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Laying the Foundation for the Internet Economy

ACCESS TO THE INTERNET VIA A HIGH-SPEED INFRASTRUCTURE

OECD

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FOREWORD

In its 2011-12 programme of work and budget, the Committee for Information, Computer and Communications Policy (ICCP) has given high priority to work on the review of the 2008 Seoul Declaration for the Future of the Internet economy. The aim of the review is *i)* to present developments in the Internet economy and the progress made since the Seoul declaration; and *ii)* to point policy makers to new issues areas that have arisen since the Seoul Ministerial and to issues for possible future work.

This document covers the first area of review "access to the Internet via a high speed infrastructure". The ICCP Committee and the Working Party on Communication Infrastructures and Services Policy discussed the document and provided comments. The ICCP Committee approved declassification of this document in October 2011.

The paper was drafted by Ms. Verena Weber with contributions from Ms. Deborah Alcocer under the guidance of Mr. Dimitri Ypsilanti of the OECD's Directorate for Science, Technology and Industry (DSTI). It is published under the responsibility of the Secretary-General of the OECD.

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Main points

This paper is the first paper of the follow-up work to the 2008 Seoul Ministerial Declaration for the Future of the Internet economy. It addresses the first theme, "*access to the Internet via a high speed infrastructure*".

The aim of the paper is *i)* to present developments and the progress made in this area since the Seoul declaration and *ii)* to point policy makers to new issues areas that have arisen since the Seoul Ministerial and to issues for possible future work.

In the Seoul Declaration, ministers identified the importance of high-speed networks and committed to a series of objectives in this area. These objectives can be broken down into six major areas:

1. Expanding access to networks and attaining greatest practical national coverage
2. Creating a market-friendly environment for investment and competition
3. Benefitting from convergence
4. Encouraging the adoption of IPv6
5. Encouraging a more efficient use of radio spectrum
6. Improving measurement and statistical instruments

The following paragraphs first present main market and policy developments for each area before main areas of future work are presented.

Markets and policy developments

Since the Seoul Declaration, *access to broadband networks* and the Internet have constantly increased. In terms of fixed broadband, penetration levels are close to maturity. In addition, further deployments of fibre networks have taken place; however, overall deployment of fibre is still at an early stage. On the mobile broadband side, 3G coverage is high and data traffic is expected to grow significantly. In terms of policies, national broadband plans have contributed to increasing access to the Internet. Some countries have furthermore invested public funds in the deployment of fibre networks.

Competition in the infrastructure market has also generally improved as customers have a wider range of communication services and prices to choose from and as new entrants and mobile virtual network operators have gained market share. To address the lack of competition in the context of specific market failures in the area of fixed broadband, some variants of functional and structural separation have been adopted by some countries. For mobile broadband, market regulators have continued to intervene to push down mobile termination rates in countries with calling-party-pays pricing structures. In addition, policy

makers have begun to more closely address high international mobile roaming rates that act as a barrier to trade and travel.

In communication markets, *convergence* has increased, along with a growing number of bundled offers such as triple play offers. Recently, some quadruple offers have emerged but are, so far, only offered in a couple of countries. There is also growing competition to cable television, satellite and traditional broadcasters from "over-the-top video services".

Another trend in communication markets is the growth of mobile voice and data traffic. Together with an increasing amount of smart devices this trend has increased and will further increase the demand for scarce *spectrum resources*. Since the Seoul Ministerial, new opportunities in spectrum allocation have arisen from spectrum bands that have been freed from the switch from analogue to digital television. Some countries have already allocated this so called "digital dividend" spectrum. In addition, technological progress has occurred as technologies have been developed that allow devices using so called white unused spectrum spaces.

In the area of *IPv6*, some policy initiatives have been put in place to spur the deployment of IPv6, such as its use by governments, but there is a pressing need for further action for the transition from IPv4 to IPv6.

Finally, a number of *indicators and price baskets* have been developed by the OECD since the Seoul Ministerial, to account for and better *measure* new developments in the area of broadband infrastructure. To track the increased importance of mobile network subscriptions, a wireless broadband indicator has been developed. Furthermore, fixed broadband price baskets have been developed to compare the price levels experienced by consumers and businesses in OECD countries for fixed broadband services provided over DSL, cable and fibre networks.

Important areas for possible future work

To develop greater coverage of broadband access, the deployment of high-speed networks including fibre networks needs increased attention. In particular, policy makers and regulators need to ensure that new investment is attracted and competition is enhanced. In rural areas, where for instance fibre deployment is at a very early stage or not currently economic, alternatives need to be explored. Investing in fibre-to-the home technology is very expensive and costs per home increase significantly for fibre in less dense areas. Governments have an important role to play in evaluating how best to provide broadband to these areas and to develop an environment conducive to investments in a range of broadband technologies.

A key question for future work that is linked to the deployment of high-speed networks is the question of how to *preserve and spur competition*. For example, due to its high cost, only one fibre network may be economically viable in some areas, in particular in less dense areas, which is a different situation than countries faced with a copper environment. In addition, the choice of the network topology determines the conditions for competitive physical access. Investment and topology decisions that are chosen today will have important effects on the future infrastructure landscape, its economic viability and competition. In mobile markets, there is also further room to spur competition, especially as far as mobile termination rates and international mobile roaming charges are concerned.

In terms of *convergence of communication services and bundled offers* such as triple and quadruple play, policy makers and regulators continue to have an important role in increasing the transparency for services and in monitoring potential abuses of market power. Developments in over-the-top video services are an important source of new competitive disciplines of pricing and offers from incumbent cable

television and satellite providers – in the same way VoIP services introduced greater competition in telephony.

The review of recent developments has further shown that due to the growth of mobile voice and data traffic as well as growing markets of smart phones and smart devices such as sensors and RFID tags, there is an ongoing need for an efficient allocation of spectrum. Where spectrum is freed, a prompt allocation should take place and market forces should be considered in spectrum reallocation and use.

In the area of IPv6, the available evidence suggests that the deployment of IPv6 remains too slow. It is thus crucial that policy makers encourage the transition to IPv6 from IPv4. Action that can be undertaken to spur the development include the upgrade and testing of hardware devices, to encourage the use of IPv6 by websites and to develop measures that record progress including for mobile networks more broadly ready for IPv6. In addition, more governments could engage in mandating IPv6 support for public procurement and further encourage the use of IPv6 by businesses and for services to households.

Finally, there is also room for improvement in terms of measuring access to broadband infrastructure on the demand side. In particular, indicators measuring the adoption and usage of broadband infrastructure can be further improved and detailed. Therefore, the OECD's model surveys for household and business use of information and communication technologies could be revised and further indicators in this area be developed.

Introduction

The present paper is the first paper of the follow-up work to the 2008 Seoul Ministerial Declaration for the Future of the Internet economy. The structure of the complete review, on the progress made on international and national levels since Seoul, tries to reflect the essential parts of the Internet economy along the lines of the Declaration's definition of the Internet economy. It is structured into the following seven thematic parts.

I. Laying the foundation for the Internet economy: Access to the Internet via a high-speed infrastructure

II. Understanding the data-driven economy: The development of a smart Internet economy

III. Innovating for economic growth and sustainability: Review of major areas of innovation in the Internet economy

IV. Cybersecurity and privacy

V. Empowering and protecting consumers

VI. Ensuring the global participation in the Internet economy for development

VII. Ensuring an open Internet economy

This paper addresses the first theme, *access to the Internet via a high-speed infrastructure*. The proposed structure of this report provides a model for the remaining six themes.

The review at international level is based on OECD publications and publication from other relevant organisations. Table A.1 in the Annex shows related OECD work in the communications infrastructure area.

The review at national level is based on existing work and documentation in this area and on responses to the Seoul questionnaire which was sent out in October 2010. At the time of writing, 60% of countries have sent their national responses to the questionnaire.

The purpose of this first report is twofold:

- First, it is intended to present the progress made since the 2008 Seoul Declaration in the area of high-speed infrastructure to policy makers and to thus provide a means for comparison.

- Second, it sheds lights on new issues areas which have arisen since the Seoul Ministerial and where further work is required and proposes points of actions.

The Seoul Declaration and a high-speed infrastructure

High-speed networks enabling access to and use of the Internet provide a platform for the Internet economy. Since the early days of the Internet, the amount of data sent via communication backbone and access networks has increased dramatically. The expansion of data traffic will continue as more and more individuals and companies rely on remote servers (see, for example, ongoing developments in cloud computing). In addition, the rapid diffusion of smart mobile devices and applications will drive traffic growth as will the increasing shift in accessing video content through the Internet rather than traditional over the air broadcasting channels. Finally, there will be increases in both the number of users and the number of devices connected to the Internet, including the increasing use of machine-to-machine communication.

In the Seoul Declaration, ministers identified the importance of high-speed networks and committed to a series of objectives in this area. Figure 1 provides an overview of commitments that are made in the Seoul Declaration regarding high-speed infrastructures. These commitments can be broken down into six major areas:

1. Expanding access to networks and attaining the greatest possible national coverage

2. Creating a market-friendly environment for investment and competition

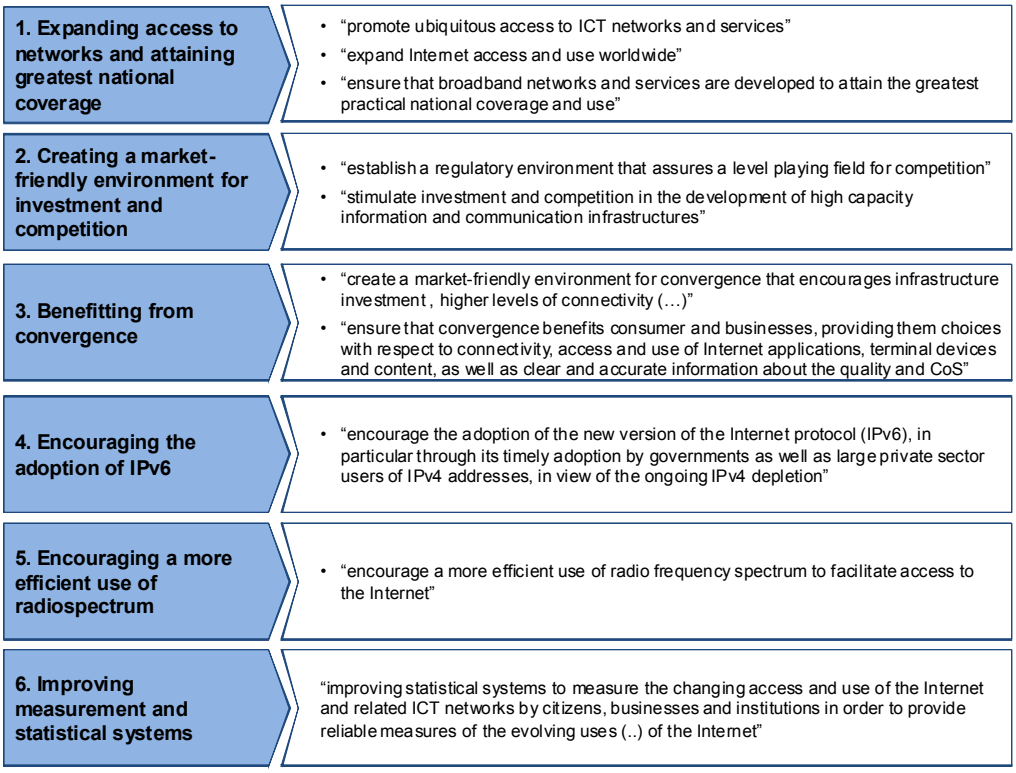
3. Benefitting from convergence

4. Encouraging the adoption of IPv6

5. Encouraging a more efficient use of radiospectrum

6. Improving measurement and statistical instruments

Figure 1: Objectives of the Seoul Declaration in the area of communications infrastructure and services



Source: OECD based on the 2008 Seoul Declaration

The report follows the structure presented in Figure 1 to discuss the progress made in light of the commitments made in the declaration. Each section begins with a brief executive summary of main achievements and areas for possible future work.

Expanding access to networks and attaining greatest national coverage

Major achievements

- Supply side: increased broadband penetration and coverage
- Demand side: increased number of households with broadband access
- Development and implementation of National Broadband Plans

Areas for possible future work

- Supply side: deployment and financing of FTTH/B
- Demand side: developing a policy framework to spur broadband **adoption** by individuals and businesses
- Monitoring the impact of National Broadband Plans

High-speed networks enabling access to, and use of, the Internet provide the foundation for the Internet economy. Acknowledging these facts, ministers in the Seoul Declaration

- identified the challenge of "*expanding Internet access and use worldwide*" and
- agreed to *"promote ubiquitous access to ICT networks and services*" and to "*ensure that broadband networks and services are deployed to attain the greatest practical national coverage and use*".

Over the last three years, policy makers have strived to meet goals set out in the Seoul Declaration. Increased access to the Internet has been the result of a number of different factors. Several of them can be attributed to policies introduced, or strengthened, following the Seoul Ministerial. The next section examines the developments made in terms of increased access to the infrastructure networks and the Internet. Policies will be presented both at international and national levels that have contributed to increased access.

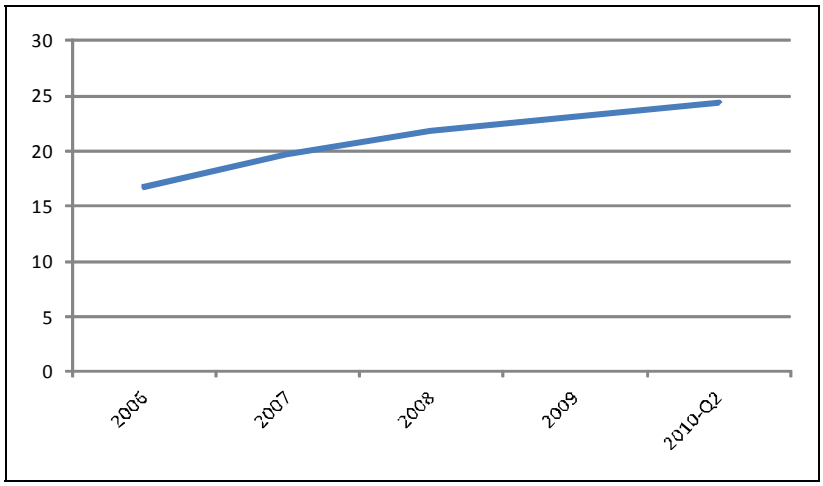
Overview of recent developments

To measure growth in access to the Internet and the deployment of broadband infrastructure, the OECD collects comparative data to report several indicators. These indicators map infrastructure developments from different perspectives. In the following, selected penetration, coverage and usage indicators for both fixed and wireless access to the Internet are examined.

A measure commonly used for broadband *penetration* is the number of broadband subscriptions. Broadband subscription data provides an indication of the number of connections supplied to users by network operators.[1] The advantage of subscription data is that it is available in a timely manner and that it provides an accurate picture of the number of broadband lines in use in different countries.

Figure 2 plots the development of fixed broadband subscriptions in the OECD area. Since the Seoul Ministerial, the number of subscriptions has substantially increased. At the end of the second quarter of 2010, the number of fixed broadband subscriptions reached on average 24.2 subscriptions per 100 inhabitants and thus has grown by 17.4% in that period. This growth rate is noteworthy as the subscription level in 2008 was relatively high and markets were supposed to be close to maturity at this time.

