VDE Position Paper

The Importance of ICT in Horizon 2020

ICT Research Funding is Essential for further Growth in Europe

ITG

VDE

Authors

Prof. Dr.-Ing. Ingo Wolff, IMST GmbH
Prof. Dr.-Ing. Ralf Steinmetz, TU Darmstadt
Prof. Dr. -Ing. Rüdiger Kays, TU Dortmund
Prof. Dr.-Ing. Reinhard Lerch, Friedrich-Alexander-Universität Erlangen-Nürnberg
Dr.-Ing. Werner Mohr, Nokia Siemens Networks Management International GmbH
Prof. Dr.-Ing. Hans-Joachim Grallert, Fraunhofer Institut für Nachrichtentechnik
Dipl.-Ing. Dietrich Schröder, Rohde & Schwarz GmbH & Co. KG
Dr. rer. nat. Erich Zielinski, Alcatel-Lucent Deutschland AG
Dr. Bruno Jacobfeuerborn, Telekom Deutschland GmbH

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VDE VERBAND DER ELEKTROTECHNIK
ELEKTRONIK INFORMATIONSTECHNIK e.V.

Stresemannallee 15 · D-60596 Frankfurt am Main
Phone +49 69 6308-0 · Fax +49 69 6312925
E-Mail itg@vde.com · http://www.vde.com/itg

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The Importance of ICT in Horizon 2020

ICT Research Funding is Essential for further Growth in Europe

A position paper by the
Information Technology Society within VDE (ITG)

The ITG with 12,000 experts in the business, science and political sectors is committed to promoting information technology and its application, together with fostering young technical and scientific talent. VDE, the Association for Electrical, Electronic & Information Technologies is one of the largest technical and scientific associations in Europe with more than 36,000 members including 1,300 companies.

Executive Summary

The new European Union framework research program Horizon 2020 for the financial period 2014 to 2020 (Multiannual Financial Framework – MFF) is currently under preparation. The EU Commission, the EU Parliament and Council are currently in negotiations on the final budget allocation to Horizon 2020, which will be broken down to research funding allocation for different sectors in Horizon 2020. EU Member States agreed in February 2013 budget cuts with respect to the original Commission proposal.
The ICT domain is essential for all areas of our societies and economies. All communication and data processing means, business and administrative processes and critical infrastructures are increasingly dependent on highly available and secure communication systems, which have to support in future significantly higher performance than today. Continuous research in Europe in this domain is needed to strengthen the position of industry in Europe in this highly competitive domain and to grow know-how on new ICT systems and solutions at all stakeholders. Research and innovation are regarded as major means to overcome the current economic crises.

From the perspective of ITG in VDE research funding for ICT should remain on the level of the original proposal by the EU Commission and should not be affected significantly by budget cuts of the overall budget in MFF in order to maintain in minimum the level of research activities like in the last phase of Framework Program 7.

This paper provides information from the ICT perspective on the economic impact and importance of the sector for Europe to demonstrate that it will be essential to maintain strong ICT research, technology and system development in Europe. It is describing the Commission proposal and the ongoing budget discussion with Member States and the EU Parliament as well as economic aspects of the ICT sector in a global context. The global ICT market is huge, where Europe has a share of about 25 %. However, the European market is stagnating compared to other regions. Studies have shown that the availability of broadband access has positive impacts on GDP growth and employment. Therefore, the availability of broadband access is essential for a positive economic development in Europe. User penetration and traffic are growing, which offer a high potential for the ICT industry and research community to develop and deploy new communication networks and systems. However, there are challenges with respect to limited available frequency spectrum and economic conditions for the investment for system deployment, which require an investment friendly environment. Europe made progress in the deployment of broadband systems in the

last years. However, Europe is still lagging behind other regions, which may reduce competitiveness compared to other regions.
Value creation in Europe in the communications network domain is increasingly based on research, innovation and development as well as knowledge and IPR generation. It should be the objective of European policy to strengthen this sector. The research environment in Europe offers means for cooperation between different stakeholders in the precompetitive domain. It is essential that Horizon 2020 takes into account the interests of stakeholders on research topics and the implementation of the program.
After a description of the current budget situation for Horizon 2020 this paper provides supporting background information and statistical data on the economic impact of the ICT sector in Europe.

Table of content

1. Introduction

Today communication networks are essential for all areas and sectors of our societies and economies in developed and emerging countries. They bring people together worldwide and enable global cooperation. Private activities, most business processes and public administrations are based on the availability of reliable communication networks.
Such systems have a long history. Electrical communication systems (telegraph lines) were introduced in the first half of the 19th century. In the second half of the 19th century wireline telephone systems revolutionised long-distance communication. In the last decades data communication became possible with more and more broadband communication systems. Today the global Internet is a major driving force for the further development of communication networks. The widespread introduction of mobile and wireless communication more than 20 years ago is providing access to global communication to a fast increasing number of users, which helps emerging economies to grow and to improve life of their citizens.
Many services and applications are based on the Internet. Critical infrastructures like energy, gas, water, traffic, health etc. are becoming increasingly dependent on information and communication technology (ICT). Therefore, ICT is also a critical infrastructure for societies and economies. It is a key enabling technology for all sectors and is making other processes and the use of resources more efficient.
Therefore, communication networks (fixed and mobile systems) are continuously further developed towards more capacity, higher throughput rates and improved Quality of Service (QoS). With respect to critical infrastructures there is an increasing demand for very high availability (99.999 % corresponding to 5.26 minutes downtime per year) and reliability of such systems. Privacy and data security is a very strong concern for users and governments.

Research, development, deployment and operation of communication networks and in particular in cooperation with other critical infrastructures require a wide know-how base in Europe in order to meet societal requirements and to guarantee secure and reliable service provision to users. Maintaining and improving the know-how base in Europe requires research on all areas of such systems.

The EU Commission is currently preparing in cooperation with EU Member States the new framework research program Horizon 2020, where ICT will be an important part. The overall budget allocation to Horizon 2020 is under negotiation with respect to the reduced overall EU budget for the financial period 2014 to 2020 compared to the original Commission proposal. Therefore, budget cuts can also be expected for Horizon 2020. The ICT domain with its impact on the entire

EU economy and society as basis for future growth and employment requires continuous research and innovation in order to maintain and improve competitiveness of European economy. Therefore, a significant budget allocation in Horizon 2020 to the ICT domain is required to achieve the expected economic objectives.
This paper is describing the Commission proposal for Horizon 2020 (Section 2). In the following sections it provides supporting information on the economic impact of the ICT sector to demonstrate the need for sufficient funding for collaborative research at European level. Economic aspects of the ICT sector are summarised in a global context in Section 3. The economic impact of the availability of broadband access is shown in Section 4. User penetration and traffic growth (Section 5) demonstrates the potential for the communication networks sector. Section 6 describes the status of broadband deployment in Europe. The research environment in Europe offers means for cooperation between different stakeholders in the precompetitive domain (Section 7). Value creation in Europe in the communications network domain is addressed in Section 8. Section 9 provides conclusions.

2. The EU Commission proposal for a new research framework program for the financial period 2014 to 2020

The European Commission is working together with EU Member States and stakeholders to prepare the next collaborative research framework program Horizon 2020 for the financial period 2014 to 2020. In November 2011 the Commission proposal was published [1 to 4].

2.1 Structure of the program

Horizon 2020 comprises three priorities (Figure 1):

- Excellent Science – Basic research,
- Industrial Leadership – Technology-driven research and
- Societal Challenges – Application-driven research.

Figure 1: Horizon 2020 priorities

It is a major objective of Horizon 2020 to address the entire value chain from basic research to technology development, the use of new technology developments to application domains close to market introduction. In particular, the different priorities should support the following overall objectives:

- Excellent Science
  - o Support the most talented and creative individuals and their teams to carry out frontier research of the highest quality by building on the success of the European Research Council.
  - o Fund collaborative research to open up new and promising fields of research and innovation through support for Future and Emerging Technologies (FET).
  - o Provide researchers with excellent training and career development opportunities through the Marie Skłodowska-Curie actions15 ('Marie Curie actions').

  - o Ensure Europe has world-class research infrastructures (including e-infrastructures) accessible to all researchers in Europe and beyond.
  - o ICT topics can be addressed in this priority. However, no particular areas are mentioned.
- Industrial Leadership
  - o Build leadership in enabling and industrial technologies, with dedicated support for
- Information and Communication Technologies
- Nanotechnologies
- advanced materials
- Biotechnology
- advanced manufacturing and processing
- Space

while also providing support for cross-cutting actions to capture the accumulated benefits from combining several Key Enabling Technologies

  - o Facilitate access to risk finance
  - o Provide Union wide support for innovation in SMEs.
  - o In particular in the domain of **Information and Communication Technologies (ICT)** the following areas are foreseen:
    - 1.1.1 A new generation of components and systems: engineering of advanced and smart embedded components and systems
    - 1.1.2 Next generation computing: Advanced computing systems and technologies
    - 1.1.3 Future Internet: Infrastructures, technologies and services
    - 1.1.4 Content technologies and information management: ICT for digital content and creativity
    - 1.1.5 Advanced interfaces and robots: Robotics and smart spaces
    - 1.1.6 Micro- and nanoelectronics and photonics: Key enabling technologies related to micro- and nanoelectronics and to photonics
- Societal Challenges
  - o Health, demographic change and wellbeing
  - o Food security, sustainable agriculture, marine and maritime research and the bio-economy
  - o Secure, clean and efficient energy
  - o Smart, green and integrated transport
  - o Climate action, resource efficiency and raw materials
  - o Inclusive, innovative and secure societies
  - o ICT topics can be addressed in this priority as part of application-oriented projects. However, no ICT technology development is foreseen in this priority.

Horizon 2020 will combine the efforts of the current Framework Program 7 and the Competitiveness and Innovation Program.
The technical content of the different priorities will be further detailed in research agendas based on consultations with stakeholders.

2.2 Funding budget considerations

2.2.1 Commission proposal

According to the Commission proposal in [1 to 4] a dedicated budget allocation for ICT topics is only proposed for the Industrial Leadership priority. In the Excellent Science and Societal Challenges priorities only rough estimates for the intended ICT budget are available. This results in the following figures for the time frame 2014 to 2020:

- Excellent Science: Intended ICT funding budget of about 4 billion €.
- Industrial Leadership: ICT funding budget of 8.975 billion € proposed. Except for photonics and micro- and nanoelectronics (1.1.6 above) no budget breakdown to different activity lines (1.1.1 to 1.1.5 above) is available yet.
- Societal Challenges: Intended ICT funding budget of about 4 billion €.

The overall budget proposal for Horizon 2020 including the Industrial Leadership priority is available in Table 1 and [2].

I	**Excellent science,** *of which:*		**27818**
	1.	The European Research Council	15008
	2.	Future and Emerging Technologies	3505
	3.	Marie Curie actions on skills, training and career development	6503
	4.	European research infrastructures (including eInfrastructures)	2802
II	**Industrial leadership,** *of which:*		**20280**
	1.	Leadership in enabling and industrial technologies*	15580 of which 500 for EIT
	2.	Access to risk finance**	4000
	3.	Innovation in SMEs	700
III	**Societal challenges,** *of which*		**35888**
	1.	Health, demographic change and wellbeing;	9077 of which 292 for EIT
	2.	Food security, sustainable agriculture, marine and maritime research and the bio- economy;	4694 of which 150 for EIT
	3.	Secure, clean and efficient energy	6537 of which 210 for EIT
	4.	Smart, green and integrated transport	7690 of which 247 for EIT
	5.	Climate action, resource efficiency and raw materials	3573 of which 115 for EIT
	6.	Inclusive, innovative and secure societies	4317 of which 138 for EIT
European Institute of Innovation and Technology (EIT)			1542 + 1652***
Non-nuclear direct actions of the Joint Research Centre			2212
		TOTAL	87740

* Including EUR 8975 million for Information and Communication Technologies (ICT) of which EUR 1795 million for photonics and micro-and nanoelectronics, EUR 4293 million for nanotechnologies, advanced materials and advanced manufacturing and processing, EUR 575 million for biotechnology and EUR 1737 million for space. As a result, EUR 6663 million will be available to support Key Enabling Technologies.

** Around EUR 1131 million of this amount may go towards the implementation of Strategic Energy Technology Plan (SET Plan) projects. Around one third of this may go to SMEs.

*** The total amount will be made available through allocations as foreseen in Article 6(3). The second allocation of EUR 1652 million shall be made available pro-rata from the budgets of the Societal challenges and Leadership in enabling and industrial technologies, on an indicative basis and subject to the review set out in Article 26(1)

Table 1: Commission budget proposal for Horizon 2020 [2]

The funding budget in "Leadership in enabling and industrial technologies" within the Industrial Leadership priority comprises the following elements:

- Overall funding budget:
  - 15580 M€ =
  - 8975 M€ (ICT including 1795 photonics and micro- and nano-electronics)
  - \+ 4293 M€ (nanotechnologies, advanced materials and advanced manufacturing and processing)
  - \+ 575 M€ (biotechnology)
  - \+ 1737 M€ (space).

