*e*Mobility Contributions to Solve Grand Societal Challenges

eMobility Technology Platform

White Paper

Steering Board

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List of Contributors

Company/institute	Contributors	e-Mail address
Centre Tecnològic de Telecomunicacions de Catalunya (CTTC)	Carles Antón-Haro	carles.anton@cttc.es
InterInnov	Jacques Magen	jmagen@interinnov.com
IST Lisbon	Luis M. Correia	luis.correia@lx.it.pt
Nokia Siemens Networks	Werner Mohr	werner.mohr@nsn.com
Waterford Institute of Technology	Jim Clarke / Keith Howker	jclarke@tssg.org / khowker@tssg.org

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1 Introduction

In the past few months, there have been extensive discussions at European level on two aspects, in which research and innovation is one of the key challenges. First, policy in Europe is increasingly considering so-called "Grand Societal Challenges" especially with respect to environmental issues and demographic concerns. Second, ICT (Information and Communication Technologies) are now recognised as more and more critical to ensuring sustainable development of a number of other business sectors. – In the context of this paper ICT is related to communication networks and services, which is the focus of *e*Mobility. – This is outlined in two of the proposed "Flagship Initiatives" from the new European Commission strategic plan towards 2020 [1]: the *Innovation Union* and the *Digital Agenda*. The aim of *Innovation Union* "is to re-focus R&D and innovation policy on the challenges facing our society, such as climate change, energy and resource efficiency, health and demographic change." Key challenges to be addressed include energy security, transport, climate change and resource efficiency, health and ageing, environmentally friendly production.

Such "Grand Challenges" are also outlined in the new EU Framework Program 7 Work Program [2] and the EUREKA "Strategic Road Map" These programs suggest to "explore opportunities [3; 4] to contribute to solutions to the "Grand Challenges", such as climate change, energy security, ageing and health, public security. In addition, also other areas will be affected by such challenges, including mobility and communication.

One of the major areas as addressed in the *Digital Agenda for Europe* [5] is "to reform the research and innovation funds and increase support in the field of ICTs, so as to reinforce Europe's technology strength in key strategic fields and create the conditions for high growth SMEs to lead emerging markets and to stimulate ICT innovation across all business sectors". ICT technologies are indeed considered more and more as a priority to help other sectors evolve into a sustainable environment. To "move towards a more sustainable and efficient economy, to ensure harmonised use of natural resources, to mitigate the effects of climate change and to preserve our environment", the European Commission also suggests to "make extensive use of connectivity and distributed information processing to redesign their business and operational processes and make them 'smart'." Smart infrastructures examples include smart energy grids, smart environmental information systems, smart systems for transport and mobility, and smart healthcare systems.

The discussion process on such challenges started in 2009 and major results became part of the new work program of the EU Commission for the period 2010 to 2015, which was agreed beginning of 2010 [2]. Solutions for the grand challenges should lead to a more sustainable economy, should establish new lead markets and generate jobs and economic growth.

The context of societal challenges and the discussion leading to actual policy directions are detailed in the Annex. This of course is likely to have an impact on future research directions and framework programmes. However, the referenced documents of the EU Commission in the Annex are not explicitly addressing the transport challenge, which is cross-functional to the identified challenges. Therefore, this challenge is addressed in addition by *e*Mobility.

This document focuses therefore on five Grand Challenges:

- Climate Change,
- Energy and Resource Efficiency,
- Health, and
- Demographic Change
- Transport (in addition addressed by *e*Mobility)

and the potential contribution of the *e*Mobility European Technology Platform to solutions in these domains: That is, the contribution of the ICT infrastructure – the mobile, wireless, satellite and fixed communications networks; the sensors and actuators of the IoT (Internet of Things); the information networking, processing and storage systems; their management and control; their trust, security, and robustness.

2 eMobility contributions to Solutions of Societal Challenges

2.1 Contributions to the "Climate Change" Challenge

In this document climate change means the impact of man-made emissions, e.g. in the generation and consumption of energy and potentially other emissions and its impact on meteorological changes, which may result in environmental hazards and disasters.

