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INTERNET FOR THE FUTURE

PARADISO reference document

May 2011

A forward-looking analysis to identify new innovation paths for the Future Internet

Open to public consultation

Call for action
Recommendations to the European Commission
Proposal to explore the Internet at its limits

Wouldn't it be paradoxical to develop a « Future Internet »
without thoroughly exploring what the future of our societies should be?

This report was prepared as part of the PARADISO2 project (www.paradiso-fp7.eu),
supported by the European Commission (DG Information Society and Media)
through its FP7 research-funding programme
as one of the FIRE (Future Internet Research and Experimentation) projects
(http://cordis.europa.eu/fp7/ict/fire)

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and consider joining it
(http://www.linkedin.com/groups?mostPopular=&gid=3252823)

THE WAY TO PARADISO

Mário Campolargo

Director, Emerging Technologies and Infrastructures
Directorate General, Information Society and Media
European Commission

The Digital Agenda for Europe is a key pillar of the Europe 2020 strategy. It includes an ambitious programme of action that promotes the Internet as a fundamental enabler of the future digital society. Its implementation has the potential to change the lives of people throughout the world and place Europe at the forefront of ICT-enabled innovation.

In this context the PARADISO message is extremely important. We all want the future Internet to be a key tool to address the world's emerging sustainability challenges – challenges that concern not only the environment but also energy, the economy and the way in which our societies operate.

This guiding vision is especially important given the size of the European research efforts in this area. We have about a hundred active projects in this domain, systematically organised through the Future Internet Assembly.

This has no real parallel on the global scene. Compared to other initiatives, our Future Internet programme takes a broader and more holistic perspective. It encompasses R&D that covers not only the technological potential of the Internet but also network infrastructures, software, services, content, and trust and security issues. Its key drivers include web 3.0[1], the growth and diversification of social networks, mobile Internet access, new content usages, the 'Internet of things'[2] and new web services.

[1] Web 3.0 is the term used to signify the coming phase of Internet development, envisioned in many different ways by different experts. It represents a step change from Web 2.0, which defined the 'second generation' phase of Internet development in which basic information-searching functionality was augmented by applications that facilitate participatory information sharing, user-centred design, e-commerce and social networking.

[2] The Internet of Things refers to the networked interconnection of everyday objects via tiny identifying devices and sensors.

For the next two years the opportunities and challenges of the Future Internet will continue to be the focus of significant attention and activity within the European Commission. A key example of this is the recent call to create a Future Internet Public Private Partnership (FIppp) as a means of driving forward the innovation-based strategy of the *Europe 2020* document. It is proposed that this Future Internet PPP will have two main aims:

- To strengthen and expand the competitiveness of the innovative European ICT industry
- To accelerate the shift towards a more sustainable society, encouraging smarter and more sustainable business practice.

The ambition of the FIppp is reinforced by the experimental approach of the FIRE initiative, within which Paradiso was launched. FIRE wants to explore advanced Future Internet concepts and ideas through real experimentation in sophisticated testing environments. This will allow us to assess in advance the possible social and economic impacts of new Internet technologies.

The Future Internet is now the subject not only of extensive technological research, but also of significant scientific investigation into where its possibilities overlap with a range of disciplines including sociology, economics, marketing and anthropology. Creating a pool of scientific expertise that is able to understand and process all these different perspectives is one of the ambitions of the « Internet science » initiative that has been launched recently.

All these developments are well in line with the Paradiso project, which aims to identify a way forward based on true sustainable development, more sustainable economic and financial models, and a more equal sharing of resources. This also fits with the Innovation Union flagship initiative recently proposed in the Europe 2020 strategy, which is aimed at "refocusing R&D and innovation policy on the challenges facing our society, such as climate change, energy and resource efficiency, health and demographic change".

We look forward to PARADISO's recommendations on how to set priorities in ICT and Internet research in order to achieve a wide range of sustainability goals. Paradiso will help all the leading players in European research to make best use of the massive investments that Europe is making in this area, especially at a time when the European Commission has been reflecting further on the future of its Framework Programmes.

Thanks to the PARADISO project for speaking to this technologically dominated world with the voice of European citizens!

September 2010

Table of contents

BACKGROUND AND OBJECTIVES OF THIS REPORT

This document has been prepared within the framework of the PARADISO project, supported by the European Commission through its FP7 programme (http://cordis.europa.eu/fp7).

The PARADISO project, coordinated by Sigma Orionis (www.sigma-orionis.com), was launched in 2007 - before the present financial and economic crisis - at the initiative of the Peccei Foundation, the Italian chapter of the Club of Rome (www.clubofrome.org). There are high expectations about what the project should achieve…

'ICT will help us, as PARADISO has said, to proactively promote a new concept of progress'
Hamadoun I Touré
Secretary General, ITU

'I hope PARADISO develops an action plan for the research needed to ensure that the web of the future empowers ALL people on the planet'
Steve Bratt
Chief Executive Officer, World Wide Web Foundation

'PARADISO will hopefully create a space for strengthening European policies on an Internet for citizens'
Amelia Andersdotter
'Lisbon' Member of the European Parliament for Sweden

'I expect PARADISO to help us clarify how the concept of knowledge societies can serve the interests of the global good'
Philippe Quéau
Former Director of UNESCO's Information Society Division

The rationale of the project is the vision that, if it is today well acknowledged that the world has profoundly changed during the last decades, it should be acknowledged too that the world will have to profoundly change in the next decades in order to avoid major risks of breakdown.

Industrialised, emerging and developing countries will need to agree, sooner or later, on an alternative way forward based on a truly sustainable approach to development, including more sustainable economic and financial models and a more equal sharing of resources. What is ultimately at stake is the wellbeing of all the citizens of the world, measured by new indexes that go beyond GDP (Gross Domestic Product).

In this context the PARADISO project (PARADISO is an acronym formed from parts of the words PARADIgm and SOcietal, and is an obvious reference to a better world) proposes to explore the particular role that that Information and Communication Technologies (ICT) in general, and the Future Internet in particular, could play in this envisioned future

In other words ***PARADISO is adopting a forward-looking approach that looks into the future of our societies in order to distil recommendations on how to develop the Future Internet to its full societal potential***.

The project's core activities consist in the analytical review of societal trends and evolution scenarios in the next decades and of the expected progress in the ICT area, in order to identify key issues to tackle. Findings from this work are reported through successive public releases of this paper, 'the PARADISO reference document', each of which is submitted to an open consultation on the PARADISO web site.

The PARADISO project is committed to wide dissemination of its findings and open to inputs from any interested individuals and organisations - both in Europe and in other regions of the world. Because of this PARADISO is organising many open workshops and conferences. The next will take place at the European Commission in Brussels from September 7 to 9, 2011.

Moreover, PARADISO can count on the involvement of a multidisciplinary expert panel composed of around 40 representatives of leading institutions, companies, research institutes and NGOs from Europe and the rest of the world.

September 2010 saw the establishment of the not-for-profit PARADISO Foundation (www.the-paradiso-foundation.org). Its aim is to extend the scope and objectives of PARADISO activities, promoting and supporting the development of ICT products, services and initiatives that can contribute to a more sustainable future globally.

Scan this QR code with your mobile to watch the PARADISO video trailer on YouTube (http://youtube.com/watch?v=oo9CvKGBnqo)

NO ONE CAN PREDICT THE FUTURE BUT WE HAVE TO PREPARE FOR IT

In a video message addressed to the PARADISO community in September 2010, Prof Dr Helga Nowotny, President of the European Research Council[3], reminded us all that "*our wish to predict the future far exceeds our ability to do it*".

