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**COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN
PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL
COMMITTEE AND THE COMMITTEE OF THE REGIONS**

Communication on future networks and the internet

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1. INTRODUCTION

Over the last decade the internet has brought about significant changes in our economies and societies. It has proved a remarkable communication and networking infrastructure, adapting incrementally to the needs of its users. It has created a world-wide web of knowledge sharing, creativity and collaboration and has been a major driver of globalisation. It has changed communication habits and is redefining the media sector by promoting the convergence of electronic communications and media services. New and traditional players are adapting to the challenges through new business models.

The Internet revolution is not over. In the next few years the internet will become much faster due to the rollout of very high speed broadband networks and this will permit the launch of many new interactive media and content services. The internet will also become more pervasive; available anytime and anyplace due to the widespread development of low cost wireless broadband and the merging of fixed and wireless communications. An "internet of things" will emerge whereby the web will become the medium for machines, vehicles, appliances, sensors and many other devices to interact. This will provide the basis for many new applications, such as energy monitoring, transport safety systems or building security. Finally it is widely predicted that software delivered as a service over the web will lower costs and raise performance, provoking a large leap in productivity for all businesses, large and small. Effectively deployed, the internet of the future will bring innovation, productivity gains, new markets and growth and jobs in the next decade.

Europeans have massively adopted broadband and internet services. This is changing the economy and transforming lifestyles. But the benefits of these significant changes for the European economy will only be unleashed if several challenges are tackled. First the internet economy must be kept open, notably to innovative business models. This requires the continuation and reinforcement of the current pro-competitive regulation of e-communications markets and appropriate consumer safeguards. Secondly, equipping networks for the internet of the future will require: major investments in infrastructure to create a high-speed internet; the development of the internet architecture to meet future needs; and more access to spectrum on a flexible basis to allow wireless services to take to the air. Third, the exponential increase in internet use will raise security and privacy challenges. Public authorities have a responsibility to make sure that citizens can have confidence that the internet of the future will be easy and accessible, safe and respectful of their privacy.

This Communication should be seen as a preparatory step towards the internet of the future with a focus on setting the framework conditions for keeping the internet dynamic, open and making it more secure. This Communication looks at these issues, now playing out on the world stage¹, and translates them in a European context by reviewing the main challenges ahead (section 2) and their related policy challenges (section 3). In the light of the importance of the internet economy for EU competitiveness, it also proposes a Broadband Performance Index to monitor developments towards a high-speed internet infrastructure (section 4).

But as Europe modernises itself for the economy of the future - in the context of the Lisbon Agenda post-2010 - it will also be of paramount importance that solid foundations are laid for

¹ OECD Ministerial Meeting — The future of the Internet economy — June 2008 and WSIS - World Summit of information society <http://www.itu.int/wsisis>

the growth that can come from this internet of the future. A broader debate on the policy implications of these developments will therefore be needed in the coming months in order to develop the broader policy response to the internet as a generalised infrastructure for modernising the economy and society.

2. EMERGING TRENDS WILL CHALLENGE THE DIGITAL ECONOMY

Evolution of social networks and the Internet of Services

The wide take-up of broadband has caused a shift in the way the internet is used⁴. In particular, we have moved from the information provision that typified the web in the mid-1990s, through fundamental advances in search engines, to the increasingly participative world-wide web of today known as ‘Web 2.0’. Experts are already talking about a further generation of the web that will permit web usage to be automated⁵. Advanced features such as the 3-dimensional web, as popularised by environments such as Second Life, will also grow. Europeans are highly active in using these emerging Web 2.0 services, at least as much as any other part of the world, which means that there is an opportunity to forge the next generation of social networking developments in the EU.

Web 2.0

New and user-friendly applications like blogs, media sharing and social networks are expanding internet participation. 24% of European citizens posted or participated in online fora in 2007². Enterprise 2.0, the business equivalent of web 2.0, is about to follow the rapid rise of social networking sites, with internet-based enterprise software expected to grow worldwide at a rate of about 15% in 2006-2011³.