Three areas where ICT can play a vital role with respect to mitigate the impact of climate change include:

- reaction to climate (environmental) change
  - environmental monitoring and analysis
  - generate alarms
  - activate responses
- minimise rate of climate change through reduced carbon footprint
  - improve the implementation of ICT systems and architectures to reduce energy consumption
  - improve control of consumption processes in other sectors (more efficient engines, power stations, …)
  - provide alternative process (tele-presence instead of travel, …)
- minimise impact.

The environment is a constant consideration in our lives, including the development of technologies and their associated impact on the environment. Therefore, the main vision when addressing the environment as a topic area is described in the following statement:

> "*We live surrounded by natural and man-made hazards that, with advances in technology, can be monitored, in order to provide the necessary alerts; but this technological evolution also translates into greater implications for our natural resources, requiring efficient technical solutions, so that we can live in a cleaner and safer environment*."

Four domains are identified where future ICT research, including the communications infrastructures, can support to develop solutions for a positive impact on the environment (an additional area, related to efficient resources management, is addressed in Section 2.2)

- environmental monitoring and analysis,
- alarms and responsive action,
- technology waste and
- minimisation of acceleration of change.

The climate of our planet is constantly changing due to *natural* causes. There is strong evidence that a significant contribution to current rates of change is due to our still growing consumption of fossil fuels and the resultant CO_2 emissions.

One of the major issues is how to be able to predict and respond to consequential events and their impact on the people's lives. Through the monitoring of environmental parameters, it is possible to study their behaviour and evolution, enabling the necessary measures to minimise catastrophe. There are parameters of strictly natural origin (e.g., geophysical) and others were humanity may contribute significantly or even have sole responsibility (e.g., radiation, pollution).

The scope of using ICT in this area is vast. The ability to collect data and disseminate information, allowing a wider knowledge data base and efficient means of monitoring the environmental aspects of people's quality of life is of great importance. ICT can be used in different applications and several projects that have been conducted state so, some examples are presented in Section 2.4.

When considering the environment, one of the major issues that we have is how quickly it can

change around us. These changes can be quite harmful to the people affected. Therefore, it is important to have means of raising alarms about the changes that are occurring, in order to take the necessary measures to decrease the impact of these events in the populations and regions.

There are several areas, where the usage of sensor networks to monitor and give alarms an event is happening is extremely helpful, for instance, to detect floods, fires, volcanic eruption, seismic indicators, and many others.

Our society is increasingly moving towards a disposable consumption economy that produces large quantities of waste. A significant portion of this waste comes from the technology used, e.g., PCs and mobile phones. Therefore, when considering the environment it is inevitable to consider the impact that the amount of waste produced has on the planet, and some questions arise:

- Where does the waste go?
- Is it possible to reduce the waste by recycling? How can it be best recycled?
- How can ICT help reduce the technology waste that surrounds us, on earth and event around the planet?

Research challenges and associated issues

The main research challenges identified for this area in the near future are:

- Reducing the carbon footprint of ICT systems by improved implementation and system architectures.
- Development of ICT-based solutions, which reduce energy consumption in other sectors by increased efficiency of technical and business processes.
- Development and deployment of systems for data monitoring, transmission collection and evaluation in order to generate actions for better use of energy and to avoid major impacts of environmental hazards on people.
- Development of interoperability between equipments sensors and communications infrastructure and the people both or acting for professional bodies or for the benefits and the access of the European citizens.
- Requirement-driven solutions that have a commercial and economic justification and can be provided at best on a global scale.
- Setting standards and conventions surpassing national and language boundaries, and also political and legal issues.
- Product reliability and other legal issues as well as prevention of malicious attacks and viruses.
- To provide guidelines that facilitate the increased availability of critical information, as well as the way the critical information is computed, transmitted and delivered.
- To increase the collaboration between environmental organisations, public sector and industry (e.g. in the field of methods, rules but also semantic interoperability and command and control cooperation).
- Reducing carbon footprint by replacement of physical travel by virtual travel. In order to do this effectively, R&D communities within *e*Mobility need to develop ICT solutions that would enable tele-presence that is a reasonable substitute for face-to-face encounters.
- Development and promotion of “Greener” technologies in future networks.

More detailed information is available at [6].