2.2.2 Budget cuts by European Council of Prime Ministers

The European Council of Prime Ministers agreed on its meeting on February 7/8, 2013 the conclusions on the Multiannual Financial Framework of the EU for the period 2014 to 2020 [5]. Compared to the Commission proposal in 2011 the funding budget in Part I, Expenditure, Sub-Heading 1a – Competitiveness for Growth and Jobs will be reduced – Horizon 2020 is part of this Sub-Heading:

15. *The level of commitments for this sub-Heading will not exceed EUR 125 614 million: (page 7) (Table 2) [5].*

SUB-HEADING 1a - Competitiveness for growth and jobs (Million euros, 2011 prices)						
2014	2015	2016	2017	2018	2019	2020
15 605	16 321	16 726	17 693	18 490	19 700	21 079

Table 2: Competitiveness for growth and jobs

The Council conclusion is asking for synergies with other funding sources [5]:

16. *There is a critical need to reinforce and extend the excellence of the Union's science base. The effort in research and development will therefore be based on excellence, while ensuring broad access to participants in all Member States; this, together with a thorough simplification of the programme, will ensure an efficient and effective future European Research Policy also ensuring better possibilities for SMEs to participate in the programmes. All policies will be called upon to contribute to increase competitiveness and particular attention will be paid to the coordination of activities funded through Horizon 2020 with those supported under other Union programmes, including through cohesion policy. In this context, important synergies will be needed between Horizon 2020 and the structural funds in order to create a "stairway to excellence" and thereby enhance regional R&I*

capacity and the ability of less performing and less developed regions to develop clusters of excellence.

According to the EU Parliament – Multiparty comments on the Council Conclusion – [6] the following budget cuts are expected:

- Sub-heading 1a ("Competitiveness for growth and jobs") appears to be one of the biggest victims of the changes. The total level of commitments is now put at 125.7 billion €, down from 152.5 billion € in the earlier proposal.
- The "Connecting Europe Facility" (CFE) under Sub-heading 1a ("Competitiveness for growth and jobs") is slashed from 41.2 billion € to 29.3 billion €.
  - o This corresponds to an overall budget cut of 17.57 %.
  - o The expected budget cut without the Connecting Europe Facility is reduced
- from 152.5 billion € - 41.2 billion € = 111.3 billion €
- to 125.7 billion € - 29.3 billion € = 96.4 billion €.
  - o This corresponds to an expected budget cut for Horizon 2020 by about 13.4 %.

With respect to the political decisions of the Council of EU Prime Ministers a funding budget reduction compared to the original Commission proposal in the range 13 to 17 % is expected. The implementation of these cuts is not yet clear,

- whether there will be a general cut of all objectives based on the same percentage value or
- whether certain priorities will be set at the expense of other objectives.

As Horizon 2020 is combining the efforts of the current Framework Program 7 and the Competitiveness and Innovation Program, the remaining funding budget per year for Horizon 2020 will basically correspond to the available funding budget per year at the end of the current financial period and no growth towards the 3 % objective of European GDP (Gross Domestic Product) is expected.

The ICT domain is a key technology for all sectors of our society and economy and therefore Europe has to invest significantly in this domain in future in order to maintain and improve its competitive position in the global market. Research funding budget cuts should be kept to a minimum in the ICT domain.

In the following sections the economic importance of the ICT sector is described to demonstrate that investment in this domain will help to generate economic growth in the entire economy.

3. Global ICT market and economic developments

3.1 ICT market

The communications technology sector is relying on international – and ideally on global – standards in order to ensure interoperability of systems and economy of scale to reduce cost. In particular mobile and wireless communications require global interoperability as much as possible to serve roaming users and devices and to ensure Quality of Service (QoS). Major global standards and systems in mobile and wireless communications as well as in optical communications are based on European collaborative research projects [7]. Results of respective projects were used for consensus building between organisations to prepare future standards, which are also cooperating in international standards organisations. This ensures the exploitation of results and economy of scale with affordable cost for communication service providers and end customers.

Communication networks are a key enabling technology for all sectors of society and economy to provide connectivity. Increasingly, many infrastructures like electrical energy systems, gas and water networks, traffic, health and other societal challenges depend on reliable and highly available communication networks. According to BITKOM [8] the worldwide ICT market volume increased in 2010 by nearly 5 % to about 2500 Billion €. The biggest ICT market is USA with a market share of 28.7 % (Figure 2). For example Germany with 5.1 % global market share is No. 4 after the USA, Japan and China. Europe with a market share of 25.2 % is in a similar order of magnitude like the US. According to GSMA [9, p. 3] the mobile communications market in Europe reached a total revenue of 174 billion € in 2010, which is comparable to the aerospace industry and larger than the market of pharmaceuticals.

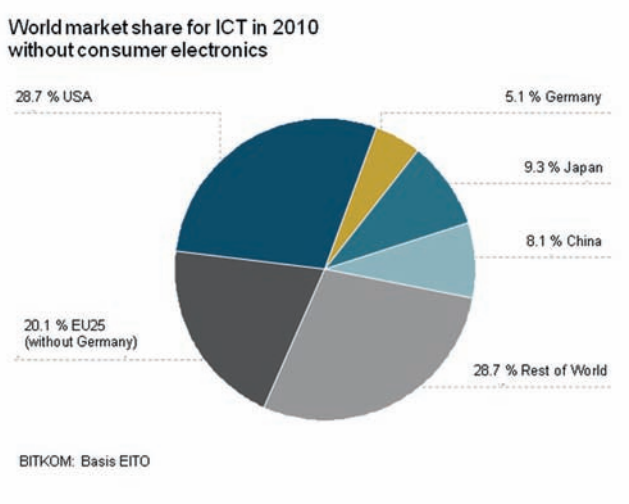
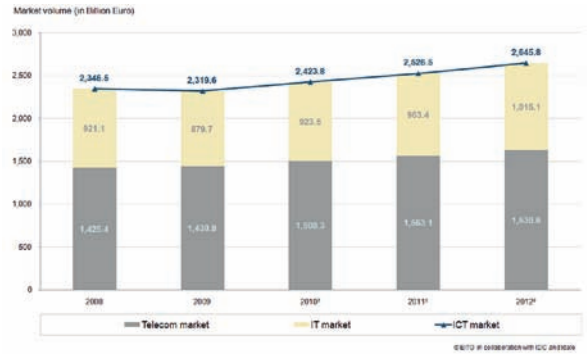


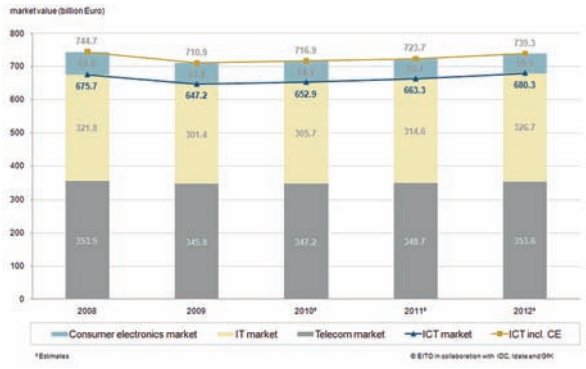
Figure 2: World market share for ICT in 2010 [8]

Industry from Europe is serving the global ICT market. Country and regional specific data (Figure 3) on market size and development are available in [10]. The global ICT market was also affected in 2009 by the financial crisis. It is slightly increasing again since 2009. However, the European ICT market is basically stagnating. Its market value is still below the figure of 2008. The Asia-Pacific region and the USA with a similar market size like Europe and in particular the BRIC (Brazil, Russia, India and China) countries show bigger growth rates, which offer promising economic prospects for industry from Europe. European industry has a significant share in this business. Industry from Europe has to be present in these markets to benefit from that growth with respect to increasing productivity in order to maintain employment and business.

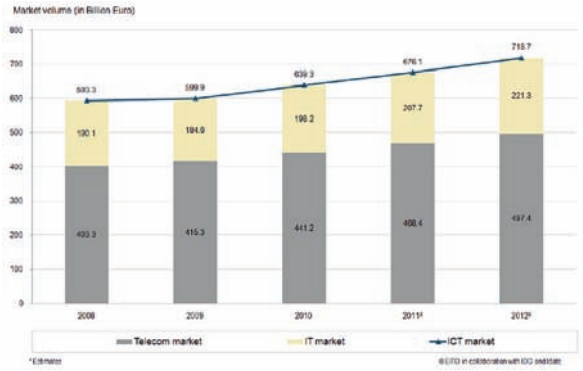
However, there is fierce global competition in particular from Asian manufacturers. Research and development is essential to maintain the position of industry in Europe to be on the forefront of the technology development.



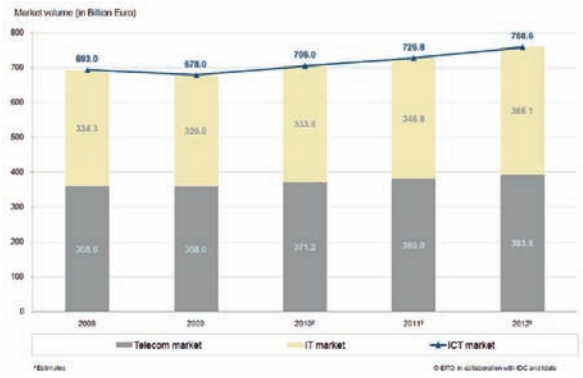
World ICT market value 2008 – 2012 *



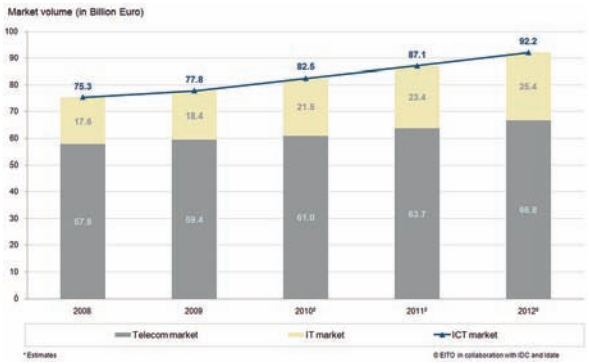
EU25 ICT market value 2008 – 2012 *



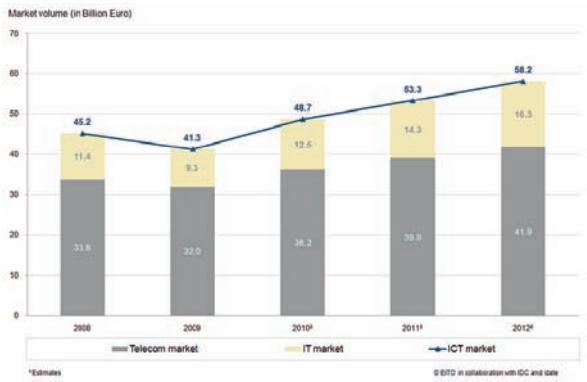
APAC ICT market value 2008 – 2012 *



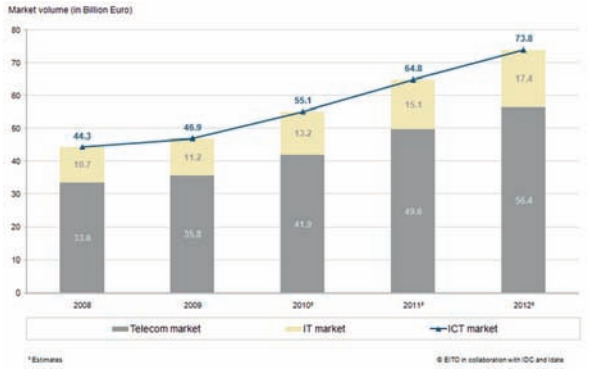
USA ICT market value 2008 – 2012 *



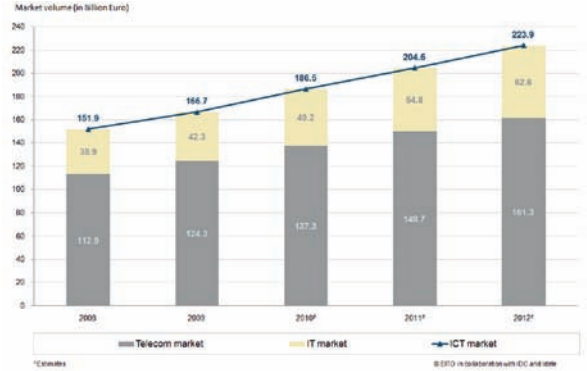
Brazil ICT market value 2008 – 2012 *



Russia ICT market value 2008 – 2012 *



India ICT market value 2008 – 2012 *



China ICT market value 2008 – 2012 *

Figure 3: ICT market in selected countries and regions [10]
* Data and forecast are based on information available as of May 2011

In particular in areas like complex devices for optical communications the European share in the global market corresponds to 45 %. However, production of components also increasingly shifted towards Asia [11, pp. 48]. The Photonics21 European Technology Platform prepared a SWOT-analysis of the optical communications sector, which shows similar conditions like in mobile and wireless communications [11, pp. 52].

3.2 Contribution of the Internet economy

The ICT market is increasingly driven by the Internet. According to [12, p. 25] the following, key messages are important to understand this impact:

- The European Internet Economy is estimated at 498 B€ in 2010, corresponding to 4.1 % of EU27 GDP. This proves that the Internet generates an important contribution to EU growth.
- The value of the Internet economy by country varied in 2010 from 118 B€ in Germany, to 6 B€ in Poland; in terms of contribution to GDP, the UK leads with 6.2 %, followed by Germany with 4.7 % and France with 4.6 %.
- The variations of the value of the Internet economy by country are influenced by the level of eReadiness (higher intensity and sophistication of Internet use and availability of enabling factors such as

broadband are correlated with higher value); by the strength of the consumer market in each national economy; by the structure of the economy in each country (countries with a strong services economy have an edge).