Of course, no one can predict the future. But in a world that is going at a faster and faster pace, we need to anticipate change to be in a better position to adapt. We cannot predict the future, but we have to prepare for it.

Gaston Berger, a father of foresight exercises, stated some decades ago: "*Our civilisation is like a car driving faster and faster on an unknown road when the night has come. Its lights have to be more and more powerful if serious problems have to be avoided.*"

The future cannot be predicted and is not set. It mainly depends on the economic, environmental and social long-term objectives chosen to drive the development of our societies, even if change can be also be accelerated by unpredictable events (the fall of the Berlin wall, the 9/11 attacks) or 'black swan' events (unpredicted but rationalised in hindsight, such as the recent economic crisis and today's social crisis in the Arab world).

Setting up long-term objectives requires a good understanding of major trends, issues to tackle, possible options and so on. We can therefore only state that "*good EU governance is also based upon forward looking and foresight exercises: analysis of societal trends, setting up of scenarios, identification of potential breakthroughs to allow decision makers to highlight their choices*" (Jean-Michel Baer, Director of DG Research, European Commission, 2010).

We can derive from all this that forward-looking approaches should not be seen as occasional exercises, to be developed from time to time. They should be a constant concern, following the Plan-Do-Check cycle envisioned by Gaston Berger.

We can also add that forward-looking approaches should be particularly recommended in the fast-changing and impactful arena of ICT, including the Internet domain.

It is widely acknowledged that the Internet has an increasing impact on societies, and that short-term socio-economic analyses are needed to fine tune developments. It is less often recognised, however, that the Internet has become so central to nearly all human activities that it is today not only an enabler of societal evolution but also a transformer of societal conditions.

It is therefore necessary in the coming decades, in order to develop an Internet truly suited to our future, to gain ***a better understanding of how the evolution of the Internet and the development of our societies are interrelated.*** **When we have this understanding** we will be better equipped to analyse the long-term societal impact of the Internet and identify how its development can be aligned with any possible societal paradigm shifts.

[3] The European Research Council is an independent agency set up to fund frontier research across Europe.

Some might argue that relatively little foresight is needed in the ICT/Internet arena because these technologies can easily adapt to any societal changes.

But in some cases the adaptation required takes time, and may be expensive or difficult to implement. It is therefore better to anticipate possible or probable requirements. Moreover, the adaptability of technologies is well proven when facing linear or incremental developments but less certain in the face of more radical and less orderly change.

Even if radical change does not materialise, we should underline that the forward-looking approach we are recommending is likely to provide interesting and potentially useful insights.

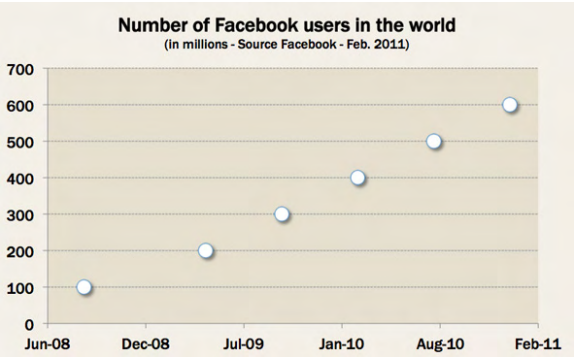
And even if looking forward involves looking mainly at a long-term horizon, the outputs of such work can and should be applied and used in the shorter term.

THE ISSUE IS NOT TO STIFLE INNOVATION BUT TO IDENTIFY NEW INNOVATION AREAS

The core question raised by PARADISO, '*Which Internet for which future?',* is not intended to re-open the old debate opposing « an autonomous science » to « societal-driven developments ».

The PARADISO project is not trying to stifle or limit innovation in the ICT and Internet domain, suggesting researchers to just develop what would be judged (who by?) as relevant for our tomorrow's societies.

It is of course appropriate that science should be allowed to develop autonomously, provided that its possible negative impacts and any thorny ethical issues can be anticipated and suitably addressed. In the Internet domain, most recent innovations were just unexpected and societal-driven approaches would have hardly led to envision the possible development of applications such as Facebook, YouTube, Skype that have known a tremendous success in just some years



PARADISO proposes not to put constraints on technological developments but to anticipate changes and eventually to highlight new research areas to explore, on the basis of foreseen societal developments.

In other words, PARADISO aims to extend rather than to reduce, to help those developing the Internet to *think outside the box and go beyond what is taken for granted*.

This means that PARADISO is in line with *Europe 2020*, the European strategy for smart, sustainable and inclusive growth, and with its two flagship initiatives: 'Innovation Union' and 'A Digital Agenda for Europe'.

LOOKING IN THE REAR-VIEW MIRROR

How will socieities and technologies evolve in the decades to come?

The recommended starting point for any foresight exercise related to a given phenomenon, system or issue is to 'look in the rear-view mirror' - ie to analyse what has happened up to now. Looking back in this way allows us to identify existing trends and to take stock of past 'black swan' events. It thus puts us in a better position to learn from past errors and anticipate possible future breakthroughs.

When looking at the past 50 years we can see that the world has experienced profound changes and anticipate that we face an increasingly complex future.

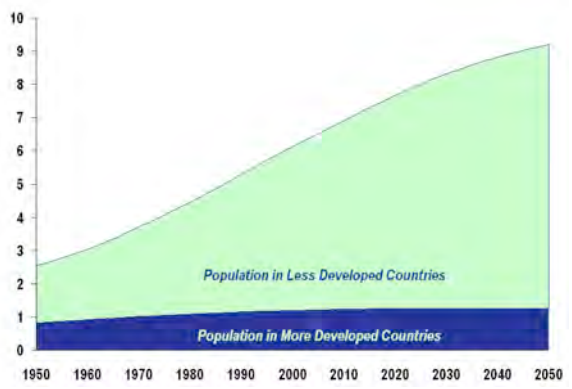
These changes have been driven by a number of factors, many of them interrelated. The most important of these are:
- The growth of the world's population (and the changes in its structure)
- The globalisation of markets and of the financial system,
- The new balance of world power, tilting increasingly towards emerging economies
- The growing use of natural resources and human impact on the environment
- The increasingly overwhelming dimension of Information and Communication Technologies.

PROFOUND CHANGES OVER THE LAST 50 YEARS

POPULATION GROWTH AND STRUCTURAL CHANGES

Since the beginning of the 20th century, and more particularly since the 1950s, the world population has been growing at an unprecedented rate. Today it stands at over 6.9 billion people. This exponential growth has influenced many other factors that will be analysed in the following paragraphs, such as increased use of agricultural and mineral resources, and the impact of human activity on the environment.

Changes in the structure of the world's population have been very important too:
- The greatest growth has occurred in less developed countries (Africa is today by far the fastest-growing continent),
- The present rate of increase (the crude birth rate minus the crude death rate) averages ***156 people each minute: four of them in developed countries and 152 in developing countries***,
- The proportion of those living in urban areas (and particularly in urban areas of 10 million people or more) has significantly increased,
- Because of increased life expectancy and a falling birth rate, the age balance of the population in developed countries has changed dramatically.

