]

> *Funding may not benefit certain companies or certain production. Nor may central funding benefit either a public or a private company, or public business activities that carry out the expansion of broadband. This could distort competition on the market for network services.*

Such initiatives take a more market-oriented approach than one of government 'intervention'. However, the Netherlands's type of initiative can create the danger of a private company creating a *de facto* monopoly. Meanwhile, Sweden's initiative may stimulate broadband usage, but not necessarily broadband infrastructure supply. Its effect is similar to including broadband service in the coverage of the universal service obligations, in that public funds (*i.e.* potential tax revenues) are 'used' for the advancement of broadband. However, the Swedish initiative does not assist in providing infrastructure to rural areas but rather only to those people who already have potential access to broadband service.

Government-owned networks

In some OECD countries governments have taken a leading role in broadband infrastructure development, viewing it as a public project.

Government ownership of broadband infrastructure

One type of government initiative is for the government or the public sector to build, operate and own the broadband network. Such initiatives are based on the perception that business leaders, as well as the public sector, have a requirement for broadband connections and that such infrastructure may not be readily available in time without special government attention. Some policies may also regard public infrastructure as a rapid way to bridge the gap between rural and urban broadband capabilities.

It is noteworthy that an increasing number of local governments seek to invest in broadband infrastructure. A common example is to lease strands of a municipally-owned fibre optic cable to private service providers. The justification for such investment is often that municipal governments have a basic responsibility to co-ordinate the placement of cabling in public rights of way. In the United States, for example, Maryland has announced plans to deploy and own a public broadband network. North Dakota also announced plans for a USD 20 million state-wide broadband network that will connect 552 locations in 194 North Dakota cities.

In Sweden, the City of Stockholm and the Stockholm County Council started to extend their fibre optic (dark fibre) network via Stokab, not only for the purpose of deploying broadband infrastructure but also in order to stimulate investments in broadband services within the region. Stokab does not offer any telecommunications services and leaves the provision of ancillary services to telecommunication carriers who use the network. The fibre is also leased to end users directly.

Some arguments have been put forward that public infrastructure projects such as street and sewer construction, which do not intend to be profitable, are the natural domain of the public sector (Niles, 1997). In this context, some claim that broadband network deployment should also be added to the list of public sector projects. However, such government involvement is highly questionable in view of the existing attempts by regulators to create effective conditions for facility-based competition. As already noted, few private companies may be motivated to enter the market once there is a public network. At the same time,

some municipalities, such as the Stockholm County Council, prohibit other telecommunication operators from laying their own cable.

Second, it is the government as an owner of the network, not the market, which decides on the type of technologies. If the government owns its broadband network, it can as a result impose specific technologies, *e.g.* fibre optic. As noted earlier, it is too early for the government to implicitly 'exclude' other possible technologies.

Third, it is costly to manage and maintain a network and to upgrade it as technology changes.

Fourth, public work projects are prone to inefficiency.

Fifth, as a network owner, a government is not well placed to separate its regulatory role from its role as a network supplier. There is a risk of bringing about 'unfair competition'. For example, a city government that owns a network may not provide access to rights of way, which will have negative implications for facility-based competition.

In light of these implications, it can be concluded that the governments must seek to create the right incentives to draw private businesses into this area rather than attempting to build their own broadband infrastructure.

Direct investment by government in broadband infrastructure

One tool used to encourage private investment in broadband by governments is through specific investment agreements with private companies. In such initiatives, the government does not operate and own the public broadband network but encourages the private sector to build it within the framework of a public project. For example, in the United States, the Arizona Department of Administration (ADOA) developed a concept called Arizona Telecommunications Systems (ATS), which is supposed to interconnect all Arizona state government offices, campuses, prisons and other institutions as well as to provide access for its citizens. The ADOA will not own and manage the system, but it will award USD 180 million in telecommunications contracts to encourage private companies to build the network. The ADOA's specific problem is that it has requested telecommunications providers to accept unprofitable contracts without providing them with assurance of more profitable contracts in the future.

In Canada, Upper Canada Networks (UCNet), a non-profit corporation, has undertaken to bring broadband connectivity to public and private enterprises and the general public in the predominantly rural area of eastern Ontario. The UCNet secured a grant of USD 1.2 million from the Ontario Ministry of Energy, Science and Technology in 2000 to build a fixed wireless network throughout the area.[48]

In these cases, the public sector attempts to contribute to the expansion of the broadband network, irrespective of geographical areas. The government regards it as beneficial to invest in the private sector for the purpose of deployment of regional broadband networks, by creating public-private partnerships as described below.

Public-private partnership

There are some policies that governments can use which minimise distortion in private sector investment. One such policy is through the aggregation of public sector demand, which creates a market sufficiently large to provide an incentive of private investment in regions where normally it may not be profitable. While this demand aggregation policy has a national as well as a regional basis, initiatives at the regional

level are the most common in most countries. In such an initiative, the government enters into a partnership and shares the cost with the private sector to build the network supported by public sector demand. Yet, the government has to be careful when it 'asks' private companies to provide the regional network in order not to reinforce the dominant position of incumbents. Initiatives such as encouraging the creation of a consortium of private operators in order to stimulate new market entry may be appropriate but this needs to be balanced against the need to have an open procurement process.

There are a series of examples of OECD countries in which the state or municipal government has taken such initiatives. In the United Kingdom, for example, Powys County Council, together with the Welsh Development Agency (WDA), established the Llwyber Pathway Project, aimed at encouraging regional public and private sectors to form partnerships to address regional economic development issues including improvement of regional networks. Aiming at building a regional network and developing broadband telecommunications capabilities, this project is funded by the Welsh Development Agency as well as local authorities and other public and private organisations involved. While this initiative seems similar to the financial support scheme, it differs critically in that the public sector does not 'subsidise' the private sector but 'shares cost' for the project.