2.2 Contributions to the “Energy and Resource Efficiency” Challenge

Nowadays, one of the major environmental issues that we are facing is the limitation in terms of the natural resources usage. The natural sources of energy (e.g., oil) and the impact resulting from exploration on the planet and economy is an unavoidable and very important topic for the time being.

Research challenges

ICT applications focussed on increased efficiency of the management of the planets natural resources are on the spotlight. There are several projects that aim at contributing to an efficient resource management, not only directly related with energy, but other areas as well, e.g., through the use of ICT to reduce the risk of natural disasters and improve the capacity of response to such events. Detailed information is available at [6].

As extensively discussed in [7], the US national energy balance reveals that coal-fired power plants still generate almost half of the electricity and are responsible for nearly two billion metric tons of greenhouse gas emissions per year which is the equivalent to the emissions of the entire transportation industry. Furthermore, although there has been explosive growth in solar, wind and biomass power in recent years, renewable generation still provides a small amount of the total energy generation. Finally, the current electricity system from generation to end-user wastes large amounts of energy.

The interconnection between various energy grids (based on nuclear, coal, renewable, etc.) as well as the addition of some inherent intelligence and communication capabilities will result into the development of the so-called *Smart Grids*. This is perceived as an urgent societal need and it poses many technical challenges. Smart Grids will be capable of detecting, communicating problems and inefficiencies in the energy generation and distribution network, or accurately monitoring consumption in the homes via smart meters. Actions such as diverting power around localised outages could then be triggered and, by doing so, make the whole system more resilient to failures or natural disasters.

The main research challenges identified for this challenge in the near future are:

- New solutions that design and implement usability and reliability in particular in energy systems.
- Increase the collaboration between environmental organisations, public sector and industry.
- Reducing the carbon footprint of ICT systems by improved implementation and system architectures.
- Development of ICT-based solutions, which reduce energy consumption in other sectors by increased efficiency of technical and business processes.
- Development and deployment of systems for data monitoring, transmission collection and evaluation in order to generate actions for better use of energy.
- Reliable network infrastructures and techniques for reducing power consumption e.g. compression and pre-processing and post-processing of data;
- The ICT sector can play a pivotal role in the realisation of Smart Grids. As rightfully pointed out in [7], it will require the addition of two-way communications (stemming from the fact that e.g. homes might be equipped with sources of renewable energy and sometimes draw power from/contribute power to the grid or, simply, from the need to convey measurements and data from/to the grid and energy consumption sides), sensors and software to the electrical system, both in the grid and in the home. By doing so, the ICT sector will, on the one hand, be instrumental in avoiding blackouts and the huge costs that they often entail and, on the other, prevent many metric tons of carbon emissions.

2.3 Contributions to the "Health" Challenge

Changes in society demand for new specific services. Such changes include an ageing society and ageing workforce, increasing life expectancy, changing family forms with an increase in people living alone. New challenges relevant to the changes above have to be faced, such as chronic and degenerative diseases, addictions, obesity, depression, etc. Health informatics and telemedicine is one of the key areas of change in the health and social services sector. From a technology perspective this challenge is closely related also to demographic change in Section 2.4.

The vision is stated by

"*Support individuals and professionals via future mobile applications to enhance healthcare delivery, clinical performance and lifestyle*".

Research challenges

Four key areas have been identified, where future ICT networks and services are of particular interest to this societal challenge:

- Future wireless diagnostic and disease management systems.
- Hospital consultation and emergency scenarios.
- Assistive technologies.
- Well being and personalisation.

Mobile technologies enable in particular new services that could lead to a dramatic change in health organisations and healthcare delivery practices. One refers in the following to the concept of M-health, defined as the emerging mobile communication and network technologies for healthcare systems [8], including sensors, WLANs, satellite, 3G, and future generation (e.g. LTE) mobile systems.

Mobile services can have a massive impact on all aspects of healthcare, from delivering the information people need to lead a healthy lifestyle to making healthcare systems more efficient, proactive and responsive and providing 'in the home' and mobile healthcare technologies. Prevention will have a key role in this scenario.

Biosensors and other new medical technologies reduce costs dramatically and lead to do-it-yourself home care. Recent advances in image and wireless video transmission will enable remote diagnosis also in wireless and mobile scenarios (e.g., ambulances).