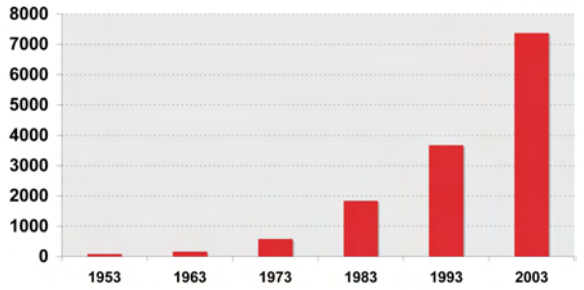


Compared population growth over the period 1950-2050
Population Reference Bureau - 2007

MARKET GLOBALISATION

International trade in industrial and agricultural products has developed at a very rapid rate in the past 50 years. This growth has been driven in part by advances in transport and communication. But perhaps the most significant factor has been the determination of market stakeholders (both companies and governments) to extend the reach of their markets and to build a world in which goods, services, people and money all move more freely.

Regional free trade agreements such as the one developed by the European Union, by the Association of Southeast Asian Nations, or more recently by the United States, Canada, and Mexico (NAFTA), and worldwide agreements (particularly the General Agreement on Tariffs and Trade - GATT - established in 1947, from which the World Trade Organization - WTO - was generated in 1995) are well-known drivers of these changes that today do ***not include only trade globalization but also, since the 90's, monetary and financial globalization***.



Growth in world merchandise exports (in $ billion) since 1953
WTO – 2006

EMERGING ECONOMIES

Taking full advantage of market globalisation, China has expanded its economy at an impressive rate over the past two decades - followed by other countries, The Chinese economy has grown by between 8% and 11% over the last ten years.

In 2003 Goldman Sachs identified a group of fast-growing nations that it called the BRIC countries (Brazil, Russia, India, China), later known as the BRICS countries (adding South Africa). Goldman Sachs predicted that the combined GDP of these countries should become greater than that of the G7 countries (Canada, France, Germany, Italy, Japan, the UK and the USA) in less than 30 years.

Indeed, in 2010, ***China has already overtaken Japan as the world's second-largest economy*** and has become number one in an increasing number of sectors.

The present and expected future development of these economies (and the growth of others such as Brazil, Indonesia, Korea, Mexico, Nigeria, the Philippines, Turkey and Vietnam) is propelling these countries into playing an increasing financial and political role in the global arena.

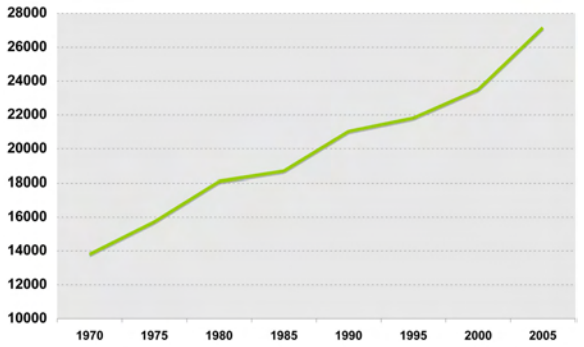
This shift in the economic balance of power is having a direct influence on other changes analysed in this chapter, particularly with regard to the use of natural resources and environmental issues.

INCREASED USE OF THE EARTH'S RESOURCES AND INCREASED HUMAN IMPACT ON THE ENVIRONMENT

We have already seen earlier in this report that the world population has more than doubled over the past 50 years. We have also noted that China and other emerging countries have experienced very fast economic growth, facilitated by a quickly developing market globalisation.

A logical consequence of this increased human activity has been a significant increase in the use of the earth's resources.

It has led to serious stresses in the energy sector and the first signs of serious water scarcity. There have also been some worrying ***anthropogenic effects on the environment.*** These include the production of climate-changing levels of greenhouse gases (particularly CO^2), a decline in biodiversity and the deterioration of a number of natural systems, among them fisheries.



World CO^2 emissions
OECD data - 2008

INFORMATION AND COMMUNICATION TECHNOLOGIES

The last factor that will be analysed in this chapter, the huge changes in the ICT domain, is no less important than the others we have looked at, even if it is not usually afforded the same significance.

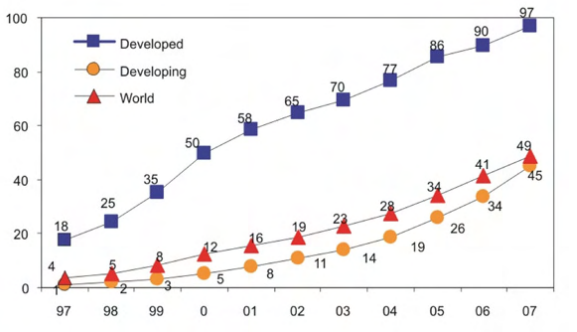
In less than 20 years Information and Communication Technologies have totally changed the way people communicate and access information. But they have also transformed the worlds of work and leisure, the way we deal with health and safety issues, the way wealth is produced and the way we govern, control energy and protect the environment. This transformation has affected both developed and less developed countries. Progress in ICT and in the Internet have been so important in the last 20 years that ***Generation Y*** - people born after the mid-1970s - can hardly imagine a life without today's products, services and applications.

Portable computers: progress made in the past 20 years
PARADISO - 2010

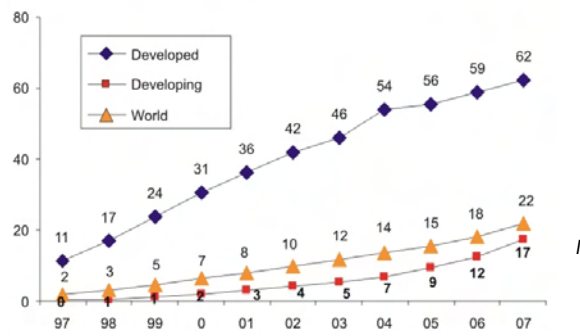
Usage statistics are impressive:

- Over a third of households worldwide now have a PC
- At the end of 2010 there were over 5.3 billion mobile subscribers and 2 billion Internet users
- Internet revenues for the EU27 countries amount to €100-200 billion per year (depending on which products and services are included)
- A million clicks are made every second, while two million emails and a million instant messages are sent
- The world's accumulated digital information amounts to 1,800 exaB (10^{18}B).

Most countries in the world see ICT playing a pivotal role in their economic development because of the opportunity it presents to develop 'smart' societies. In the 40 years since it was invented, the Internet has come so far - with a host of products and applications and now the emergence of an 'Internet of things' - that most countries are attempting to design a Future Internet that will be more suited to the expected size and scope of Internet applications.



Mobile phone users per 100 inhabitants - ITU - 2011



Internet users per 100 inhabitants - ITU - 2011

Scan this QR code with your mobile to watch the 2008 Future Internet video clip of the European Commission on YouTube (EU Tube channel)
(http://www.youtube.com/watch?v=MOpLERCrrT4)

2000-2010 IN FOCUS: A DECADE OF ACCELERATED CHANGE

The world has undoubtedly changed profoundly since the 1950s, as detailed in the previous paragraphs. However, when looking more carefully in the rear-view mirror, it is important to isolate and analyse what has occurred in the past ten years in particular.

If we consider the decade from 2000 to 2010, ***it has been the period when some of the most impactful changes have occurred***.

It is within this period that:

- Emerging economies, led by China, have truly experienced a dramatic development
- The use of the world's resources and our human impact on the environment have expanded most rapidly
- Financial globalisation has really taken hold worldwide
- The role of ICT and the Internet in economic development and in all our lives has become absolutely pivotal.