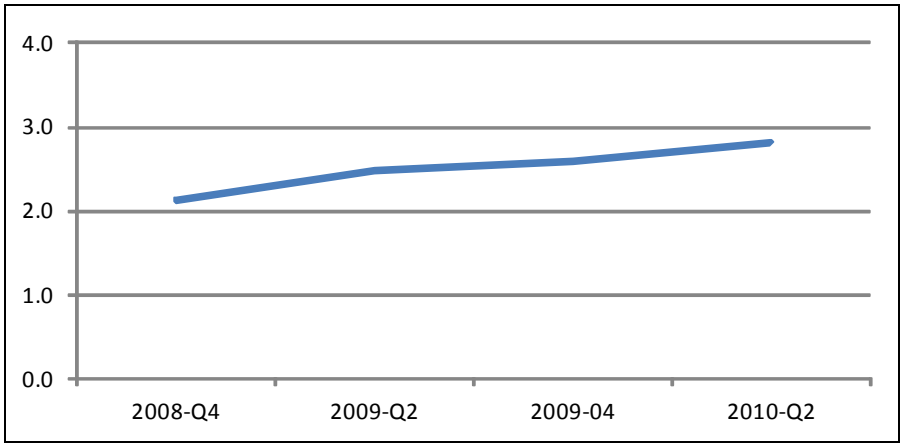
Figure 2: Fixed broadband subscriptions in the OECD per 100 inhabitants



Source: OECD Broadband Portal (2011)

Underlying the progress in broadband deployment has been an important increase in quality with an increase in the capacity of lines in particular with the acceleration in the deployment of fibre in the local loop. Since the end of 2008, Fibre to the Home (FTTH) and Fibre to the Building (FFTB) subscriptions have increased by 33.1% from 2.13 subscriptions per 100 inhabitants to 2.81 subscriptions per 100 inhabitants (see Figure 3). These numbers suggest, albeit with two exceptions, that the overall uptake of FTTH/B networks is still at an early stage (OECD, 2010b). The two exceptions, where uptake has been very significant, are Korea and Japan where extensive fibre networks have been deployed (17.92 and 14.55 subscriptions per 100 inhabitants). Further significant progress is being made in Northern European countries. The increasing use of fibre networks has raised a set of new issues and seems to be leading to diverging solutions among OECD countries on how to best build and finance FTTH/FTTB networks (see also the next section).

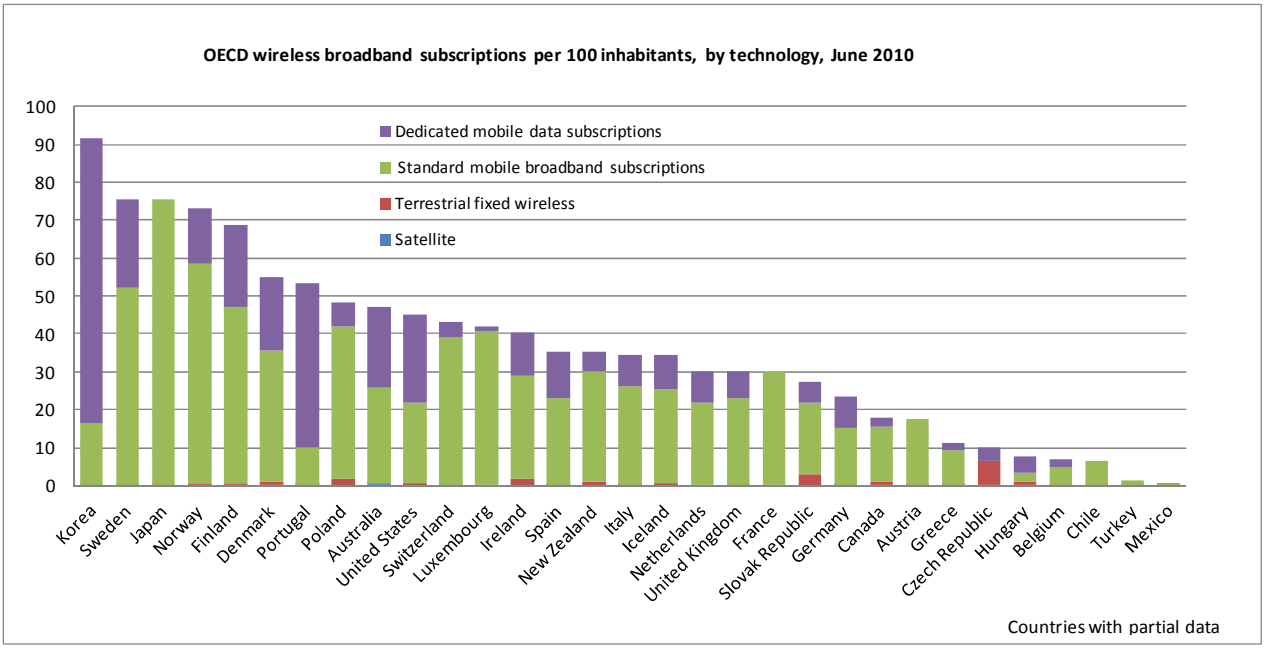
Figure 3: Fibre subscriptions per 100 inhabitants



Source: OECD Broadband Portal (2011)

In addition to developments in the fixed market, mobile subscriptions have also accelerated at a very rapid pace (OECD 2010i). In a follow-up to the request to develop new indicators, agreement was reached with member countries on a definition of an indicator for wireless broadband. Since 2010, the OECD has been collecting data on wireless broadband penetration. Figure 4 shows very high subscription rates for Korea, Sweden, Japan and Norway with over 70 subscriptions per 100 inhabitants. Especially in Korea, dedicated mobile data subscriptions are an important part of overall data subscriptions and it is expected that data subscriptions will increase significantly in the OECD area.

Figure 4: OECD wireless broadband subscriptions per 100 inhabitants, by technology, June 2010



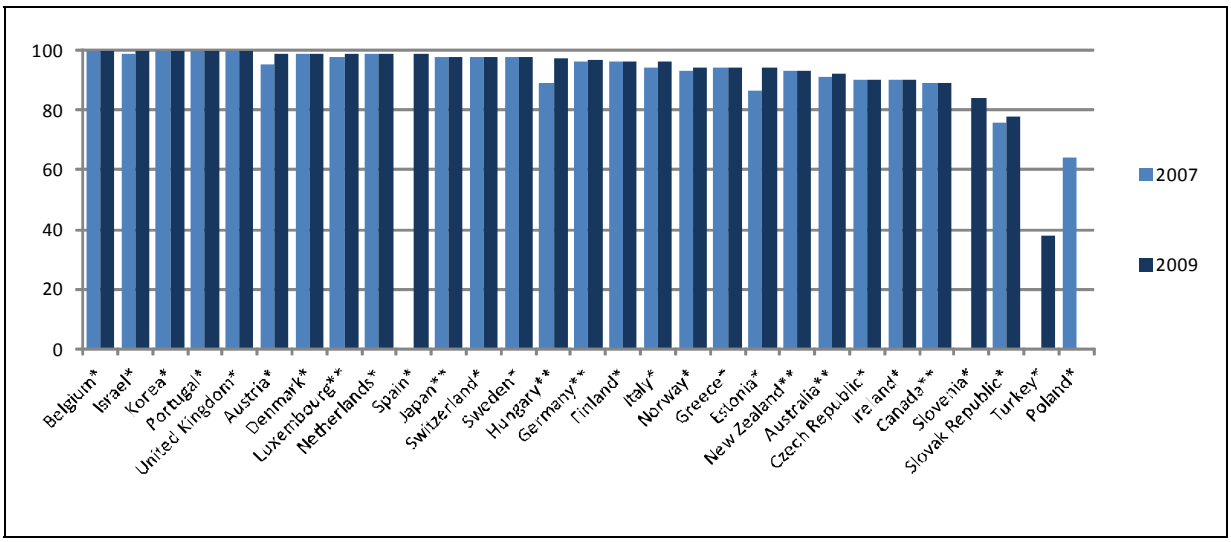
Note: Standard mobile broadband subscriptions may include dedicated mobile data subscriptions when breakdowns are not available.

Source: OECD Broadband Portal (2011)

The increasing number of subscriptions is related to the increased availability of high-speed broadband, both fixed and wireless, as well as significant changes that have occurred in the types and availability of terminals supporting mobile broadband.

Figure 5 and Figure 6 show the development of DSL and 3G coverage respectively. In the OECD area, DSL has the most extensive broadband coverage and there has only been a marginal increase in coverage in most countries given that there was already a very high availability in most OECD countries before the Seoul Ministerial (see Figure 5). Some countries that have a low coverage of DSL lines have seen high rates of growth from 2007 to 2009.

Figure 5: Coverage of digital subscriber lines (DSL)



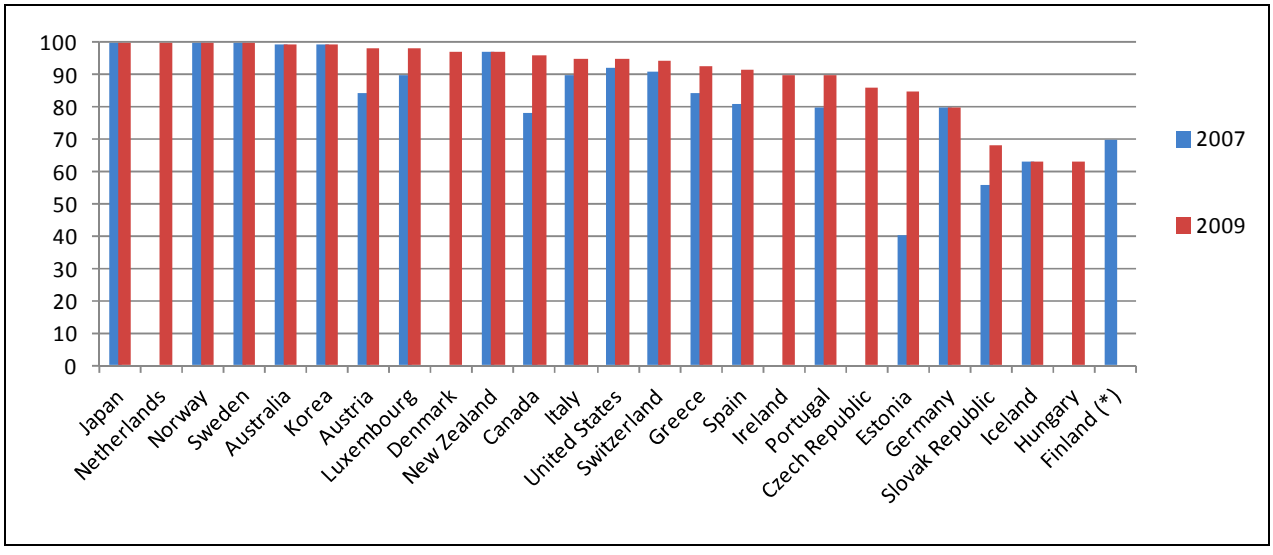
(*) Coverage as a percentage of lines; (**) Coverage as a percentage of population

Note: The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Source: OECD Broadband Portal (2011)

3G coverage figures show more variances than DSL coverage, but overall, coverage figures are also very high (see Figure 6). At least 19 countries had attained a coverage rate of 90% in 2009 and there have been significant gains in Slovak Republic, Canada and Austria.

Figure 6: 3G mobile networks coverage in percentage of population



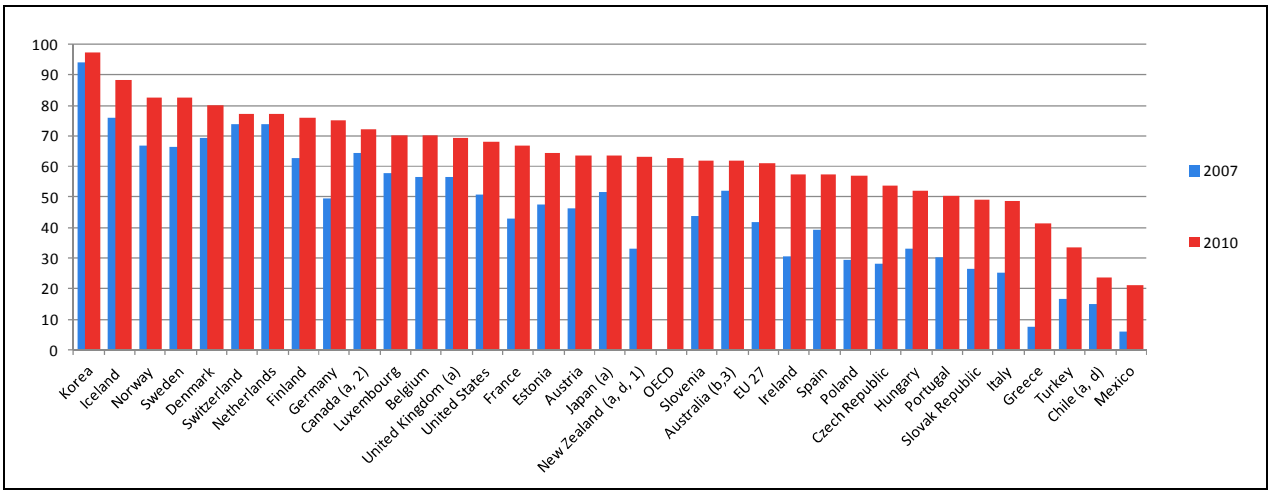
Source: OECD forthcoming – Telecommunications database 2011

The figures above show that, on the supply side, developments in OECD countries in terms of penetration and coverage are propitious. Broadband provides the platform to support the Internet and

services and applications for the Internet economy. While the supply side is important, however, policy makers must also pay attention to the demand side.

An important source of data on the development of Internet access is drawn from sample surveys[2]. The development of broadband infrastructure, and in many countries increased speeds, has stimulated the take-up and use by households of the Internet. Data from household surveys shows (Figure 7) how the number of households that have accessed the Internet via broadband connections has developed in OECD countries. In 2007, before the Seoul Ministerial, 50% of OECD member countries had a household access rate of above 50%. Since then, OECD countries with lower access levels have, in most cases, experienced significant growth rates. In 19 countries, the number of households with broadband access grew by more than 25% between 2007 and 2009. In 2009, more than 50% of households accessed the Internet via broadband connections in 23 member countries. In 2009, more than 90% of all Korean households used broadband connections, followed by Iceland (86.7%).

Figure 7: Households with broadband access, percentage of all households



Notes:
a. 2009; b. 2008; c. 2007; d. 2006

Internet access is via any device (desktop computer, portable computer, TV, mobile phone etc.).

Generally, data from the EU Community Survey on household use of ICT, which covers EU countries plus Iceland, Norway and Turkey, relate to the first quarter of the reference year. For the Czech Republic, data relate to the fourth quarter of the reference year.

Country notes:

(1) The information is based on households in private occupied dwellings with access to the Internet. Visitor-only dwellings, such as hotels, are excluded.

(2) Statistics for 2001 and every other year thereafter include the territories (Northwest Territories, Yukon Territory and Nunavut). For the even years, statistics include the ten provinces only.

(3) Data is based on a multi-staged area sample of private and non-private dwellings, and covers the civilian population only. Data for '2005-06' to '2008-09' includes persons aged 15 years and over except members of the permanent defence forces, certain diplomatic personnel of overseas governments customarily excluded from census and estimated population counts, overseas residents in Australia, and members of non-Australian defence forces (and their dependants) stationed in Australia.

Source: OECD The Internet economy – A Statistical Profile

Overall, the figures above show that access to broadband networks and the Internet have constantly increased since the Seoul Ministerial in 2008. In the case of fixed broadband penetration and coverage, levels of access are relatively high in a growing number of countries. However, deployments of fibre networks are still at an early stage and there remain open issues regarding the best way of deployment and

financing (see also section two). On the mobile broadband side, 3G coverage is high in the OECD area and data traffic is expected to grow significantly over the next few years (see Figure 8). A new technology, Long Term Evolution (LTE) is coming to the market, which can provide higher speed wireless data services with low latency (see OECD 2010i) with deployments taking place for instance in Northern Europe, Japan and the United States.