- The lion's share of the European Internet economy is generated by end-user spending for goods and services over the Internet (BtoC – Business to Customer), which grew from 273 to 323 B€ in 2010, increasing its share of the total Internet economy from 63 % to 65 %. In other words, consumption, rather than investments, drives the growth of the Internet economy.
- The penetration of Internet buyers on the population is expected to continue to grow fast across the EU, reaching 56 % in the EU27 by 2014, corresponding to 282 million buyers.
- Thanks to these growth trends, and if the general economic climate remains positive, BtoC eCommerce will grow in the EU27 from 323 B€ in 2010 to 566 B€ in 2014, with an average growth rate of 15 % per year.
- Business to Business (BtoB) eCommerce, also known as Supply chain eCommerce, cannot be measured as a contribution to GDP, because it involves intermediate transactions between organizations. But its relevance for global supply chains and business processes is even higher.
- According to IDC estimates, the value of BtoB eCommerce reached 1,874 B€ in 2010, with a 19 % growth on 2009. This is almost 6 times as much as the value of BtoC. BtoB eCommerce is projected to grow to 2,746 B€ in 2014, with an average growth rate of 10 %.
- BtoB is strongly correlated with company size, with a much higher presence in large enterprises. Therefore, it is not surprising to find Germany as the largest market, followed by the UK and France. Italy's manufacturing base explains why its BtoB market is much larger than that of Spain. But BtoB is also growing fast in countries such as Poland.
- The need for global standards and business demand for ever more sophisticated innovation will play a key role in BtoB diffusion.
- European BtoC eCommerce represented the largest share (46 %) of worldwide BtoC eCommerce in 2010, and this share is expected to increase to 48 % by 2014. China's share is also expected to grow, while the US one will shrink.
- The US instead dominate worldwide BtoB. European BtoB eCommerce represented the second largest share of worldwide BtoB in 2010: 29 % of 6,422 B€, against 36 % for the US. Both shares will decrease by 2014, while China's and especially the Rest of the World's ones will increase substantially.

Figure 4 shows the contributions from different stakeholders to the Internet economy [12, p. 28; 13, p. 58]. The BtoC component provides the biggest contribution.

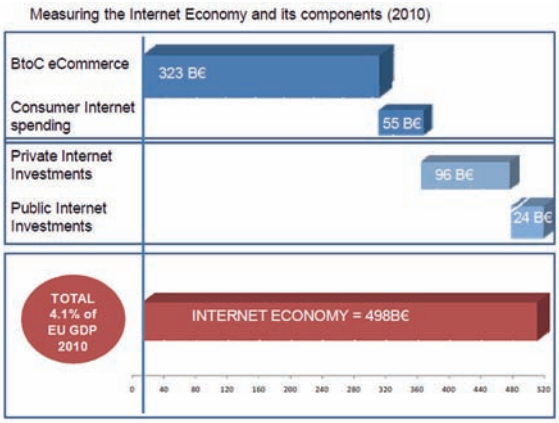


Figure 4. Internet economy, value and share of EU GDP, B€ and % of total spending, 2009 and 2010 [12, p. 28; 13, p. 58]

The share of the Internet economy in different European countries is different (Figure 5). In particular in more service-oriented economies the share in GDP is bigger [12, p. 31].

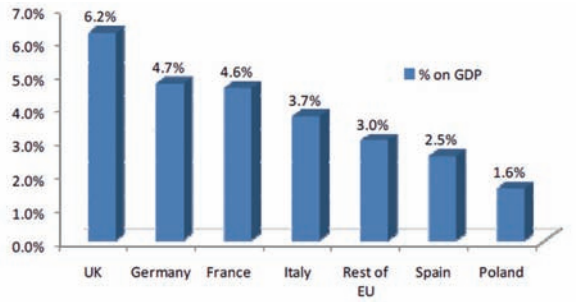


Figure 5: Internet Economy for the main EU Countries, Share of Country GDP, 2010,
Source: IDC 2011 [12, p. 31]

Internet telecom services generate the biggest revenues, Internet network equipment and Internet IT services are at the second place [12, p. 51; 13, p. 14]. However, their contribution is much lower than for Internet telecom services. 60 % of the revenues in the European Internet industry are coming from telecom services (Figure 6) [13, p. xv; 14, p. xiv].

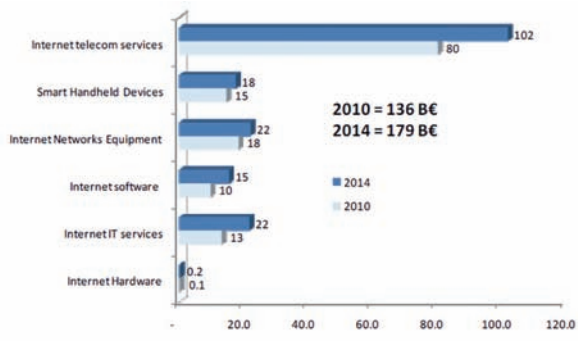


Figure 6: Core Internet Industry Revenues by Segment, EU 27, Billion €, 2010-2014,
Source: IDC 2010 [12, p. 51; 13, p. 14]

According to Figure 6 there are five main segments in the Internet economy [14, p. xiii]:

1. Network equipment suppliers
2. smart handheld devices suppliers
3. Internet-related software and services companies
4. Internet-related telecommunication providers
5. players in the “web ecosystem”

All these segments are mutually dependent from each other. Communication networks are the enabler to make these contributions possible. Table 3 from [13, pp. 38; 14, p. xvi] shows the determinants for growth and competitiveness for the five segments. In particular, Internet network equipment suppliers are facing economic challenges due to high R&D cost and the dependence from investment decisions of communication service providers. The smart handheld sector is highly competitive.

Segment	Determinants for growth and competitiveness
Internet network equipment suppliers	1. Operating in world market: very high costs to keep up with technological progress (R&D) combined with intense price competition 2. Growth crucially dependent of investment decisions of telecommunications network operators 3. Global players successful manage external growth (purchasing “innovators”) and integrate them
Smart handheld devices suppliers	4. European players lag behind international competitors that have managed to tie terminal equipment with exclusive provision of services and applications 5. Likely path-dependency and lock-in effects for end-users due to vendor specificities 6. Entry barriers due to considerable economies of scale regarding R&D, capital requirements and existing patents
Internet-related software and services companies	7. High economies of scale due to R&D requirements, requirements to keep up with technological/market trends (e.g. cloud) and therefore high capital needs 8. Lack of skilled personnel 9. Lack of venture capital for SMEs 10. Management of external growth
Internet-related telecommunication providers	11. Significant economies of scale due to high fixed costs of networks (e.g. regarding NGA networks), and therefore high capital needs 12. Intensive price competition on the end user side: low willingness-to-pay for access 13. Lack of competencies to rapidly establish new business models related to the web ecosystem (e.g. regarding content, advertising) 14. Managerial competencies for external growth (incorporation of innovators from outside) 15. Geographical fragmentation in Europe with respect to fixed link and mobile activities 16. Fragmentation of the European markets regarding pan-European business models for multi-nationals
Web ecosystem	17. High investment needs for physical infrastructure in specific segments leading to capital scarcity (e.g. regarding cloud computing or platform business) 18. Lack of skilled personnel 19. Capability to work efficiently rests on an appropriate access to capital for start-ups 20. High transaction costs due to fragmentation, due to security and privacy rules, language, etc.

Table 3: Determinants of growth and competitiveness by segment [13, pp. 38; 14, p. xvi]

The following market and technology trends are affecting the Internet industry and have to be considered [14, page xv]:

1. Future Internet industry revenues continue to grow, particularly in the web ecosystem.
2. Increasing demand for ‘big data’ management due to an explosion of data traffic.
3. Growth in cloud computing is four times the growth of IT market as a whole.

4. M2M traffic will increase 40-fold between 2010 and 2015.
5. 64 % of Internet users will be regular social network users in 2015.
6. Tablets and smart phones enable Internet mobility with sophisticated user-interfaces.
7. Convergence phenomena regarding telecommunications, mobile services and media will shape the future of the Internet industry.
8. Governance regarding net neutrality may affect investment behaviour and innovation potential.
9. New requirements regarding network security and data protection create opportunities and challenges for the Internet industry.
10. Advertising is becoming a dominant business model in the web ecosystem.

There is a different economic weight of the ICT sector for different economies. In particular Asian economies like Taiwan, Korea, Japan and China are putting a high emphasis on the ICT sector (Figure 7) [15, p. 13]. The US economy is showing a similar percentage value like China. The ICT domain in the EU has a much lower percentage of the overall economy and is in a similar order like India.

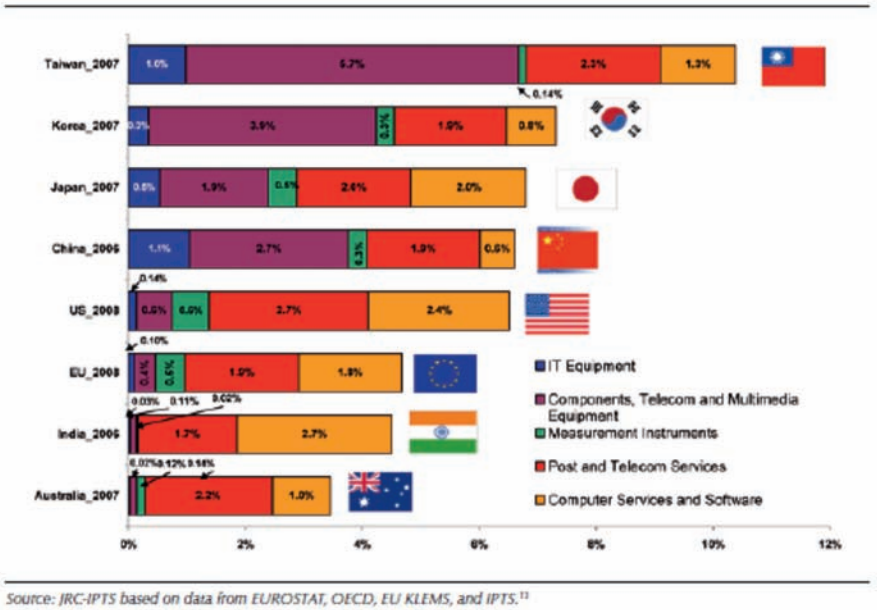


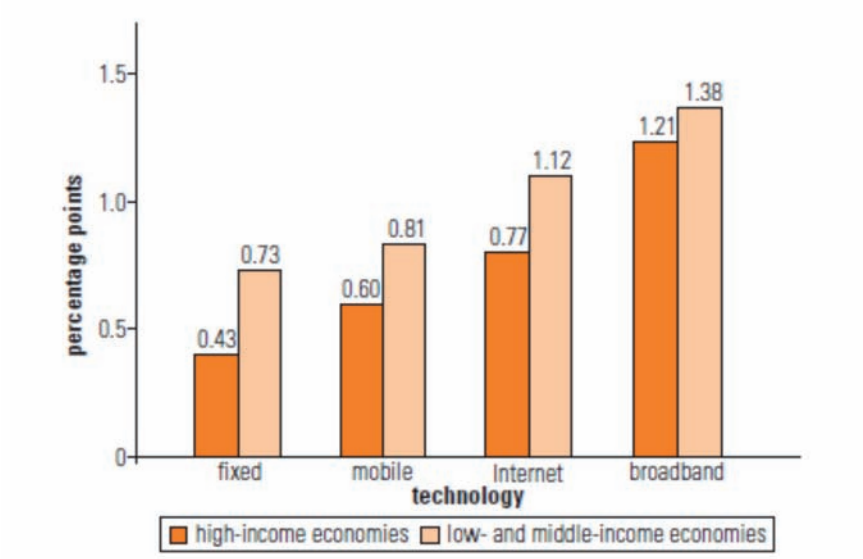
Figure 7: Economic weight of the ICT sector. % of sector's value added in GDP, 2008 or latest data available [15, p. 13]

4. Economic impact of the availability of broadband access

4.1 Impact on GDP growth and employment

The Worldbank has studied the impact of broadband communications on economic growth in developed and developing economies for different network systems like fixed networks, mobile communications, Internet and broadband communications [16]. The right hand-side bars in Figure 8 from [16, p. 45] indicate that increased broadband penetration can create GDP growth up to 1.38 per cent points in low- and middle-income economies. In high-income economies the effect is slightly smaller with 1.21 per cent points of GDP growth. However, in the current economic climate with low growth rates such effects would stimulate the global economy significantly. This productivity improvement will increase GDP without increasing resources used in production. For example, the US could increase its GDP by 100 billion $ with an increase of 10 additional broadband lines per 100 individuals (30 million lines).

Similar figures are also reported by the EU Commission: 50 % of economic growth in the European Union is driven by ICT [17].



Source: Qiang 2008.

Note: The y axis represents the percentage-point increase in economic growth per 10-percentage-point increase in telecommunications penetration. All results are statistically significant at the 1 percent level except for that of broadband in developing countries, which is at the 10 percent level.

Figure 8: Impact of Broadband on GDP [16, p. 45]

Usage pattern in low income countries are different, which may lead to different business models. Such systems are helping users to obtain better paid work, help farmers in agriculture, improve health outcomes, survive emergencies and natural disasters, support financial inclusion and low-carbon economy [18, p. 25]. The ITU report [18, pp. 76] provides a detailed summary of impact of the availability of broadband systems on various economies, which also demonstrates the importance of these systems for societal and economic development. OECD (Organisation for Economic Co-operation and Development) figures also demonstrate the contribution of investment in ICT on GDP growth [19]. Figure 9 shows the impact in percentage points for two time periods. The increased investment and use of ICT in the period 1995 to 2003, e.g. due to the availability of mobile and wireless communications results in bigger impacts on GDP growth than in the period 1990 to 1995.