Regardless of technology advances, the health sector currently lags behind other sectors in the use of recent advances in information and communications technology. This is both due to technical barriers and to limited professionals' adoption of mobile technologies for healthcare. Addressing the challenges in this area will result in great potential for rapid sustained growth [9].

The main research challenges identified for this challenge in the near future are:

- The barrier that comes from doctors not using ICT citing a lack of training and technical support.
- The quality (e.g., medical data) provided by the available systems.
- The demanding requirements regarding energy, size, cost, mobility, connectivity, and coverage for pervasive healthcare systems and applications.
- The need for enhancement of the main functionalities in terms of speed, data compression.
- The requirement for high quality medical video, bandwidth limitation/error prone characteristics of the wireless channels and real-time requirements of most of the services.
- The need to address legal and regulatory issues.
- The integration/interaction of the security (e.g., of data), privacy (e.g., location, health records/data) and trust (e.g. of the networks/services/applications) issues with the whole transmission system.
- The need for high standards with regard to reliability, scalability, privacy-enhancing technologies, interoperability, and configurability.
- The need to build user-friendly platforms thereby diminishing complexity through better design.
- To develop research projects on customised and accurate platforms to exchange homogeneous data among different devices, services and healthcare personnel.
- To initiate research projects which focus on easy to use, highly reliable, unobtrusive, low power, transparent technologies and devices in order to gain the users confidence. The implementation of stress detectors and face recognition applications utilising emotion recognition techniques is expected to meet the expectations and cognitive capabilities of the end users.

- Equality and design to make any service adaptive to the conditions of the user and the device they are currently using.

More detailed information is available at [6].

2.4 Contributions to the "Demographic" Challenge

With respect to potential ICT solutions, the challenge on demographic change is closely related to the health challenge in Section 2.3. As many of the technical solutions and requirements are the same, they are not repeated here again.

2.5 Contributions to the "Transport" Challenge

The transport challenge is not explicitly mentioned in documents of the EU Commission as referenced in the Annex. However, transport is a cross-functional issue for the four Grand Societal Challenges

- Climate Change,
- Energy and Resource Efficiency,
- Health, and
- Demographic Change.

From a technical perspective, this challenge provides additional requirements on solutions. Therefore, this area is addressed in the following by eMobility.

One of the areas where ICT could be used to address this challenge head on is within the areas of Smart Cities and Transportation. Mobile and wireless technologies can contribute to the sustainable development of cities and facilitate national and international transportation. New approaches for reducing traffic congestion and shortening travel times are under development through the creation of Intelligent Transport Systems (ITSs). At the same time, users' desire to obtain as a wide range of services whilst they travel to leverage their time continues to grow. Examples of such services include location based services, context-aware services, spare time applications, transportation-based services including passenger information, etc.

Research challenges

In the exploration of future trends for mobile and wireless technologies to enhance the users experience when travelling, four key research lines we identified:

- Urban and road traffic management.
- Efficient trip management.
- Communication services and new applications for Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications.
- The mobile office.

On **urban and road traffic control**, there is a wide range of activities at both European and national level that focus on various applications and services in the transport industry and primarily intelligent transport systems. They include advanced vehicle control systems, travel information and traffic management systems, public transport applications, digital mapping solutions, smart cards and communications technologies that enable the various components and applications to interact. Many of these applications are focusing on integrating vehicle movement with the road and wider transport environment. Many of these applications and services must also be understood in the context in which they take place and the related impact they may have on policies for mobility, transport and the environment.

Another aspect is to look into how mobility can be enhanced via applications and services that focus on creating **efficient travel**. Providing efficient and cost effective public transport is considered a key objective of national transport policy in order to cope with the ever-increasing mobility demands, and to manage increasing energy prices as well as environmental pollution. Today, the traveller

using public transport is faced with several public information challenges, e.g., which tram to take if tram A is delayed or which alternative bus route would be best, or where should the traveller park the car to change to a bus. One potentially important advance would be to utilise “pervasive computing” technologies to enable users to better organise their travelling needs. However, for this to succeed an overall multi-modal travelling solution is required.