Table 1: Recent mobile traffic growth of selected network operators in OECD countries

Operators	Experiences
AT&T	Mobile traffic has increased more than 5 000% over the last three years.
Orange	Cumulated mobile data traffic in four European countries (France, United Kingdom, Spain and Poland) increased fivefold in 2008.
O2	Mobile data traffic was 18 times higher in 2009 than in 2008.
TeliaSonera	Mobile data traffic in their Nordic and Baltic operation increased by 500% in 2008.
Telstra	Traffic on the wireless network doubles every eight months.
T-Mobile (USA)	Mobile data traffic increased by 45% from Q2/09 to Q3/09.
Vodafone (Europe)	Data traffic has increased more than 300% over the last two years.

Source: OECD 2010i

Policies and programmes to spur increased access

The previous section described the developments in access to broadband infrastructure since the Seoul Ministerial. This section focuses on policies and programmes, both at international and national levels put in place that contributed to achieve the objectives of the Seoul Declaration.

International and national broadband plans

Since the Seoul Ministerial, a number of countries have developed national broadband plans and the economic downturn gave an impetus to the development and implementation of these plans. This was because of increased recognition of the productivity and growth impetus this could provide. In respect to the latter point, high-speed broadband was viewed as "shovel-ready", that is, could be implemented rapidly (OECD 2010j, OECD 2011a). During this period, many countries have developed and started to implement national broadband plans.

The plans have a number of different objectives. On the supply side, objectives include coverage, speed and technology objectives. In terms of coverage, governments have specified concrete coverage targets within a certain time frame, and some of these targets are linked with providing certain minimum levels of speed and in some cases linked to specific technologies. Very high, close to ubiquitous coverage targets have been set, for example, by Australia (93% by 2016), European Union Member States (100% basic broadband access by 2013 (see Box 1)), Israel (broadband included in universal service), Japan (100% fibre by 2015) and Turkey. Attaining a broader coverage in rural and remote areas is at the heart of many plans.

Most of the Enhanced Engagement countries identified by the OECD have also set coverage targets in their national broadband plans (see Table 2). Compared to OECD targets, however, those have been set at a lower level reflecting less mature levels of deployment and access. Several aim to attain ubiquitous access.

Box 1: Broadband targets and policies in the European Union: the *Europe 2020 Strategy* and *the Digital Agenda for Europe*

The Europe 2020 Strategy has emphasised the importance of broadband deployment "to promote social inclusion and competitiveness in the European Union" (EU, 2010b). Objectives set in the Europe 2020 Strategy are both directed at coverage and speed. They include *i)* bringing basic broadband to all Europeans by 2013; *ii)* ensuring access for all Europeans to Internet speeds of above 30Mbps by 2020; and *iii)* ensuring that at least 50% of European households subscribe to Internet connections of above 100Mbps. To achieve these objectives, the European Union Commission adopted a Broadband Communication 2010 laying out the framework of actions that include the following instruments:

Promotion of investments and reductions of investment costs: Several actions are proposed, *e.g. i)* the reduction of civil engineering costs (through the co-ordination of policies, town planning rules as well as through regulatory requirements for operators to disclose their local infrastructure), and *ii)* support of broadband deployment by public financing.

European Union broadband finance instruments for high speed broadband networks: Instruments include funding through the European Union financial framework, public-private-partnerships, the development of new finance instruments (*e.g.* guarantees, equity type instruments) and a more efficient use of structural and rural development funds for broadband deployment in rural areas.

Spectrum policy programme: First Radio Spectrum Policy Programme of the European Union Commission proposed to the European Parliament and Council in 2010. The programme sets up regulatory principles and policy objectives and defines concrete actions. Among others, it calls for an inventory and monitoring of needs for spectrum and calls for improvements in standardisation. In addition to these measures, European Union member states are asked to set fully operational plans for their national broadband strategies.

Sources: European Commission 2010a, 2010b, 2010c, 2010d.

Table 2: Broadband targets in the EE5

Country	Objective
Brazil	By 2014 to have 30 million fixed broadband connections, including homes, businesses and co-operatives, plus 100 000 telecentres
Russia	By 2010 to have 15 lines per 100 population By 2015 to have 35 lines per 100 population
India	By 2010 to have 20 million broadband connections
China	By 2014 to raise broadband accessibility to 45% of the population
South Africa	By 2014 to have 5% broadband penetration (min. 256 kbps)
Indonesia	No awareness of a national broadband plan

Source: Based on OECD (2010j)

For many countries, the coverage goals of broadband plans are focused on extending access to rural and remote areas. A couple of countries aim at accessing some remote areas via wireless broadband connections, *e.g.* Australia, Estonia and Ireland. Other countries link coverage obligations to spectrum auctions. In Germany, for example, operators who have succeeded in obtaining 800 MHz spectrum in the auction had to commit to extend rural coverage by 2016. In addition, the operators have to cover first rural areas with fewer than 5 000 inhabitants before they can start using the acquired frequencies in more densely populated areas.

In terms of speed, many national broadband plans have defined some minimum down- and upstream speeds. For 2010, the United States set a download speed target of 100Mbps and an upload speed target of 50 Mbps for at least 100 million households. Germany set the target of a download speed of 50 Mbps for 75% of all households by 2014. Denmark has the target that all households and enterprises should have access to 100 Mbps or more in 2020. Some countries such as Japan or Singapore have even committed to a nationwide ultra high speed fibre-to-the-home (FTTH) access infrastructure for every household.

Acknowledging new technological developments in the area of high-speed broadband, some national broadband plans emphasise specific broadband technologies. For instance, Luxembourg, Singapore and Japan have committed to fibre deployment. Australia decided to invest in a fibre-to-the premises network to 93% of households and businesses and to deploy next generation wireless and satellite services for the remaining 7%.

On the demand side, an important objective of many plans is to spur adoption by households and businesses. The level of adoption depends on multiple aspects such as digital literacy, hardware availability (*e.g.*, laptops, smart phones) as well as the availability of infrastructure and its quality. Demand factors, such as availability of online applications, digital content and eGovernment-services, also play a role. Policies to spur adoption differ significantly from supply side policies. So far, a number of national broadband plans (*e.g.* Hungary, United Kindom, Norway) address measures in several areas of demand. As far as digital literacy is concerned, concrete measures include, for instance, training courses to acquire sufficient skills and communication strategies highlighting the benefits of being connected to the Internet. Overall, policy measures in national broadband plans intended to increase adoption levels are often 'softer' than supply side policies aimed at network deployment and performance of networks. In addition, it is often more challenging to measure adoption levels (see also measurement section).

Overall, broadband plans have contributed and will further contribute to the Seoul Declaration objective of expanding access to the Internet in OECD countries and likely in most EE5 countries. National plans have been playing a major role in the deployment of broadband in remote and rural areas. They have further contributed to higher speed objectives in countries and some countries have committed to deploy nationwide FTTH broadband access. In addition, national broadband plans have also focused on the demand side, *i.e.* on the Seoul Declaration objective to increase the use of broadband.

However, governments have, in general been less active in pushing forward with policies which would give a significant boost to demand, for example, by stimulating the availability of smart electricity grids, or investing in smart transport networks, and so forth. Although the metrics of broadband coverage, subscribers and usage are important, it is less clear how countries are monitoring the implementation of their national broadband plans and their impact. Peer reviews of national broadband plans could be a very useful instrument to identify good practices and the experience gained in different broadband plans to increase the effectiveness of public spending in the area of broadband network deployments, Internet access and use.

Next Generation Access (NGA) networks

Many countries have engaged in increasing deployment of next generation access networks with a focus on fibre networks. In some countries, the deployment of these networks is well advanced. Examples include Japan and Korea and some of the larger cities in some countries such as France, Italy, Portugal, Slovak Republic, Sweden and the United States. However, overall investments are in some cases not proceeding as fast as policy makers would like and coverage of most urban areas in OECD countries remain to be developed (OECD 2011a). Table 3 gives an overview of the state of fibre deployment in 2010.

Table 3: State of FTTH/FTTB Deployment in 2010

	Homes Passed[1]	Main Topology[2]	% Main Topology	Largest party deploying
Australia	40 000	PtMP	100%	Government
Austria	63 000	PtP	90%	Municipalities
Belgium	3 750	na	na	Incumbent
Canada	280 000	PtMP	na	Incumbent
Chile	20 000	PtMP	na	Incumbent
Czech Republic	195 000	PtMP	100%	Altnets[3]
Denmark	795 300	PtP	85%	Utilities
Finland	544 000	PtP	100%	Incumbent(s)
France[4]	1 383 588	PtMP	55%	Incumbent
Germany	560 000	PtP	70%	Utilities
Greece	5 000	PtP		Altnets
Hungary	215 000	PtMP	100%	Incumbent
Iceland	33 000	PtP	80%	Utility
Ireland	16 900	PtP	95%	Altnets
Italy	2 245 500	PtP	100%	Altnets
Japan	46 000 000	PtMP	80%	Incumbent
Korea	16 000 000	PtMP	100%	Incumbent
Luxembourg	56 000	PtP	100%	Incumbent
Mexico	100 000	PtMP	na	Incumbent
Netherlands	662 500	PtP	90%	Incumbent
New Zealand	50 000	PtMP	80%	Altnets
Norway	381 700	PtP	100%	Utility
Poland	90 265	PtP	95%	Utility
Portugal	1 470 000	PtMP	100%	Incumbent
Slovakia	615 000	PtMP	95%	Incumbent
Slovenia	310 000	PtP	100%	Altnets
Spain	412 500	PtMP	100%	Incumbent
Sweden	1 464 500	PtP	90%	Altnet
Switzerland	212 500	PtP	90%	Incumbent
Turkey	200 000	PtP	na	Altnets
United Kingdom	138 000	PtP	na	Altnets
United States	19 676 200	PtMP	na	Incumbent

Notes 1) Homes Passed are potential premises to which an operator has the capability to connect in a service area, but the premises may or may not be connected to the network. Typically new service activation will require the installation and/or connection of a drop cable from the homes passed point (*e.g.* fibre-pedestal, handhole, chamber, utility-pole) to the premises, and the installation of subscriber premises equipment, including an ONT (Optical Network Termination) device at the premises. 2) Topologies can be either point to point (PtP) or point to multipoint (PtMP). 3) Altnets are alternative network operators other than the traditional Incumbent operator. 4) Data excludes the Numericable network.

Source: OECD, 2010b based on IDATE for the FTTH Council Europe, FTTH Council North America, FTTH Council Asia Pacific, European Communication Committee, primary[3]

Investing in fibre to the home technology is expensive. The costs per home increase for fibre in less dense urban areas, and even more so for rural areas. Countries have taken very different approaches to investment in fibre networks and to define the terms of competition. In countries such as Australia, the government is deploying fibre networks whereas other countries such as the Netherlands prefer a market-driven approach. Investment decisions taken today will have an important effect on the future

infrastructure landscape and competition. The two main deployment topologies that are currently used, Point to Point (PtP) and Point to Multipoint (PtMP), differ significantly in the competitive physical access conditions that they provide. Physical access alternatives are significantly more limited when PtMP is deployed. Consequently, this limitation in a PtMP network might limit future competition. In this context, policy makers need to assess potential solutions in order to ensure competition is maintained.

For the future, policy makers have two main challenges:

1. Policy makers could continue to encourage investments in high-speed networks including fibre networks. Thereby, policy makers should carefully evaluate the advantages and drawbacks of the different approaches that are currently taken. A comparison of best practises and results of the different approaches on an international level can provide a very valuable decision support tool for the approach to be taken.

2. Policy makers should ensure that adequate competition is maintained during and after the deployment of the fibre networks. Only attractive offers for consumers and business ensure the take-up of the networks and further innovation. Increased take-up, in turn, spurs further investments in networks as they determine return on investment.

Creating a market-friendly environment for investment and competition

Major achievements

- Communications services have expanded over the last few years, as subscriptions have grown and usage has increased; Competition has generally improved, customers now have a wider range of communications services and price layers to choose from and new entrants and mobile virtual network operators have gained market share expanding consumer choice.

Areas for possible future work

- Need to develop an environment conducive to investment in Next Generation Access networks, while preserving competition and increasing access. Significant economic and social benefits should arise once fibre networks are broadly deployed.

- Improvement of competition and market dynamics in mobile markets, especially in the areas of mobile termination rates and international mobile roaming services.

In the Seoul Declaration, Ministers highlighted the important role of competition in the development of a high-speed broadband infrastructure. They agreed to:

- "*establish a regulatory environment that assures a level playing field for competition*" and to

- "*stimulate investment and competition in the development of high capacity information and communication infrastructures*"

Recent developments[4]

Since the Seoul Ministerial, competition in telecommunication markets has increased and has been beneficial for households and consumers. The share of new entrants in total PSTN[5] subscriber lines has risen and new entrants in the PSTN line subscriber market have gained market share since 2008 as shown in Table A.2 in the Annex. In addition, prices have fallen and new technologies and services have emerged.

Competition outcomes have been more marked in fixed broadband markets which are still growing in the OECD area though at a slower pace than in the previous decade. Competition remedies such as local loop unbundling have been very successful in some broadband markets and have increased the number of providers available for consumers and businesses, especially in urban areas. Most OECD countries also have at least one cable operator which provides end-to-end infrastructure competition, although in some cases not on a nation-wide basis.

The private sector has accounted for major investments in broadband infrastructure. However, policy makers are assessing whether governments have to support the deployment of next generation access networks in less populated areas to ensure broadband availability. Fibre "local loop" network deployment has been to date very limited, with the exception of Japan and Korea (see also section 1), and some urban areas of other countries (*e.g.* Portugal, the Slovak Republic, Sweden and the United States). The business case for fibre deployment is in many cases not compelling for operators which are reluctant to face the significant investments involved. Policy makers are concerned that the pace of deployment of these networks may not meet their policy objectives.

In the area of wireless networks, a major development has been triggered by smart phones that have driven the competition in higher speed mobile services. Mobile broadband services are expected to grow over the coming years and to significantly contribute to operators' revenues. Mobile operators continue to invest in upgrading their networks and thus provide a means for effective competition to fixed networks for traditional voice and complement fibre network services and, for some services, can compete with fibre broadband services. An indicator for this recent development is the number of households that have given up their traditional PSTN line and have not replaced it by a fixed broadband service. Another indicator is the boost of mobile broadband which has rapidly overtaken fixed broadband in terms of penetration in many OECD countries. While clearly valued by users in its own right, mobile broadband plays an important complimentary role to fixed networks in improving connectivity and communications uptake.

Mobile operators have been successful in building revenue during the economic crisis. Most large operators have maintained market shares and some of them are expanding their footprint to non-OECD countries. Mobile virtual network providers (MVNOs) provide competitive pressure to established operators. A number of them are offering new services, previously only offered by more established providers, such as pre-paid smart-phones, thus entering new market and segments spurring competition. Number portability remains a key instrument of competition as it allows users to switch to the providers and the services of their choice.

Policies fostering competition

Next generation access networks – fibre and cable networks

In terms of next generation network deployment, countries are following a number of different approaches. Key factors being taken into account include how to stimulate investment and competition in order to achieve social and economic benefits, bearing in mind the challenges of deploying fibre ever closer to users.

Australia, New Zealand and Singapore are investing public funds in deploying next generation access networks. The European Union issued "Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks".[6] India is also considering a proposal, from its regulatory authority, to publicly fund a national broadband network. While the use of public funding is not uncommon, in itself, these countries have introduced changes in market structures associated with this investment. In order to foster competition, associated with publicly funded networks, some countries are implementing some form of vertical separation between the wholesale and retail service provision. A

further group of countries have introduced functional separation for fixed broadband networks, not always in association with public investment, such as in Sweden, and the United Kingdom and proposed in Japan. In a further group of countries, public investment is associated with "open access" networks, such as fibre backbone networks. This is the case for proposals in Chile and India. A further group of countries seek to enhance competition via unbundling of legacy copper networks or shared use of new fibre infrastructure. Finally, a number of countries principally rely on infrastructure competition, such as Canada, Korea and the United States (OECD 2011a). In these countries, public investment has primarily been used for expansion, and network upgrades in rural areas, sometimes with open access requirements but little use of unbundling.