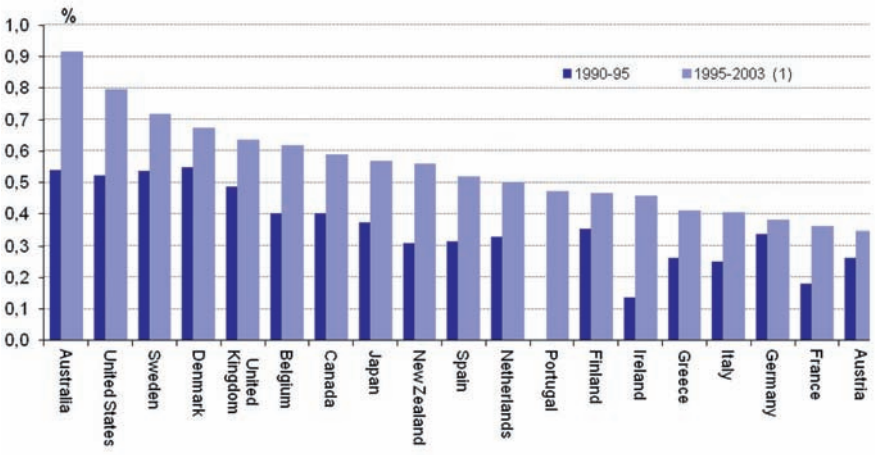


Figure 9: OECD Key ICT indicators: Contributions of ICT investment to GDP growth, 1990-95 and 1995-2003 (1), in percentage points [19]

According to [18, p. 6] and the Boston Consulting group, the estimated size of the Internet economy in the G20 countries [20] corresponds to around 2.3 trillion US $ or 4.1 % of GDP in 2010. By 2016 the market size could nearly double to 4.2 trillion US $. McKinsey estimated that the Internet accounts for 3.4 % of total GDP for the G8 countries [21] plus five major economies (Rep. of Korea, Sweden, Brazil, China, and India). ITU sees the following trends which will influence the mobile high-speed future and how they will impact users [18, p. 10]:

- Real-time status updates for objects, as well as people, in a growing 'Internet of Things';
- Using location-based services and Global Information Systems (GIS) in many different ways in our lives – for example, to summon taxis, avoid traffic jams, track late buses or stolen cars, locate friends – and ourselves;
- Apps 'pushing' out information to users, rather than users searching for and 'pulling' in information;

- Sharing our likes and dislikes, resulting in targeted advertising, as well as search results tailored to our personal preferences;
- Better access to healthcare or government services and job opportunities;
- Collaborative crowd-sourcing in authorship, project management, funding relief efforts, generating encyclopaediae or news reporting;
- 'Collaborative consumption'10 or the outsourcing of tasks or household chores for a price;
- Changes to our notions of privacy, or even the demise of privacy?
- Converged cross-platform malware, as well as converged services;
- Storing data in the cloud – you need never again be dependent on your physical device.

These considerations show the importance of the combined capabilities of broadband, reliable and highly available communication networks for the competitiveness of economies. A knowledge-based and service-oriented society needs such networks to be competitive.

Communication networks infrastructure as fixed (optical) and mobile communication systems is the basis for the provision and generation of content and associated applications. Content is responsible for the huge expected traffic growth. Such systems are based to a huge extend on software. Therefore, the know-how on software technology is essential for Europe to be able to develop future ICT systems. In addition, access to micro- and nanoelectronics as critical components and know-how is strategically important for industry in Europe to be on the forefront of new developments.

The ICT sector has a huge economic impact and a mutual dependency of different sectors like infrastructure, content, software and components as well as system operation. All elements in the value chain are needed to be competitive and successful in the global market.

There are different impacts on the creation of jobs in the domain of communication networks:

- Direct impacts can be seen in maintaining research and development of communication network technology in Europe – in particular for new and future systems – to generate and maintain know-how. With respect to telecommunication policies in other regions of the world like the request for local research, development and manufacturing, and the need to mitigate trade barriers and risk of currency exchange rates there is on one hand strong pressure on industry from Europe to be present in such growth markets (cf. Figure 3); on the other hand the necessary know-how has to be available in Europe, because communication networks are increasingly used also to operate other critical infrastructures like energy, water, traffic, health etc. Therefore, communication networks are also a critical infrastructure themselves.
- Other direct impacts are the operation of communication networks.

Bigger impacts are expected from secondary effects like the use of deployed broadband communication networks. Investment in broadband communication systems provides positive effects on economic

growth and additional employment [9, p. 4 and 38; 22]. Figures 10 and 11 show the expected impacts for the European mobile industry and the example of Germany. Broadband investments in Germany between 2010 and 2020 will add 170.9 billion € to GDP (Gross Domestic Product) and 968.000 jobs. Similar effects can be expected in other European countries. The revenue of European mobile industry of 174 billion € corresponds to 1 % of total EEA (European Economic Area) GDP. A similar study has been performed already in 2004 by Deutsche Bank [23], which estimated a significant contribution to job creation in Europe by means of mobile communication systems.

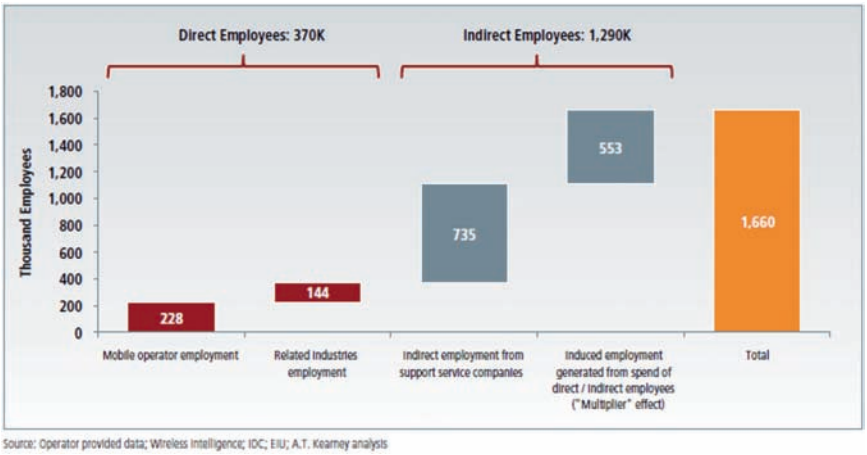


Figure 10: Direct and indirect employment created by the European mobile industry, 2010 [9]

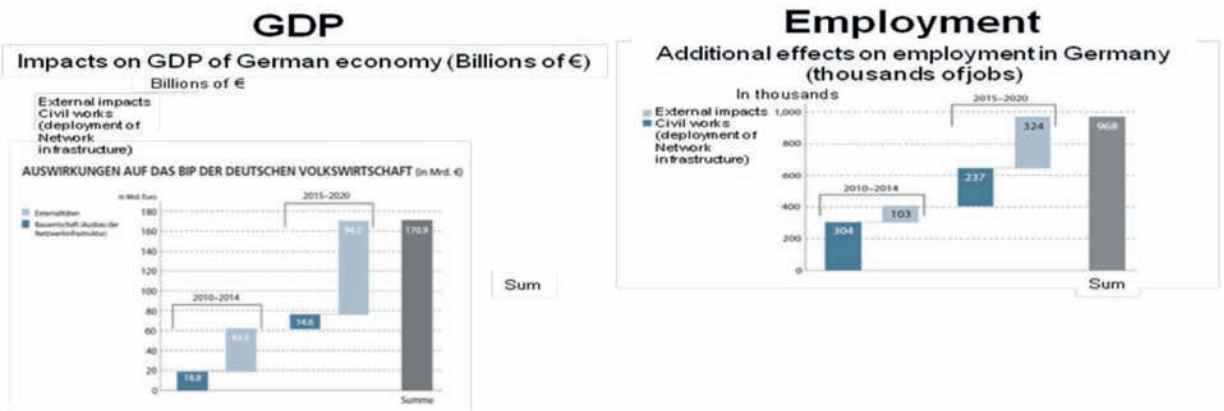
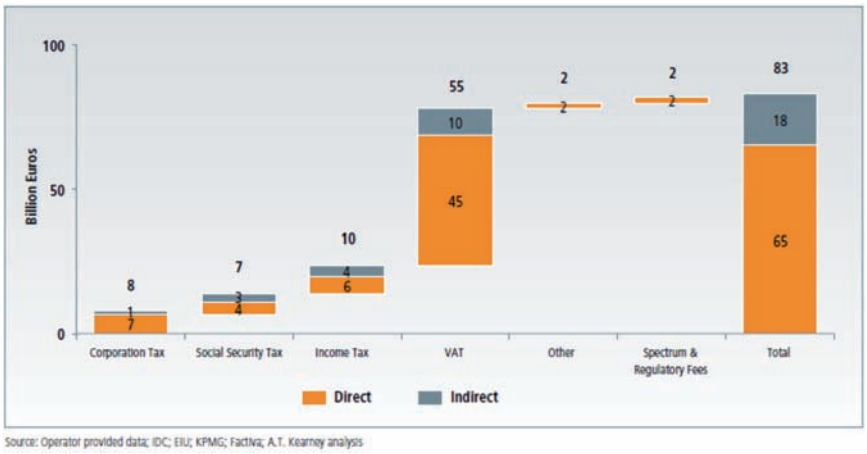


Figure 11: Impact of Broadband Investments in Germany [22]

The sector is contributing approximately 65 billion € to public funding (taxes) plus additional 18 billion € from related industries (Figure 12) [9, p. 38].



Source: Operator provided data; IDC; EIU; KPMG; Factiva; A.T. Kearney analysis

Figure 12: Contributions (taxes) to public funding by the ICT sector, 2010 [9]

Photonics21 prepared a market study of the photonics sector and other sectors on the leverage effects of specific technologies. According to Table 4 the photonics and the telecommunication infrastructure sector show the highest leverage effects on economy between the investigated sectors [11, pp. 169]. The definitions of the different parameters are explained in 11, p. 173].

Impact Summary	EU-Market (€bn)	Employment (1000's)	Photonics LIM Max 2010	Photonics Market Impact PML (€bn)	Photonics employment Impact PEL (1000's)
Manufacturing					
Manufacture of Electronics and Optical Equipment	462	4320	70%	325	3039
Manufacture of Vehicles and Large Machinery	682	4118	59%	405	2448
Manufacturing of Fine Chemicals and Pharmaceuticals	88	1030	31%	27	321
Manufacturing of Textiles and Clothing	440	2218	11%	48	244
Media Production and Broadcasting	246	756	65%	159	489
Food and Beverage Production	900	4000	17%	152	674
Printing & Publishing Activities	104	243	49%	50	118
Oil and Gas Exploration	74	203	28%	21	57
Final Markets					
Medicine & Healthcare Activities	974	5331	47%	456	2497
Defence and Security Activities	246	5342	58%	144	3115
Aviation and Space Infrastructure	128	1101	55%	71	606
Road & Rail Transport and Logistics Infrastructure	1393	6104	26%	358	1568
Telecommunications Infrastructure	431	954	81%	350	774
Science, Research & Development	4	940	71%	3	671
Electricity Generation & Supply	321	933	34%	108	313
Construction and Built Environment	1384	13548	10%	138	1355
Environmental Monitoring and Protection	3	171	35%	1	60
Recreation, Culture and Education	598	9442	43%	258	4075
Retail & Services	1892	25272	28%	538	7191
Total	**10371**	**86027**		**3613**	**29614**

Table 4: Overview of Leverage Impact Measure (LIM) impact to employment and EU market, regarding enabled manufacturing industries and final markets [11]

The Digital Agenda Scoreboard of the EU Commission provides data on employment in different ICT sectors (Figure 13) [24]. The overall employment is rather stable between 7.2 to 7.5 million employees since 2002. There are some shifts between sectors.
In the telecommunications sector employment decreased since 2002 from about 1.2 million employees to about 1 million employees in 2010 (Figure 14) [24]. Reasons for this reduction are changes in technology, reduced maintenance requirements, more software intensive solutions and reduced specialised manufacturing of equipment. The overall employment remains rather stable due to growth in other sectors.