Having committed its support for the development of telecommunications infrastructure in 1998, the government of Alberta in Canada sought to form a strategic alliance with a vendor consortium or with individual organisations. In November 2000, the government announced the creation of a high speed broadband network called SUPERNET to link every school, hospital, library, and government facility in the province within three years. In addition to the investment by the private sector, the government of Alberta will provide USD 125 million to the private consortium to build the network. As vendors, the consortium will be able to factor the government's current network expenditures into their financial models and have the possibility of a one-time investment to offset some of the up-front costs, while it is expected that this project will reduce ongoing costs.[49]

These cases can be categorised as successful examples of forming or utilising a private consortium in a cost-shared project. The government aggregates its own needs for broadband and 'asks' for the private capital to invest in the construction using its purchasing power. Within the consortium, both incumbents and new entrants can play a leading role for the broadband deployment.

The City of Chicago in the United States has been actively pursuing bids from competitive local carriers to achieve the broadband connection of local governments and hospitals. The City has committed USD 32 million a year for the next 10 to 12 years to encourage the deployment of high speed fibre and switches throughout the city. It will act as a key tenant for the new network, but unlike Alberta's SUPERNET the government does not actually own the fibre (Forbes, 2001). This provides a good example in which the government attempts to create the right incentives to draw private companies into broadband deployment via competitive bids (Krebs, 2001).

The City of Austin, Texas in the United States also has entered into a similar type of public-private partnership. After a two-year process of selecting a vendor partner, the City of Austin finally voted to accept a partnership with Central and South West Communications to build a regional broadband network in April 1996. Having considered the feasibility of broadband networks and the importance of market competition, it has attempted to stimulate competition by making capacity available to all operators during the two-year period.[50]

These initiatives are indicative of government demand side initiatives instead of being an infrastructure supplier. The government acts as an 'anchor tenant' via the partnership with the private sector to trigger investment in broadband networks. Such arrangements are at the core of demand aggregation activities

which are designed to transform otherwise marginal sources of demand into one which provides a sound base for commercial investments.[51]

Stimulating broadband demand and supply

Using a demand side approach, the government can assist in the development of appropriate broadband applications and content, such as for education and health care. It can also simulate production of applications and content by the private sector through promotional activities. One example is Australia's "Networking the Nation" Programme. It is a Commonwealth of Australia grant programme providing over AUD 400 million in funding to non-profit organisations to support activities and projects designed to address a range of telecommunications needs in regional, rural and remote Australia.[52]

From the supply side approach, it is necessary to remove unnecessary regulations that prevent broadband roll-out and ensure a stable regulatory framework. For example, to ensure rapid roll-out of broadband, rights of way should be available so that new entrants may build their own broadband network more easily. This requires active co-operation by municipalities. In addition, regulations need to be reviewed to ensure that they do not slow down the development of new technologies. Previous OECD work has already noted that cable ownership by incumbent telecommunication companies slows down the growth of cable modem markets. Similarly, it is important to ensure that policies such as co-location are working effectively.

Viable initiatives for the future: differentiating networks

Differentiating broadband networks

As it is difficult to predict future market trends at present, especially with broadband at such an embryonic stage, it would be useful to consider viable alternative initiatives in the event of market failure. While effective competition among telecommunications operators is expected to enable nation-wide broadband access in due course, some areas might remain underserved for a long time. Furthermore, it is likely that infrastructure costs would lead to the creation of a small number of networks with competition only found in particularly dense areas. In this case, government involvement could be necessary although it would be extremely difficult to decide on its timing.

It is also important to differentiate between the different levels in the broadband network on the basis of current network structure, in that government measures will differ according to where the bottleneck lies. There are three levels in the network: backbone network, community network, and subscriber access network. The backbone network is the network between trunk exchanges. The community network refers to a regional network between local exchanges. The subscriber access network is a network between subscribers and local exchanges, which is often called the "last mile". In these categories, the initiatives that the government is required to take in case of a possible future 'malfunction' of the market mechanism differ.

Policy alternatives in respective networks

Backbone network

For the most part, investment in backbone networks will take place without the need for government intervention. However, there are countries where such backbone networks may be insufficient, *e.g.* in the north of Canada or remote areas of Australia.

Community network

For the deployment of community networks, regional demand must be taken into account. There could be a gap with regard to the needs for broadband across different communities. The most desirable way to deploy community networks would be the private-private partnership with minimum engagement by the public sector. As each community must have an understanding of its own broadband needs, they are in the position to form the strategic partnerships to meet these needs.[53] One of the leading examples is the case of the Lanark Communications Network (LCN) in Ontario, Canada. It is a consortium of institutions and businesses from Lanark County that are committed to improving services and facilitating economic and community development. Recognising the central importance of broadband in the economy of the future, the LCN formalised partnerships with the largest telecommunications operator in Canada, Bell Canada, in February 1999. By virtue of this partnership, broadband services are being activated in the county's major population centres, and the community network has linked the county's hospitals and schools to centres in Ottawa.[54]

Subscriber access network

It is in the subscriber network that the challenges of bringing broadband are the greatest. It is also here that government intervention might tend to distort investment decisions the most and have adverse effects on competition. Thus, regulatory arrangements are the most important in this area.

One policy to stimulate the roll-out of broadband in some countries is to require new multitenant buildings to provide inside wiring for broadband, as has occurred in Korea. In May 2001, the government required installation of facilities that enable broadband communications in new condominiums built by the state, municipalities, government enterprises and designated private companies. Additionally, the government has established an optional certification system for indoor wiring and plumbing in condominiums for the purpose of accelerating broadband network deployment since October 2000. The condominiums are graded by the extent of installation of broadband facilities based on government guidelines. As far as the government does not choose specific broadband technologies, these requirements may facilitate the deployment of subscriber access infrastructure. However, care must be taken that the inside wiring does not result in the emergence of a bottleneck facility.