Vehicle-to-vehicle and vehicle-to-infrastructure communications will play a major role in the future. V2V communication capabilities offer the ability to detect traffic problems through the dynamic exchange of position and speed information among nearby vehicles, while V2V-V2I communication technologies can improve traffic management through real-time exchange of data among vehicles and with road infrastructure. Once a particular road condition requiring traffic engineering is detected, V2V and V2I communications will be used to route and disseminate the information to the vehicles approaching the problematic area. Wireless vehicular cooperative systems are an attractive solution to improve road traffic management, thereby contributing to the European goal of safer, cleaner, and more efficient and sustainable traffic solutions. The use of V2V (Vehicular to Vehicular) and V2I (Vehicular to Infrastructure) communication technologies can help reduce road fatalities and also provide more efficient and adaptive traffic management that contributes to reducing energy and environmental costs while improving our lives.

The other main area is the concept of the **mobile office**. Mobile users wish to use their devices in multiple locations and for different reasons to access the information they require at any time. Furthermore, this will be amplified over the coming years as personal mobility increases, access to a range of networks proliferate and “mobile workers” will continue to desire access to their working environment everywhere with the same tools and applications they would have in their office. Our working environment is in a process of transition, due to the forces of globalisation and competition, location has diminished in importance. Mobility adds to the flexibility of knowledge workers, but this flexibility could be constrained in the future due to concerns about sustainable development. Thus, new working environments across organisational boundaries have become important, if not imperative, and are enabled by user-friendly information and communication technologies and new ways of working.

The main research challenges identified for this challenge in the near future are:

- The need for certification guidelines across a wide range of areas including safety issues.
- The issues surrounding personal privacy and protection of privacy.
- How individual automated vehicles would operate in a shared environment (with other traditional vehicles) as opposed to a constrained environment such as a campus or private business park.
- Reliability in cruise control and stop and go systems due to the complexity of the system with the driver and the driver’s environment.
- Training of personnel to use adaptive driver assistance systems if implemented in a business environment (say by a bus firm).
- Services that increase the safety of pedestrians in traffic.
- Services that provide the right information as required (e.g., free parking places).
- To have the right information (context aware, potentially with context prediction) at your fingertips.
- To have “easy” service creation for end users, or service providers in a personalised, context aware fashion.
- To have the right service architecture including algorithms for context awareness/ prediction.
- To have tools for semantically enhanced service creation.
- To have the right set of APIs.
- To have smart user interfaces.
- To have multimodality of travel information services.
- To guarantee efficient traffic data distribution within vehicular networks, the routing, broadcasting and dissemination communication protocols have to incorporate reliable transmission policies, such as congestion control or back fire algorithms.

- Wireless communications for vehicular applications have not yet reached the “one size fits all” or “one technology fits all” solution. Standards at all layers and their integration are still lacking.
- Cost (e.g., equipment cost, usage cost: airtime, flat fee, data volume, etc.).
- Quality of Service (e.g., bandwidth, latency, scalability, etc.).
- Availability (e.g., coverage area, indoors, outdoors, etc.).
- Wireless mesh networks have not yet witnessed mass-market deployment. However, it is fundamental to consider this technology as a part of the global communication puzzle.
- The requirement for future standards in the ITS field to be able to provide multiple services, over multiple different platforms, that will work in different countries (as vehicles can easily cross borders), while maintaining a simple-to-use interface that requires minimum intervention from the driver.
- Multimodal interfaces need to be exploited and improved.
- Exploiting new emerging communication technologies (Zigbee, RFID, etc.). It is vital to improve the current state of the art, interoperability, communication continuity, and handoff approaches (in an environment where the communication is not always available) in homogeneous and heterogeneous networks (UMTS, WiFi, etc.), that will be key for providing transparency to the user.
- Applying security in such a heterogeneous environment requires new solutions for managing security while at the same time providing the users the possibility to control their identity, personal information, etc.
- ICT developments need to be capable of reducing our demands on natural resources and consumption while maintaining the growth brought on by a longer living population, who will continue to work later into their lifetimes. *e*Mobility must contribute to the support of less consumptive technologies.

3 Conclusions

The *e*Mobility European Technology Platform constitutes the foundation on which the “smart infrastructures” described in the *Digital Agenda* [5] are going to be built upon. Information and communication technologies for future networks provide the key technologies and systems, which enable the essential building blocks for many application sectors and will support solutions for Grand Societal Challenges. The development of such solutions requires the close cooperation of different industry and application sectors, which is going beyond the today’s industry structure.