It is expected that social networking tools applied in the firm will generate an Enterprise 2.0, based on collaboration tools. This, together with the emergence of software as a service, will lead to a new generation of computer services available on demand and with much reduced overheads. End user businesses will themselves be able to use software more easily and cheaply into their own products and service thus engendering a massive productivity leap across the whole economy.⁶

Rise of the Internet of Things

The notion of the Internet of Things refers to the seamless connection of devices, sensors, objects, rooms, machines, vehicles, etc. through fixed and wireless networks. Connected sensors, devices and tags can interact with the environment and send the information to other objects through machine-to-machine communication. Such applications have immediate relevance for transport through intelligent cars, logistics and traffic systems, for environment through smart buildings, for security systems,

Health monitoring

Body-worn sensors and the Internet of Things facilitate the use of lightweight systems for monitoring vital health parameters like heart rate, respiration rate and blood pressure. Patients can simply wear monitoring systems while continuing to go about their daily business. This is particularly beneficial in the context of Europe’s ageing society with many people suffering chronic ailments.

² Eurostat Community Survey of ICT Usage in Households and by Individuals, 2007.

³ Source: Gartner Dataquest Market Databook, September 2007 Update.

⁴ OECD DSTI/ICCP/IE(2007)4/final.

⁵ The Semantic Web was first proposed by the inventor of the World Wide Web, Tim Berners Lee <http://www.sciam.com/article.cfm?id=the-semantic-web>.

⁶ E.g.: Nessi: European Software Strategy, June 2008.

generating large efficiency gains in the wider economy. Looking ahead, the market value for RFID is expected to grow 5 times worldwide by 2018⁷ with the promise of delivering innovative applications.

Nomadic use

Consumers are increasingly adopting a range of portable devices such as laptop computers, PDAs, MP3 players, mobile TV sets, GPS navigation devices or portable gaming consoles. Citizens and businesses will want to access their preferred internet services easily and cheaply wherever they roam. This development – a Web 2.0 on the move adapted to user needs - will not only generate many new business opportunities and transform work organisation patterns; there will also be many applications of social benefit such as support to disabled travellers or emergency workers.

Nomadic use of ICT will challenge the meaning of ‘at work’

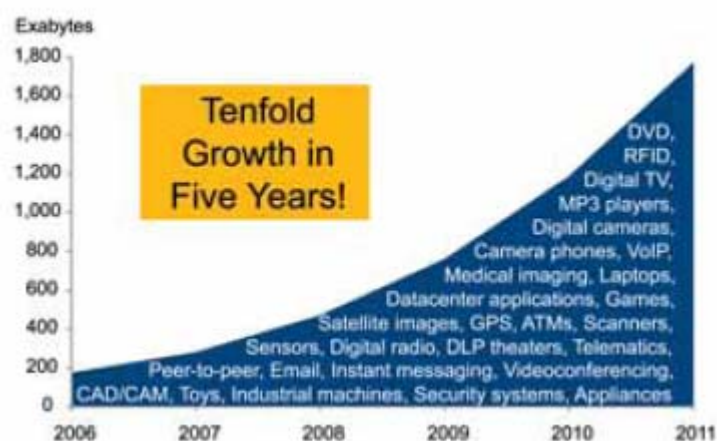
Nomadcity will make work patterns less fixed in time and space. This will create major challenges for both employers and employees. Making working life and education more sustainable in terms of working and studying from home intensifies the need for realising the nomadcity that ICT can provide.

Networks and business models are adapting to handle more data

One immediate consequence of the previous trends is the explosion of data traffic over the net. By 2011, as the diagram shows, the digital information on networks and the internet is expected to be 10 times greater than in 2006⁸.

Rising data traffic will promote the transition to a second-generation broadband based on the Internet Protocol (adding intelligence in the core networks) and offering significantly higher speeds (Next Generation Networks).

Digital Information Created, Captured, Replicated Worldwide



The increase in bandwidth is most needed in the access network. This move towards fibre-rich and wireless access networks is one of the most significant challenges facing European telecommunications in the coming years, but it is a transition that must happen if the internet of the future is to become a reality.

3. CHALLENGES AND RESPONSES

Meeting the challenges outlined above requires that public authorities maintain an environment that is favourable to investment and innovation by providing clear and predictable rules, where access to the internet is kept open through pro-competitive

⁷ IDTechEx RFID Market projections 2008 to 2018

⁸ IDC ‘The Diverse and Exploding Digital Universe’, March 2008, IDC.

regulation, where consumers are empowered through choice and information, and where privacy and security are more firmly embedded within the design principles of the future internet. These are policy principles that the EU also supports in international discussions on internet governance.