Conclusion

The availability of broadband capacity at reasonable prices is likely to be the key factor to develop e-commerce and an information communication society. While broadband services can be delivered over many different technologies, the infrastructure will play a crucial role in the emergence of new services. Accordingly, it is important to ensure that the appropriate initiatives are in place to promote broadband deployment.

Broadband technologies and applications are still nascent, but they are expected to make great strides. Presently, it is not known how broadband supply will be shaped over time. At such a stage, it is fundamentally up to the market to drive forward the broadband network roll-out, and the government's role should be limited to facilitate and encourage the process. The timeframe for financing broadband infrastructure will be determined primarily by market conditions. In other words, future broadband markets will depend on what new infrastructure might be developed by the marketplace as well as technological changes that are likely to have impact on that infrastructure. Therefore, the associated government goal for broadband should be set in such a way as to ensure that infrastructure competition is not hindered in any way by forces other than the marketplace. Care must be taken that government initiatives do not distort market incentives. Aggregation of traffic policies may be the most useful to develop competing infrastructures. In areas where it has become fairly clear that there will be no private investment, or that it can be a long time coming, assistance should be used in such a way as to promote market competition.

There is sufficient evidence from OECD countries themselves that competition is the best way to diffuse new technologies rapidly. Where assistance of some kind is deemed necessary, it would be useful if regulators were involved in drawing up the assistance framework so they can be ensured that such assistance limits market distortions.

APPENDIX

Table 1. Government actions for broadband

Australia	• The National Bandwidth Task Force was established in 1998 to consider the issue of bandwidth availability and pricing within the country. It issued a report, the "National Bandwidth Inquiry Discussion Paper", in April 2000.
Canada	• The National Broadband Task Force was established by the Minister of Industry in January 2001 and issued a report entitled "The New National Dream: Networking the Nation for Broadband Access" in June 2001.
Denmark	• The former Ministry of Information Technology and Research, now the Ministry of Science, Technology and Innovation, issued a report in June 2001 entitled "From Hardware to Content" to present its strategy for broadband penetration. The new Liberal government will evaluate the strategy in spring 2002 in relation to a new IT and telepolitical strategy, even though the main liberal principle of infrastructure development, based on private sector investments and competition, will prevail. This strategy has already proved a great success due to high internet penetration (approximately 70%) and a rising demand for high speed connections.
Finland	• The National Broadband Task Force was established in 2001 by the Ministry of Transport and Communications.
France	• The Government Action Plan for the Information Society (PAGSI) was established in January 1998 and the government issued a report entitled "France in the Information Society 1999".
Ireland	• Under the National Development Plan (NDP) 2000-2006, the "second call for broadband proposals" has been established to further develop broadband communications infrastructure services.[1]
Italy	• Following the Action Plan eEurope 2002, the Document for Economic Financial Planning (DPEF) 2002-2006, approved by the Italian government in July 2001, sets out the national action plan for the development of broadband telecommunications infrastructures across the country. • In September 2001, the Minister of Communications, jointly with the Minister for Innovation and Technologies, defined a common framework of key measures and initiatives for the roll-out of the action plan.
Japan	• The IT Strategy Board was established in the Cabinet Office in January 2001 and successively issued the e-Japan Strategy, e-Japan Priority Policy Programme, and e-Japan 2002 Programme. • The Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT) announced the "National Broadband Initiative: Towards the Most Advanced IT Nation in the World" in October 2001.
Korea	• A four-year plan entitled CYBER KOREA 21, which includes a programme on broadband network deployment and IT education, was established in March 1999.
Netherlands	• The Ministry of Transport, Public Works and Water Management issued a memorandum entitled "Delta Networks" in December 2000 to present its policy for ICT infrastructure over the next three years.
Norway	• The first eNorway Action Plan was presented in June 2000. The plan has since been revised every six months. • In October 2000, the Norwegian government presented its action plan for broadband communication. The plan will be implemented over several years and updated regularly. In April 2002, the government reassessed this plan and established new goals. • The government is currently considering implementing special measures in areas where market imperfections make broadband deployment impossible at reasonable prices and within reasonable time.
Sweden	• The ICT Commission was established in January 1995 and presented a vision of a future-proof IT infrastructure for Sweden in 1999. • The government set up a state inquiry into IT infrastructure with broadband capacity in 1998 and issued reports entitled "An Information Society For All" in 2000 and "The Development of the IT Infrastructure" in 2001. • The IT Bill was established in 2000. • In June 2001, the ICT Commission addressed the "General Guide to a Future-proof IT Infrastructure" to persons in local government responsible for questions and decisions concerning the implementation of IT infrastructure within a municipality.

Table 1. Government actions for broadband *(cont'd)*

Switzerland	• The government adopted the "Strategy and Measures for Information Society in Switzerland" in February 1998. • The Information Society Co-ordination Group (GCSI) was established and issued a report about the information society in April 2001.
United Kingdom	• The Prime Minister issued a report entitled "UK Online: The Broadband Future" in September 2000. • Based on the UK Online recommendation, the Broadband Stakeholder Group to advise government was established and issued a recommendation report entitled "The Next Steps for UK Broadband" in September 2001.
United States	• The President's Information Technology Advisory Committee was established in February 1997 and issued a report entitled "Information Technology Research: Investing in Our Future" in February 1999[2] • The Information Technology for the 21st Century Initiative has been set up as a commitment to research in information technology. It issued a report entitled "Information Technology for the 21st Century: A Bold Investment in America's Future" in January 1999.[3] • The Next Generation Internet (NGI) programme, which aimed at connection of universities and national laboratories via broadband networks as well as experimentation of next generation networking technologies, has been implemented. • Federal agencies are currently co-ordinating advanced networking research programmes under the Large Scale Networking (LSN) Co-ordinating Group.[4] • The FCC issued a report on the availability of high speed and advanced telecommunications services in February 2002.