The *e*Mobility European Technology Platform has identified these research and innovation topics in the future networks domain in its Strategic Research Agenda [10] and Strategic Applications Agenda [6], which are needed to implement solutions for Grand Societal Challenges. In order to provide the basis for these developments, it is important to carry on research and innovation in these areas, so that such smart systems and environments can be developed and implemented. At the next level, such smart infrastructures will be the basis for

- smart cities,
- smart transport,
- smart homes and
- other such smart environments

will contribute to the Grand Societal Challenges.

In Section 2 the major research areas for the different Societal Challenges are identified. Basic ICT concepts and systems for different application areas and Societal Challenges are rather similar. However, the detailed requirements will be different depending on the application area. The similarities in concepts allow the identification of so-called common enablers, which will allow a more generalised network core platform and by means of standardised interfaces economy of scale. This will offer affordable systems, which will be essential for viable business models and the adoption of new services and applications. The actual EU Framework Programme 7 Work Programme for the Future Internet Public-Private-Partnership (FI PPP) [2] is based on this approach.

The FI PPP will support the closer cooperation across different sectors and the development of solutions for Grand Societal Challenges.

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Annex – Context of Grand Societal Challenges

The discussion in the European Union on Grand Societal Challenges is ongoing since about two years. In the following, the major documents are summarised as background information in order to relate the discussion to research and innovation in the ICT domain and its potential impact on future research framework programs.

A1 The Lund Declaration

In July 2009 the *Lund Declaration* [11] was agreed as part of the Swedish Presidency. This document explains the need for cooperation in research and innovation across different sectors in the society and economy. The major identified challenges were

- global warming,
- tightening supplies of energy, water and food,
- ageing societies,
- public health,
- pandemics and security.

The *Lund Declaration* is asking the European Research Area for a process to identify further challenges, which gain political support and which may move away from current thematic approaches. According to [11] meeting the Grand Challenges also requires the following:

- **Strengthening frontier research initiated by the research community itself**. It is fundamentally important to create knowledge diversity, endowing the European Union with expertise, especially when confronted with unforeseen Grand Challenges and "shocks". Competition among researchers will ensure that research carried out in Europe is of international excellence.
- **Taking a global lead in the development of enabling technologies** such as biotechnology, information technology, materials and nano-technologies.
- **Bringing together supply- and demand -side measures to support both business development and public policy goals**. Measures are needed to maximise the economic and societal impact of new knowledge in areas such as industrial, environmental and social policies, agriculture and regional development. Links between these policy areas and research policies must be strongly improved. Supply-oriented research and innovation policies should be more strongly supported by demand-oriented policies, such as lead market initiatives, public procurement, problem- and issue-driven policies and priority setting.
- **Excellence and well-networked knowledge institutions**. Modernisation of universities and cooperation between universities and research institutions is a key element for enhancing the competitiveness of European research. There is a need to develop instruments to stimulate and support initiatives for cross-border cooperation between knowledge-building institutions in creating peak of excellence environments including for less developed research institutions.
- **The creation and maintenance of world class research infrastructures** in Europe including installations for big science as well as those serving the needs of social sciences and humanities.
- **A risk-tolerant and trust-based approach in research funding** entailing actions for necessary changes in the Communities' Financial Regulation and Rules for participation and dissemination.

This declaration provides general requirements on future research and innovation activities.

A2 ETP 2009 Conference, Brussels, 13 October 2009

The EU Commission organised on 13 October 2009 a meeting of the leaders of the European Technology Platforms (ETPs) in Brussels in order to discuss the future role of ETPs and societal challenges to be addressed in future research and innovation activities [12]. This meeting focussed on the following major topics:

- Climate change and clean energy,
- Sustainable transport,
- Sustainable consumption and production and
- Public health.

These challenges are in line with the context of [11]. It was the intention to involve European Technology Platforms in this discussion and to take their contribution into account.