It is also during this decade that our world has experienced some major tensions and breakthroughs:

- An unprecedented global economic and financial crisis, prompted by the collapse of the US housing bubble but ultimately caused by a loosely regulated financial system and insufficient government controls across the world.
- The crisis led most developed countries to enter a deep and probably long-term recession, characterised by a sharp increase in unemployment rates in industrialised countries and by increased fragility in the economies of developing countries.
- Increasing social disorder in Europe and in other regions of the world. precipitated by the financial crisis and its consequences (costly recovery plans, state debt restructuring and so on)
- A recognition at the 2009 UN Climate Change Conference in Copenhagen that the world faces environmental challenges of unprecedented urgency - although there was a conspicuous failure to take ambitious decisions.

TODAY'S SITUATION: SIGNIFICANT PROGRESS BUT INCREASING UNCERTAINTIES AND THREATS

The challenges we face are so significant that it is difficult to identify clearly and agree consensually what can be seen in the rear-view mirror and how we should proceed. The assessment made necessarily depends on who is making it, with a degree of variation between different countries, regions and political perspectives.

What can be quite easily agreed, however, is that we have made significant progress in societal development in recent decades and yet our societies are facing increasing uncertainties and threats.

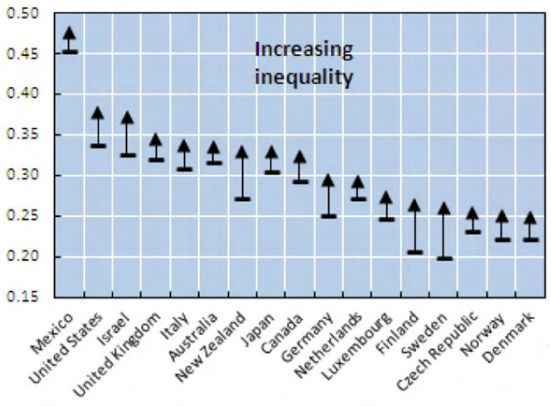
The progress made over the past 50 years is unquestionable, both in Europe and in the wider world in general. We have seen progress being made in many sectors, including health, education, housing, transport and communications.

A lot remains to be done in all these sectors and in all countries, of course, and particularly in less developed nations. But it seems that the challenge we are facing is no longer one of incremental progress to be achieved: there is a critical situation to cope with.

> ***'We have to be aware of the potential dangers of unfettered markets, environmental degradation and the limits to free trade'***
> *Joseph Stiglitz - Nobel Prize in Economic Sciences*
>
> ***'For the first time in its history, humanity is confronted with the real possibility of a collective suicide'***
> *Marc Luycks Ghisi - Former member of the Forward Studies Unit of the European Commission*

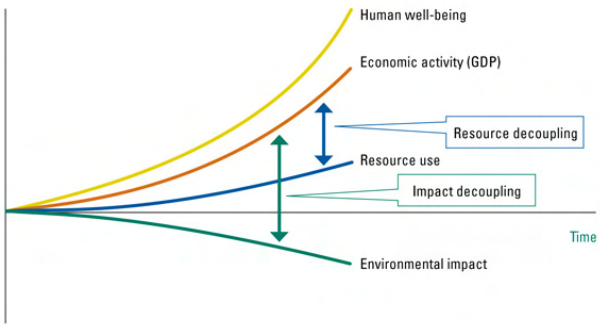
'***Rapidly approaching category 5***'
2010 report of the « Rising Above the Gathering Storm Committee, prepared for the President of the US National Academy of Sciences

Many leading analysts underline that the ***risks of economic, social and environmental breakdown*** highlighted by PARADISO are becoming ever greater, that « mega-risks » (major financial crisis, cyber attack, or social revolution for instance) are in sight. In addition, a growing number of citizens in a growing number of countries seem to share a sense that ***business cannot go as usual***. They sense that we have to go beyond GDP to measure the progress of our societies, that new models of globalisation and capitalism are needed, and that it is urgent to tackle increasing inequalities and environmental challenges.



Increasing inequalities in the OECD countries from mid-1980s to late 2000s (OECD - April 2011)
Evolution of the Gini index
(ranging from 0 - identical incomes for everybody - to 1 - only one person gets all income)

In other words, the time might now have come to pursue the "***alternative way forward***" that PARADISO has suggested since the launch of the initiative, "*based on a true sustainable development, more sustainable economic and financial models, more equally shared resources*".



Time has come to decouple natural resource use and environmental impacts from economic growth
Report from the UNEP International resource panel
May 2011

How will our societies evolve in the decades to come?

As already stated in the previous chapter, the future cannot be predicted but it is of paramount importance - at a time of accelerating changes - to analyse current trends, possible scenarios and potential breakthroughs. In this way we can make better-informed political choices and be prepared to adapt to any situations that may occur.

A number of quite exhaustive forward-looking analyses and foresight exercises have been undertaken by leading organisations in recent years, both in Europe and elsewhere.

It is not possible to list all of them and to do them justice in the limited space we have available here. But it is worth introducing some of them to provide a little context about the kind of facts and findings that PARADISO has been considering during the development of its overall analysis.

Overview of foresight exercises

Project Europe 2030

Project Europe 2030 : Challenges and opportunities is a report submitted to the European Council in May 2010 by the 'reflection group' looking at the future of the EU in 2030. Ziga Turk, co-chair of PARADISO's expert panel, acted as Secretary-General of this group.

The report underlines that reforms are needed at a time when "***Europe is at a turning point in its history***". It asserts that "the Internet and ICT in general is one of the main transformative powers that are reshaping the world today".

It describes the difficult environment in which our future has to be shaped as follows: *"A global economic crisis: states coming to the rescue of banks; ageing populations threatening the competitiveness of our economies and the sustainability of our social models; downward pressure on costs and wages; the challenges of climate change and increasing energy dependence and the eastward shift in the global distribution of production and savings. And on top of this, the threats of terrorism, organised crime and the proliferation of weapons of mass destruction hang over us."*

The main issues to tackle are identified by the first five letters of the alphabet:

- A : Automation of industrial production (and the resulting abundance of goods and information)
- B : BRICS (globalisation)

- C : Climate change (and energy security)
- D : Demographic decline
- E : e-technologies.

THE WORLD IN 2025

The World in 2025 - Rising Asia and socio-ecological transition is a report published by the European Commission's DG Research in 2009. Its main findings can be summarised as follows:

- Trends
  - The Asian century
  - Poverty and mobility
  - Increasing scarcity of natural resources, and vulnerability of the planet

- Tensions
  - Methods of production and consumption versus availability of resources
  - Increasing economic interdependence and differentiation
  - Accelerated urbanisation and cultural distance
  - Possible splits in global governance and other unforeseeable turbulences
  - Persistence of the economic crisis / major war / technological disaster / pandemics
  - Blocking of the EU / acceleration of climate change / weakening of world governance.

- Major transitions
  - Stabilising the world, recognising the new key players
  - ***Drawing on ecological and demographic challenges to invent a new development model.***

- Conclusions
  - Tomorrow challenges: new industrial and trade situation; pressures on energy supplies and security; climate change; technological revolutions; increased ageing of the population; international migration
  - Better coordination between the EU and member states (MS) is needed – Europe is a unique 'laboratory' of globalisation and can launch the global debate on sustainable development and social cohesion.