Overall, as mentioned in the previous sections, fibre-based networks (either based on fibre-to-the-home or as an upgrade of current cable television networks) are not always being deployed at the speed, or with the geographic coverage, policy makers would wish. In terms of competition, it is important that policy makers set up a clear regulatory framework where terms of conditions are transparent and reliable and where the longer-term implications for investment have been assessed. Current decisions may have a large impact on the future competition environment, as the upgrade to fibre is expected to have an impact over the next decade. If policy makers decide to support the deployment of next generation networks, they need to pay careful attention in order to provide the right incentives, not to interfere with private investment nor distort competition where it can be avoided, while preserving the regulatory certainty for the players involved. Overall, they need to strike a balance between four key objectives when relying on public investments: improving connectivity, increasing competition, stimulating innovation and growth and increasing social benefits (OECD 2011a, p. 8)

An important source of competition in high speed broadband markets and substitutes to fibre networks are cable networks in countries with widespread cable coverage. Since the Seoul Ministerial, considerable investments in cable networks in some countries have been undertaken. The DOCSIS 3.0 (Data Over Cable Service Interface Specification) spurred this development. In terms of competition within the cable market, local-loop unbundling has been mandated by few countries but not effectively implemented due, to a large extent, to technical challenges. A couple of countries (*e.g.* Canada) have regulated the market by imposing bitstream obligations on operators. These wholesale remedies may provide an arguably inferior solution in terms of service innovation and independence for new entrants. However, given the architecture of cable networks, it is not clear whether any technically and economically practical solutions exist that permit full unbundling.

The mobile communications market – Mobile termination rates (MTR) and international mobile roaming

Challenges to competition remain in many mobile markets, such as high mobile termination rates and for international mobile roaming services. These factors can act as a barrier to greater use of mobile services in supporting the Internet economy. This can include acting as a drag on the growth of the global Internet economy in areas such as trade and travel.

In the mobile communication market, mobile termination rates are the fees that mobile operators charge other carriers to terminate calls on their networks. They can represent a significant element of the price paid by users in providing retail services of mobile-to-mobile or mobile-to-fixed calls – in countries with a "calling party pays" system. An example may be the high cost of termination on an international call from a user in a developing country to the mobile phone of a user in an OECD country.

These termination rates can be a barrier to competition and to lower prices for calls if they are set at a much higher price than the actual costs. High MTRs impede operators to behave independently from competitors, prevent flat-rate mobile plans and thus might decrease the usage of mobile phones. In addition, they provoke market distortions in the fixed and mobile communication markets by creating

transfers from the fixed to the mobile communication market (OECD 2011a). In order to improve competitive conditions in the mobile communication market, regulators, in countries with calling party pays pricing structures, have continued to intervene to push down termination rates toward long run incremental cost.

The high prices for international mobile roaming services are a further concern for all stakeholders. Since the Seoul Declaration, policy makers and regulators have begun to address more closely high international mobile roaming rates. In 2009 and 2010, three reports were prepared by the OECD that addressed this issue. They proposed a range of options. These included, among others, the empowerment of consumers through raising awareness about substitutes and an increased price transparency and well as the measure of an increased level of international co-operation. They also include the possibility of wholesale and retail price regulation, should other measures not result in lower prices paid by consumers (see also the OECD reports OECD 2009f, OECD 2010c and OECD 2010d).

Most regulators and international organisations have been engaged in addressing the insufficient competition in mobile roaming markets. The European Union, in 2007, issued the European Roaming Regulation which was subsequently amended and expanded. It enforced retail and wholesale price regulation and included other measures to improve transparency and consumer empowerment. Other entities in multiple regions have also been engaged in discussions (*e.g.* APECTEL and APT Telecommunications -Asia-, IIRSA/CITEL -Latin America-, AREGNET -Arab countries-). In addition, the governments of Australia and New Zealand have started the evaluation of bilateral roaming services (OECD 2011a), with a view to examining the lack of competition in these markets. However, prices for both mobile voice and data services remain high and further action to reduce prices of international mobile roaming are required.

Benefitting from convergence

Major achievements

- Broad availability of triple-play offers and emerging quadruple-play offers
- First websites that compare the offers of several bundled services

Areas for possible future work

- Need for a coherent and holistic regulatory approach that takes the increasing convergence of fixed and mobile phone, broadcasting and Internet services into account
- Continued effort in spurring competition, especially in areas where bundled offers prevail and where there are bundling arrangements with new devices
- Lack of transparency of bundled offers: Regulators need to require providers to provide clear and transparent information of services offers and related costs
- Careful continued monitoring of potential abuses of market power

Ministers committed in the Seoul Declaration to: **"***Create a market-friendly environment for convergence that encourages infrastructure investment, higher levels of connectivity and innovative services and applications*" and to

"*Ensure that convergence benefits consumer and businesses, providing them choices with respect to connectivity, access and use of Internet applications, terminal devices and content, as well as clear and accurate information about the quality and cost of services*".

The following paragraphs depict recent convergence developments.

Recent developments

Since the Seoul Ministerial, convergence in communication markets has increased, along with an ever growing number of bundled offers. Many DSL providers offer VoIP and IPTV services, challenging the market position of traditional PSTN-offers as well as other television broadcast platforms. Cable operators, in turn, offer high speed broadband and data services, including voice services. Convergence has spurred an important level of cross-platform and cross-services competition, because several technology platforms provide similar services. For instance, the advent of Skype and other free VoIP services has added competition and new services to the traditional fixed and mobile voice market (OECD 2011a).

Along with trends in convergence, the number of bundled services (double-, triple-, or quadruple-play) is constantly increasing. In 2010, broadband services were overwhelmingly sold as mixed bundles, *i.e.* consumers had the choice between bundled services and stand-alone offers (OECD 2010a). Triple-play offers are available in many countries now, however, not always in remote areas as these offers depend on network upgrades by operators in those areas. Quadruple-services are just emerging and are, so far, only offered in some countries. A couple of challenges, such as arrangements that have to be made with mobile operators, expected revenue decreases from packaged mobile and fixed offers (instead of selling them separately) and limited options for incumbents to provide these offers due to their market power and respective regulations hamper a fast roll-out of quadruple-play. However, some mobile providers in France, the United Kingdom and further providers in Austria, Germany, the Netherlands, Portugal and in the United States have launched quadruple-play offers (OECD 2011a).

Besides these bundled offers, new devices such as the Apple's iPad, iPhone or Amazon Kindle trigger new ways of bundling. These devices use mobile services and have a commercial relationship with mobile operators. Smart devices have often been bundled with the offer of one mobile operator which raised concerns regarding competition (OECD 2011a). In addition, sponsored connectivity models are arising where device providers, such as Amazon for the Kindle, negotiate with telecommunication operators and where the end-customer of the device has no direct contact with the connectivity provider. In the case of a Kindle, the customer pays for the service through the content purchased.

Bundling can have benefits and drawbacks to consumers and businesses. On the benefit side, bundled offers are usually less expensive than the sum of standalone services. In addition, customers profit from the fact that several services are offered by one provider only. On the negative side, however, the complexity of bundles makes a comparison of different offers difficult so there is a lack of market transparency. Compared to stand-alone prices, customers are confronted with the task of mapping different services from different operators to prices. Furthermore, bundles can lead to consumer lock-in, making it harder to switch providers. Finally, there are some fears that bundling may enable abuse of market power if some incumbent operators are able to cross-subsidise some services in product bundles while new entrants usually have difficulty if they are not able to provide all the components of a bundled offer.

Roles for policy makers and regulators

The increasing convergence of fixed and mobile phone, broadcasting and Internet services create the need for a coherent regulatory approach. In terms of organisational structures of regulators, it could be

reasonable to merge different regulators. Some countries have already merged telecommunications and broadcast regulators.

In terms of bundled services, a major aim of policy makers and regulators is to ensure that competition is fostered. To achieve this aim and to overcome the drawbacks of bundled services, policy makers have a role in *i)* increasing the transparency of services and pricing; *ii)* avoiding customer lock-in, and *iii)* avoiding the abuse of market power by large operators.

In the first area of increased transparency, policy makers and consumer protection agencies should encourage service providers to "provide more information on the characteristics of packages they are selling and to make prices clear and understandable" (OECD 2010a, p. 4). To date, however, offers are still promoted in a rather non-transparent way and policy makers should require providers to clearly indicate all services and costs of the bundled offers. Websites that are comparing offers of different providers are a helpful tool for customers to compare the different packages and service characteristics. In some countries such as Belgium and Ireland, regulators have already sponsored dedicated websites. In other countries, private websites fulfil the role of comparing different broadband offers. However, only few of them compare sophisticated bundled offers and sometimes it is not clear whether there are some offers that receive preferential treatment in bundling rankings.

To avoid customer lock-in, regulators should ensure that customers of bundled-services can switch providers quickly and easily (see, for example, the BEREC report on "best practices to facilitate consumer switching" (BEREC, 2010)). Policy makers have a role in educating customers about their rights and switching procedures. The possibility of number portability for fixed and mobile phone numbers further reduces perceived switching costs of customers. Furthermore, regulators could prohibit automatic initial contract renewals.

Finally, in the area of a potential abuse of power, "regulators and competition authorities may need to work together to address lingering problems with market dominance, noting that operators face varying levels of competition in different areas of the country" (OECD 2010a, p. 4). Options to avoid those abuses include extended unbundling regulations or investments in separated infrastructure. In some countries, operators have already determined that bundles with a broadcast component could lead to abuse of market powers by large operators. In Luxembourg, for instance, the incumbent's bundled offer does not include television services.

The pressing need for encouraging the adoption of IPv6

Major achievements

- Policy initiatives that have been put in place for the deployment of IPv6,...

Areas for possible future work

- however implementation of IPv6 remains too slow. The transition to IPv6 should be spurred by the following actions:
  - Encourage the upgrade of routers, firewalls, middleware and support systems and encourage that these devices are **tested** regarding the proper support of IPv6s
  - Mandate IPv6 support in public procurement
  - Develop measures to make mobile networks ready for IPv6
  - Encourage the support of IPv6 by websites

- Encourage the use of IPv6 by businesses

On 3 February of this year, the Internet Assigned Numbers Authority (IANA) distributed the last blocks of IPv4 addresses to the Regional Internet Registries (RIRs). The growth of Internet connections in recent years along with a fast growing number of different internet-connected devices such as smart phones have contributed to this run-out. The RIRs will be able to further distribute the remaining addresses of this last block for a couple of months but it is expected that the IPv4 address exhaustion will take place in 2011.

The internet community first addressed this issue in 1992 with the establishment of the RIRs, who implemented Classless Interdomain Routing and strict guidelines to issue addresses. Technological fixes like Network Address Translation further delayed the complete exhaustion and its impacts. Today, there will likely emerge a market for IPv4 addresses, where those who came too late can buy new addresses, which may extend the life of IPv4 by a few more years. However, the deployment of IPv6 is seen as the only sustainable and long-term solution to ensure that the Internet continues to be a driver of innovation and growth (see OECD 2011a, Chapter 5).

IPv6, a newer version of the Internet protocol, uses 128-bit addresses and has a quasi-virtual address space of 2^{128} IP addresses. Furthermore, it has several advantages over IPv4 such as improved quality of service (QoS), authentication and privacy qualities and better support for the mobile Internet (OECD 2011a, Chapter 5).

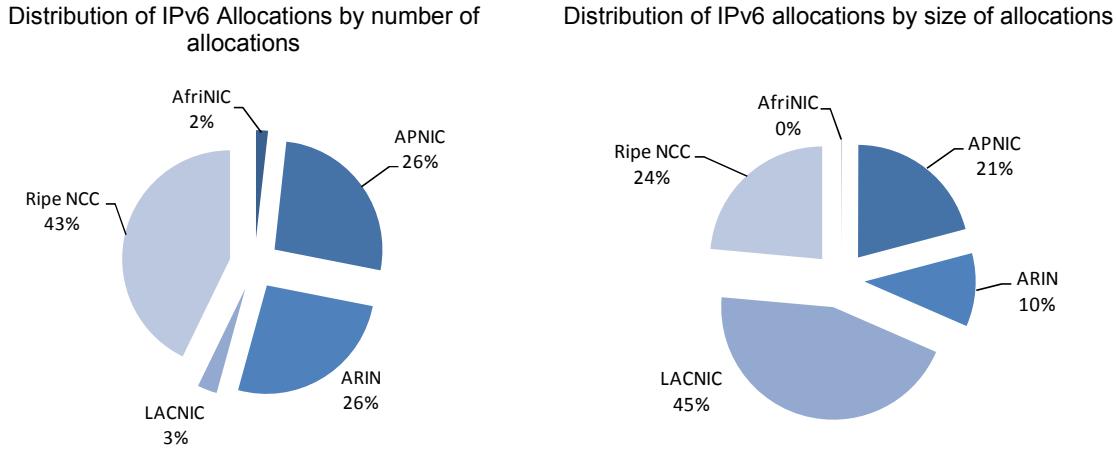
In the Seoul Declaration, ministers recognised the need to deploy IPv6 in a timely manner. They committed to *"encourage the adoption of the new version of the Internet protocol (IPv6), in particular through its timely adoption by governments as well as large private sector users of IPv4 addresses, in view of the ongoing IPv4 depletion"*.

Recent developments in IPv6 deployment

Due to the upcoming IPv4 exhaustion, the deployment of IPv6 becomes a pressing issue. The current IPv6 deployment can be mapped in several ways. In the following, developments in allocation[7] of IPv6 addresses and the use of IPv6 by Internet users are discussed.

Following the same procedure as for IPv4, IANA allocates IPv6 address space to RIRs based on needs. Figure 8 (left) shows the regional distribution of IPv6 allocations by the number of allocations. In the first half of 2010, OECD countries accounted for 74% of total IPv6 allocation.

Figure 8: Distribution of total IPv6 allocations by the RIRs, August 2010



Source: OECD (OECD 2011a, Chapter 5). Based on data from the RIRs.

In terms of size, the Latin American Market had the largest share of IPv6 allocations which can be interpreted as a high interest to deploy IPv6 at a large scale. However, this high number is likely due to an extremely large allocation by the National Internet Registry of Brazil in 2008 (see Table 4). Other large size allocations were assigned to European and Asian telecommunication operators as well as to Departments of Defence. For example, a/19 blocks have been allocated to the operators France Telecom and Deutsche Telekom and a/20 blocks to providers in Italy, Japan and Korea and the Australian Government Department of Defense.

Table 4. Selected large IPv6 allocations

PREFIX	COMPANY	DATE
2804:0000:: /16	NIC Brazil	2008/11/28
2003::/19	Deutsche Telekom, Germany	2005/01/13
2a01:c000::/19	France Telecom, France	2005/12/30
2a01:2000::/20	Telecom Italia, Italy	2006/05/16
2400:2000::/20	Softbank BB IPv6 Network, Japan	2005/07/12
2400:0000::/20	Korea Telecom, Korea	2005/06/01
2401:6000::/20	Australian Government Department of Defence, Australia	2007/08/10
2a01:1000::/21	Telekomunikacja Polska S.A.	2006/02/01
2608:0000::/22	United States Department of Defense (DoD), United States	2008/05/06
2a00:2000::/22	British Telecom, United Kingdom	2007/08/29
240e:0000::/24	China Telecom	2010/05/20
240a:0000::/25	Japan NIC	2010/03/02
2a02:1000::/26	German Federal Ministry of the Interior	2009/11/16
2a02:1400::/26	B2 Bredband AB, Sweden	2010/03/01

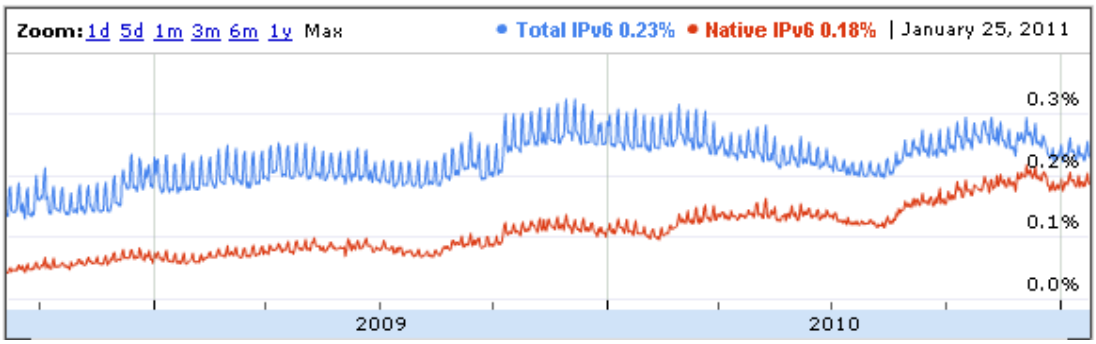
Source: OECD (OECD 2011a Chapter 5). Extracted from RIR IP Whois databases.