A3 Bruegel Report

Bruegel is a European think tank devoted to international economics. This consultancy organisation issued a report in 2009 on "Europe's economic priorities 2010 – 2015" [13] towards

- The President of the European Commission
- The Commissioner for Economic and Monetary Affairs
- The Commissioner for Financial Services
- The Commissioner for Competition Policy
- The Commissioner for the Single Market
- The Commissioner for Enterprise and Industrial Policy
- The Commissioner for Knowledge
- The Commissioner for Climate Change
- The Commissioner for Employment, Social Affairs and Equal Opportunities
- The Commissioner for Enlargement and Neighbourhood Policy
- The Commissioner for Trade
- The Commissioner for Development

in order to provide recommendations for the work program of the new Commission for the period 2010 to 2015. Based on the identified challenges policy directions are proposed.

A4 Work Program of the new Commission for the period 2010 to 2015

Based on the discussion in 2009 and general policy challenges the President of the Commission Mr. Barroso summarised his objectives for the new Commission ahead of the appointment by the European Parliament [4]. Challenges like global warming, sustainable economy, energy efficiency, ageing population health and accompanied research and innovation are high on his agenda. The main areas are shown in Figure 1 [14].

These discussions resulted in the agreed work program of the EU Commission "Europe 2020 A European strategy for smart, sustainable and inclusive growth" [1], which is explicitly addressing societal challenges as part of

Smart growth – an economy based on knowledge and innovation:

Smart growth means strengthening knowledge and innovation as drivers of our future growth. This requires improving the quality of our education, strengthening our research performance, promoting innovation and knowledge transfer throughout the Union, making full use of information and communication technologies and ensuring that innovative ideas can be turned into new products and services that create growth, quality jobs and help address European and global societal challenges. But, to succeed, this must be combined with entrepreneurship, finance, and a focus on user needs and market opportunities.

Figure 1 Focus area for the new Commission as proposed by President Barroso

In particular, in the **Flagship Initiative: "Innovation Union"** the aim is to re-focus R&D and innovation policy on the challenges facing our society, such as [1]:

- climate change,
- energy and resource efficiency,
- health and
- demographic change.

In particular, the 20/20/20 climate energy targets should be met by 2020 with

- the reduction of green house gas by 20 %
- the increase of renewable energy use in the EU to 20 % and
- the increase of energy efficiency by 20 %.

These objectives will have an impact on EU research and innovation policy as well as future research framework programs to generate economic growth again and to achieve leading positions in certain technology areas. This work program is providing a clear link to information and communication technologies and its contribution to economic growth, which will be detailed in the "Digital Agenda (Strategic Initiative No. 9)" and "A European plan for research and innovation (Strategic Initiative No. 11)". The detailed work program of the Commission for 2010 is available in [15]. In 2010 the focus of work of the Commission will be mainly on preparatory activities for societal challenges [15]:

3.3. Addressing long-term societal challenges

European society faces a number of long-term trends which will have a direct impact on the daily life of citizens: these include the spread of new technologies, immigration and the pressure of demographic ageing, the consequences of climate change and environmental threats. Public policy needs to address these trends, both mitigating their risks and factoring their opportunities into future initiatives. These trends require careful analysis and the input of a wide range of stakeholders. The Commission will open public debates and work on the following issues:

- *The future of pensions by presenting a green paper (strategic initiative n° 27): This will look at options for ensuring the sustainability and adequacy of pensions in the light of ageing, mobility patterns in Europe and the functioning of financial markets.*

- *The need to further develop legal immigration policies to alleviate the pressures of demographic ageing and to enhance Europe's competitiveness, combined with renewed integration policies.*
- *A new EU biodiversity strategy by presenting a communication (strategic initiative n° 28): This will set out the concrete actions that the EU should consider to meet its international commitments and in the light of the pressures on the ecosystem.*
- *An EU rapid response capacity by presenting a Communication on the EU's disaster response capacity (strategic initiative n° 29) to improve the EU's response to disasters.*

Public debates will also be launched in the light of scientific progress on issues such as animal cloning, biotechnology and nanotechnology.

The European Council basically supported the work program of the Commission in its meeting on 25/26 March 2010 [16]. However, several topics will be discussed in later Council Meetings in 2010 and 2011 for final decision. The main overall two objectives of the Council are [16; 17]:

- Europe 2020: A New European Strategy for Jobs and Growth, which is followed by
- II. Climate Change: Refocusing our Efforts after Copenhagen.