Notes:

1. See National Development Plan, http://www.ndp.ie/newndp/displayer?page=home_tmp.
2. See PITAC, Report to the President, http://www.itrd.gov/ac/report/.
3. See "Information Technology for the Twenty-First Century: A Bold Investment in America's Future", http://www.itrd.gov/ac/it2/initiative.pdf.
4. See National Coordination Office for Information Technology Research and Development, http://www.itrd.gov/iwg/pca/lsn.html.

Table 2. Government plans and goals for broadband

Australia	• 3% of Australian businesses will adopt broadband connections by 2003.[1]
Canada	• Broadband services will be available to businesses and residents in every Canadian community by 2004. (Report of the National Broadband Task Force) • The Canadian government announced that it shifted its target of furthering broadband Internet coverage to 2005. The government has decided not to fund broadband investments at this time. (Part 6 of the Budget Plan 2001)
Denmark	• The telecommunications sector expects that by 2002, 95% of all households (including businesses) in Denmark should have access to one or several technologies (high speed/broadband via ADSL, FWA or internet through cable TV modem). The goal is based on data from the telecommunications sector. The actual development in access will be analyzed by the Danish National Telecom Agency in 2002.
Finland	• Finland will be developed into an information society, in which knowledge and expertise form part of the culture and are also the key factor in production. (The Government Programme, April 1999) • Broadband services should be available to all citizens and enterprises by 2005. (Goal set by the Ministry of Transport and Communications)
France	• All French citizens will enter an information society that embraces solidarity. (France in the Information Society)[2]
Ireland	• Ireland will actively pursue the positioning of the country as a global leader in electronic commerce.[3.] (1998 report of the Advisory Committee on Telecommunications)
Italy	• Italy seeks to transform the country into a knowledge-based society and to ease its entrance into the Information Society over the next five years. (DPEF 2002-2006)
Japan	• By 2005, an environment that provides 24-hour connection to high speed Internet access networks for at least 30 million households, and to ultra high speed Internet access networks for 10 million households, will be created for all Japanese who need access to those networks at affordable rates. (e-Japan Strategy) • By 2005, Japan will attempt to deploy public LANs that connect schools, libraries, community centres and city halls across the country. (National Broadband Initiative)
Korea	• The Korean government expects subscribers to broadband services to increase 13 million, 84% of the total Korean households, by 2005. • By 2005, broadband subscriber access network will be deployed.
Netherlands	• It is essential to create the conditions under which intricate glass fibre infrastructure can be constructed in the Netherlands faster than, or at least as fast as, in those countries with which we would wish to be compared. (Smart Digging)
Norway	• Norway should have favourable market offers that enable broadband in all parts of the country. • All primary schools, public libraries and local authority administrations should be offered broadband connections at competitive prices by the end of 2005, while all secondary schools should have this offer by 2003. • All hospitals should have favourable market offers that enable broadband connections by the end of 2002. (Action Plan on Broadband Communication: reassessed version)
Sweden	• Sweden will be the first country to become an information society for all, which means that everyone will have access to IT, have confidence in IT, be able to use it and benefit from the advantages it brings. (An Information Society for All – a publication about Swedish IT policy) • All households and businesses in Sweden should have access to an IT infrastructure with high transfer capacity (broadband) by 2005. (The Development of the IT Infrastructure – A publication about one of the priority areas of Swedish IT policy) • Over the next few years, households and business in all parts of Sweden should acquire access to IT infrastructure with a high transfer capacity. (The IT Bill of 2000) • The government will aim to connect 98% of the nation's population within two years, dividing the cost between the state, districts and commercial operator. (The IT Bill of 2001) • Everyone will have a fixed Internet connection of at least 5 Mbps real through put capacity within Sweden by 2005. • By 2005, Sweden should have constructed a fine-meshed fibre optical network available to all. • The network shall be technically and competitively neutral and open to all operators, the aim being for everyone, through free competition, to gain access to high transmission capacity at low cost. (General Guide to Future Proof IT Infrastructure)[4]
United Kingdom	• The UK will have the most extensive and competitive broadband market in the G7 by 2005. (UK Online: The Broadband Future: An action plan to facilitate roll-out of higher bandwidth and broadband services)
United States	• The government will increase investment in the fundamental information technology research in software, human-computer interaction and information management, scalable information infrastructure, and high-end computing. (Information Technology for the 21st Century)

Notes:

1. *Newsbytes,* October 26, 2000, http://www.newsbytes.com/news/00/157225.html.
2. Internet.gouv.fr, "France in the Information Society", http://www.internet.gouv.fr/francais/index.html.
3. *The Irish Times*, October 20, 1999, http://www.ireland.com/newspaper/ireland/1999/1020/hom14.htm.
4. See the Swedish ICT Commission, General Guide to a Future-proof IT Infrastructure: http://www.itkommissionen.se/extra/document/?id=347.

Table 3. Government position regarding public and private roles in broadband deployment