The scope of this work has been broadened by DG Research since the publication of the report. A new EU expert group, Global Europe 2030/2050, has been formed and should report on its first findings soon.

In the meantime it is useful to look (see below) at some aspects of the SSH (Social Sciences and Humanities) Work Programme of DG Research for 2011. It can help us to understand the issues and direction envisioned by the *World in 2025* report.

'Europe moving towards a new path of economic growth and social development'
(WP 2011 - DG Research, European Commission)

The challenge

The underlying globalisation trends and the current acute financial and economic crisis open up a decade of uncertainties. In particular, they trigger questions about models of human development and social well-being and therefore about the links between social and economic priorities. As highlighted by recent forward-looking analyses carried out at national, European and international levels, there are trends in the use of natural

resources, in the development of ICTs, in the demographic outlook of our societies, in the distribution of income and wealth which call for a 'socio-ecological transition'. This transition will involve major tensions between different models of capitalism, between social groups, between policy priorities.

Tensions will also emerge between different economic interests in competition for business growth, between different types of consumer behaviours, between short-term and long-term political considerations, between 'traditional' and 'modern' values. Given the current international and national evolutions, EU and national policies need to be reassessed and adapted to the new requirements of a transition to a socio-ecological model of development. The new Europe 2020 agenda made to foster these new development and social well-being trajectories needs an accompanying research agenda.

Among identified research directions

- How can ICTs efficiently contribute to the achievement of economic, social and environmental objectives?
- What can interdisciplinary analyses (economics, sociology, history, philosophy and anthropology, for example) tell us of the complex collective meanings of 'well-being'?

FACING THE FUTURE: TIME FOR THE EU TO MEET GLOBAL CHALLENGES

Facing the Future: Time for the EU to meet global challenges is a report prepared in 2010 for BEPA (the Bureau of European Policy Advisers) by the JRC Institute for Prospective Technological Studies.

Three challenges (needs) were identified in this report, based on the criteria of urgency, tractability and impact:

- Change the ways in which essential natural resources are used
- ***Anticipate and adapt to societal changes***
- Bring about more effective and transparent governance for the EU and the world.

Three main policy issues to be considered at EU level were identified:

- Policy alignment towards sustainability
- Social diversity and ICTs contributing towards citizen empowerment
- Anticipation of future challenges, in order to turn these into new opportunities.

EUROPE 2020

Europe 2020: A European strategy for smart, sustainable and inclusive growth is not a foresight analysis per se. But it is based on an extensive forward-looking approach that sets out the context within which a new strategy for Europe will need to be forged. That context that can be summarised by the following extracts:

- "The crisis has wiped out years of economic and social progress"
- "In the meantime the world is moving fast, and long-term challenges (globalisation, pressure on resources, ageing) intensify"
- "It is the time to be bold and ambitious"
- "***Europe must act to avoid decline***"
- "Enhancing economic prosperity and social cohesion"

Europe 2020 is based on three mutually reinforcing priorities: smart growth, sustainable growth and inclusive growth. It includes headline targets for 2020, and is to be implemented through seven flagship initiatives. These include 'A Digital Agenda for Europe' (introduced later in this paper) and:

- The 'Innovation Union' initiative, which incorporates a major research programme on public sector and social innovation
- The 'European platform against poverty', which aims to ensure "social and territorial cohesion such that the benefits of growth and jobs are widely shared and people experiencing poverty and social exclusion are enabled to live in dignity and take an active part in society".

STIGLITZ-SEN COMMISSION

In January 2008, French President Sarkozy appointed a commission to make recommendations on "***how to (go beyond GDP and) more completely measure the nation's collective performance***". It was chaired by Joseph Stiglitz and Amartya Sen, Nobel laureates in economics. Since then Germany has also started to explore such perspectives. The twelve recommendations of the Stiglitz-Sen Commission are highlighted here:

1. When evaluating material well-being, look at income and consumption rather than production
2. Emphasise the household perspective
3. Consider income and consumption jointly with wealth
4. Give more prominence to the distribution of income, consumption and wealth
5. Broaden income measures to non-market activities
6. Steps should be taken to improve measures of people's health, education, personal activities and environmental conditions
7. Quality-of-life indicators in all the dimensions covered should assess inequalities in a comprehensive way

8. Surveys should be designed to assess the links between various quality-of-life domains for each person, and this information should be used when designing policies in various fields
9. Statistical offices should provide the information needed to aggregate across quality-of-life dimensions, allowing the construction of different indexes
10. Statistical offices should incorporate questions to capture people's life evaluations, hedonic experiences and priorities in their surveys
11. Sustainability assessment requires a well identified 'dashboard' of indicators
12. The environmental aspects of sustainability deserve a separate follow-up based on a well chosen set of physical indicators.

Going beyond GDP?

For a long time Gross Domestic Product per capita (or the GDP ppp per capita index, taking into account people's 'purchasing power parity') has been the main indicator used to measure the progress of societies. This despite the fact that GDP only characterises economic development, measuring the economic value of goods and services produced by a country and bringing this down to the level of the individual citizen.

In the 1990s the following joint statement was made by 400 leading economists, business leaders and other professionals - including Nobel laureates: "*Since the GDP measures only the quantity of market activity without accounting for the social and ecological costs involved, it is both inadequate and misleading as a measure of true prosperity. Policy-makers, economists, the media and international agencies should cease using the GDP as a measure of progress and publicly acknowledge its shortcomings. New indicators of progress are urgently needed to guide our society*."

Over the years new indexes such as the Human Development Index (HDI) have appeared, particularly to evaluate progress in developing countries. New indicators and indexes have been put forward by research organisations, NGOs and even governments, emphasising the importance of going 'beyond GDP' in order to find new ways to drive and measure the progress of societies.

One well known initiative was launched in the 1970s by the Kingdom of Bhutan. It concerns the Gross National Happiness (GNH) index, based on the vision that collective happiness should be the ultimate goal of governance. Another example is the Happy Planet Index launched by the UK-based New Economics Foundation in 2006.

More recently, other major countries have explored the possibility to go « beyond GDP ». In China for instance, at a time when the new «national five-year plan (covering the period 2011-2015) was unveiled, promoting a more inclusive growth and the reduction of income inequality, many local initiatives were launched or reinforced, based on the use of « well-being indexes ».

Scan this QR code with your mobile
to watch the 'Going beyond GDP' video clip of the European Commission on YouTube (EU YouTube channel)
http://www.youtube.com/watch?v=h3pyxfxilQc

Changing expectations and lifestyles

An important issue to take into consideration in any foresight exercises is how people feel about their lifestyles and what hopes and expectations they have for the future. Analysis in this area can provide weak (or stronger) signals of future societal shared needs, and thus reveal new ways to ensure that political decisions meet citizens' expectations.

Article 1 of the 'Table des droits de l'homme', prepared during the French Revolution of 1789, starts with the words "The goal of the society is collective happiness"

It is not an easy task to capture lifestyle change and individual expectations and identify emerging trends. It requires objective analysis and the careful selection of information from the abundance available via social networks, in newspapers and magazines, and in various reports.