Overall, the size of IPv6 deployment could give some indication of the planned scale of IPv6 deployment. Since 2007, the demand for IPv6 addresses has surpassed IPv4 demand and the RIRs had made 6 000 allocations in the first half of 2010. However, allocations have so far been largely driven by some operators and heavy users.

The allocation numbers in the preceding paragraphs have given some indications on the general interest to deploy IPv6 but they do not show the actual usage. To check the current state of deployment, it is thus crucial to monitor the usage of IPv6.

Figure 9 shows the availability of IPv6 connectivity among users of Google. Google checks whether it would have been possible for a user who still uses IPv4 to have used IPv6 to reach the site. On 25 January, for example, only 0.23% of Google users that accessed the webpage via an IPv4 or IPv6 connection were capable of using IPv6 and an even lower percentage (0.18%) were capable of using native[8] IPv6 connections (see also Colitti *et al*., 2010). Noteworthy is that the percentage varies during a course of the week with higher percentages over the weekend. This indicates that IPv6 is more available for households than for users at workplaces. Over the years 2009 and 2010, IPv6 connectivity has been growing but the percentage is still *very low* especially in light of this year's IPv4 exhaustion.

Figure 9: Availability of IPv6 connectivity among Google users



Source: Google IPv6 Statistics.

Overall, despite the foreseeable exhaustion of IPv4, the deployment of IPv6 has been very slow and substantial challenges have to be overcome to achieve the transition from IPv4 to IPv6 as IPv6 is not downward compatible. The relative use of IPv6 has to be increased significantly in a short period of time to satisfy future foreseeable demand. Important investments have to be made in order to upgrade, for example, the hosts, support systems and networks. For instance, the take-up in mobile network upgrades has been very limited to date (see also OECD 2010i). Overall, all stakeholders of the Internet economy have to be mobilised.

Although in the Seoul Declaration ministers called for a timely adoption of the new Internet protocol in 2008, developments have not been very promising during the last three years. The next section will discuss policies that have been put in place since the Seoul Ministerial and ways to move forward to a quicker adoption of IPv6.

Policies and programmes to spur the deployment of IPv6

In 2008, the OECD made recommendations for a policy environment to spur a timely deployment of IPv6 (OECD 2007). Recommendations included: *i)* Working with the private sector and other stakeholders to increase education and awareness and reduce bottlenecks; *ii) d*emonstrating government commitment to adoption of IPv6; and *iii) p*ursuing international co-operation and monitoring IPv6 deployment.

Since this time, governments have engaged in initiatives to promote the deployment of IPv6. Table A3 in the Annex provides an overview of national policy initiatives.

In terms of broadband infrastructure readiness, Slovenia made a very remarkable commitment: In its strategy for the development of broadband networks, all networks have to be IPv6 ready to enable future innovation and development in many areas of the Internet economy such as e-health, e-commerce and

e-government. It also seems to be the only country to have commercial availability of IPv6 over mobile networks.

In addition, most governments in OECD countries have undertaken awareness building initiatives. These include the publication of IPv6 activities (*e.g.* Japan), IPv6 taskforces (*e.g.* Austria, Ireland, Italy, Japan, the Netherlands), IPv6 educational programmes and training (*e.g.* Japan, Korea, New Zealand) and public-private partnerships (*e.g.* Denmark, Korea, Norway). Furthermore, some countries such as Denmark, Germany and Japan have engaged in IPv6 pilot projects and testing platforms.

Several countries have further focused on IPv6 adoption by governments. As governments are important users of networking equipment, it is supposed that an early adoption by governments has an important multiplier and spill-over effect on businesses and households. The United States, for example, have set a timeline for the use of IPv6 on public servers by 2012. The Netherlands, Denmark, the Czech Republic, New Zealand and Switzerland, for instance, have mandated IPv6 support in public procurement contracts. Australia and Germany have set up strategies for a comprehensive adoption of IPv6 by the transition of government agencies to IPv6 and a centralised IPv6 public administration respectively.

Overall, many initiatives are in place. However, IPv6 deployment is currently still too slow in light of the fact that the final IPv4 blocks have been distributed to RIRs. While government initiatives are in place for the use of IPv6 by government agencies, it is crucial that the adoption of IPv6 gains momentum. Upgrading existing networks, Internet eXchange points, endhosts and routers, webpages and so forth, is further a key issue to spur IPv6 adoption.

Overall, the following actions should be taken: *i)* Encourage the upgrade of routers, firewalls, middleware and support systems and encourage that these devices are tested regarding the proper support of IPv6s; *ii)* develop measures to make fixed and mobile broadband networks ready for IPv6; ensure IPv6 readiness for new networks; *iii)* mandate IPv6 support in public procurement; *iv)* encourage the support of IPv6 by websites; *v)* encourage the use of IPv6 by businesses and households; *vi)*expand governments' use of IPv6 and vii) pursue international co-operation and further monitor the state of IPv6 deployment.

Encouraging a more efficient use of radio spectrum

Major achievements

- Spectrum allocations during the last three years, many of them part of the digital dividend providing an important source of public revenues

Areas for possible future work

- Continued efforts to increase the efficiency of spectrum management and use of market forces in spectrum reallocation and use
- Allocation of freed spectrum

Mobile voice and especially data traffic is expected to increase significantly in coming years and further fixed-mobile convergence is taking place. In addition, the market for smart devices, including sensors and RFID tags is growing. These trends will increase the demand for scarce spectrum resources and require more efficient ways to allocate and use spectrum. Ministers in the Seoul Declaration committed to *"encourage a more efficient use of radio frequency spectrum to facilitate access to the Internet"*.

Since the Seoul Ministerial meeting, new opportunities in spectrum allocation have arisen from the release of spectrum resources that have been freed due to the switchover from analogue to digital TV. This spectrum which is located between 200 MHz and 1 GHz is known as the "digital dividend". It is especially attractive and considered as premium spectrum since it provides an optimal balance between distance coverage and transmission capacity (European Commission, 2007) making it particularly suitable for rural and remote areas.

Some countries have already undertaken the switchover and further countries are planning to do so over the next months. The European Union, for example, has advised its Member States to perform the transition by 2012. By 2010, 12 OECD member countries have undertaken the transition (see also OECD 2011a). Table A.4 in the Annex provides information on spectrum allocation processes in the OECD area since 2008, the year of the Seoul Declaration. Most of the countries that have been allocating or are planning to allocate digital dividend spectrum have relied or will rely on a spectrum auction generating significant public revenues.

For instance, Germany not only linked certain obligations such as the deployment of broadband in remote areas to the auctions in 2010 but also generated around USD 6 billion for different spectrum bands with the auction of the 800 MHz band generating more than 80% of these revenues. Japan allocated spectrum in the 1.5 and 1.7 GHz band for the recent mobile technology LTE. The Australian Communications and Media Authority has released spectrum of several bands for different purposes: Spectrum in the 3.6 GHz band has been allocated for wireless access services in regional and remote areas. For the deployment of public telecommunication services in specified remote areas, spectrum in the 2 GHz band has been made available. In addition, the 2.5GHz band is being considered for mobile broadband access services and Australia plans to auction the digital dividend spectrum comprising the range of 694-820 MHz in 2012.

These examples as well as Table A.4 show that many countries have engaged in the allocation of additional spectrum and in a more efficient management of spectrum since the 2008 Seoul Declaration. Due to the growth of mobile services and mobile data traffic and the fact that smart devices such as sensors and RFID tags are gaining momentum, the efficient allocation of spectrum will even become more important in future.

It is therefore crucial that countries continue to engage:

- in carefully evaluating the potential uses of spectrum that will be released and balancing multiple factors regarding investments, competition issues and consumer choice before decisions are taken on defining the particular use of released spectrum;

- in increasing the efficiency of spectrum management (*e.g.* through avoiding too narrow bands) to spur the further growth of the mobile communication sector and smart ICTs;

Improving measurement and statistical systems

Major achievements

- Development of the OECD wireless broadband indicator

Areas for possible future work

- Development of a price basket for wireless broadband

- Further development of indicators measuring the adoption and the use of the Internet:

  - revision of the OECD ICT Model surveys;
  - creation of indicators measuring the engagement and technology dependency of consumers and businesses with the Internet;
  - collection of Internet-based statistics.

The final area of this first paper on access to the Internet via a high-speed infrastructure is dedicated to measurement and statistical systems. In the Seoul Declaration, Ministers agreed on "*improving statistical systems to measure the changing access and use of the Internet and related ICT networks by citizens, businesses and institutions in order to provide reliable measures of the evolving uses and the impact of the Internet*".

This commitment towards improved measurement is directed towards all areas of the Internet economy. This is why each report of the Seoul follow-up work contains a section on measurement, indicators and the improvement and further development of statistical systems. The following paragraphs present developments in improving measurement and statistical systems in the area of broadband infrastructure.

Indicators measuring the Internet economy can be grouped into *readiness indicators*, *intensity indicators* and *impact indicators* (OECD 2009c). Readiness measures include indicators that capture "the technical, commercial and social infrastructure which is necessary to support ICT use" in the Internet economy (OECD 2009c, page 2). Intensity indicators deal *inter alia* with the volume and the nature of the Internet and ICT use and impact indicators measure the economic and social effects of the Internet.

Indicators that measure the deployment of a high-speed broadband infrastructure can be mainly grouped into the category of readiness indicators measuring the readiness and deployment of the infrastructure and into the category of intensity indicators which measure the availability of broadband to households, business and government.

Recent developments

Since the Seoul Declaration, a new important indicator has been developed: the *wireless broadband indicator* (OECD 2009k). It can be attributed to the group of readiness indicators. The rationale behind it was to account for the increasing importance of mobile network subscriptions with data services which were not included in OECD or ITU statistics to that date.

In historical OECD broadband subscriber statistics, two wireless technologies, *i)* satellite and *ii)* terrestrial fixed wireless have always been included but have contributed only a small percentage to overall numbers. Mobile network subscriptions with data services were not included as transmission speeds used to be low and as it was difficult to estimate the usage, especially for standard subscriptions.

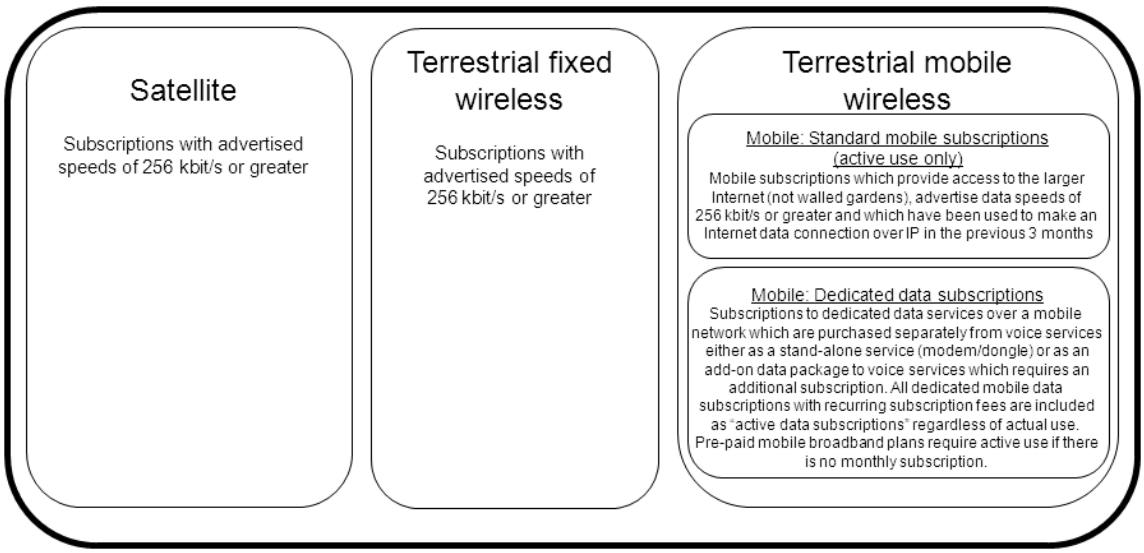
The upgrading of 3G networks provide higher transmission speeds and further upgrades to new platforms including LTE are under way facilitating the development of improved mobile broadband data access.

To account for these developments, the OECD developed a new wireless broadband methodology based on an expert meeting and several rounds of contributions from and discussions with member countries.

Figure 10 provides an overview of the elements of the wireless broadband indicator. It consists of satellite, terrestrial fixed wireless and terrestrial mobile wireless. Only connections with advertised speeds of at least 256 kbits/s are considered.

Two subcategories constitute the terrestrial mobile category. Standard mobile subscriptions and dedicated data subscriptions. The first category contains mobile subscriptions that provide access to the broader Internet (and not only to walled-garden content) and which are considered as being in active use, *i.e.* which have been used to make an Internet data connection over IP in the previous three months. The second category comprises dedicated data subscriptions that are purchased separately from voice services, either as standalone packages or as add-on data packages. The OECD now publishes two broadband indicators: a fixed and a wireless broadband indicator.

Figure 10: Components of the wireless broadband indicator



Source: OECD 2009k

With the development of this new indicator, the OECD has a means to measure and to compare the growing wireless broadband connection markets of different countries.

Besides the development of the wireless broadband penetration indicator, the OECD also developed new pricing baskets for fixed broadband. The fixed broadband baskets allow to compare the price levels experienced by consumers and businesses in OECD countries for fixed broadband services provided over DSL, cable and fibre networks. Overall, ten baskets for five different speed tiers and two usage levels in each tier (high and low) were created. In addition, the existing PSTN baskets, mobile baskets and leased line baskets have been updated to reflect changing usage patterns and improve the methodology (see also OECD 2009i). An area for potential future work related to price baskets is the creation of a new wireless broadband price basket.

At national levels, several countries have engaged in developing new indicators and measuring new relationships between several indicators since the Seoul Declaration. Table 5 provides a non-exhaustive list of examples. On the supply side, Denmark, and Germany, for example, created indicators to monitor the deployment and availability of broadband infrastructure. Another example is the NTIA's national broadband map in the United States[9] and ANACOM's information system on broadband infrastructures in

Portugal. Some countries are also evaluating the relationship between the deployment of broadband infrastructure and economic (*e.g.* productivity, firm level growth) measures and social benefits.

On the usage side, countries are increasingly assessing the take-up and uses of households and businesses. Australia, for instance, collects new data in the areas of media use in homes and the move to an online environment. Ireland is evaluating how much value users place on incremental improvements in particular service attributes, such as listed download speed or contention as well as the effects of broadband on companies and consumer behaviour. The Netherlands is developing new methods to measure the actual use of broadband and Spain is performing a demand analysis for telecommunications and Internet services in households. These developments show that countries are increasingly interested in the measurement of the adoption of broadband technology, services and use. The next section discusses possible ways to move forward in this direction.