Canada	(Report of the National Broadband Task Force to the Ministry of Industry[1]) • The private sector should play a leadership role in the development and operation of broadband networks and services. • Governments should facilitate the development of broadband networks, services and content through policies and regulations that favour private sector investment, competition and innovation, as well as by supporting communities, the creation of Canadian content and the use of broadband to deliver public services.
Denmark	• Investment in developing the digital infrastructure should be made within the framework of the private market. • The public sector's demand for digital infrastructure and useful content and services is an important incentive in developing the infrastructure of the future.
Finland	(Finland as an Information Society: The Report of the Information Society Advisory Board to the Government) • The operation of the public sector in the markets, especially in the prevailing sensitive competition situation, would most likely distort competition, stop the investments of the private sector in the infrastructure and thus endanger the provision of commercial services and the development of alternative data-transfer channels. • The role of the government is best implemented through regulatory measures.[2]
Italy	(Italian Broadband Task Force Report) • Broadband development calls for a systemic approach and involves a specific national industrial policy, and the market alone is unable to guarantee an even broadband infrastructure deployment. • The government will play an active role in drawing policy, co-ordination and stimulation for the supply of infrastructures and services as well as demand. However, interventions should mostly be in an indirect manner. • The government should assume an important role in the supply of digital service.
Japan	(e-Japan Priority Policy Programme) • In principle, the private sector is to play the leading role in the area of IT. The government's role is, therefore, to implement an environment where markets function smoothly through the promotion of fair competition and revision of regulations. • It is necessary for the government to play an active role in the area where the private sector's activities come short of goals such as realising e-government, closing the digital divide and R&D on basic technology. • In order to promote the construction and use of fibre optic networks that are needed upon diffusion of the ultra high speed Internet, etc., and in order to encourage private businesses to flexibly construct network infrastructures, measures will be taken for tax incentives and budgetary support for carriers. (Study Group Report of the MPHPT: Programme for high speed and ultra-high speed Internet permeation promotion[3]) • The private sector is to play the leading role, and therefore, public investment should be considered as a supplementary step to this principle. • In the meantime, it is possible to implement broadband deployment as municipality businesses, whereas it can also be an idea that the government is to play the leading role. (National Broadband Initiative) • The public sector is required to deploy subscriber access fibre optic lines in terms of improvement of the geographical digital divide.
Korea	• The government should stimulate competition among telecommunications service providers to enhance user benefits as well as provide loans to carriers for building information infrastructure in rural areas. • The private sector is to develop the advanced network infrastructure to provide services to users with a reasonable price.
Netherlands	(Smart Diggings) • The connection of all households to a broadband network is a matter for market forces. • A government subsidy is needed to ensure the separation of infrastructure and services and to accelerate the connection process. • Although central government does have a role to play, it would be impossible for it to take on the construction of an intricate broadband network itself. Local government however can indeed play a significant role in this. (The Parliament of the Netherlands[4] • The government should guarantee broadband access in less populated areas. (Delta Networks[5]) • The government wishes to play an active role in its attempts to further strengthen the ICT base.
Norway	• The market players will be responsible for building and developing broadband access within the framework of a functioning market. • The government does not intend to be a player in making basic investments in infrastructure, but public procurement will be used to bring forward products and services at an early stage. • Special measures will, if necessary, be applied in those areas of the country where the market does not function as desired.

Table 3. Government position regarding public and private roles in broadband deployment *(cont'd)*

Sweden	(IT Bill of 2000) • The goal for access to IT infrastructure is primarily to be achieved through market channels. Central government, however, has the overall responsibility for ensuring that IT infrastructure with a high transfer capacity is available nation-wide. (The development of the IT infrastructure) • The central government is responsible for ensuring that the IT infrastructure is of a sufficiently high standard for everyone in the whole country. • Central funding should be given to areas that are prioritised for reasons of regional policy and which would probably not have access to broadband via commercial channels within five years. • The regional network between municipalities will simplify the links between urban centres where market channels will not satisfy the needs.
United Kingdom	(UK online) • It seems likely that in due course the market should be in a position to ensure that most people in the country are able to receive higher bandwidth services at a price that is affordable for the majority. • The government should provide leadership on broadband via setting the goal as well as creating a strategic partnership with key players in the private and public sectors, and continue to drive forward competition in the supply of infrastructure and services.
United States	Telecommunications Act of 1996) • The FCC should conduct regular studies of availability of advanced telecommunications services and, if necessary, take actions to accelerate it. (Advanced Telecommunications in Rural America: The Challenge to Bridging Broadband Service to All Americans[6]) • Policy makers should promote competition, where possible. Competition leads to lower prices, more customer choice, rapid technological advances, and faster deployment of new services. Given the unique challenges faced by rural Americans, however, other government policies must be considered as well. (NTIA Guidepost) • Wherever possible, the market, not government, should drive broadband deployment. Government's role is to remove the regulatory underbrush that impedes efficient capital investment. Carriers' decision to deploy and consumers' decisions to subscribe should then be left to the market. • The government should pursue policies that promote rational facilities investment. Facilities-based competition has always been a desired means for achieving a robustly competitive market. Obviously, there should be reasonable opportunities for resale competition as well. However, there are network reliability and security advantages to having a diversity of facilities-based competitors. • Where possible, the government should promote competition via a technology-neutral paradigm. The differing histories and regulations surrounding each type of platform make absolute regulatory parity difficult to achieve, but it is important to try to regulate comparable services in a manner that does not interfere with marketplace outcomes. • The government should be mindful that the market might not always work as well or at the same pace in all areas, particularly in rural and certain urban areas, In developing a policy, the government needs to be aware of the differing forces and needs in those areas. • Once we establish the right regulatory framework, effective enforcement is critical to making it work. Regulations must have teeth and penalties must deter non-compliance.

Notes:

1. See http://www.fin.gc.ca/budget01/pdf/bpe.pdf.
2. The Information Society Advisory Board, "Finland as an Information Society", Helsinki: Ministry of Finance, 2000, p. 52.
3. Ministry of Public Management, Home Affairs, Posts and Telecommunications, Press release, August 3, 2001, http://www.soumu.go.jp/joho_tsusin/pressrelease/japanese/sogo_tsusin/010803_1.html,.
4. *Newmedia, Business News*, http://www.newmedia.com/nm-ie.asp?articleID=2640.
5. Ministry of Transport, Public Works and Water Management, "Delta Networks: First-class Facilities for a Network Economy and Information Society", http://www.minvenw.nl/dgtp/home/docs/DeltaNetworks.pdf.
6. United States Department of Commerce and United States Department of Agriculture, "Advanced Telecommunications in Rural America: The Challenge of Bringing Broadband Service to All Americans", http://www.ntia.doc.gov/reports/ruralbb42600.pdf.