Special issue of Courrier International (October 2009) on the theme of 'A better life: a user guide'

The following list may help to summarise a number of emerging trends, both in Europe and in many other countries of the world:

- ***A post-consumerist*** (rather than post-capitalist) attitude, with decreasing reference to the 'Western model'
- A progressive shift ***from individualism to community*** *values*
- The wish for a slower and simpler life (***well-being and quality of life*** being given first priority)
- A shift ***from global to local economy, with an increasing appetite for*** enjoying a bigger share of globalisation benefits
- Increasing ethical values
- Growing ***environmental consciousness*** (doing more with less and the '3Rs' attitude: reduce, reuse, recycle)

A great number of initiatives can illustrate these trends. Among them:

- The international Cittaslow network ('slow cities'),
- The increasing number of 'participatory buildings' and 'green city' developments (particularly in Europe),
- The development of local food and economies,

- Pilot projects such as the one of the UK-based Unilke Minds at The Monastery in Manchester (« a vision of continuing personal well-being and sustainable living ») and the one of IPTI in Brazil (« an environment for innovation, creativity and human development »).

We could also underline at this stage the 'manifesto for a happier planet' developed by the New Economics Foundation, based on strong interaction with the public at large:

1. Eradicate extreme poverty and hunger
2. Improve healthcare
3. Relieve debt
4. Shift values
5. Support meaningful lives
6. Empower people and promote good governance
7. Identify environmental limits and design economic policy to work within them
8. Design systems for sustainable consumption and production
9. Work to tackle climate change
10. Measure what matters.

Scan this QR code with your mobile to watch the talk of Nic Marks (NEF) at TED 2010 on YouTube
http://www.youtube.com/watch?v=M1o3FS0awtk

REFERENCE TRENDS AND ISSUES

From the above foresight exercises, a number of core issues and trends can be identified - see panel, below. In our final chapter we will conduct a cross-analysis to examine such issues and trends in the light of current Internet developments and likely future progress in ICT, in order to make a series of recommendations on how the Future Internet could be best suited to tomorrow's societies.

- ***The need to recover from the current economic crisis***
- ***Increasing tensions and risks of breakdowns***
- ***Economic and social resilience versus economic growth (reducing inequalities, going beyond GDP)***
- ***The rise of Asia in an increasingly multipolar world***
- ***Increasing scarcity of resources***
- ***The necessity to limit environmental impact***
- ***Ageing Europe***
- ***Increasing centrality of ICT and the Internet in economy and life***

How will technologies evolve in the decades to come?

The overall objective of this document is to better understand the interactions between societal and Internet developments, in order to advise on how the future Internet should be developed today to help meet the needs of tomorrow.

This is why the previous chapter focused on how our societies will evolve in the decades to come and why this chapter highlights how technologies are likely to evolve – before we conclude with a cross-analysis and recommendations in the final chapter.

Exploring the future of information and communication technologies generally, and of the Internet in particular, requires is an approach that is quite similar to the one that needs to be taken to anticipate the future needs of our societies.

There are a number of trends concerning technological progress that we can distil into some reasonable predictions. To a large extent, however, the future of ICT and the Internet is not set. It will depend on decisions yet to be taken, on external factors, on some unexpected events (such as the quick development of innovative technologies or applications). This is why foresight exercises are needed: to help us anticipate possible issues to tackle, breakthroughs to take into consideration, and so on.

What progress should we expect from ICT and the future Internet?

In a message addressed to the PARADISO community in June 2008 Leonard Kleinrock, a father of the Internet, envisioned that the future of ICT would be *"a future of extreme mobility, mass personalisation, video addiction, location-based services, considerable convergence, continued surprising applications and very serious societal and lifestyles changes"*.

We can add to this vision some more specific predictions that can be deduced with a reasonable degree of certainty from current trends:

- Speed and storage capacity will continue to increase rapidly
- Transaction costs should continue to decrease

- Mobile devices should confirm their supremacy as central consumer devices while an 'Internet of things' should rapidly expand, underlining the urgency of an IPv4-IPv6 transition (the address space offered by IPv4 being unsuffici for an « Internet of Things »)
- Surprising applications will continue to pop up while some of today's innovations should become well established (wireless endoscopy, intelligent clothes, safe driving, robots and so on)
- The potential negative impacts and risks associated with ICT and the Internet should increasingly become a key issue to address (privacy and security issues, the digital divide, artificial intelligence and so on)
- Last but not least, environmental issues should have an increasing impact on the ICT sector (because of the need to mitigate the impact of ICT, for example, and through the development of ICT-based approaches to limit resource use and reduce environmentmal impacts.

ABOUT ICT AND SUSTAINABLE DEVELOPMENT

Today's questions for ICT, with an eye on tomorrow's trends, as proposed by UK-based Forum for the Future in 2008

www.forumforthefuture.org

Making IT: do you...

- Minimise the resources used in manufacturing the hardware?
- Maximise the social benefits for workers and communities in the supply chain?

Using IT: do you...

- Radically improve the energy efficiency of the technologies, reducing energy use overall and increasing the use of renewable energy?
- Ensure re-use, recycling and responsible disposal and address rapid obsolescence?

Applying IT: do you...

- Create wealth and satisfy needs with a lower environmental impact?
- Reduce the need for people and things to move, and transport things more efficiently?
- Give consumers wider access to cheaper, more sustainable products and services?
- Enable people to connect, interact and strengthen their communities?
- Innovate to solve the problems of how we live together sustainably – here and across the world?

When focusing more precisely on the progress to be expected in the Internet domain, some logical trends can be listed:

- Increasingly global, instant and ubiquitous solutions
- Higher and higher bandwith
- Lower prices
- More and more hidden complexity for end users.

Similarly, the following limitations on progress are commonly underlined:

- Problems with mobility, accessibility and scalability issues
- Security, trust and reliability
- The heterogeneity of devices and the complexity of network management
- Quality of service (QoS), data deluge, information quality and ownership, and so on.

These limitations, and the need to overcome them, have been among the drivers for the development of a Future Internet. They open up a range of technical and non-technical questions that must be addressed beyond the core question: should there be evolutionary development or a clean slate?

Roberto Saracco, Director of Telecom Italia's Future Centre and co-chair of the PARADISO expert panel, posed a number of key questions in 2010 about the Future Internet:

- Will it complement or replace today's ways of working?
- Will it create virtual spaces or augment physical spaces?
- Will it soften perceptions about privacy and its value, or will it generate a strong reaction against 'Big Brother'?
- Will it kill the geography of commerce or will it reinforce the value of local production and distribution?
- Is it driving towards a more fragmented world or towards a more homogeneous one?
- Is it bringing technology and science to the fore, or reinforcing a sense of the value of the humanities?

Another member of this panel, Ashok Jhunjhunwala (who is also a member of the Indian Prime Minister's Scientific Advisory Committee), raised an even more fundamental question: "***Will the Internet give higher chances of peace and harmony between communities and nations?***"

How do we prepare today for the Internet of the future?

A number of foresight exercises have been conducted in recent years, both in Europe and in other regions of the world, to exlplore the future of ICT or of the Internet. It is not possible in this document to analyse them all in detail. However, a selection of the main findings is set out below. Together these projects offer quite a complete set of conclusions and visions that we can take into consideration in our own cross-analysis (see final chapter).

COST Foresight 2030

This is an initiative of European Cooperation in Science and Technology (COST). Its aim has been to "explore a broadly shared vision for a future world beyond 2030, permeated and shaped by the digital revolution".

After a first workshop where the main trends anticipated in ICT up to 2030 were examined, Foresight 2030 activity focused on a number of fields considered to be of utmost importance: life enhancement, energy, food security, natural resources management and way in which our societies are organised.