Table 5: Examples of new indicators developed on the national level in the area of broadband (supply and demand side)

Country	Development of new indicators
Australia	- New data collections in areas of specific government policy interest such as media use in homes, the move to an online environment, - Development of new mobile wireless broadband data collection and measurement of benefits of broadband and of fibre infrastructure.
Austria	- E-government feedback forms were recently centrally developed, in order to get feedback from users and to evaluate the e-government services.
Canada	- Data retrieved on residential broadband availability by technology platform and by speed. Using the following sub-indicators: • Percentage of households with access to broadband by technology. • Percentage of Internet subscriptions. Average Gigabytes (GB) downloaded per month per user.
Denmark	- Availability and take up of high-speed broadband access. - Use of cloud computing in enterprises, as an add-on to the annual surveys carried out by Statistics Denmark. - Study on impact of digitisation on the productivity of Danish firms.
Egypt	- ICT indicators portal in Egypt (2008): currently includes more than 160 indicators that monitor the use of ICT by different educational and economic levels. -Collaboration with ITU to enhance ICT measurement in the Arab states and facilitate building a unified and comprehensive data base for Arab ICT indicators. - MCIT has developed an alternative and more representative price index for ICT service. Thus allowing to review and validate the contribution of ICT to real GDP
France	-Measurement of number of citizens with high speed network (FTTH or FTTB) availability
Germany	- New IT-based instruments were introduced to monitor the broadband infrastructure development.
Ireland	The work programme includes modelling the market for broadband services, economic and social aspects of broadband availability and adoption, effects of electronic communications services on company performance and implications of behavioural economics for economic regulation. - How much value users place on incremental improvements in particular service attributes such as listed download speed or contention. - Broadband demand and supply, - Market dynamics: propagation of innovative features pricing of services contracts. -Measure effects of broadband on firms and consumer behaviour.
Italy	- Examine the influence of the social-territorial-cultural factors on the adoption and the use of innovation.
The Netherlands	Development of projects related to online trade, location based services by using mobile phones, measuring actual use of broadband, etc First results are expected during 2011
Norway	-Study on “Impact of ICT on the productivity of firms. - Developed a methodology to measure ICT capital in firms - Compare the impact of ICT capital in firms in the service and manufacturing sectors.

Country	Development of new indicators
Portugal	Three new surveys: Use of ICT in hospitals (2006), use of ICT in Hotels (2008), use of ICT by individuals ten to fifteen years old. Adoption of new indicators for uses that are coming more prevalent than traditional fixed access and web browsing, e-science, e-commerce etc.
Slovak Republic	- E-government platform. To serve the individual requirements and needs. (also answers questions of perception, willingness, trust and, the expectations of users and the satisfaction of citizens and businesses with former electronic services).
Spain	- Analysis of demand for telecommunications and Internet Society services in households. To obtain: attitudes toward new technologies, cost/benefit ratio of ICTs and ICT devices, computer and internet skills and level of skills, equipment and services.
Sweden	To seek relations between firm-level growth and their use of broadband and their innovation practices

Source: OECD Seoul Follow-up Questionnaire, Questions five and six, see also OECD 2011b .

Areas for potential future work on indicators

While indicators measuring the deployment of broadband infrastructure by Internet Service Providers are well advanced both at national and international levels, also in light of the development of the mobile broadband indicator, it can be observed that more and more countries are focusing on the measurement of the demand side, *e.g.* how households and businesses adopt and use the Internet. It is proposed that an important area for future work consists in the further development of demand-side indicators on an international level which will reflect the adoption and use of the Internet by households and businesses at a more detailed level. These indicators belong to the group of intensity indicators.

In this context, the OECD is proposing to revise two ICT model surveys, one for households and individuals and the other one for businesses (see OECD 2010l). In order to reflect potential changes in technologies, it is proposed that additional questions could be added. For instance, it is suggested to add questions on the measurement of wireless broadband access by households and businesses.

In terms of usage indicators, two additional and interesting areas include the concepts of *technology engagement* and *technology dependency.* In 2010, suggestions were made for the definitions of these concepts and a framework for measurement (see OECD 2010h). The rationale behind these measures is to not only track frequencies of use which in some cases might be misleading (*e.g.* permanent Internet connection at work), but to measure to which extent users of the Internet are engaged and committed to their online activities and to what extent they effectively depend on the Internet.

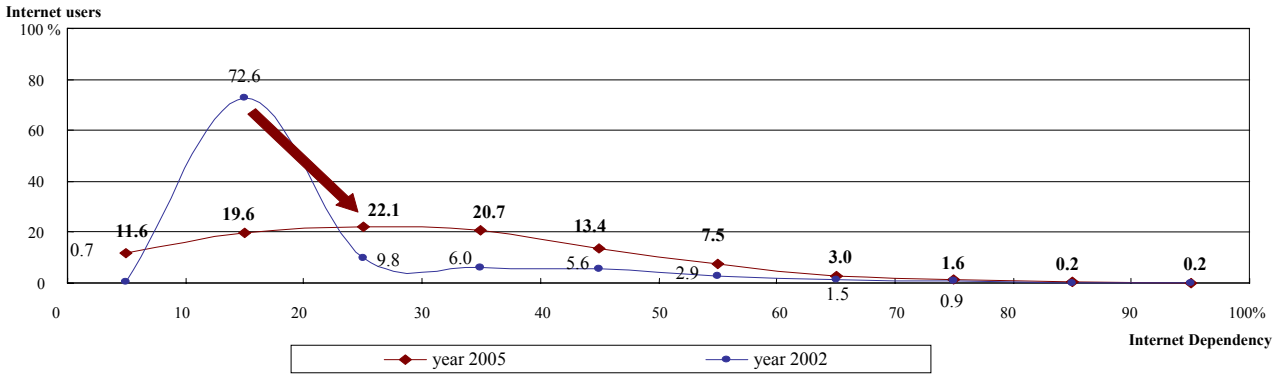
A proposition for *technology engagement* has been formulated as follows: "an individual may be said to be 'engaged with a technology' when three conditions are true: *i)* S/He uses the technology on a regular basis; *ii)* S/He perceives the potential utility of a technology; and *iii)* S/He tries to improve his/her capability to use the technology (OECD 2010h, p. 3). Regarding *technology dependency: "*an individual may be said to be 'dependent on a technology' if he/she uses this technology on a regular basis for a common set of his/her daily activities" (OECD 2010h, p. 4).

Based on these definitions, potential new indicators for the measurement of these concepts would include the *intensity of use*, the *perceived utility of use* and the *learning attitude*. An interesting way to move forward for the measurement of the *intensity of use* is the measurement of the share of a daily activity carried out online.

The Korean Information Society Development Institute (KISDI) uses this indicator and defines it as the ratio of the daily time spent on activities carried out on the Internet (online activities) to the overall daily time spent on the same activities (online and offline activities summed up). This measure has the advantages that it *i)* not only counts the time persons spend online; and that it *ii)* provides a proportion of the intensity of Internet use by activity (OECD 2010h). Fifteen Internet activities have been defined by

KISDI for which the online percentages are calculated. In a next step, the average of these shares is calculated which is then termed as the Internet Dependency Index. Figure 11 shows the distribution of this index in Korea for the years of 2002 and 2005.

Figure 11: Distribution of the Internet dependency index across Internet users, 2002-2005



Source:OECD 2010h; KISDI.

Measuring the daily share of an activity carried out online is one example of how to measure the Internet engagement and dependency of individuals. The report OECD 2010h proposes a framework for a whole set of new indicators to measure engagement and dependency in order to obtain a more precise picture of the demand side, of the extent and the way the Internet is adopted and used.

To complement the survey data presented above, a further potential area of future work is the collection of Internet-based statistics. The OECD is currently working together with the European Commission to conduct a feasibility study. First preliminary results were expected for June 2011 (OECD 2010e). Currently, three methods for the collection of Internet-based statistics are examined: *i)* the self-filling questionnaire Internet usage; *ii)* Internet Access Provider survey; and *iii)* Web search.

Overall, for potential future work, it is suggested to advance in the development of demand-side and usage indicators and to determine ways of efficient data collection for these indicators. To fully benefit from this work, it should be carried out at an internationally harmonised level.

NOTES

[1] OECD 2008a.

[2] For more details on the methodology, see OECD 2008a, p. 14.

[3] For additional data on European countries, see also the BEREC Report on „Next Generation Access – Collection of factual information and new issues of NGA roll-out", *http://erg.eu.int/doc/berec/bor_11_06.pdf*.

[4] The following paragraphs are based on the OECD Communications Outlook, Chapter 2 (OECD 2011)

[5] Public switched telephone network (PSTN).

[6] *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2009:235:0007:0025:EN:PDF*.

[7] The following paragraphs on allocation are fully based on Chapter 5 of the OECD Communication Outlook 2011 (OECD 2011a).

[8] The native IPv6 graph excludes users using 6to4 or Teredo.

[9] *www.broadbandmap.com*.

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OECD (2009h), *Network Developments in Support of Innovation and User needs*, DSTI/ICCP/CISP(2009)2/FINAL, OECD, Paris.

OECD (2009i), *Revision of the Methodology for Constructing Telecom. Price Baskets*, DSTI/ICCP/CISP(2009)14/FINAL, OECD, Paris.

OECD (2009j), *The Role of Broadband Infrastructure Investment in Economic Recovery*, DSTI/ICCP/CISP(2009)1/FINAL, OECD, Paris.

OECD (2009k), *Wireless Broadband Indicator Methodology*, DSTI/ICCP/CISP(2009)13/FINAL, OECD, Paris.

OECD (2010a), *Broadband bundling: Trends and Policy Implications*, DSTI/ICCP/CISP(2010)2/FINAL, OECD, Paris.

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ANNEX

Table A. 1: Overview of OECD reports related to work on a high-speed infrastructure

Work area	Report	Main findings
Broadband Over Power Lines (PBL)	Broadband over Power Lines (BPL): Developments and Policy Issues DSTI/ICCP/CISP(2008)3/FINAL	• BPL as a means to further competition in the broadband market • Little evidence, however, that is provides a competitive alternative to xDSL or FTTH in the near future • Regulators should nevertheless ensure that no unnecessary barriers are in place for the commercial diffusion of BPL and that interference with other licensed wireless services is minimised
Cable broadband	Developments in Cable Broadband Networks DSTI/ICCP/CISP(2009)9/FINAL	• Report on developments of cable broadband networks • Over the last ten years, cable companies in the OECD have transformed themselves from providers of analogue video services to providers of an array of advanced digital communications services, upgrading their networks to support bandwidth intensive services • One of the key trends: Consolidation of cable providers to more effectively compete with traditional telephone providers • While cable companies do provide important infrastructure-based competition there is still asymmetric treatment of different delivery platforms such as DSL and cable in several OECD markets
Broadband bundling	Broadband bundling: Trends and Policy Implications DSTI/ICCP/CISP(2010)2/FINAL	• Broadband services in the OECD are overwhelmingly sold as mixed bundles • Broadband bundling can provide both benefits and drawbacks to customers. Benefits to consumers largely derive from the choice between stand-alone and bundled services; stand-alone offers still a key role in maximising consumer surplus • Regulators and consumer-protection agencies should encourage ISPs to provide more information on the characteristics of packages they are selling and to make prices clear and

		understandable. Consumers should further be able to switch providers
Broadband coverage indicators	Indicators of Broadband Coverage DSTI/ICCP/CISP(2009)3/FINAL	• Overview of how broadband physical coverage and availability can be measured • Coverage and availability measures related to different types of technologies
Broadband, the economic recovery and national broadband plans	The Role of Broadband Infrastructure Investment in Economic Recovery DSTI/ICCP/CISP(2009)1/FINAL	• Examination of the role of communication infrastructure investment in economic recovery and policy options • Policy makers need to evaluate the costs and benefits of any public investment in telecommunication infrastructure and select projects which can deliver both strong immediate aggregate demand effects and strong longerterm aggregate supply-side effects • All public investments in telecommunications should balance four key items – connectivity, competition, innovation/growth and social benefit
	National Broadband Plans DSTI/ICCP/CISP(2010)9/FINAL	• Survey of national broadband plans across the OECD area • Overview of goals and common elements of the plans • Most governments have set targets for the plans and an important focus has been to make high speed broadband available at affordable prices in rural areas
Broadband, innovation and fibre	Network Developments in Support of Innovation and User needs DSTI/ICCP/CISP(2009)2/FINAL	• Objective of the report is to support two key elements of the Seoul declaration – stimulating investment and competition in broadband networks and developing policies which maintain an open environment supporting innovation • Case for investment in a competitive, open-access national fibre-to-the-home network rollout based on potential spillovers in four key sectors of the economy: electricity, health, transportation and education • Cost savings of between 0.5% and 1.5% in each of the four sectors over ten years resulting directly from the new broadband network platform could justify the cost of building a national point-to-point, fibre-to-the-home network
	Fibre Access – Network Developments in the OECD Area DSTI/ICCP/CISP(2010)10/FINAL	• Assessment of developments on the use of fibre to provide local broadband access networks • There is no simple solution to the question of how to get FTTH/B networks built

		• Countries that wish to achieve an accelerated improvement in their FTTH/B deployment should consider measures to improve access competition on current networks
NGA Networks and Market Structure	Next Generation Access Networks and Market Structure DSTI/ICCP/CISP(2010)5/FINAL	• Report focuses on developments in broadband market structures emerging from the deployment of high-speed broadband services and the policy and regulatory implications • Aim: To underline good practices for policy and regulation in relation to "next generation access networks" (NGA) and the market structures to enhance their development • Recently, a number of different approaches in respect to NGA market structure have been taken by OECD countries • Given that there is a high probability that public funding will be needed to construct high-speed broadband networks in a number of geographic areas, this will have a profound effect on how a market structure will evolve in those areas
Measurement	Data Collection on Broadband Mobile Services DSTI/ICCP/CISP(2009)13/FINAL	• Draft on the development of a methodology on how to define mobile broadband and on how to collect and report mobile broadband statistics across the OECD • Proposal for an indicator measuring the development of wireless broadband connections across OECD countries
	Wireless Broadband Indicator Methodology DSTI/ICCP/CISP(2009)13/FINAL	• Proposal for the wireless broadband indicator methodology incorporating comments received by the Secretariat in July 2009
	Implementing the Seoul Agenda, Discussion Points for the Round Table on "ICT Measurement: Assessment and Proposals by Member Countries DSTI/ICCP/IIS/RD(2009)1	• Report identifies issues related to the current measurement of ICTs and suggests possible room for development
	Measuring ICT engagement and Dependency: A Statistical Framework DSTI/ICCP/IIS(2010)4	• Report discusses a framework for the measurement of technology engagement and technology dependency • Indication of direction for future indicator development in this area
	Proposals for a Revision of the OECD Model Survey of ICT Access and Use by Households and Individuals DSTI/ICCP/IIS(2010)2	• Proposal to revise the two OECD ICT Model Surveys (Households and Individuals; Businesses)