Table 4. Examples of central government initiatives for broadband deployment

Australia	• The government set up the 'Networking the Nation' programme, in which it grants over AUD 400 million to non-profit organisations to support activities and projects designed to address regional telecommunications needs.
Canada	• The government, in partnership with the private sector, has completed the world's fastest national fibre optic network called CA*net3, which connects individual universities, federal and provincial government laboratories and research institutes. • The government has implemented financial support to CommunityNet project developed by the government of Saskatchewan, which will provide broadband Internet access to communities, educational and health facilities, schools and government offices.
Czech	• The State Information Policy defines the basic tasks including promotion of broadband access, such as introduction of the Internet to all schools, state libraries, and hospitals. Different policies are under consideration to support broadband access.
Denmark	• In early 1998, regulation of access to the last mile to the home (raw copper) was implemented in order to promote easy and cheap access to the incumbent's network. • In 2002 the National Telecom Agency will publish price information about fast internet to promote transparency. • On the home page of The National Telecom Agency, consumers can test their internet capacity/speed and get other kinds of product information. • Universities using the research network typically have connections of 2-10 Mbps. • In spring 2002, the Danish government expects to introduce a tax reduction programme for businesses, deploying PCs and internet access to the private households of their employees.
Ireland	• In July 1999, the government signed an agreement with Global Crossing to purchase half the capacity of a new broadband undersea fibre optic cable for IEP 60 million (approx. EUR 76 million). • In January 2001, the Minister for Public Enterprise announced funding of EUR 75 million for the extension of broadband facilities to the less developed parts of the country. The funding is expected to secure a further EUR 250 million from the private sector. • The public enterprise minister has announced a IEP 120 million (approx. EUR 152 million) subsidy to roll out IEP 700 million (approx. EUR 889 million) worth of broadband capacity to every parish in the country. • Under the National Development Plan 2000-2006, up to EUR 55 million of funding is earmarked for the extension of broadband facilities to the less developed parts of the country.
Italy	• After reviewing and adopting the Report of the Task Force, the Minister of Communications and the Minister for Innovation and Technologies, together with the contribution of the Ministerial Committee for the Information Society, will draw up a framework of initiatives and interventions to drive forward broadband networks.
Japan	• The government has been operating a system of tax incentives and subsidies to encourage the private sector to provide fibre optic networks since 1995. • In 2000, the Minister of Construction proposed the possibility to finance local governments for utilising existing sewage lines for fibre optic network deployment. However, the Minister of Posts and Telecommunications (MPT) opposed it to avoid dual investment between government and private sectors. • In 2001, the government rolled out the coverage of assistance to other broadband networks, including DSL, FWA, and cable modems, via low interest loans. • The Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT), the former MPT, has requested 2002 FY budgets of JPY 1 billion in order for municipalities to extend fibre optic cable, especially to rural areas.
Korea	• The government has implemented low interest loans to telecommunications providers that arrange broadband networks in rural areas. • The Ministry of Information and Communication encourages all rural communities to make an association that includes municipal governments, regional education leaders and telecommunications operators for the purpose of promoting IT in these areas. • The government has established an optional certification system of the indoor wiring and plumbing in condominiums and office buildings for the purpose of accelerating broadband network deployment since July 1999. • Since May 2001, mandatory installation of the broadband network has been implemented in condominiums newly built by the government, government enterprises, and designated construction companies.
Luxembourg	• The government is active in a number of areas to support the deployment of broadband networks such as promoting competition under the control of the Luxembourg Regulation Institute or raising awareness among cable network owners that broadband networks should be brought up to technical standards. • The government introduced the Restena pilot project which gradually introduces Ipv6 into public networks.[1]

Table 4. Examples of central government initiatives for broadband deployment *(cont'd)*

Netherlands	• The government established an initiative called Kenniswijk to create the consumer marketplace within the next two years via roll-out of fibre optic networks. The Ministry of Transport, Public Works and Water Management announced that it would provide NLG 100 million to fund this project to test which business models are the most viable for offering fibre-to-the-home. • The government will subsidise more than 20 000 homeowners (end users) who will take part in the Kenniswijk initiative so that they may choose the infrastructure and content provisioning package. • The parliament supported a motion stating that the government should guarantee broadband access in less populated areas.[2]
Spain	• The Minister of Science and Technology explained in April 2001 that the government is studying a new fiscal and legal framework to support the development of broadband infrastructure and services.[3]
Sweden	• In August 2000, the government commissioned the Swedish National Grid to construct a backbone network with high transfer capacity between all municipalities for the purpose of linking all the main urban centres by December 2002. The expansion is based on fibre optical cable in the Swedish power network's trunk network. • The government announced in December 2000 that an investment of SEK 10 billion is planned for 2001-2004 to ensure broadband access for 98% of towns and villages. • Municipalities in sparsely populated areas can receive a state subsidy that covers one-third of the cost of broadband network construction for their inhabitants. The municipalities must have completed the networks by 2004 in order to receive the funding. (To date, however, no municipality has applied for this subsidy. The government is therefore considering whether to give the poorer areas further support to stimulate broadband growth.[4]
United Kingdom	• The Department for Education and Employment (DfEE) is spending GBP 79 million from the Standards Fund over 2000-2002 to begin to provide schools in England with broadband access to the Internet. The fund is allocated to a number of Regional Broadband Consortia. • The National Health Service (NHS) is committed to providing all hospitals and the majority of General Practitioners with broadband connections. • The government is committed to providing all public libraries in the UK with UK online centres managing a GBP 120 million budget.
United States	• There are currently two bills in the House of Representatives that would provide USD 3 billion for low interest loans to broadband service providers to encourage them to deliver broadband services to rural and under-served areas. One of the bills stipulates USD 100 million to be made available as loans for broadband telecommunications providers. • The Senate bill recommends a USD 25 million increase for broadband and dial-up Internet access for rural Americans, half of which would be available as low interest loans. • The Internet2 project, led by over 130 leading US universities, working with industry and government, to enable and facilitate the advanced network applications necessary to meet emerging needs in higher education, is developing broadband network and applications. • As a part of the Economic Adjustment Program, the Commerce Department's Economic Development Administration (EDA) grants funds to local government and community groups for their broadband deployment for the purposes of generating new jobs, helping to retain existing jobs, and stimulating industrial and commercial growth in economically distressed communities. • The Rural Utilities Service (RUS) is implementing a loan programme to finance the construction and installation of broadband services in rural America. This programme will provide loan funds to communities of up to 20 000 inhabitants to ensure that rural consumers enjoy the same quality and range of telecommunications services as those available in urban and suburban communities.[5] • In July 2001, a group of leading equipment vendors and service providers announced the formation of a new Fibre-to-the-Home (FTTH) Council aimed at accelerating the deployment of fibre-to-the-home in North America.