3.1. Stimulating investment in high-speed broadband access

The EU regulatory framework for electronic communications has opened up markets and stimulated investment. Recent OECD figures show four Member States leading the global broadband rankings⁹. Competitive pressure remains the most effective force behind the migration to broadband. But, as local access loops are upgraded to deliver a high-speed internet over the coming years — to ‘next generation access’ — it will be crucial to keep the internet open and e-communications markets competitive.

This challenge stems from the high investment cost of the civil engineering works necessary to build the ducts for these new fibre-rich networks, representing up to 80% of the total costs, and the uncertainty as to whether consumers are willing to pay a sufficient premium for the services delivered via next generation networks for these investments to be profitable. Moreover, operators are not on equal footing with respect to such investment. In some cases incumbent operators may be able to re-use their own ducts in the streets and conduits in buildings, so access to these ducts, where there is space, becomes an important factor in order to keep markets open. However, where completely new facilities have to be constructed, given the uncertainties facing investors, there is a need to make sure that access regulation does not take away all incentives to develop next generation access networks. For this reason, the Commission is preparing a Recommendation that will provide guidelines to regulators on how to maintain competition on the access networks while allowing investors a sufficient rate of return on their investments.

At the same time public authorities, particularly at municipality level, can encourage investment in the new networks and lower civil engineering costs by facilitating access to their ducts or by coordinating such upgrades with works on roads or other utilities, especially electricity or sewers. They can also assist by permitting access to infrastructures, by providing sufficient open-access ducting on green-field sites and by mapping the existing infrastructure or making plans for civil works public. Finally, they can facilitate coordination between service providers and building owners when pre-cabling new premises.

On the basis of current EU legislation, local authorities may impose the sharing of facilities on town planning and environmental grounds¹⁰, but more needs to be done to raise awareness and exchange best practices in this area, such as the stakeholder fora established in some Member States. Moreover, in the event of market failure, public authorities can provide direct funding in full respect of state-aid rules. Such funding should be limited to the provision of passive infrastructure (e.g. ducts, manholes or dark fibre) and on the basis of open access: i.e. access to the network must be available to all operators on a non-discriminatory basis.

3.2. Broadband for all

Broadband has already been taken up by around 40% of European households. As its use widens still further and as it becomes a necessity of daily life, the risks of information

⁹ OECD December 2007.

¹⁰ See Article 12 of the Framework Directive 2002/21/EC.

exclusion for citizens that do not have access to broadband or who cannot afford it will rise. Thus, as we move towards the internet of the future, today's digital divide may become tomorrow's 'info-exclusion', with some members of society — due to geography or disparities in resources and skills — left behind and permanently disadvantaged. As technologies evolve, making sure that the benefits of high-speed networks are available in rural as well as urban areas will become a policy priority.

One of the primary aims of the Commission's information society policy strategy, i2010, is to promote an inclusive information society by taking active steps towards 'broadband for all'. This 'broadband for all' strategy was laid out in the March 2006 Communication 'Bridging the broadband gap'¹¹. In particular, it shows how regional and local authorities in the EU can mobilise the EU's Structural and Rural Development Funds, particularly in remote and rural areas, not only for infrastructure but also for e-services and applications for citizens (e-health, e-government, e-learning and e-inclusion). In addition, the Commission will actively update and summarise its guidance on state-aid rules applicable to broadband projects, including for next-generation access as case law develops.¹² Finally, the Commission will soon adopt a Communication reviewing the scope of universal service and opening a debate on the role of universal service in achieving the 'broadband for all' objective.

3.3. Keeping the internet open: competition and convergence

Convergence is blurring the market boundaries between telecoms, consumer electronics, media services and internet companies. Telecom and cable operators are increasingly bundling TV, internet and fixed and mobile telephony ('quadruple play'). New media and internet companies are delivering content for download or moving into the provision of mobile communications content services. As these markets shift and merge, vigilance will be needed to make sure that competition remains effective.

It is against this background that concerns have been raised about preserving "**net neutrality**" as the internet evolves. New network management techniques allow traffic prioritisation. Operators may use these tools to optimise traffic flows and to guarantee good quality of service in a period of exploding demand and rising network congestion at peak times. However, traffic management could be used for anti-competitive practices such as unfairly prioritising some traffic or slowing it down and, in extreme cases, blocking it.

It is for this reason that the Commission has, in its legislative proposals to reform the Universal Service Directive¹³, proposed measures to reinforce end users' interests and rights to information as regards any limitations on access to lawful services and the specification of minimum quality of service requirements to prevent degradation of service¹⁴. Additionally, EC competition rules (Articles 81 and 82 EC) will play a crucial role in preventing and removing anti-competitive conduct. These provisions allow tackling both abusive conduct of dominant network operators as well as co-ordinated conduct aimed at excluding other services or alternative operators from the market.