	Internet-Based Statistics Proposals for a Feasibility Study DSTI/ICCP/IIS(2010)3	• Proposals for a Feasibility Study for the collection of Internet-Based Statistics
Mobile broadband	Mobile Broadband: Pricing and Services DSTI/ICCP/CISP(2008)6/FINAL	• Overview of prices, speeds and data caps of mobile broadband services • At the time of the report wide range of subscriptions available with considerable variation between and within countries
Mobile communications	Mobile Communication Developments in the OECD area DSTI/ICCP/CISP(2010)3/FINAL	• Report on the development of mobile communications in the OECD area • Examination of the impact of mobile communication developments on market dynamisms and the implications for policy makers and regulators
International Mobile Roaming	International Mobile Roaming Charges: Proposal by Australia DSTI/ICCP/CISP(2008)12	• Report by the Government of Australia proposes that CISP examine competition, costs and prices as well as policy options in international mobile roaming charges
	International Mobile Roaming Charging in the OECD area DSTI/ICCP/CISP(2009)8/FINAL	• Information and analysis on market developments and pricing in international mobile roaming service (IMRS) • Wholesale rates charged are major contributor to high retail charges • Roaming rates are excessive and similarities exist with the fixed market prior to the collapse of the accounting rate system
	International Mobile Roaming Services: Analysis and Policy Recommendations DSTI/ICCP/CISP(2009)12/FINAL	• Follow-up to the first report on international mobile roaming charging and proposition of solutions to described problems in the first report • This report strongly supports the implementation of transparency measures that increase consumer awareness of retail roaming charges • The report acknowledges that directly regulating roaming prices may be the only way to guarantee that consumers are not unreasonably charged. The aim should be to protect consumers and remove international barriers for trade and travel
	International Mobile Roaming Services: Next Steps and Recommendations DSTI/ICCP/CISP(2010)1/REV1	• Presentation of a framework of recommendations and thus provision of guidance for policy makers and regulators • Recommendations in 5 areas: empowering the consumers (roaming substitutes, transparency measures), competition issues and market structure (cross-country network expansion, alliances), improved information in the wholesale market (interoperator tariffs, WTO framework, localisation), price

		regulation (wholesale, retail), consideration of other impacts
	International Mobile Data Roaming DSTI/ICCP/CISP(2010)12/FINAL	• Examination of the pricing of international mobile data roaming • Data roaming prices very high compared to domestic rates
Voice markets	Developments in Voice Service Markets DSTI/ICCP/CISP(2008)9/REV1	• Overview of developments in voice markets across the OECD • Voice services commoditised, shift from charging my minute to flat-rate pricing • Dramatic shift from fixed-line to mobile telephony • Shift from circuit-switched to packaged-switched voice
Telecommunication Price Baskets	Revision of the Methodology for Constructing Telecommunication Price Baskets DSTI/ICCP/CISP(2009)14/FINAL	• 2009 revisions to the OECD's basket methodologies • New aspects in the areas of voice call calculations, selective discounts and local calling areas for the PSTN baskets
International Traffic Exchange	Network Externality Premiums and International Telecommunication Traffic Exchange DSTI/ICCP/CISP(2008)4/FINAL	• Examination of the economic impact of proposals to add a non-cost "premium" to international telecommunication charges to fund network expansion • Conclusion: Attempts to use non-market methods are likely to have negative implications for the provision of international telecommunication services. Competition meets policy goals more efficiently
IP traffic exchange	IP traffic exchange: Market Developments and Policy Challenges DSTI/ICCP/CISP(2011)2/FINAL	• Outline of a report on IP traffic exchange • Main topics to be discussed include an overview of the development of the IP market, the performance of the market and future challenges
IPv6	Economic Considerations in the Management of IPv4 and in the Deployment of IPv6 DSTI/ICCP(2007)20/FINAL	• Overview of Internet addressing • Managing of IPv4 exhaustion and deployment of IPv6 • Proposal for a policy environment conducive to the timely deployment of IPv6
	Internet Addressing – Measuring Deployment of IPv6 DSTI/ICCP/CISP(2009)17/FINAL	• Report provides an overview of several indicators and data sets for measuring IPv6 deployment • Areas considered: indicators of infrastructure readiness, indicators of actual use of IPv6 on the Internet, results from a survey on network operators' deployment of IPv6
Geographically segmented regulation	Geographically Segmented Regulation for Telecommunications DSTI/ICCP/CISP(2009)6/FINAL	• Aim: To appraise the case for, and developments in, the use of sub-national geographically segmented regulation for fixed telecommunications networks
M2M	M2M communications: Connecting	• Analysis of the impact of the Machine-to-

communications	Billions of Devices DSTI/ICCP/CISP(2011)4/FINAL	Machine communication on business models and regulation. Main conclusion: governments need to liberalise access to the mobile communications market to stimulate the growth of M2M

Table A. 2: Competition in Fixed Lines: Subscriber Market Share of New Entrants (% of total fixed analogue subscriber lines)

	2002	2003	2004	2005	2006	2007	2008	2009
Australia*[1]	0.9	1.8	2.5	1.8	1.9	2.2		13.8
Austria	5.3	6.0	7.4	9.6	10.2	14.3	16.0	17.3
Belgium*			7.7	11.3	13.9	18		
Canada	32.1	36.7	37.2	39.5	42.6	46.2	50.3	52.0
Chile	20.0	30.0	30.0	30.0	30.0	40.0	40.0	40.0
Czech Republic				3	3		15	18
Denmark	13.1	14.1	18.5	19.8	19.0	18.9	18.0	18.1
Estonia	0	0	0	10	10	10	20	20
Finland					33.6	32.0	33.0	33.6
France			2.3	1.3				5.2
Germany	0.8	3.0	5.0	8.0	13.0	19.0	27.0	33.0
Greece								
Hungary	21.0	21.0	22.0	23.0	25.0	27.1	29.82	21.0
Iceland								
Ireland				20.0		23.0	27.0	28.0
Israel								
Italy						14.3	21.2	25.7
Japan			5.3	6.2	7.5	9.0	10.0	12.1
Korea	4.0	4.4	6.2	6.8	7.9	9.6	10.2	10.1
Luxembourg				1.2	3.0	4.0	9.0	11.5
Mexico								
Netherlands								28.0
New Zealand					8.0	11.5	19.0	25.0
Norway								
Poland	1.3	10.0	9.0	10.4	11.7	14.7	18.2	26.8
Portugal	4.7	5.6	6.7	10.8	21.5	28.0	31.0	35.3
Slovak Republic	0	0	0	0.05	0.08	2.26	3.69	4.75
Slovenia				0.5	0.5	0.5	0.5	

[1] Government estimate

Spain	4.9	5.6	6.7	10.7	21.7	28.4	21.1	27.4
Sweden				0.5	0.5	0.5	0.5	
Switzerland*	0	0.1	0.2	0.2	0.3	0.3	0.3	
Turkey								
United Kingdom	17.0	18.0	20.0	24.0	30.0	32.0	36.0	42.0
United States	13.0	16.0	18.0	18.0	17.0	18.0		

Table A. 3: National Policy initiatives for the deployment of IPv6, 2010

	IPv6 adoption in government	Awareness building efforts	Initiatives
Australia	Yes	Yes	The Australian Government Information Management Office (AGIMO) is coordinating the transition of Australian Government agencies to IPv6, and has developed 'A Strategy for the Implementation of IPv6 in Australian Government Agencies', that aims for Australian Government networks to be IPv6-enabled by the end of 2012.
Austria		Yes	An industry platform (IPV6 Task Force Austria) dealing with various IPv6 issues was founded in 2004 with the support of the government and telecommunications regulatory authority.
Belgium		Yes	
Canada		Yes	Canada does not currently plan to use legislation or other government-led measures, such as target-setting for industry, to influence the introduction of IPv6. The American Registry for Internet Numbers (ARIN) has assisted with awareness-raising efforts within the Canadian government.
Switzerland		Yes	Switzerland does not have an active policy to encourage IPv6 deployment. However, IPv6 support is a requirement for public procurement contracts.
Chile			
Czech rep	Yes		In June 2009, the government approved a resolution according to which ministries and central state bodies must: i) Include IPv6 support as a public procurement condition, and ii) ensure that by the end of 2010 government websites and eGovernment services are accessible over both IPv4 and IPv6. The document "MPO State Policy in Electronic Communications - Digital Czech" further addresses IPv6 deployment (approved by CR government on 19 Jan 2011).
Germany	Yes	Yes	A national IPv6 plan for Germany was launched in 2009 (German IPv6 Roadmap). The objective is a complete technical and organisational setup for a centralised IPv6 public administration in Germany as of 2011. IPv6 was also included in the 3rd and 4th German IT Summits declarations under the patronage of German Chancellor Angela Merkel. The German Federal Ministry of the Interior was allocated and administers a /26 IPv6 address block for all -federal, state and local- public administration in Germany end of 2009. In 2008 two large programs were launched to modernise the communication infrastructure of the public administration based on IPv6: i) "Netze des Bundes" (NdB), the Common network for the federal administration, and ii) "Deutschland-Online Infrastructure" (DOI), which serves federal government, states and municipalities. In addition to these two large network infrastructures operated by the Federal Government, IPv6 is being introduced through a variety of IPv6 projects and initiatives at different policy, organisational and technical levels, with numerous IPv6 pilot projects, working groups and activities at state and local level.
Denmark		Yes	The National IT and Telecom Agency has developed a strategy as well as an action plan for the deployment of IPv6 in Denmark, approved by the Minister of Science, Technology and Innovation after public hearings and four-pronged: i) Creating awareness of IPv6 and the exhaustion of IPv4 addresses, through the establishment of a private/public partnership that represents relevant Danish stakeholders (*e.g.* content providers and telecom operators); ii) Public procurement IPv6-compliant mandate; iii) Creating an IPv6 test-bed in the future, and; iv) Potentially making IPv6 support mandatory for Danish state institutions and agencies (as opposed to the current 'recommended standard').
Estonia			No active policies for IPv6 deployment, some trials.
Finland		Yes	
France		Yes	
Hungary			
Ireland		Yes	No active policies for IPv6 deployment. However an IPV6 Task Force is in place, co-founded in 2004 by the TSSG research center, the HEAnet and the Department of Communications, Energy and Natural Resources (DCENR). In 2005 the Irish National IPv6 Centre was established.
Iceland			
Israel			
Italy		Yes	IPv6 taskforce
Japan		Yes	In February 2009, the Japanese Ministry of Information and Communication (MIC) convened a "Study Group Concerning the Improved Use of IPv6 on the Internet". MIC is also developing policies such as the "Guideline of information disclosure for ISPs to cope with IPv4 address exhaustion". The MIC has developed an IPv6 testing platform to build IPv6 expertise. The "Task Force on IPv4 Addresses Exhaustion, Japan", launched by MIC and telecommunications/Internet associations in September 2008 helps interested Internet operators to build action plans, publicise IPv6 activities, and develop IPv6 educational programs.
Korea		Yes	In December 2008, the Korea Communications Commission (KCC) announced the "Second Basic Plan for the Promotion and Management of Internet Address Resources for 2009-2011" and has been conducting various activities to help all stakeholders adopt IPv6.

			In order to encourage the voluntary adoption of IPv6 by Internet stakeholders such as ISPs and Web portals, the KCC created a public-private consultative body and is providing systematic support for the deployment of IPv6 in Korea through pilot projects, offering training, conducting promotional activities, and operating IPv6 interconnection networks. The Ministry of Strategy and Finance stipulates in its "2010 Guidelines for the Execution of Budget and Fund Operation Plan" that all of its network infrastructure should support both IPv4 and IPV6. The Ministry of Public Administration and Security also issued a government notification that applies the same principle to public administrative organisations
Luxemburg		Yes	
Mexico		Yes	
Netherlands	Yes	Yes	IPv6 is expected to become compulsory by end of 2010 for governmental procurement of ICT equipment. The promotion of IPv6 by government is an action point in the progress report of the National ICT Agenda 2008-2011. The central government has taken the initiative to deploy IPv6 in its applications, starting with pilots. In 2009 the Dutch IPv6 task Force rewarded winners of IPv6 implementation in different categories and will do so again in 2010. In 2010 research funds were awarded to monitor the implementation of IPv6 in The Netherlands.
Norway		Yes	The Norwegian Government is working with the private sector and other relevant stakeholders to increase awareness of the need for IPv6 adoption. The Norwegian strategy for the deployment of IPv6 is focused on creating awareness of the need to focus on IPv6 among managers and CEOs in the private and public sectors, rather than technical staff, as a pre-requisite for a successful IPv6 transition. In October 2010, a national meeting on IPv6 resources was held to exchange knowledge and information on the IPv6 transition. The Norwegian Post and Telecommunications Authority and The Ministry of Transport and Communications, invited Internet providers, the .no registry, hardware and software suppliers, the public sector and other interested organisations.
New Zealand		Yes	To date the government response to IPv6 deployment has generally been to raise awareness of the issue. Recommendations have been issued to government agencies: i) Procurement: Agencies should ensure that any hardware or software purchased is IPv6 capable, through a clear statement in all requests for proposals; ii) Training: Agencies should consider training key technical staff on IPv6 to build test IPv6 networks and build experience and capability for IPv6. Agencies with good technical capability should consider implementing IPv6-only networks for new offices or new buildings, and; iii) IPv6 support by applications: Agencies with in-house applications should check for potential IPv4 / IPv6 issues. New applications should be required to be IPv6-capable.
Poland		Yes	There is political debate on IPv6 in Poland. Poland wishes to take into account commitments made at the OECD level by further promoting the development of IPv6 in Poland.
Portugal		Yes	The Portuguese IPv6 Task-Force was created in 2004. FCCN, which manages the Portuguese Research and Education Network, has been an active promoter of IPv6 since the late 90s. As it manages the ccTLD for Portugal and the national Internet Exchange Points, it assured IPv6 capabilities of DNS at top level very early. Its other main activities are related to the promotion of the adoption of IPv6 in a timely manner in all higher education and R&D institutions. The backbone of the network operates in dual-stack mode (IPv4 and IPv6) since 2003. During 2008 significant investments have been made to enable dual-stack operation of the following services in these institutions: DNS servers, mail servers and Web servers. Trainings and Workshops have been organised as well. There is still a lot of work to be done in terms of IPv6 awareness and IPv6 training. Some vendors have already included IPv6 content in their training programs, but in some cases the real IPv6 support is still not comparable to IPv4 support. IPv6 is a mature protocol in terms of standards defined in the IETF, however there is still a long path to be taken in order to make all Internet applications compatible with IPv6. Portugal considers that the main problem with the low degree of IPv6 deployment is its low priority status in each network/environment, despite its efforts close to national entities in particular electronic communications providers.
Slovak Republic		Yes	IPv6 support is mandatory in public services since 2008. Awareness is promoted through several channels and survey on IPv6 usage is being coordinated by the Ministry of Finance in November 2011.
Slovenia		Yes	In 2008, the Slovene Government adopted a strategy for the development of broadband networks in the Republic of Slovenia. One of the commitments included in the strategy is that broadband networks will be ready for the implementation of IPv6 protocol, to enable further development of e-government, e-health, e-education, e-commerce and other services. Moreover, the IPv6 Forum for Slovenia and the Go6 Institute endeavor to accelerate IPv6 deployment among industry, research communities and state administration.
Spain		Yes	
Sweden			
Turkey			
United Kingdom		Yes	The United Kingdom encourages a market-lead, needs-driven approach. The UK wishes to encourage stakeholders to be proactive with adopting IPv6, while being mindful of their commercial needs and costs.
United States	Yes	Yes	The United States has set a timeline for adopting IPv6 6 for use on public servers by the end of 2012.