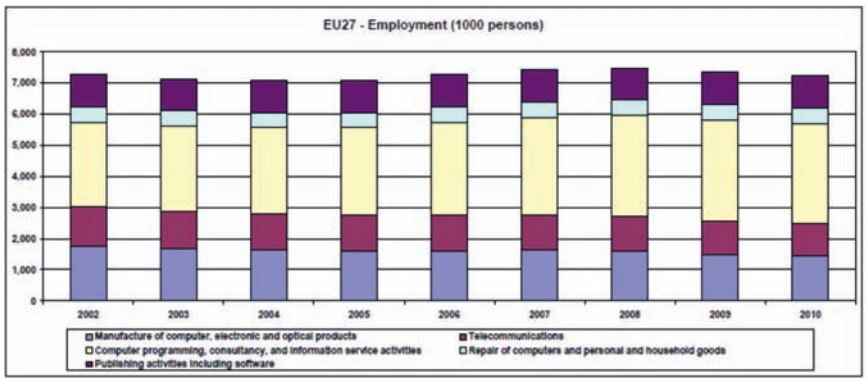


Figure 13: EU27 – Employment (1000 persons)

(Source: Eurostat, national accounts by industry (NACE Rev.2 by 64 branches)) [21]

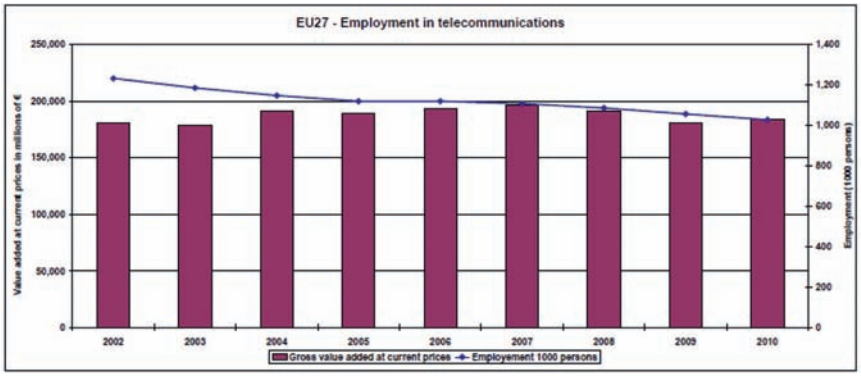


Figure 14: EU27 – Employment in telecommunications

(Source: Eurostat, national accounts by industry (NACE Rev.2 by 64 branches)) [24]

Employment figures for Germany from BITKOM [25] clearly show the shift between the IT and telecommunications sector. The overall employment increased slightly in the last years. The decrease of employment in the telecommunications sector was overcompensated by the increase in the IT sector (Figure 15), where software and IT services are dominant. Vendors of information technology, telecommunication and Internet services are the second biggest employer in German industry after mechanical engineering and ahead of automotive and electrical engineering.

According to [13, p. xvii; 8, p. xvii] *"the growth of the Internet Industry generally leads to an increase in employment in the Internet industry itself. This does not automatically imply an increase in total employment, because many of the new jobs in the Internet sector represent displaced employment. But in the rich ecosystem of highly dynamic and networked SMEs under the Tipping Point scenario, the Internet industry is more likely to produce high-quality employment than in the other two scenarios." However, both reports indicate that "between 2018 and 2022 the employment effect of the Future Internet is estimated to be negative."*

BITKOM

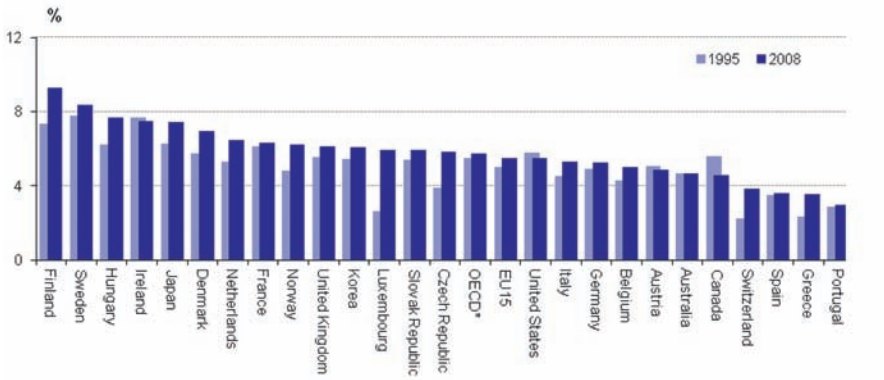
Erwerbstätige* in der ITK-Branche Deutschland (in Tsd.)	2007	2008	2009	2010	2011**	Wachstum 2008	2009	2010	2011
Summe ITK + CE	**830,8**	**835,2**	**835,5**	**847,7**	**857,7**	**0,5%**	**0,0%**	**1,5%**	**1,2%**
CE	12,1	12,1	10,9	11,1	10,7	0,1%	-10,3%	2,3%	-4,0%
Summe ITK	**818,8**	**823,1**	**824,6**	**836,6**	**847,0**	**0,5%**	**0,2%**	**1,5%**	**1,2%**
Informationstechnik	**550,6**	**577,7**	**587,3**	**609,2**	**624,6**	**4,9%**	**1,7%**	**3,7%**	**2,5%**
IT-Hardware***	26,3	26,5	23,8	21,0	19,5	0,6%	-10,1%	-11,8%	-7,1%
Software & IT-Services	524,3	551,3	563,5	588,2	605,1	5,2%	2,2%	4,4%	2,9%
Telekommunikation	**268,2**	**245,4**	**237,3**	**227,4**	**222,4**	**-8,5%**	**-3,3%**	**-4,2%**	**-2,2%**
TK-Hardware	63,5	57,2	53,6	51,1	50,0	-9,9%	-6,3%	-4,8%	-2,1%
Telekommunikationsdienste	204,6	188,1	183,7	176,4	172,4	-8,1%	-2,4%	-4,0%	-2,2%

* jeweils zum Jahresende, einschließlich Selbständige
** Prognose
*** Neue wirtschaftsfachliche Zuordnung eines größeren Betriebes im Jahr 2009. Werte für 2007 - 2008 wurden rückwirkend bereinigt.

Quelle: BITKOM, Bundesagentur für Arbeit, Bundesnetzagentur, Statistisches Bundesamt
Stand: Juli 2011

Figure 15: ICT employees in Germany [22]

In many countries the number of ICT employees increased in the last 15 to 20 years (Figure 16) according to OECD statistics [26]. This helped to make societies and economies more efficient and also contributed to economic growth.



Note: 2007 instead of 2008 for Portugal and the United Stated. 2000 instead of 1995 for Hungary

Figure 16: OECD Key ICT indicators: Share of ICT employment in business sector employment, 1995 and 2008, percentages [26]

4.2 Impact on competitiveness

There is a correlation between the availability of broadband access and the global competitiveness index score (Figure 17) [27]. Countries with high penetration rates (top right corner of Figure 17) show much better competitiveness than countries with lower penetration rates (bottom left corner in Figure 17). Therefore, investment in broadband access stimulates the economy.

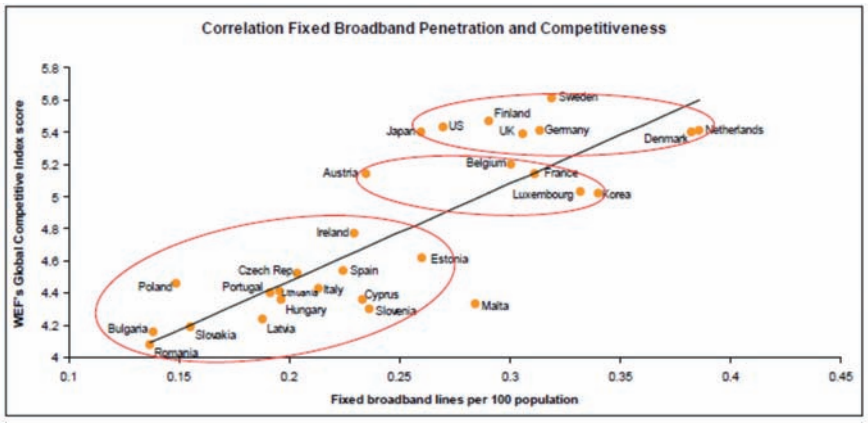


Figure 17: Correlation between penetration of fixed broadband and competitiveness
(Source: EC services based on COCOM and WEF) [27]

In order to achieve these benefits it is essential that an investment friendly environment is provided by suitable regulation and under certain conditions by stimulus programs to enable that investors can develop a positive business case. Otherwise, such necessary investments will not happen and opportunities for macroeconomic benefits may be missed. In order to gain from this correlation many countries have set targets for national broadband plans (Figure 18) [18, p. 39].

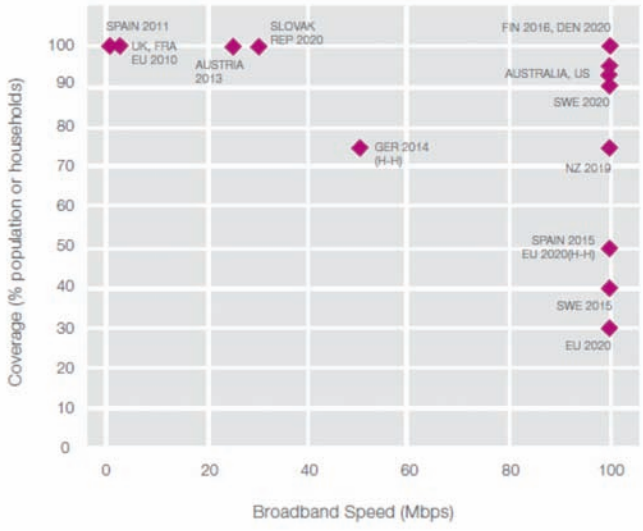


Figure 18: Targets set by national broadband plans [18, p. 39]

Source: ITU. Note: Australia's targets specify 100 % coverage, with 93 % at 100 Mbps and 7 % at 12 Mbps. The EU has a dual objective for 2020 of 30 MB for all households & 100 MB for 50% of households.

5. User penetration and traffic growth

According to Figure 3 growth in market size can especially be observed in markets with lower penetration rates compared to Europe. There is still a huge potential to connect underserved regions to communication networks and the global Internet. According to ITU statistics the number of subscribers is growing globally (Figure 19) [28]. The number of fixed telephone lines with low global penetration is decreasing, where the number of mobile subscribers is growing fast globally. With respect to the increase of Internet users the number of fixed and mobile broadband subscriptions is also increasing. Broadband access is growing fast in particular in developed countries. However, globally and also in developing countries the number of subscriptions is increasing. The active mobile broadband subscriptions per 100 inhabitants in Figure 19 explain the different growth rates per market in Figure 3. Europe with already a higher penetration than other regions has less growth potential. Therefore, further growth in the European ICT market can be stimulated by an upgrade of European communication networks to real broadband systems with significantly higher sustainable throughput rates than today and an increased use of communication networks for other critical infrastructures.

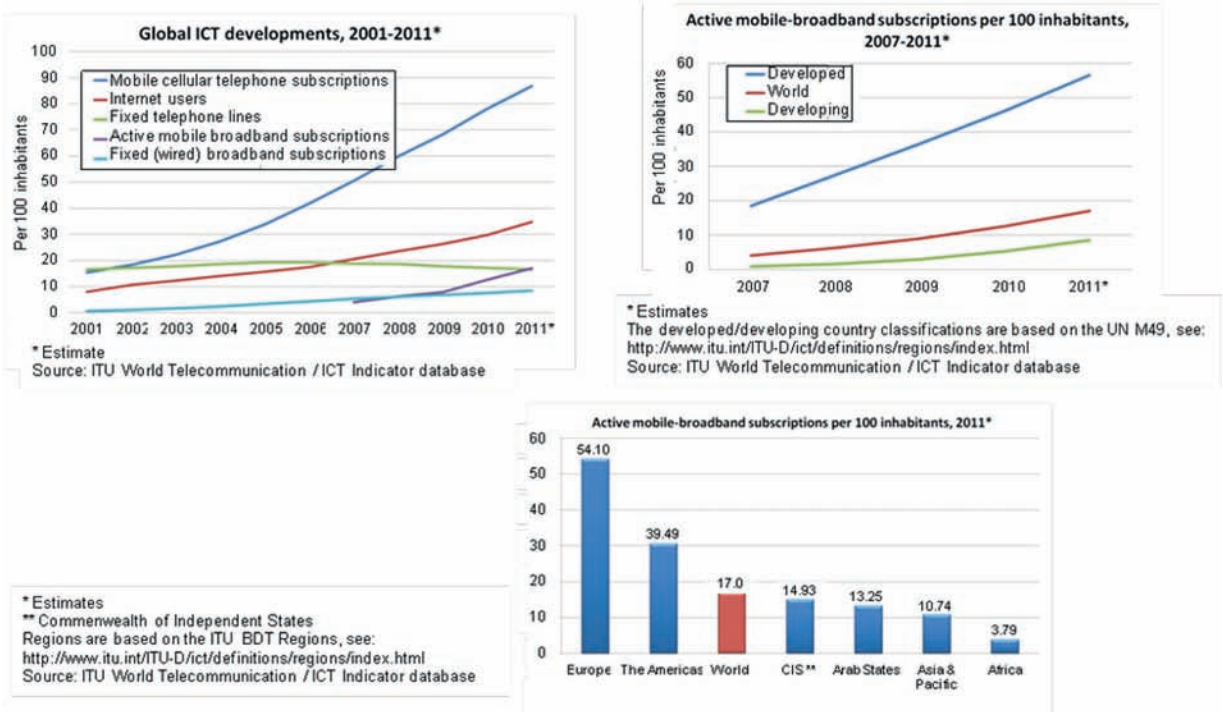


Figure 19: Global availability of ICT development [28]

In addition, the global Internet with more than 2.4 billion users globally (status June 2012) is growing further [29] (Figure 20). This development requests reliable and highly available communication networks, which provide the necessary QoS and security in order to support all

kinds of Internet based services and applications. European industry is supporting this growth by developing and deploying, e.g. the necessary networks.