¹¹ COM(2006) 129.

¹² Updates are available on the Commission's dedicated website:
http://ec.europa.eu/comm/competition/sectors/telecommunications/overview_en.html

¹³ COM(2007) 698.

¹⁴ See the revised Articles 20(5) and 22(3) of the USD.

Convergence is also leading to many different devices and services having to talk to one another. For instance, the proliferation of nomadic services requires networks, handsets, content protection and security applications that are interoperable. Most of the time, these issues are resolved by market mechanisms: the win-win of open interfaces and standards is that the market can grow for all. However, and this is particularly relevant in the presence of network externalities, dominant players may try to use proprietary standards to lock consumers into their products or to extract very high royalties from market players, ultimately slowing innovation and foreclosing market entry by new players. EC competition rules will play an important role in tackling such practices.

This is why open standards are so important, although more complex to promote with the shift towards global ICT standards. The Aho Panel's recent review of EU-funded ICT research concludes that more proactive use of standardisation policies can play a decisive role for innovation and growth in the context of the internal market, as indeed has been demonstrated by European leadership in mobile telephony (the GSM standard) and mobile TV (the DVB-H standard)¹⁵. The Commission is launching a policy strategy to address the impact of these changes on its policies in areas like ICT standardisation¹⁶ and the development of pan-European public services¹⁷.

Content creation is another major area of potential economic growth that depends on the development of the internet of the future. Policy on media content, i.e. the first generation of interactive content services, is embodied in the Content on line Communication¹⁸ in which the Commission has already identified a number of issues to be addressed to improve the availability and distribution of content, and the forthcoming Recommendation on online content will address transparency and interoperability of DRMs, licensing regimes and anti-piracy measures. As Intellectual Property Rights remains a vital factor in determining sustainable business models for digital content the Commission has sought to structure the debate on the long-term future of copyright policy in the knowledge economy in a Green Paper¹⁹. However the EU approach to licensing regimes and copyright policy in the digital environment does not yet fully support the emergence of new business models based on user created content and the shift towards "own and share" approaches to intellectual property. Nor is the protection of minors or the safeguarding of the integrity of information yet assured in the internet of the future.

3.4. Founding the internet of the future

The internet has proved to be remarkably robust and capable of scaling up to meet virtually all of the demands placed on it. However, the sheer scale and complexity of nomadic computing and the Internet of Things will place the existing internet architecture under strain. In order to confront these changes, the internet has to develop, building on its existing principles, to meet the rising demands of scalability, mobility, flexibility, security, trust and robustness.

¹⁵ Information Society Research and Innovation: Delivering results with Sustained Impact, May 2008, available at http://ec.europa.eu/dgs/information_society/evaluation/data/pdf/fp6_ict_expost/ist-fp6_panel_report.pdf

¹⁶ COM(2008) 133.

¹⁷ See the ongoing Review of the European Interoperability Framework <http://ec.europa.eu/idabc/en/document/7728>.

¹⁸ COM(2007) 836

¹⁹ GREEN PAPER - Copyright in the Knowledge Economy – COM(2008) 466

For example, the number of smart radio tags, a key driver of the Internet of Things, is predicted to rise 300-fold in the next ten years from 2 billion today²⁰. But it is not yet certain that there will be the spectrum resources to connect this number of tagged objects, sensors and other smart devices, nor that, unless the transition to IPv6 runs smoothly, there will be enough addresses for all these objects.

Some steps have already been taken. Firstly, the Commission has proposed a target of 25% of European internet users being able to connect to the internet using IPv6 by 2010, and has called upon Member States, Internet Service Providers, content and service providers, manufacturers and industrial stakeholders to begin facilitating the transition to IPv6²¹.

A second step is to anticipate the main challenges posed by the Internet of Things, notably its architecture and governance model. Governance issues applicable also for the Internet of Things are crucial and have received attention in a global context through the World Summit on Information Society (WSIS) process. The Commission is launching a public consultation on the Internet of Things and provides background for this in the related Staff Working Paper issued with the present Communication. The discussion will lead to a Commission Communication setting out a series of concrete actions in early 2009.