In October 2010 a COST-ESF workshop was convened to explore this area, entitled 'Future Internet and society: a complex systems perspective'.

Further outputs of this activity are expected in 2011.

Lund declaration

On the occasion of the conference organized under the Swedish Presidency of the European Union in Lund, in July 2009, a Declaration has been adopted, calling upon the European Council and the European Parliament to take this process forward in partnership with the European Commission.

The declaration states that "***European research must focus on the grand challenges of our time,*** moving beyond current rigid thematic approaches". These challenges include: global warming, security, limited resources (energy, water and food), ageing societies, pandemics and other public health issues.

Five main areas are identified for ICT:

- Energy grids
- Environmental information systems
- Systems for transport and mobility
- Healthcare systems
- Culture and knowledge.

FUTURE INTERNET CHALLENGES

The European Commission website has its own portal devoted to the future of the Internet - see http://ec.europa.eu/information_society/activities/foi. The information it contains is based on various forward-looking approaches from European Internet stakeholders, and should thus be mentioned here.

The web pages identify challenges to be addressed, including governance challenges (ensuring a democratic and neutral Internet) and three key technical challenges:

- Increasing Internet capacity: more addresses (IPv6), more storage and transport capacity (from text to 3D experiences), making technology compatible (standards interoperability, lower costs)
- Making the Internet more user-friendly: better search tools (95% content not taken into account by current searches), from data to knowledge (useful information), deploying an 'Internet of services' (easy tailor-made services), Internet for all (access and skills)
- Making the Internet safe and trustworthy: hacking, phishing, cybercrimes, privacy, secure networks, child protection and so on.

FUTURE INTERNET 2020

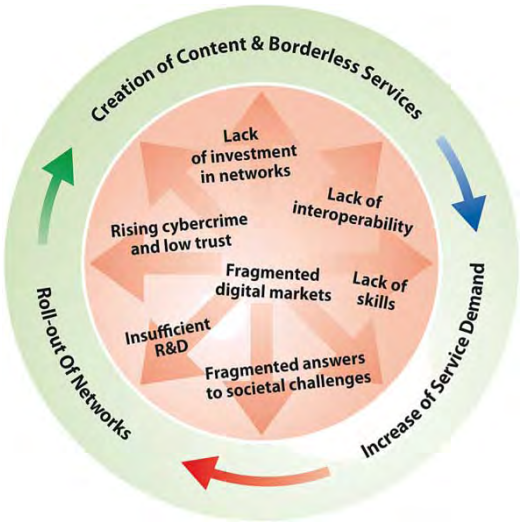
In May 2009 a report entitled *Future Internet 2020 - Call for action by a high-level visionary panel* was submitted to the European Commission, based on a set of non-disruptive (business as usual) scenarios, describing a situation (users), explaining why the scenario is important, and deriving needs and enablers.

Challenges have been identified, such as "users will play a prominent role in shaping winning applications and services, and in turn influence societal changes". Its recommendations include "***a major push in socio-economic research*** to ensure societal and economic factors are taken into account in Future Internet development".

THE DIGITAL AGENDA FOR EUROPE AND THE FP7 WP

As already mentioned in this document, the Digital Agenda for Europe is one of the flagship initiatives of the Europe 2020 strategy. It should therefore be considered alongside other documents in this chapter.

The Digital Agenda for Europe has been "set out to define the key enabling role that the use of ICT will have to play if Europe wants to succeed its ambitions for 2020". It aims to "***deliver sustainable economic and social benefits*** from a digital single market based on fast/ ultra-fast Internet and interoperable applications".



The virtuous circle of digital economy (Digital Agenda for Europe)

The agenda is based on a vision of a "virtuous circle of digital economy" and leads into seven pillars:

- A vibrant digital single market
- Interoperability and standards
- Trust and security
- Fast and ultra-fast Internet access
- Research and innovation
- Enhanced digital literacy, skills and inclusion
- ICT-enabled benefits for EU society.

It identifies a number of key applications to develop, including:

- ICT to help protect the environment
- Sustainable healthcare, and ICT-based support for dignified and independent living
- Promoting cultural diversity and creative content
- eGovernment
- Intelligent transport systems, for efficient transport and better mobility.

"Key performance indicators" of the Digital Agenda for Europe

- Basic broadband coverage for all (100%) by 2013
- Fast broadband by 2020: 30 Mbps or more for 100% of EU citizens and above 100Mbps for 50%
- 50% of the population should be buying online by 2015
- Increase regular Internet use from 60% to 75% by 2015 and from 41% to 60% for disadvantaged people
- Halve the proportion of the population that has never used the Internet by 2015 (to 15%)
- 50% of citizens using eGovernment, with more than half of them completing forms online
- ICT R&D increase: double public investment to €11 billion

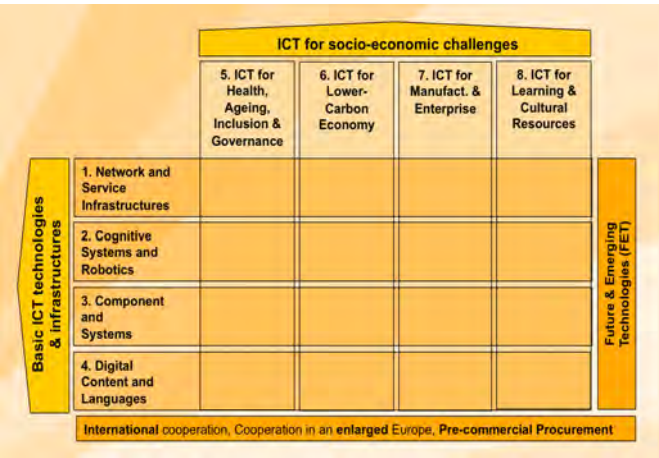
The FP7 ICT Work Programme (WP) has been developed with the Digital Agenda for Europe in reference, and also needs to be considered in a chapter addressing how we prepare today for the Internet of the future. The ICT WP is aimed at "improving the competitiveness of European industry and enabling Europe to shape ***future developments in ICT so that the demands of its society and economy are met***".

The development of the Future Internet is mainly addressed through WP Challenge 1 ('Pervasive and trusted network and service infrastructures'), which includes a number of (mainly technical) objectives.

FP7 ICT Challenge 1 objectives

- Future Networks that support the convergence and interoperability of heterogeneous mobile, wired and wireless broadband network technologies, including notably novel Internet architectures; network management and operation frameworks, wireless and broadband systems and ultra-high capacity all-optical networks.
- Cloud computing, Internet of Services and advanced software engineering that emphasise technologies specific to the networked, distributed dimension of software and the access to services and data.
- Architecture and technological foundations for Internet-connected sensors, actuators and other smart devices and objects, enabling person/object and object/object communications.
- Trustworthy ICT including security in networked service and computing environments; trust, privacy and claims management infrastructures; and data policy, governance and socio-economic aspects of trustworthy ICT.
- Networked media and search systems, including digital media delivery platforms, end-to-end immersive and interactive media technologies, and multimedia search technologies.
- Experimental facilities (known as FIRE) for experimentally-driven research on the Future Internet; the facilities will provide larger scale and diversity to test and validate the developments at closer to reality conditions.