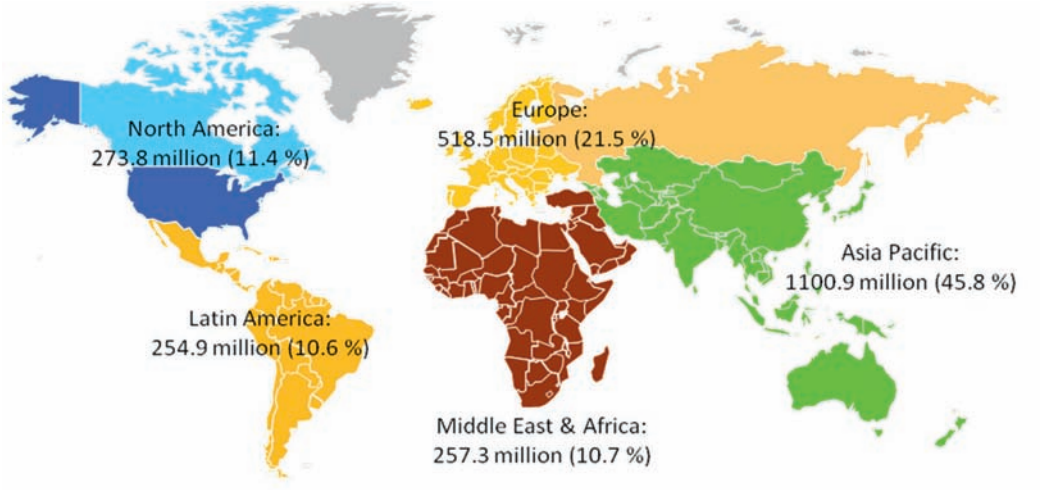


Figure 20: Worldwide Internet audience [29]

Table 5 from [18, p. 12] is summarising broadband access globally including Internet access, fixed and mobile subscriptions and handheld shipments (status 2011).

	Total 2011	Broadband Total, 2011	% Global Total high-speed, 2011
Internet users	2.26 billion	-/-	-/-
Fixed Internet subscriptions	658.8 million (2010)	589 million (2011)	80% (2010)
Mobile subscriptions	5.97 billion	1.09 billion*	18.3%
Handset shipments	1.55 billion	491.4 million (smartphones)	31.8%

Table 5: Summary statistics for high-speed connectivity [18, p. 12]

Source: ITU (www.itu.int/ITU-D/ict/statistics/at_glance/KeyTelecom.html) Smartphone shipment statistics from IDC 2012 at www.mobithinking.com/mobile-marketing-tools/latest-mobile-stats#phone-shipments.
Note: * includes data-only subscriptions.

It is expected that data traffic for different traffic types will further grow significantly. Figure 21 from a CISCO study estimates an exponential growth in the coming years [30; 31].

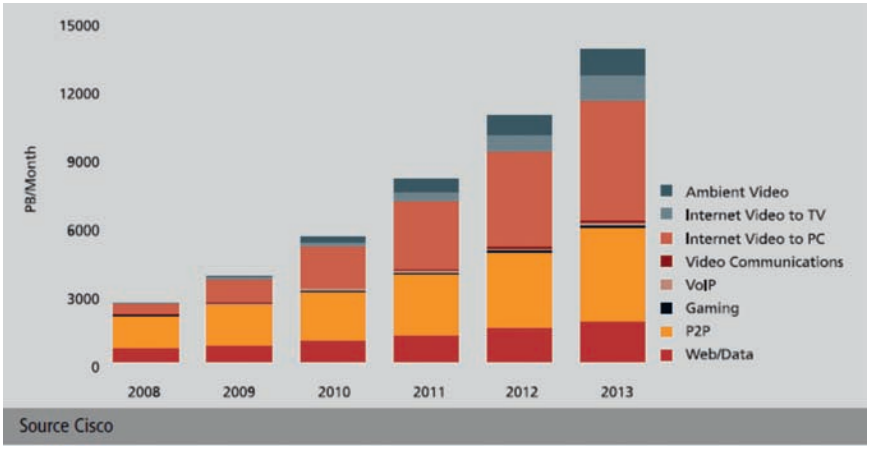


Figure 21: Consumer Internet traffic growth forecast [30; 31]

Figure 22 from an Ericsson study compares traffic from voice communication, data traffic from mobile phones and mobile PCs/tablets [18, p. 15]. Voice traffic will nearly remain constant and very small compared to data traffic in the future.

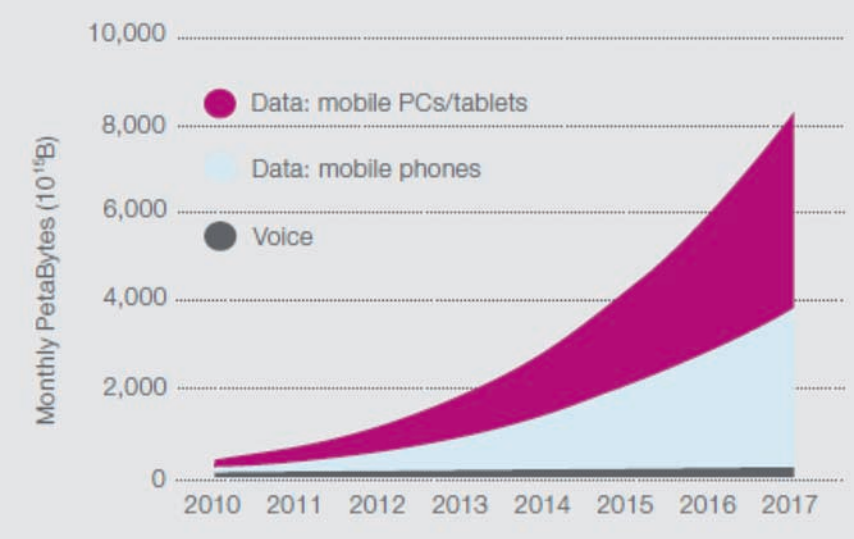


Figure 22: Global mobile traffic: Voice and data, 2010-2017 [18]

Figure source: Ericsson Traffic and Market Report 2012. Box sources: Intel, Ericsson and Cisco Virtual Networking Index 2012.

Machine-to-Machine communications (M2M) for example in the Internet of Things (IoT) and sensor-based networks is an additional driver for traffic growth. Figure 23 from [14, p. 21] demonstrates an expected 40-fold increase between 2010 and 2015.

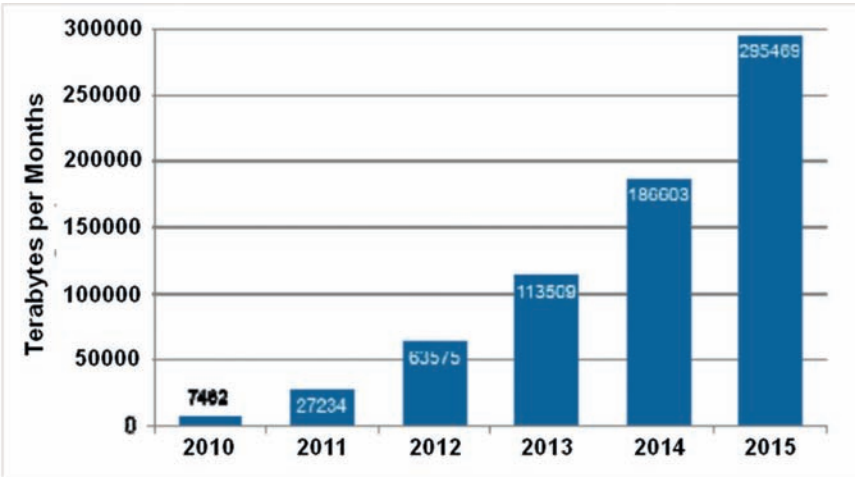
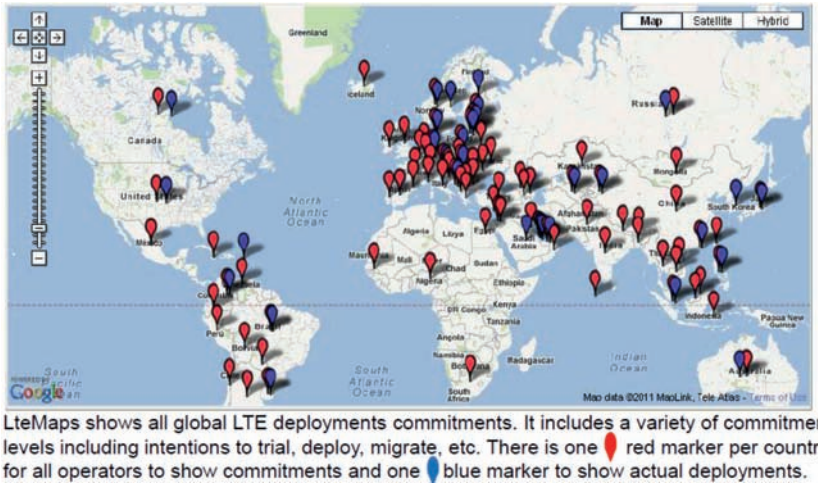


Figure 23: Machine-to-Machine traffic to increase 40-fold between 2010 and 2015 [14]

Source: Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010-2015.

Drivers of the Future Internet are all kind of services and applications and the variety of devices, which support such services and applications. Communication networks as the interface between user devices and the services and

applications domain have to provide the necessary performance and system capacity in order to cope with the expected traffic growth.
In order to keep pace with the expected traffic growth new and more broadband communication networks need to be developed and deployed in the coming years. Currently, the LTE (Long-Term Evolution) mobile communication system, which is based on a series of European collaborative research projects, is now being globally deployed (Figure 24) [32]. LTE systems require broadband optical and/or microwave links as backbone network. This system offers more cost-efficient broadband access than fixed networks even in areas that are underserved today. Figure 19 confirms this observation, which indicates a much stronger growth for mobile broadband than for fixed broadband access. However, barriers for investments, e.g. in the regulatory domain and the lack of sufficiently available frequency spectrum in reasonable frequency bands with good propagation conditions have to be removed to provide a positive business case in such areas and to allow everyone to get access. Figure 25 shows the situation in Europe, where LTE has already been commercially been launched in several countries [9, p. 26].



LteMaps shows all global LTE deployments commitments. It includes a variety of commitment levels including intentions to trial, deploy, migrate, etc. There is one red marker per country for all operators to show commitments and one blue marker to show actual deployments.

Figure 24: LTE deployments and commitments [32]

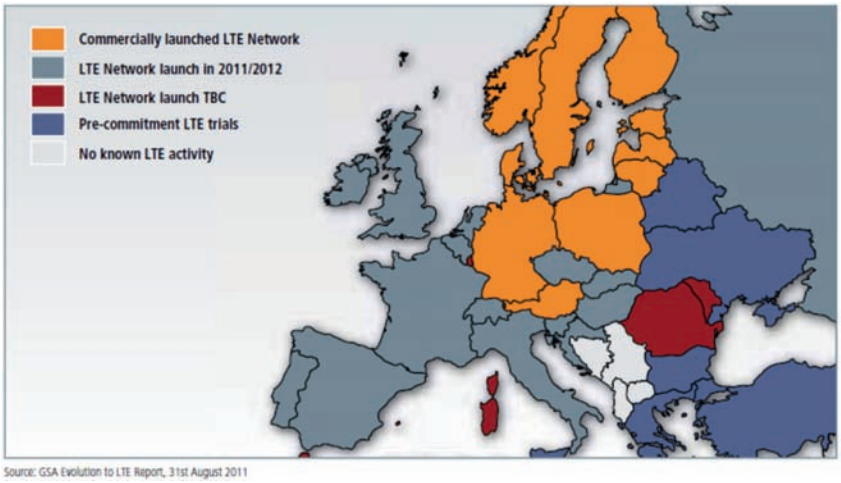


Figure 25: Commercial LTE status, August 2011 [9]

On a global basis, broadband communication is available to a significant extend in developed and industrialised countries. In particular in emerging economies there is a huge potential for further growth (Figure 26) [18, p. 8].

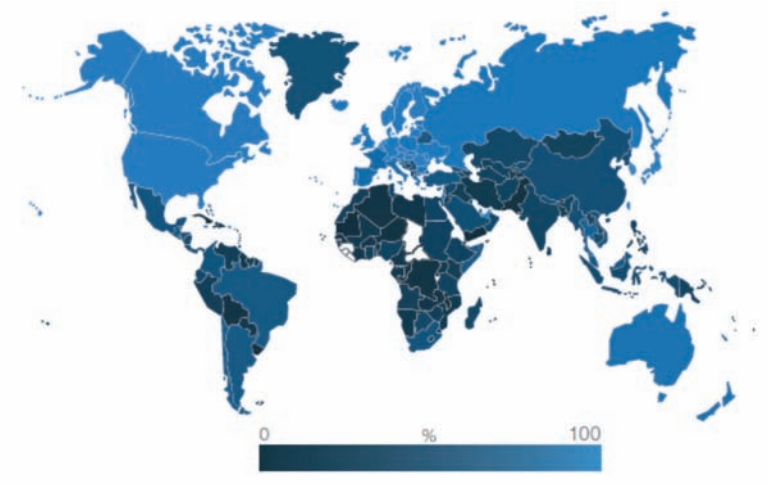


Figure 26: High-speed Countries with % connections > 5 Mbps, shown on a sliding scale with light blue showing 100 % [18]

6. Status of broadband deployment in Europe

Statistics on the deployment of broadband communication systems depend on the definition of broadband technology. According to [27] "There is a range of definitions of 'basic' broadband with download speeds from 512 Kbps to 4 Mbps."
The Major developments are summarised in [27]:

- "The broadband market grew in 2011 but the growth rate continued to slow down. The fixed broadband penetration rate in January 2012 was 27.7% of the population, just 1.3 percentage points up from 26.4% in 2011.
- Despite the slower growth, the EU penetration rate exceeded that of Japan in 2011 for the first time. The difference with the US is 0.5 percentage points behind only.
- Speeds of fixed broadband lines increased significantly in 2011 with almost 50% of all lines providing download speeds of 10 Mbps and above.
- But the take up of fast and ultra-fast broadband, i.e. 30 Mbps and 100 Mbps, is still low with just 7.2% and 1.3% (respectively) of all fixed lines providing those speeds.
- In the second half of 2011, the number of new broadband lines based on xDSL was almost equal to the number of new lines based on alternative technologies sold both by new entrants and incumbents, indicating a shift towards other technologies closely linked to Next Generation Access Networks (NGAs) and capable of providing faster speeds. In 2011 there was an explosion in mobile broadband with penetration reaching 43% of the population in January 2012 from 26.8% in January 2011. This growth was fuelled by handheld devices; there were 35.1 mobile broadband connected handheld devices per 100 citizens in January 2012, up from 19.6 in 2011.
- Data revenues increased by 22.6% in Q3 2011 compared to Q3 2010 in the five largest Western European markets. LTE (Long-term evolution) networks are already available in eight EU Member States and mobile broadband traffic is already more than twice as high as fixed traffic and is expected to grow exponentially in the coming years."