Over a longer-term perspective, research into the internet of the future has already been launched world wide with the GENI initiative in the US or the AKARI programme in Japan. The Seventh Research Framework Programme will keep Europe at the forefront of these truly global developments. It is now time to coordinate these efforts more coherently by creating a clear technology roadmap for this area. The Commission also intends to consolidate the fragmented research efforts relevant to the internet of the future by investigating the scope for a fully fledged public-private partnership at European level²² to research key design principles, including end-to-end connectivity, openness, neutrality and transparency.

3.5. Privacy and security

Privacy on the net is already a major concern. The future internet will only increase demands for a more robust and secure network. Anticipated privacy risks stem from user profiling, the use of identifiers for users or objects linked to RFID, unnoticed processing, and linking or disclosure of information, such as the re-use of personal information in social networks or the use of RFID for user profiling. A 2008 Eurobarometer survey²³ shows that two thirds of users are concerned about leaving personal information on the internet. It is clearly necessary to take steps now to make the internet of the future safe by design.

The Community data protection legislation is technology-neutral and therefore well adapted to future challenges. However, the implementation of these rules needs constant monitoring. The forthcoming Commission Recommendation on 'RFID, data protection, privacy and security' will provide guidance on the design and operation of RFID applications in a lawful, ethically admissible and socially and politically acceptable way, respecting the right to privacy and ensuring protection of personal data and appropriate information security. Data protection techniques are a first line of defence against unlawful use of the internet. Recent

²⁰ IDTechEx (2008) — RFID Analyst.

²¹ COM(2008) 313.

²² Declaration Bled Conference - <http://www.future-internet.eu/publications/bled-declaration.html>.

²³ Flash Eurobarometer Series #225 Data Protection in the European Union — Citizens' Perceptions Survey conducted by Directorate-General for Justice, Freedom and Security, 2008.

years have seen an exponential rise in both the scale and sophistication of the security threat posed through the internet. A number of actions to meet these threats have been outlined within the framework of the Commission anti-cyber crime policy²⁴. The internet of the future is likely to introduce new vulnerabilities. Here, there are opportunities to build in greater security at the architectural design stage, but a scaling up of efforts to ensure the security and integrity of networks and services is needed between Member States and so that Europe can show international leadership on the global stage. To this end, the Commission is currently preparing a forward-looking strategy on privacy and trust in the ubiquitous information society.

4. CONCLUSION

The full breadth of the social and economic potential of the internet of the future has not yet been mapped out, but is already central to development strategies in many regions of the global economy and is beginning to take place in Europe as part of the post-Lisbon agenda. This potential includes: a leap in productivity, needed to maintain growth and prosperity in the face of globalised competition, an ageing workforce and costs of achieving environmental sustainability; and many societal innovations which can keep the quality of life of Europeans on the rise.

Unlocking this potential however requires responses to make sure that the internet of the future develops into a strong platform for European innovation and growth. The fundamental requirements are an internet that is high speed and ubiquitously available to all; that is internationally open and competitive; and that it is secure and safe to use, with transparent and effective governance procedures. These fundamental conditions of accessibility, openness, transparency and security form the basis of the Commission's short term agenda for the internet of the future which can be summarised in the following six action points:

- (1) The construction of high-speed internet infrastructures that are open to competition and give consumers real choices. The Commission believes that the current pro-competitive approach provides the best way to achieve these objectives. Accordingly, in addition to its 2007 proposals for reform of the e-communications framework,
 - the Commission will issue guidelines on the application of the e-communications rules in Member States in a **Recommendation on Next Generation Access Networks in early 2009**.
- (2) Promoting access for all to a good-quality internet connection at an affordable price. As part of the implementation of its policy to 'Bridge the Broadband Gap':
 - The Commission will actively update and summarize its practice on state-aid rules applicable to broadband projects.
 - The Commission will, as part of its review of the scope of Universal Service, launch **in autumn 2008 a debate on the role of Universal Service in achieving the target of broadband for all**.

²⁴ COM(2007) 267.