Notes:

1. For details, see http://www.ipv6.restena.lu.
2. Europemedia Net, April 12, 2001, at: http://www.europemedia.net/shownews.asp?ArticleID=2597.
3. ibid.
4. Ledstiernan, April 19 2001, http://www.ledstiernan.com/.
5. Rural Utilities Service, "New Broadband Funding Opportunity", at http://www.usda.gov/rus/telecom/dlt/broadbanddlt.htm.

Table 5. Examples of local government initiatives for broadband deployment

Canada	• In November 2000, the provincial government of Alberta announced the creation of a high speed broadband network called SUPERNET to link every school, hospital, library and government facilities in the province within three years. Alberta will provide CAD 193 million to a private consortium to build the network. The government will serve as the anchor tenant but will not own the network. • In 2000, the Ontario Ministry of Energy, Science and Technology (MEST) awarded a grant of CAD 1.8 million to the private sector to build a wireless network in a rural part of the province. • In June 2001, the City of Bromont announced the Bromont Connected to the World project, a CAD 3.3 million project that will connect 95% of the town's population with high speed Internet service.[1]
Denmark	• Many municipalities in Denmark have taken initiatives, such as the establishment of broadband connections between municipal institutions, high speed and broadband connections to home workstations for the municipality's staff and politicians. • Many regional and local authorities have established partnerships to expand and co-ordinate the use of public broadband networks. • The government and local private and public investors have funded a large-scale IT project in the region of Northern Jutland. One of the initiatives is to test broadband's possibilities with regard to new kinds of content and services in the municipality and local enterprises.
France	• In several provinces, municipalities deploy their own fibre optic networks, Metropolitan Area Networks (MAN) with their own average budget of about EUR 30.5 million. They use the network either to link public universities and hospitals or for lease to private telecommunications providers.
Italy	• Many local communities have already launched different initiatives that require broadband use, which span from civil engineering work for fibre ducts to setting up specific partnership with the private sector to lease capacity to all operators. • Some regions, where the market is active, are co-ordinating initiatives of different municipalities through ventures and consortia. • The southern regions are considering using EU structural funds to finance some projects requiring broadband networks.
Japan	• The City of Okayama is providing a fibre optic network using sewage lines for lease to regional companies and inhabitants at a low price. It aims to deploy broadband within the region by 2005.[2] • The Gifu prefecture is implementing its Gifu Information Superhighway Programme' with the deployment of municipal fibre optic network.[3] • The Mie prefecture is going to interconnect regional cable television companies' fibre optic networks and establish a broadband network which covers all regional areas. • The City of Ohta, in collaboration with regional companies, has established Broadband City Ohta (BBCO) and began ADSL service in August 2001.[4] • In October 2001 the Arakawa Ward in Tokyo Metropolitan City introduced a subsidisation system that assists construction of fibre optic networks to households and office buildings.[5]
Korea	• The Chungbuk Province has obliged providers of new apartment complexes to offer ADSL for Internet access.
Norway	• The municipality of Modalen has come to be known as the world's first broadband-enabled municipality since all of its 350 citizens were given broadband access. • In Alta, public home care workers are connected to their base and hospitals via radio (WLAN 802.11 3Mbits). The system enables them to have closer contact with patients and hospitals, increases safety for both patients and care workers, and reduces time-consuming travel. • The municipality of Oppdal is setting up a project to deliver online services to the public based on PKI, advanced maps and forms. The goal is to stimulate communication between the administration and the public, increase efficiency and generate a demand for broadband in the public and the local industry and business. • In Ryfylket, six municipalities have negotiated the establishment of a regional broadband network and outsourced the maintenance of their IT-systems to save costs. The project was able to cover broadband investment costs through reduced maintenance costs.
Sweden	• The City of Stockholm and the Stockholm County Council jointly own Stokab, which offers dark fibre connecting public institutions, several industrial offices and business centres without provision of services, for the purpose of promoting the expansion of the infrastructure in Stockholm County.
Switzerland	• The "School on the Net" project on the basis of public-private partnership plans to train some 30 000 teachers in virtual teaching and to link around 4 000 primary and secondary schools to the Internet. The operation, spread over five years, will cost the Swiss Confederation CHF 100 million and be complemented by an equal contribution from the private sector (Apple, Ascom, Cisco, IBL and Swisscom) and CHF 800-900 million from the cantons.[6]

Table 5. Examples of local government initiatives for broadband deployment *(cont'd)*