6.1 Fixed broadband

In the EU average fixed broadband penetration reached 27.7 % in January 2012. However, penetration rates in EU Member States are very different (Figure 27). In particular less developed Member States have significantly lower penetration rates. As shown in Section 3 the availability of broadband networks in such countries will improve economic growth and GDP.

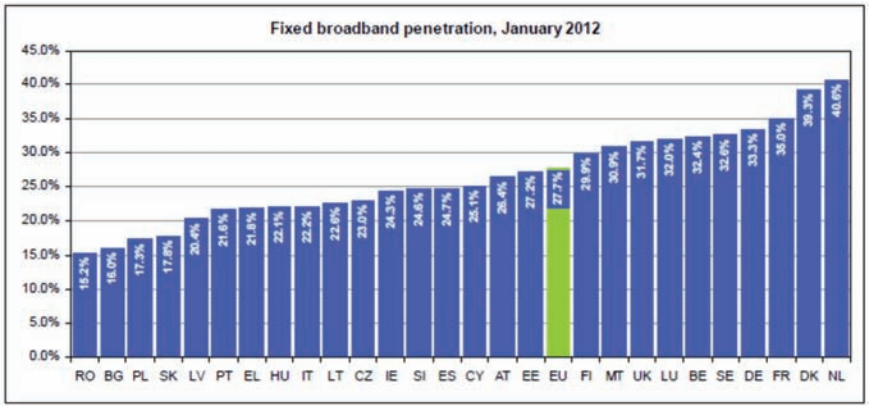


Figure 27: Fixed broadband penetration rate, January 2012
(Source: Communications Committee) [27]

The available throughput rates are increasing, which are partly exceeding 100 Mbps. In particular in countries, where new networks are being deployed, basically higher throughput rates are becoming available compared to already rather developed countries (Figure 28).

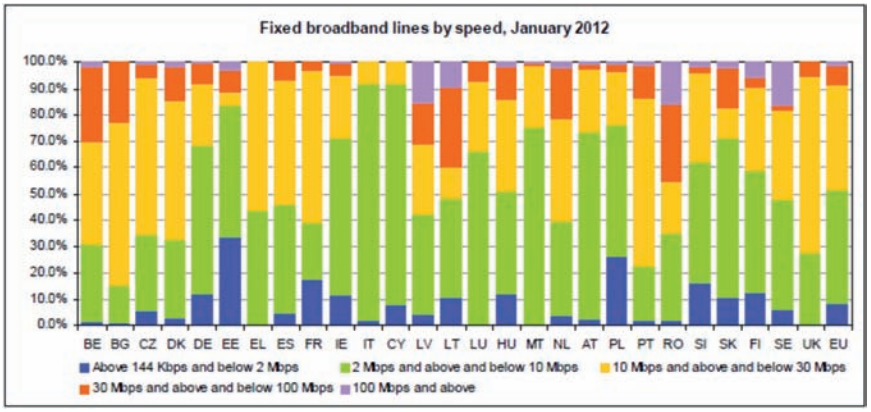


Figure 28: Fixed broadband lines in the EU Member States by speed
(Source: Communications Committee) [27]

The average penetration rate in the US is the same like in the EU. However, some countries in Asia exhibit penetration rates, which are much higher than the EU average and which are similar to the most penetrated countries in Europe (Figure 29). From that perspective Europe has to catch up with some major Asian countries.

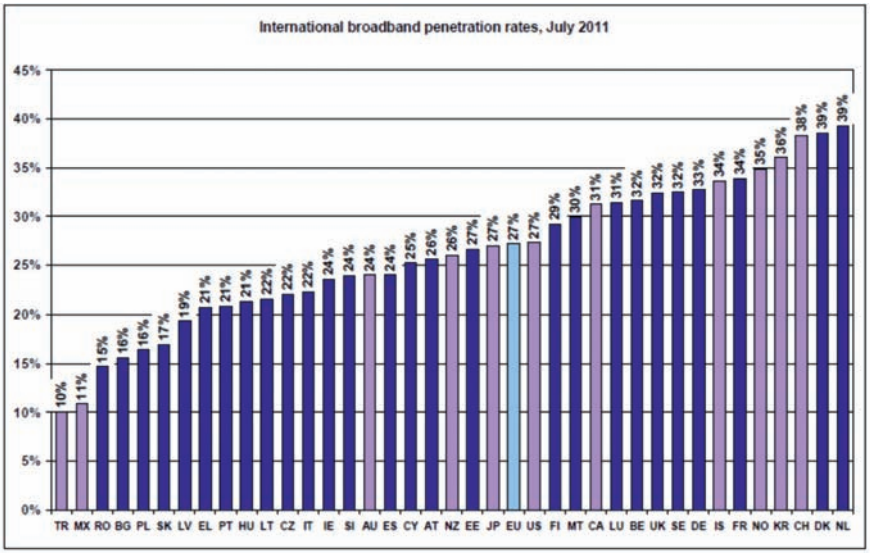
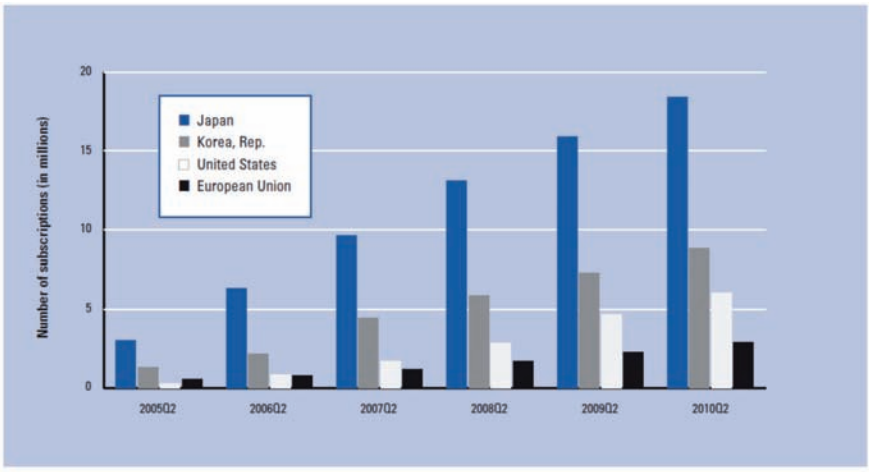


Figure 29: International broadband penetration rates, percentage of population
(Source: Communication services based on COCOM and OECD figures) [27]

Japan and Korea are very much advanced in the deployment of FTTx (Fibre To The x) systems, which provide a very powerful broadband network infrastructure (Figure 30) [33]. The US and the EU are significantly behind. However, the business case is rather difficult, if deployments are based on private investments only in particular outside of major cities. Therefore, means have to be developed which support faster deployment of FTTx systems by, e.g. infrastructure sharing, support of an infrastructure provider, incentives for investment and an appropriate regulation.



Source: European Commission services on the basis of Point Topic database.
Note: Figures include FTTH and FTTB + LAN.

Figure 30: FTTx deployment in the European Union, the United States, Japan and Korea, Rep. [33]

6.2 Mobile broadband

In mobile communications very high penetration rates have already been achieved. Major market trends are summarised in [27]. The mobile communications market is developing much faster than the fixed network market.

- "Total revenues of the EU mobile sector decreased by 0.8% in 2011.
- Nevertheless, data revenues increased by 22.6% in Q3 2011 compared to Q3 2010 in the five largest Western European markets.
- Europe remained the region with the highest mobile subscription penetration at 127%. Penetration increased by 4.3 percentage points in 2011. Machine-to-Machine SIM cards represented 4.1% of total subscriptions in the EU. Fifty percent of subscriptions were postpaid.
- Market leaders' and main competitors' (second largest operators in national markets) market shares have slightly decreased. Mobile Virtual Network Operators (MVNOs) have 4.1% of subscriptions.
- Average Revenue per User declined by 9% in 2010. Average Revenue per Minute stood at EUR 0.11 in 2010.
- Mobile broadband coverage (HSPA) reached 85% in 2010. LTE is already available in eight EU Member States.
- Mobile broadband penetration (all active users) went up to 43% in January 2012 from 26.8% in January 2011.
- Mobile broadband traffic is already more than twice as high as voice traffic and is expected to grow exponentially in the coming years."

Figure 31 shows the general penetration rates per member states for mobile communications, which are in average beyond 100 %. In particular in new Member States the penetration rates are higher than in mature markets. The driver for this development has been the low availability of fixed network access connections. Mobile networks can be deployed faster and more cost efficient than fixed networks.

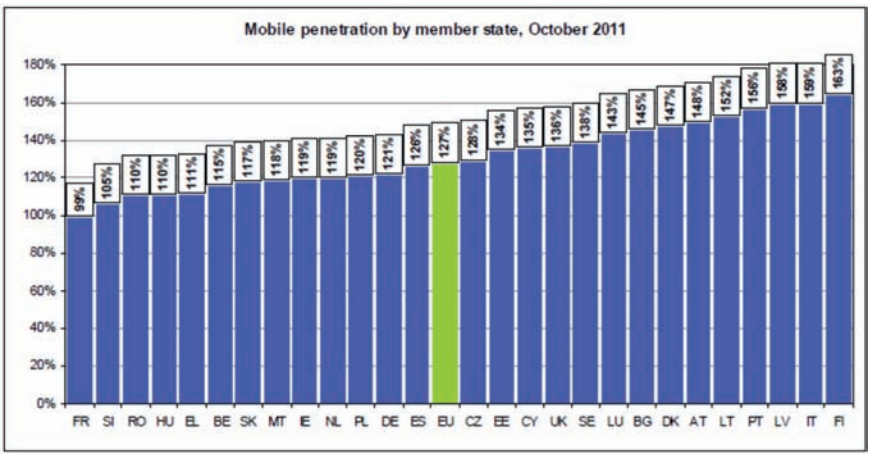


Figure 31: Mobile penetration by Member State, October 2011

(Source: Communication services) [27]

In particular in these countries voice traffic is mainly provided by mobile communication systems, where in mature markets fixed networks still dominate voice traffic (Figure 32).

However, mobile broadband penetration rates (Figure 33) are still much lower than the general mobile penetration rates (Figure 31). In this domain highly developed Member States show much higher penetration rates than new Member States. However, the EU average is already quite high. In particular Scandinavian countries have already reached very high broadband mobile penetration rates. Broadband mobile communications have a high potential for further growth in the coming years.

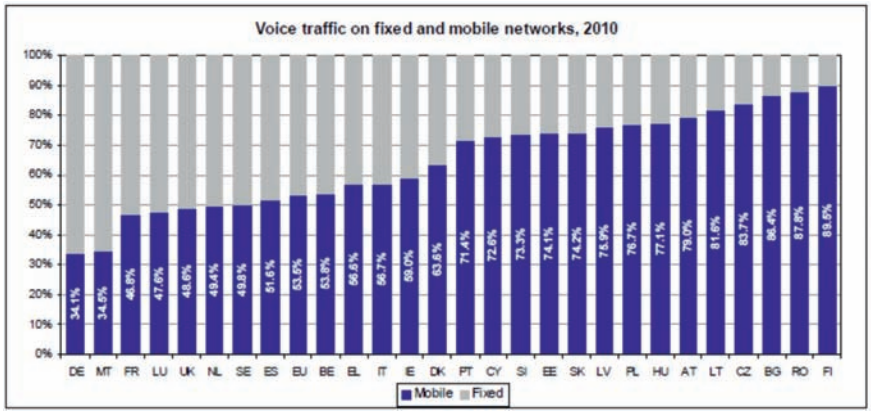


Figure 32: Voice traffic on fixed and mobile networks, 2012

(Source: Communication services) [27]

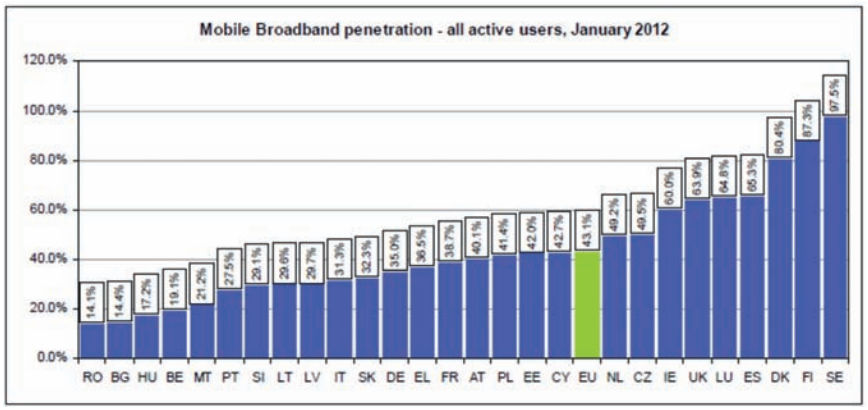


Figure 33: Mobile broadband penetration – all active users

(Source: Communications services) [27]

7. Research environment

7.1 Research intensity and basic approach

The ICT sector is one of the most research intensive sectors in industry. The IT components and telecommunications equipment domain spend about 13 to 15 % of net sales for R&D, where the relative spending in the US is slightly higher than in Europe (Figure 34) [15, p. 15.]. The top R&D investing ICT companies from the EU and the US have similar ICT R&D intensity levels (R&D investment / net sales). However, there are many more US firms than EU firms in the worldwide group of top R&D investing ICT companies.