- (3) Keeping the internet open to competition, innovation and consumer choice, avoiding users being locked to services and products. Proposals to this end have been included in the 2007 e-Communication framework reform and these are expected to be adopted in 2009.
- The Commission will continue to apply **EC competition rules** to practices harming competition and consumer choice over the internet.
 - The Commission will adopt a **White Paper on ICT standardisation in early 2009**.
- (4) Launching a debate on the design and development of the internet of the future. To this end,
- The Commission will implement the Action Plan as set out in the related Communication to foster the introduction of IPv6²⁵ and will assess progress made by Member States and industry by 2010;
 - The Commission is launching a public debate on the architecture and governance of the Internet of Things, which will lead to a **Communication in early 2009**;
 - The Commission will also examine the possibility of creating an EU-level public-private partnership on research on the internet of the future and will report in early 2010.
- (5) Providing clear guidelines on the implementation of existing rules on data protection and a coherent strategy for a secure internet of the future, so that Europe can better meet future security threats and lead international debate. To this end,
- The Commission will adopt a **Recommendation on the application of general data protection rules for the use of RFID systems in autumn 2008**;
 - A **Communication on Privacy and Trust** in the ubiquitous information society is under preparation.
- (6) Taking into account the crucial role played by international policy, regulatory dialogue and research cooperation in all these developments, which is why
- the Commission will publish a **Communication on the external dimension** of information society policies by the end of 2008.

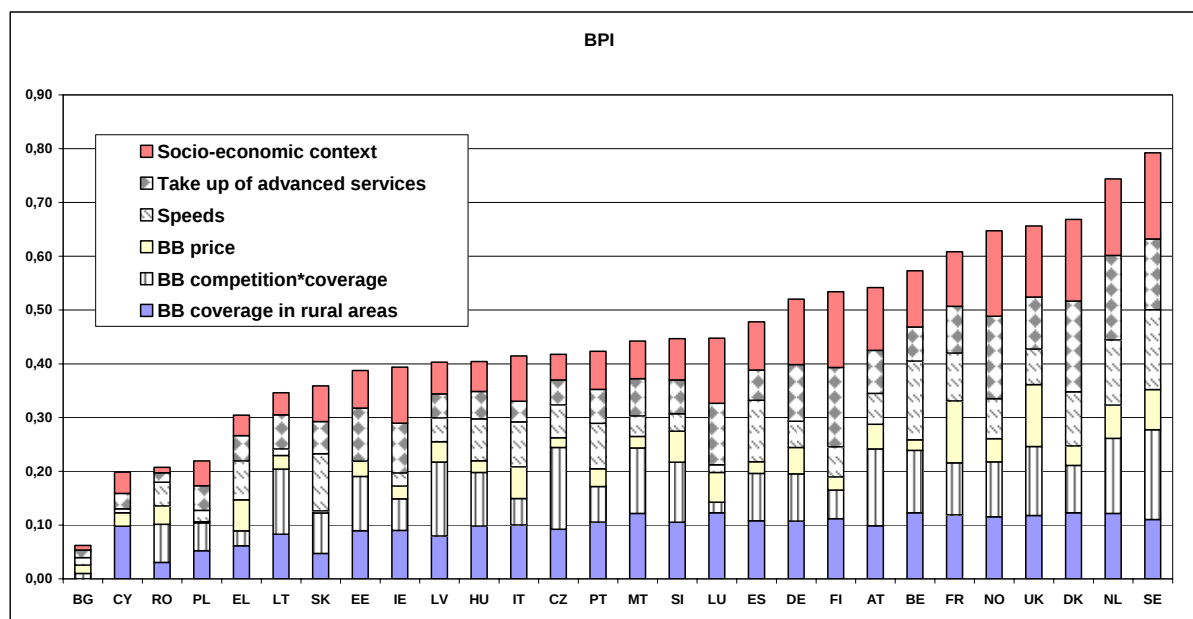
Overall, the transition to the internet of the future can only happen when high-speed internet access is available to all. Therefore, broadband strategies will and must remain a strong focus for policy makers. This is why the Commission proposed a 'Broadband Performance Index' in its Annual Progress Report on the Lisbon Strategy²⁶, which was endorsed by the Spring European Council. The Index reflects the needs for speed, coverage, affordable prices, innovation, high-quality services and a favourable socio-economic context. The 'Broadband Performance Index' is therefore a composite indicator that combines these different

²⁵ COM(2008) 313.

²⁶ COM(2007) 803.

dimensions and enables Member States to benchmark performance and understand better the areas where more policy attention is needed²⁷.

The broadband performance results confirm that the leading countries are consistently those which have successfully put in place a policy mix based on competition, innovation and inclusion. These principles are actively supported by European policies: regulation for telecoms is an example of best practice in encouraging competition, lower prices and investment in networks; it is complemented by comprehensive ‘broadband for all’ policies and demand-side policies that stimulate the development and use of advanced services.



²⁷

See the Staff Working Paper accompanying this Communication for detailed indicators and results.