Source: OECD Communications Outlook, Chapter 5 (OECD 2011)

Table A. 4: Spectrum allocations

	Has additional spectrum for new generation wireless services been made available since 2008? If so which bands?	**How was/will this spectrum been/be allocated? Comparative selection, auction, etc.**
Australia	Yes. Spectrum in the 3.6 GHz band (3575-3700 MHz) has been released by the Australian Communications and Media Authority (ACMA) to support deployment of wireless access services in regional and remote areas of Australia. Spectrum in the 2 GHz Band (1920-1980 MHz & 2110 – 2170 MHz) was also made available by the ACMA in mid-2010 in specified remote and regional areas of Australia for public mobile telecommunication services. The ACMA is considering the 2.5 GHz band (2500-2690 MHz) as a candidate band to address emerging demand for broadband wireless access services in Australia. In addition, the Government is examining its approach to the reissue of expiring key 15 year spectrum licences that are used to provide mobile phone and wireless services. In June 2010, the Australian Government confirmed for release a contiguous 126 Megahertz of spectrum comprising the frequency range 694-820 MHz inclusive as Australia's digital dividend.	The 3.6 GHz band (3575-3700 MHz) – the ACMA is allocating spectrum in this band on a staged basis for specified geographic areas using an administrative allocation process and then a price based allocation (auction) process for the right to apply for apparatus licences. Any remaining spectrum will then be allocated by the ACMA on an administrative allocation basis. The process chosen depends on the level of supply and demand of spectrum in a specified geographic area. The 2 GHz band (1920-1980 MHz & 2110 – 2170 MHz) – the ACMA is allocating spectrum in this band on an apparatus licence basis using an administrative allocation process (over the counter process). Digital dividend spectrum (694-820 MHz) – The Government intends that this spectrum be allocated via a price-based allocation (auction) process.
Austria	Yes, parts of the 3.5 GHz and 900 MHz spectrum. An assignment procedure for the 2.6 GHz spectrum is currently ongoing.	Auction
Belgium	The following royal decrees have been developed: 1) Arrêté royal du 24 mars 2009 concernant l'accès radioélectrique dans les bandes de fréquences 3410-3500/3510-3600 MHz et 10150-10300/10500-10650 MHz. 2) A royal decree for the identification of a fourth 3G operator has been prepared. After publication of this decree, the auction can start 3) A royal decree for the identification of 4G-operators in the band 2500-2690 MHz has been prepared. After publication of this decree, the auction can start	The following procedures apply: -bands 3410-3500/3510-3600 MHz: comparative selection (beauty contest). -fourth 3G-operator : auction. -4G networks in the band 2500-2690 MHz: auction.
Canada	Advanced Wireless Services (AWS) Auction On November 28, 2007, Industry Canada released its policy framework for the auction for 105 MHz of AWS and other spectrum. Of the 90 MHz of AWS spectrum, 40 MHz was set aside for new entrants. Under the licence conditions, licensees are mandated to negotiate roaming agreements with new entrants, under certain conditions. On July 21, 2008, Industry Canada announced that 282 licences (worth $4.25 billion) were conditionally assigned to 15 companies in the auction. In September 2009, all 15 companies were issued licences. 700MHz Spectrum Band The CRTC has announced August 31, 2011, as the shut-down date for analog over-the-air television. The transition to digital transmission of over-the-air TV signals (DTV) will reduce the amount of radio spectrum currently dedicated to	Auction

	over-the-air TV, thereby freeing-up spectrum to be used for other purposes, including public safety and commercial uses *e.g.* wireless broadband. On December 20, 2008, Industry Canada published a post-transition DTV allotment plan, in consultation with the industry, that will accommodate DTV broadcasting in channels 2-51, and free-up spectrum in what is now TV channels 52 to 69. The same day, it also published an interim agreement between Canada and the United States concerning DTV which deals with potential cross border interferences.	
Chile	The band for 3G services (1.710 ~ 1.755 paired with 2.110 ~ 2.155 MHz)	It was a comparative selection (beauty contest) process based on deployment plans and population coverage.
Czech Republic	The bands 800 MHz, 900 MHz, 1800 MHz, 2.6 GHz and 3.4-3.8 GHz have been identified for the purpose of electronic communication services according to the relevant European harmonisation documents. The bands 800 MHz, 2.6 GHz and additional spectrum in the 1800 MHz band will be subject of upcoming tender for operators providing broadband electronic communication services. Deployment of new innovative mobile communication systems is anticipated.	Auction format is supposed for the assignment of the radio spectrum rights.
Denmark	The frequency band 2500-2690 MHz has been made available in 2010 on a service and technological neutral basis. It is most likely that the spectrum will be used for LTE, though this is not a requirement. The 900/1800 MHz bands was liberalised on 1 January 2011 in accordance with the 2009 amendment of the GSM-directive and the Commission Decision. A decision has been taken to make the 800 MHz band available for other uses than broadcasting including mobile broadband services. The allocation is expected to take place by the end of 2011 through an auction process.	The frequency band 2500-2690 MHz was subject to auction during spring 2010. In the 900 and 1800 frequency bands, one frequency block of 2 x 5 MHz in the 900 MHz band and one frequency block of 2 x 10 MHz in the 1800 MHz band was awarded through auction in October 2010 to accommodate a new operator in each band. Hi3G received both licenses and may - as well as the three current operators - use wireless technologies other than GSM for the purpose of testing new technologies since 1 January 2011 and may use it commercially from 1 May 2011.
Estonia	No.	
Finland	The 2500-2690 MHz spectrum band in autumn 2009 For more details, see; http://www.ficora.fi/en/index/palvelut/palvelutaiheittain/radiotaajuudet/huutokauppa.html	Auction
France	Yes: 1) ARCEP has allocated 5 MHz in the 2.1 GHz band to Free Mobile (4th 3G license), in January 2010. Free Mobile is also entitled to use 5MHz duplex in the 900 MHz band, following reallocation of spectrum released by the three existing mobile operators. 2) ARCEP has also allocated, also in the 2.1 GHz band, 5 MHz duplex to SFR and 4.8 MHz duplex to Orange France in May 2010. 3) Finally, the 800 MHz (790-862 MHz) et 2.6 GHz (2500-2690 MHz) bands have been identified for the purpose of high-speed wireless broadband, and should be allocated in the following months..	1) The 4th 3G license has been allocated following a call for proposals (comparative selection process). There were nine selection criteria: coherence and feasibility of the project, service and tariff offers, coverage, deployment speed, coherence and feasibility of the business plan, QoS, relations with service providers and consumers, impacts on the environment and employment. 2) The remaining spectrum in the 2.1 GHz band has been allocated by means of a comparative selection process, depending on two criteria: price commitments

<table>
<tr><td></td><td></td><td>for future MVNO deals and financial offer.

3) Allocation in the 800 MHz and 2.6 GHz band for 4G mobile networks are under review.

The allocation of the 800 MHz band will have to observe the needs for territorial cohesion (Law against the digital divide, 17 December 2009).</td></tr>
<tr><td>Germany</td><td>Yes, in the following frequency ranges:

<u>800 MHz Band</u>
791,0-821,0 and 823,0-862,0 MHz

<u>1,8 GHz Band</u>
1710,0-1725,0 MHz, 1730,1-1735,1 MHz, 1805,0-1820,0 MHz, 1825,1-1830,1 MHz, 1853,1-1858,1 MHz

<u>2 GHz Band</u>
1900,1-1905,1 MHz, 1930,2-1940,1 MHz, 1950,0-1959,9 MHz, 2010,5-2024,7 MHz, 2120,2-2130,1 MHz, 2140,0-2149,9 MHz

<u>2,6 GHz Band</u>
2500,0-2690,0 MHz</td><td>The Federal Network Agency allocated these frequency ranges by auction in April/May 2010.

The results are given in the following table

<table><tr><th>Frequency range (MHz)</th><th>Results (EUR)</th></tr><tr><td>800</td><td>3,576,475,000</td></tr><tr><td>1800</td><td>104,355,000</td></tr><tr><td>2000</td><td>359,521,000</td></tr><tr><td>2600</td><td>344,295,000</td></tr><tr><td>Σ</td><td>,384 646, 0</td></tr></table></td></tr>
<tr><td>Hungary</td><td>Frequency bands:
a) 2.6 GHz (2500-2690 MHz)
b) 5.8 GHz (5725-5875 MHz)
c) 26 GHz (25.5-26.5 GHz)</td><td>Methods for authorisation:
a) 2.6 GHz - auction
b) 5.8 GHz - licence exemption
c) 26 GHz - comparative selection</td></tr>
<tr><td>Ireland</td><td>ComReg has issued licences to several local area broadband providers using spectrum in the 3.6 GHz, 10.5 GHz, and 26 GHz frequency bands

In order to maximise the efficient use of the 3.6 GHz band, and particularly in light of a recent EC Decision which Ireland must implement, ComReg must ultimately replace the current 3.6 GHz FWALA licensing scheme with a scheme that best facilitates the provision of fixed, nomadic and mobile wireless access services.
ComReg is also developing its plans for the liberalisation of the 900 MHz and 1800 MHz frequency bands currently used for the provision of second-generation (2G) GSM-based mobile services to consumers.

With the liberalisation of spectrum in these bands, operators will be able to offer higher speed electronic communications services to consumers (such as mobile broadband and other innovative services) with better quality and more comprehensive coverage.</td><td>ComReg endorses the policy of technology neutrality in the drive to enhance competition and investment. Management of the radio frequency spectrum is becoming more market-oriented, with greater reliance placed on operators (following consumer preferences) to decide on the best use of spectrum.
The management of spectrum centres on facilitating early access to spectrum rights on a non-discriminatory basis, using competitive selection mechanisms where appropriate. ComReg strives to ensure an efficient and fair allocation of this resource.
In general ComReg strives to apply appropriate competitive mechanisms such as auctions when making spectrum available in response to market demand.

ComReg is currently working towards the liberalisation</td></tr>
</table>

		of the 900 MHz band, which will provide Mobile Network Operators (MNOs) with the flexibility to upgrade current capacities and has proposed an auction for allocation of this spectrum.
Iceland	No.	
Israel		
Italy	Yes: - 900 MHz: Agcom, by Decision n. 541/08/CONS, has allowed in 2008 the refarming of 900 MHz band to be authorised for 3G services by the Ministry of economic development (Communications Department) and Agcom, according to the new EC provisions (revised GSM Directive 2009/114/CE and accompanying EC Decision 2009/766/CE). The Agcom Decision paves the way to complete a new re-assignment plan for 900 MHz band on the basis of 5 MHz blocks. One 5 MHz block has been made available on a progressive way for 3G new entrants, which previously had 2.1 GHz spectrum only. The operators' migration is ongoing. In particular it is foreseen that the new entrant will also obtain 3G roaming on the 900 MHz networks of the incumbents where technically feasible. - 2100 MHz: three 5 MHz FDD blocks of 2100 MHz have been made available on September 2008 for 3G services by Agcom decision n. 541/08/CONS; related rights of use of spectrum has been assigned in 2009 by the Ministry of economic development (Communications Department) by auction to the existing 2G/3G mobile network operators. No 3G new comers were emerged during the assignment procedure made by the Ministry. - 2600 MHz: AGCOM is fine tuning the spectrum assignment rules based on consultation results emerged by Agcom decision n. 559/08/CONS and taking into account EC Decision n. 2008/477/EC; the process will be launched shortly. - 1800 MHz: specific regulation on 1800 MHz is under study. AGCOM is studying the spectrum assignation rules based on information to be made available by Ministry of economic development (Communications Department) on spectrum availability, taking into account EC Decision 2009/766/CE; the process will be launched as soon as possible. Agcom Decision n. 541/08/CONS also introduced a possible reservation of two 5 MHz blocks at 1800 MHz for 3G new entrants that became also a new comer at 900 MHz. - 800 MHz: Agcom decision n. 300/10/CONS regarding the new Italian National Frequency Assignment Broadcasting Plan has envisaged the allocation of the upper part of UHF band for mobile services to be used by ECS other than broadcasting. Specific regulation on 800 MHz should be defined by Agcom as soon as possible, taking into account the European Commission general framework and related provisions. - 2500 MHz This band has to be made available for telecommunication services and the Ministry of economic development and the Ministry of Defence (the current assignee) is discussing the conditions under which this will be possible.	In 2009, released spectrum in the 2100 MHz band has been assigned to TLC mobile applications by the Ministry of economic development (Communications Department), on the basis of Agcom rules/decisions, by means of auctions. For spectrum in the 800, 1800 and 2600 MHz bands (TLC new generation wireless services), an auction is expected to be the assignment procedure (see also Agcom decision n. 300/10/CONS for 800 MHz band and decision n. 559/08/CONS for 2600 MHz band). Procedures will be shortly defined.
Japan	On 6/2009, spectrum was allocated in the 1.5/1.7GHz band for LTE(3.9G) technology.	The application of the deployment plans are accepted after the MIC announces the deployment guidance of specified base stations and the deployment plans are approved through the examination.
Korea	Spectrum in the 800/900 MHz and 2.1 GHz bands for IMT-Advanced was allocated (The spectrum allocation plan was announced on Feb. 22, 2009, and the allocation was completed in May 2010).	Method of spectrum charge assignment: comparative selection + assignment of spectrum charge

	- Allocated spectrum was in the 800 MHz, 900MHz and 2.1GHz bands with 20 MHz bandwidth.	considering economic values of the spectrum to be assigned Spectrum charge is calculated based on the expected sales revenue during the period of spectrum use, bandwidth and the characteristics of the spectrum
Luxembourg	No	No
Mexico	During 2009, the process of spectrum tenders for bands 1850-1910/1930-1990 MHz and 1710-1770/2110-2170 MHz began, which were allocated on May 25, 2010.	By a simultaneous ascending process (auction).
Netherlands	1/1/2008: 2010-2019.7 MHz. Allocated to Mobile Communications. 1/1/2008; 2500-2690 MHz. Allocated to Mobile Communications (excluding aeronautical applications). 20/1/2010; 1900-1980 MHz. The restricted use of IMT 2000 technology in the NFP (National table of allocations) has been cancelled. 20/1/2010; 2019,7-2025 MHz. The restricted use of IMT 2000 technology in the NFP (National table of allocations) has been cancelled. 20/1/2010; 2010-2170 MHz. The restricted use of IMT 2000 technology in the NFP (National table of allocations) has been cancelled. August 2010: 900 MHz frequency band and 1800 MHz frequency band. The restricted use of GSM technology in the NFP (National table of allocations) has been cancelled.	2008: 2010-2019.7 MHz. This frequency band process is not licensed. (Was subject of the 2.6 GHz auction in 2010) 2008: 2500-2600 MHz. Auction. 2010: 1900-1980 MHz. Auction. 2010: 2019.7-2025 MHz. Auction. 2010: 2110-2170 MHz. Auction.
Norway	Norway allocated the 2500-2690 MHz band in 2007 on a technology neutral basis through an auction. Norway has also made the frequency band 790-862 MHz band available for new services. The allocation has not yet taken place, but will take place during 2011.	The 790-862 MHz band will be allocated through an auction. The 2.6 GHz band was allocated through an auction.
New Zealand	No.	When it is allocated it will be likely done by auction
Poland	Mobyland 1800 GHz Centernet 1800 GHz Aero2 2620 GHz	Auction
Portugal	Yes, additional spectrum for new generation wireless services has been made available since 2008. In 2008, 2x1.25 MHz in the 450-470 MHz on a national basis. In 2009/2010, 36 lots of 2x28 MHz in the 3.4-3.8 GHz band on a regional basis (4 lots per region). ICP-ANACOM launched a public consultation for the 2.5-2.69 GHz band and it is planned to be awarded during 2011, probably in conjunction with remaining spectrum in the 1800MHz and 2100 MHz bands. Additional spectrum in the MHz band is also available (e-GSM) which is envisaged to be assigned in the near future.	For the 450-470 MHz spectrum a beauty contest was used, while for the 3.4-3.8 GHz band a spectrum auction was implemented. For the 2.6 GHz band, and probably in conjunction with the remaining spectrum (*e.g.* the 1800MHz and 2100 MHz), ICP-ANACOM is planning to conduct an auction.
Slovak Republic	The frequency bands 800 MHz, 1800 MHz, 2,6 GHz and 3,6-3,8 GHz have been identified for new generation wireless services according to the relevant EC Directives and Decisions. Spectrum in the band 800 MHz have been made available after switch-off analog terrestrial TV broadcasting since October 2011. Frequency band 2,6 GHz is used by MMDS operators. These licenses will expire on 31st December 2011 and will be not prolonged.	Spectrum in the bands 800 MHz and 2,6 GHz will be subject of prepared tender for operators providing broadband electronic communication services in the first half of 2012. Procedures will be shortly defined.
Slovenia	No.	
Spain	It is foreseen to launch the awarding processes of bands 2500-2690 MHz and 790-862 MHz in 2011. The 790-862 MHz band will be effectively made available on 1 January 2015 at the latest.	It is foreseen to launch the awarding processes of bands 2500-2690 MHz and 790-862 MHz in 2011. The 790-862 MHz band will be effectively made available on 1 January 2015 at the latest.
Sweden		

Switzerland	No	
Turkey		
United Kingdom	No.	When it is allocated it will be done by auction
United States		

Source: Communications Outlook 2011