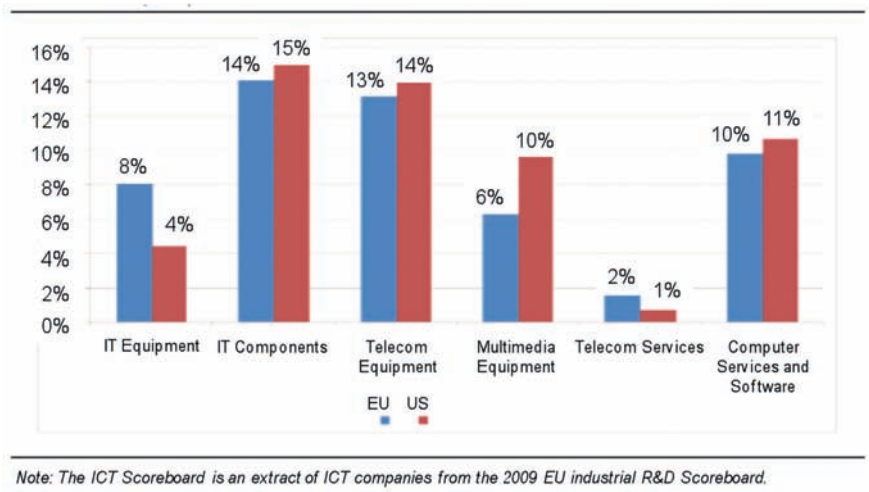


Figure 34: R&D intensities (R&D investment / net sales) in EU and US Scoreboard companies (2008) [15, p. 15]

Similar figures are also provided by [12, p. 59] for the IT and Internet domain (Table 6).

	Top 103 by segment, N.	Top 103 on whom R&D data is available, N.	R&D /Turnover, average ratio
Internet Software	24	24	14%
Internet Network Equipment	8	8	14%
Internet IT services	19	15	4%
Smart handheld Devices	4	4	5%
Web actors	4	4	11%
Telecom Services	44	26	1%

Source: IDC, 2010

Table 6: R&D investment of selected top 103 Internet suppliers as of turnover, 2009 [12]

In addition, many sectors in the ICT domain and in particular communication networks are highly dependent on global standardisation in order to ensure interoperability of interfaces like for global roaming in mobile communication networks and to ensure economy of scale.
Collaborative research programs support the cooperation of all stake-

holder groups such as bigger industry, SMEs, communication service providers, R&D centres and universities in joint projects in order to develop new solutions and systems and to build consensus ahead of future standardisation. Therefore, collaborative projects are part of the overall research and development process in the research community and industry.

Collaboration between competitors in such programs is feasible in the precompetitive phase, where all partners have similar interests to develop new solutions and where IPR portfolios are not build-up (Figure 35). When the development is moving towards standardisation, the common interest may go down and the activity is increasingly becoming competitive. In the product development and market introduction phase cooperation is usually not possible anymore. Therefore, the time window in an early phase of the development is essential to cooperate and to achieve consensus ahead of standardisation. Such consensus solution can then directly be exploited in the standardisation process. This helps to accelerate the standardisation process, shares risks and resources of involved organisations and prepares the ground for future economic success.

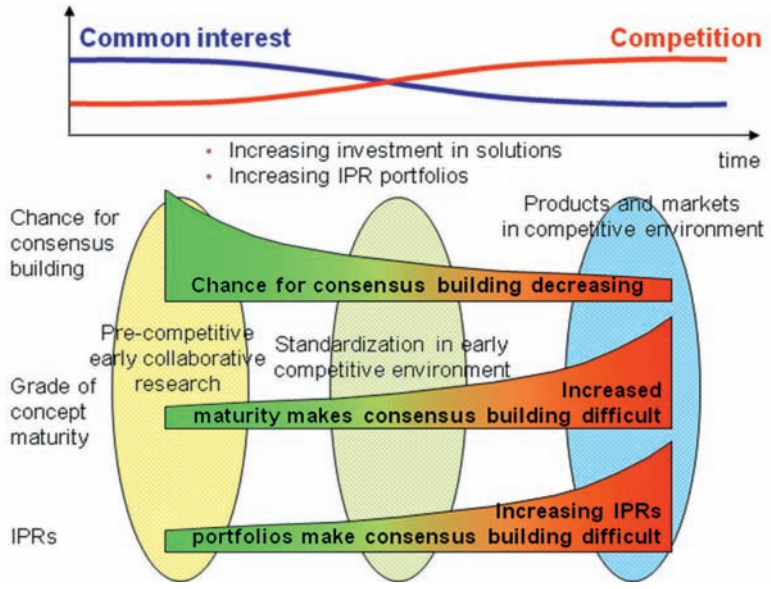


Figure 35: Collaborative research: International consensus building at an early stage

For example in the domain of mobile communications collaborative research in different framework programs contributed significantly to the development and standardisation of systems like 3G – UMTS, LTE, IMT-Advanced and their further evolution. Research on future radio systems is underway (Figure 36).

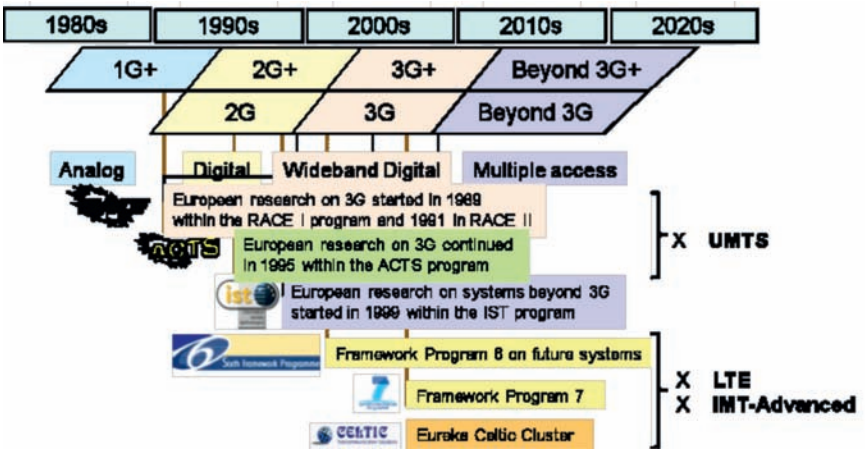


Figure 36: European research programs on mobile and wireless

7.2 Collaborative research programs

Europe offers different means for cooperation in funded projects between different stakeholders such as manufacturers, communication service providers, service and content providers, SMEs, universities and R&D centres on EU and national level.
Actual framework programs at EU level are

Framework program 7 by the EU Commission [34]

e.g. Eureka clusters (Celtic-Plus, ITEA 2), funding by national administrations [35; 36]

Currently, the new framework program Horizon 2020 for the financial period 2014 to 2020 is under preparation [37].
Member States are also offering collaborative research programs on national level like

in Germany [38]

Similar programs are also available in other countries.
These activities are supported by European Technology Platforms (ETPs) and Joint Technology Initiatives (JTIs), which are currently under review for the preparation of Horizon 2020:

ETP [39]

ETP [40]

ETP [41]

ETP [42]

ETP [43]

ETP [44]


JTI [45]

JTI [46]

It is essential for the European economy with respect to growth and jobs and in relation to the global economic environment and competition

- that Horizon 2020 is taking into account the necessary research topics, which are in the interests of European stakeholders,
- that the rules for participation in Horizon 2020 are appropriate with respect to flexibility and administrative overhead and
- that sufficient budget is allocated to Horizon 2020 and in particular to the ICT part in order to support the Lisbon objective to spent 3 % of European GDP for research and innovation.

The budget allocation is not clear and is currently being debated between the EU Commission, EU Parliament and Council. The President of the EU Commission, Mr. José Manuel Durão Barroso, stressed in his speech "State of the Union 2012 Address" on September 12, 2012 the importance of research for recovery of the European economy and as means to overcome the financial crises [47]:

> *"... And we could go further, with a realistic but yet ambitious European Union budget dedicated to investment, growth and reform. Let's be clear. The European budget is the instrument for investment in Europe and growth in Europe. The Commission and this Parliament, indeed all pro-European forces, because most member States support our proposal, must now stand together in support of the right multi-annual financial framework that will take us to 2020. It will place little burden on Member States, especially with our proposed new own resources system. But it would give a great boost to their economies, their regions, their researchers, their students, their young people who seek employment, or their SMEs. ...*
>
> *... It is a budget that will promote a research intensive and innovative Europe through Horizon 2020. Because we need this European scale for research. ..."*

8. Value generation in Europe

European industry is strong in research, development and the integration of complex systems like communication networks. A wide spread and well established research community in R&D centres and universities is cooperating with industry for knowledge and IPR generation. In addition, communication networks are increasingly based on software technology and software development. However, know-how is also required in hardware and RF design as well as in manufacturing technology for equipment, network planning and operation.

With respect to the fact that communication networks are increasingly regarded as critical infrastructure, it is essential for Europe that system research, development, knowledge creation and IPR generation is performed in Europe. All critical parts of system design and manufacturing need to be done in Europe in order to have full access to the technology.

Many hardware systems are today based on standardised hardware. That allows that parts of manufacturing is being done close to target markets in order to have direct contact to customers, to reduce transportation cost and to mitigate trade barriers and risks of currency exchange rates. However, it is essential that critical parts of communication networks such as system software and special hardware components with the potential to distinguish products from the competition are designed in Europe and provided to the global manufacturing process.

The technology shift from hardware-oriented systems in the past towards software- and signal processing-dominated systems today requires different skills. However, this allows Europe to create higher skilled jobs in this industry as well in the system design as in the development of applications. Therefore, the political discussion should not be focused mainly on industrial manufacturing of hardware systems but more on system and solution design. In this domain Europe is in the position to compete on global basis. This requires continuous innovation and significant investment in research, innovation and development to achieve and maintain technology leadership.

9. Conclusions

Communication networks are a key enabling technology for basically all sectors of our society and economy. This domain depends on global standards to ensure interoperability and economy of scale for affordable cost. The European ICT market corresponds to about 25 % of the global market. The global ICT market is growing, whereas the market in Europe is stagnating in the last years on high level. In particular the BRIC countries show significant growth rates. Emerging economies are investing to build up an own ICT industry, which is increasing global competition. In particular Asian countries have a bigger share of the ICT domain in their national GDP compared to European economies.
Different studies have shown that the availability of broadband access stimulates the economy by additional GDP growth and positive effects on employment in particular in secondary sectors for the use of communication technology, application development and service provision.
ICT is also an important enabler for productivity growth in all sectors.
Employment in Europe in the ICT sector is rather stable in the last years. However, there are shifts between sectors towards IT and software development at the expense of the telecommunication and hardware sector. In total in many countries the workforce in the ICT domain has been increased. There is a direct correlation between the high availability of broadband access and competitiveness of economies. However, this requires an investment friendly environment to mobilise the necessary investment for the deployment of systems. The development towards a competitive European Internet industry will help to support further economic growth and employment in Europe.
Europe has already achieved a reasonable penetration of broadband communication systems compared to the world average. The number of users for mobile communications exceeded the number for fixed network users significantly and is still growing. The number of global Internet users is less than 50 % of mobile subscribers. It is expected that traffic is growing exponentially in the coming years due to Internet and video applications. New broadband mobile communication technologies are available and are now being deployed globally like LTE, which will help to solve the challenges. The regulatory environment should support the deployment of broadband networks in order to enable the expected macroeconomic effects on GDP and employment.
The deployment of broadband access and especially of mobile broadband systems made progress in the EU. However, in the backbone and fibre based systems, Europe is lagging behind other regions, which could lead to competitive disadvantages for Europe. Therefore, Europe has to keep pace with other regions in research, innovation and deployment of systems.

The ICT sector is one of the most research intensive sectors. Collaborative research helps to share risk and resources and to build consensus in the precompetitive phase ahead of future standardisation. Europe offers publicly funded collaborative research programs on EU level and on national level. Such programs are supporting the development of new mobile communication systems, optical communications and broadband access. Such investments are required also in future to maintain competitiveness compared to other regions. The preparation of the next EU framework program Horizon 2020 is ongoing. However, there are no final budget allocations available. Negotiations are ongoing between the EU Commission, the EU Parliament and Council how to implement budget cuts compared to the Commission proposal, which were agreed between EU Member States in February 2013. In order to stay competitive with other regions in a changing world, Europe needs to continue to invest significantly in collaborative research programs in the ICT domain to develop necessary technologies and systems in Europe, which are increasingly critical infrastructures for our societies and economies. Therefore, the order of magnitude of finally allocated research funding for ICT in Horizon 2020 should be very similar as in the original Commission proposal.

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VDE

VDE ASSOCIATION FOR ELECTRICAL,
ELECTRONIC & INFORMATION TECHNOLOGIES

Stresemannallee 15
60596 Frankfurt am Main

Phone 069 - 6308 - 0
E-Mail service@vde.com
http://www.vde.com