United Kingdom	• CW2000, a public/private sector initiative developed by Coventry University, will subsidise more than GBP 7 million to small and medium-sized businesses (SMEs) in Coventry and Warwickshire in order to make them more competitive by exploiting broadband networking. • Powys County Council, together with the Welsh Development Agency (WDA), established the Llwybr Pathway Projects which encourage the public and private sector to form partnerships to upgrade the broadband network in rural Wales for supporting ADSL. The total cost will be GBP 6.2 million for 1999-2002.
United States	(1) Iowa: ICN (Iowa Community Network) • The state's 133 independent telephone companies can connect government-built 3 200-mile fibre optic loop, which links the state's schools, hospitals, libraries, and government agencies. • The problem is that the state faces an estimated USD 45 million in upgrades and maintenance to keep the ageing network's technology current. (2) Arizona: ATS (Arizona Telecommunications Systems) • The Arizona Department of Administration (ADOA) developed a concept called ATS, which is to interconnect all Arizona state government offices, campuses, prisons, and other institutions as well as provide access for the state's citizens. • ADOA will not own and manage the system, but will award USD 180 million in telecommunications contracts to encourage private enterprise. • The problem is that the ADOA has not secured carrier support for the system; *i.e.* it has requested telecommunications providers to accept unprofitable contracts without providing them with assurance of more profitable contracts in the future. (3) Colorado: Beanpole Fund • The USD 4.8 million fund was created in May 1999, from which awards are given to carriers to provide telecommunications services for government and non-profit organisations. • Once communities have established their telecommunications needs, they will present a proposal for funding to the administrators of the Beanpole Fund, which encourages much faster infrastructure deployment. • The fund directly enables communities to select their own telecommunications provider, and this increased competition should promote lower prices and better services. (4) Washington • In 1999, the Spokane School Board deployed dark fibre to all 50 schools in their district with capital cost of over USD 1 million. (5) Georgia • The City of LaGrange financed and constructed a two-way hybrid fibre coaxial network, and is considering providing residents with free Internet services using cable modems. (6) Illinois • The City of Chicago has been pursuing bids from competitive local exchange carriers to connect local governments and hospitals to the Internet at broadband speeds. (7) Texas • The City of Austin went into partnership with Central and South West Communications (CSW) to build a regional broadband network in April 1996.

Notes*:*

1. See CEONET, http://www.ceonet.on.ca/more.htm.
2. Ministry of Public Management, Home Affairs, Posts and Telecommunications, Press release, August 3, 2001, http://www.soumu.go.jp/joho_tsusin/pressrelease/japanese/sogo_tsusin/010803_1.html/
3. Ministry of Public Management, Home Affairs, Posts and Telecommunications, Heisei 13 nen: Jyouhoutsuushin nikansuru genjyouhoukoku, Tokyo: MPHPT, 2001, p. 95.
4. See http://www.city.ota.gunma.jp/whatsnew/20010907-01-1.htm.
5. See Arakawa-ku no Houmupeiji, http://www.city.arakawa.tokyo.jp/topic/hp/2.htm.
6. See http://www.educa.ch.

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1. Office of the e-Envoy, UK Online: The Broadband Future: An Action Plan To Facilitate Roll-Out of Higher Bandwidth and Broadband Services, London: Cabinet Office, 2001, p. 12.

2. "Medicine in an Information Age", http://www.stanford.edu/~fgazitua/.

3. *UK online*, p. 17.

4. *UK online*, p. 18.

5. See http://webnet1.oecd.org/oecd/pages/home/displaygeneral/0,3380,EN-document-41-nodirectorate-no-21-3225-13,FF.html.

6. Everything DSL, http://www.everythingdsl.com/types/index.shtml.

7. DSL Net, http://www.dsl.net/how/how.html.

8. Everything DSL, http://www.everythingdsl.com/types/index.shtml.

9. UK Online, p. 36.

10. UK Online, p. 20.

11. Minister for Communication, Information, Technology and the Arts, National Bandwidth Inquiry Discussion Paper, http://www.noie.gov.au/projects/information_economy/bandwidth/papers/discpaper_full.htm.

12. UK Online, p. 6.

13. Report of the National Broadband Task Force, "The New National Dream: Networking the Nation for Broadband Access", Ottawa: Information Distribution Centre, 2001, p. 1, Available at http://broadband.gc.ca.

14. UK Online, p. 5.

15. Report of the National Broadband Task Force, "The New National Dream", p. 1.

16. ibid., p. 3.

17. ibid., p. 2.

18. The Ministry of Industry, Employment and Communications, "The Development of the IT Infrastructure", A publication about one of the priority areas of Swedish IT policy, p. 7, 11. Available at http://naring.regeringen.se/pressinfo/infomaterial/pdf/n2000_075en.pdf.

19. ibid., p. 14.

20. The Minister for Innovation and Technologies was appointed for the first time in July 2001.

21. The working group of the task force is responsible for formulating common policies and strategies to speed up the roll-out of broadband infrastructure within the country.

22. Ministry of Public Management, Home Affairs, Posts and Telecommunications, 2001 White Paper: "Information and Communications in Japan: The Accelerating IT Revolution: A Broadband-driven IT Renaissance", Tokyo: MPHPT, 2001, p. 4.

23. See Ministry of Public Management, Home Affairs, Posts and Telecommunications, Press release, October 16, 2001, http://www.soumu.go.jp/s-news/2001/011016_2.html.

24. Report of the National Broadband Task Force, The New National Dream, p. 4.

25. e-Japan Priority Policy Programme, March 29, 2001, http://www.kantei.go.jp/foreign/it/network/priority-all/2.html.

26. UK Online, p. 7.

27. UK Online, p. 23.

28. Forfas: The National Policy and Advisory Board for Enterprise, Trade, Science, Technology and Innovation, Broadband Telecommunications Investment in Ireland, http://www.forfas.ie/publications/bband.htm.

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33. The Ministry of Industry, Employment and Communications, "The Development of the IT Infrastructure", p. 5.

34. For example, see Barry Forbes, "Broadband and the Digital Divide", September 1999, http://www.civilrightsforum.org/broadband.htm.

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39. FCC News, January 28, 1999, http://www.fcc.gov/Bureaus/Common_Carrier/News_Releases/1999/nrcc9004.html.

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