ICT can contribute to the second overall objective.

A5 Digital Agenda and R&D Framework Programs

A5.1 Digital Agenda

DG Information Society is currently working on the preparation of the "Digital Agenda", which has been published on May 19, 2010 [5].

The Digital Agenda will address, how ICT can support the solution of societal challenges like

- ICT for sustainable healthcare in an aging society and
- Use digital technologies for a sustainable life style.

In her speech [18] on 12 March 2010 Commissioner Kroes mentioned the following societal challenges to improve economic growth:

Making a clear and short list of priorities is also needed, or else nothing will get done. This is why we have set only five big targets for 2020:

1. *75 % of the population aged 20 –64 should be employed*
2. *3 % of the EU's GDP should be invested in R&D*
3. *The "20/20/20" climate/energy targets should be met*
4. *The share of early school leavers should be under 10 % and at least 40 % of the younger generation should have a higher education degree*
5. *20 million fewer people should be at risk of poverty.*

ICT can support the development of respective solutions.

The Council of Telecommunications Ministers of EU Member States supported the basic approach of the Digital Agenda and the linkage of ICT with societal challenges in their statement [19]:

Strengthening the Competitiveness of Europe's ICT sector

Support ICT innovation through R&D in areas where Europe has a lead market potential, e.g. health, green mobility, smart grids & meters and energy efficiency; or which are strategic such as Future Internet or cloud computing.

The ministers also mentioned areas like Internet, security and trust as well as low carbon economy. In addition, it is recognised that 50 % of productivity growth are initiated by ICT.

A5.2 Research, Innovation and Development

Commissioner Maire Geoghegan-Quinn responsible for DG Research, Innovation and Science is linking the grand societal challenges:

- climate change,
- energy security,
- food security,
- health and an
- ageing population

to research and innovation [20]. This will have an impact on discussions on future framework programs and instruments.

For example, the Future Internet PPP in Framework Program 7 is already addressing societal challenges by means of linking application domains with ICT. In addition, the PPPs on Energy Efficient Buildings, Factories of the Future, and Green Cars as launched in the recovery plans of the EU in 2008 are supporting other parts of societal challenges. In this respect already the actual work programs in Framework Program 7 are supporting research and innovation beyond basic technologies by developing solutions for entire value chains.

A6 DigitalEurope's Perspective

Industry associations like DigitalEurope are also promoting the support of societal challenges [21] and supporting the EU Commission's work program [1]. The DigitalEurope's position is described as follows:

> *Digital technologies will increasingly drive productivity, sustainable growth, innovation and employment throughout the European economy in a myriad of ways. These are best demonstrated at the disaggregated levels of industry sectors, individual organisations and individual empowerment. European trends, case examples and success factors from six sectors help to create a wider vision of productive, innovative digital Europe by 2020:*

- **Energy:** Europe's three long-term energy policy objectives – greater energy independence, reduced greenhouse-gas emissions and a competitive, continental scale Single Market – are squarely predicated on the power of digital technologies to transform, starting with our grid infrastructures and extending to consumer control over consumption.
- **Manufacturing / Automotive:** The transformation in all manufacturing sectors to customer-driven innovation based on the sustainable use of resources and integrated manufacturing cycles will depend on the pervasive penetration and use of digital technologies.
- **Transportation and logistics (T&L):** Transport and logistics companies are evolving from forwarding and warehouse-managing companies to highly industrialised, ICT-driven supply-chain providers. Services based on a mobile 'Internet of things' hold particular strategic important for the sector, as do digital solutions for traffic congestion, emissions reduction and intermodal transport.
- **Small- and medium-sized enterprises:** Entrepreneurial activity represents 99% of an estimated 23 million enterprises in Europe, providing two thirds of private sector jobs (75 million), and more importantly around 80% of new jobs created over the past five years. Enterprises need access to digital tools on-demand, which will help eliminate distance, assist in delivery of services on-demand, virtual organisations and enhance networked innovation.
- **Healthcare:** The traditional healthcare delivery model, built around dealing with acute episodes, will no longer be sustainable as European society ages. Harnessing the transformational power of digital technologies is the key for moving to a "continuum of care", while improving quality and productivity, as the practice and delivery of care continues to evolve.