A Future Internet Public Private Partnership (FI-PPP) is also part of the plan. It focuses on the development of innovative open network and service platforms with generic common enablers serving a multiplicity of demand-driven use cases in "smart applications". The PPP includes a strong experimentation and validation dimension and targets early results at a~5 years horizon.



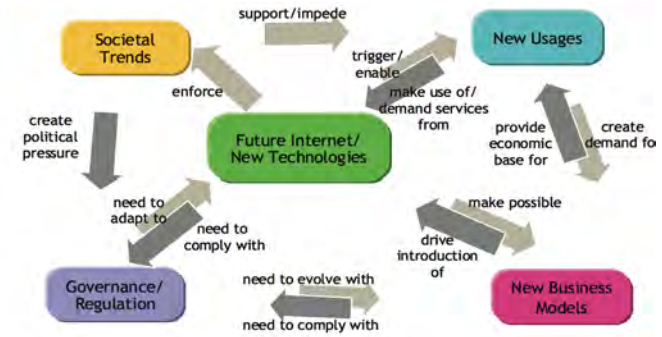
Structure of the FP7 ICT WP (European Commission)

THE FUTURE INTERNET ASSEMBLY

The Future Internet Assembly (FIA) is a forum through which projects funded by the European Commission in the area of Future Internet (addressing FP7 ICT Challenge 1) are given the opportunity to interact and develop collaborative work.

One of the FIA working groups, FISE, focuses on socio-economic issues, which, in the 2011 edition of the FIA handbook, are identified as follows:

- Communication mechanisms in dedicated, flexible and tailored support of user (application) and provider (network) demands, addressing technological and socio-economic challenges in an integrated manner
- Business models and value chains for Internet applications and services
- Fairness, competition, cost and pricing models for emerging services
- Modelling of user behaviour, the quality of the user experience (QoE), and trust and security requirements.



Socio-economic issues of the Future Internet (FISE position paper)
http://dx.doi.org/10.3233/978-1-60750-007-0-1

THE FIARCH GROUP

The European Commission's DG Information Society and Media launched the Future Internet architecture group, FIArch, in 2010. Its aim is to coordinate and give consistency to the various Future Internet-related initiatives supported by the European Commission, particularly the ones developing through the Future Internet Assembly.

In October 2010 this group published a report identifying the 'fundamental limitations of the current Internet and the path to the Future Internet'. These included:

PROCESSING AND HANDLING LIMITATIONS

- Hosts cannot diagnose potential problems, and the network offers little feedback for hosts to perform root-cause discovery and analysis
- Lack of data identity in the network
- Lack of methods for dependable, trustworthy global processing and handling of network and systems.

STORAGE LIMITATIONS

- Lack of efficient storage management
- Lack of inherited data integrity, reliability and trust
- Lack of efficient caching and mirroring.

TRANSMISSION LIMITATIONS

- Lack of efficient transmission of content-oriented traffic
- Security requirements of the transmission links.

CONTROL LIMITATIONS

- Lack of flexibility in control
- Segmentation of data and control
- Lack of unified architecture of the IP control plane
- Lack of efficient congestion control

OPERATIONAL LIMITATIONS THAT MAY FALL IN MORE THAN ONE CATEGORY

- Lack of bandwidth in some network segments
- The current inter-domain routing system is reaching fundamental limits
- Scaling to deal with flash crowding.
- Etc.

THE TAFI STUDY

The Towards a Future Internet study (TAFI), supported by the European Commission and led by the Oxford Internet Institute, held its concluding workshop in November 2010. It was aimed at "*investigating the links between technological, social and economic trends related to the Future Internet, **exploring the future needs of Internet users, and outlining the principles that should guide its future development**".*

Four interconnected and non-exclusive scenarios of plausible future socio-economic conditions with differing needs have been envisioned:

- SMOOTH TRIP: the rise of the Internet economy as a whole life and work style – a middle road in contrast to more disruptive scenarios
- GOING GREEN: Internet technologies are used to combat growing environmental challenges
- COMMERCIAL BIG BROTHER: a heavily commercialised consumer platform
- POWER TO THE PEOPLE: a forum for democracy and freedom.

Key principles or guidelines for progress towards a future Internet that could be the basis of functional requirements have been proposed:

- Available and accessible
- Diverse and inclusive
- Scalable and sustainable
- Open and shareable
- Green and affordable
- Reliable and resilient
- Safe and secure
- Private and trustworthy
- Appealing and usable
- Adaptable and customisable.

THE FI3P STUDY

FI3P is the name of an ongoing study supported by the European Commission. Led by Rand, it aims to identify the potential economic and societal longer-term impacts of the Future Internet public private partnership (FIppp or FI 3p) through:

- The analysis of the current contribution of the Internet industry to the European economy and society and of its likely future contribution (2015-2020) with a fully deployed ppp and in its absence,
- The identification of any economic, legal & societal barriers to the competitiveness of EU/Internet industry, and the assessment of the ways to mitigate them,
- The provision of policy recommendations grounded in the analysis.

Among current findings:
- Two parallel trends (individual identities and engagement with the Internet / collective identities and engagement through the Internet),
- Analysis of impact mechanisms related to technology trends.

THE IGF SCENARIOS

The Internet Governance Forum in the United States is "a multi-stakeholder effort to illuminate issues and cultivate constructive discussions about the future of the Internet".

One of its substantial pieces of work led in 2010 to the suggestion of three possible scenarios for the future:

Internet islands
- Driven *by the threat of cyber attacks and economic or ideological protectionism*

Global government for the Internet
- *Cyber* criminality *is not controllable, so people ask governments to control the Internet*

Users reign
- *Everyone does what s/he wants: the Internet cannot be controlled, with consequent problems of privacy and the protection of authors*

THE FUTURE OF INTERNET III

The Future of Internet III (2020 horizon) is a report published in 2008 and based on a survey of experts by the Pew Internet and American Life Project.

The main conclusions of this report are:
- The mobile device will be the primary connection tool to the Internet for most people in the world by 2020
- The transparency of people and organisations will increase, but that will not necessarily yield more personal integrity, social tolerance or forgiveness
- Voice recognition and touch-screen interfaces with the Internet will be more prevalent and accepted by 2020
- Those working to enforce intellectual property law and copyright protection will remain in a continuing arms race, competing with the crackers who find ways to copy and share content without payment
- The divisions between personal time and work time and between physical and virtual reality will be further erased for everyone who is connected, and the results will be mixed in their impact on basic social relations
- Next-generation engineering of the network to improve current Internet architecture is more likely than an effort to rebuild the architecture from scratch.

How do people envision the Internet of their future?

In the previous section, several foresight exercises focusing on the Future Internet" were briefly introduced. But what do users think? Why not ask people what they expect from the Internet for their future? This is exactly what PARADISO did at the European Commission's ICT even held in Brussels in September 2010). Visitors to the PARADISO exhibition booth at the event were invited to record short video statements. The contributors, ranging from a Director of the European Commission to a teenager, vouch for ***a wide diversity of expectations***...

Scan this QR code with your mobile to watch how ICT 2010 visitors envision the iInternet of their future
http://www.youtube.com/watch?v=4WBGOzWewbM

RECOMMENDATIONS

PARADISO is taking a forward-looking approach to exploring the co-evolution of the Internet and our societies in the decades to come. It aims, through a cross-analysis of anticipated Internet and societal developments, to make recommendations on how to develop the Future Internet so that it can serve the complex needs of our societies in the future - particularly in the event of possible significant shifts in the way those societies operate.

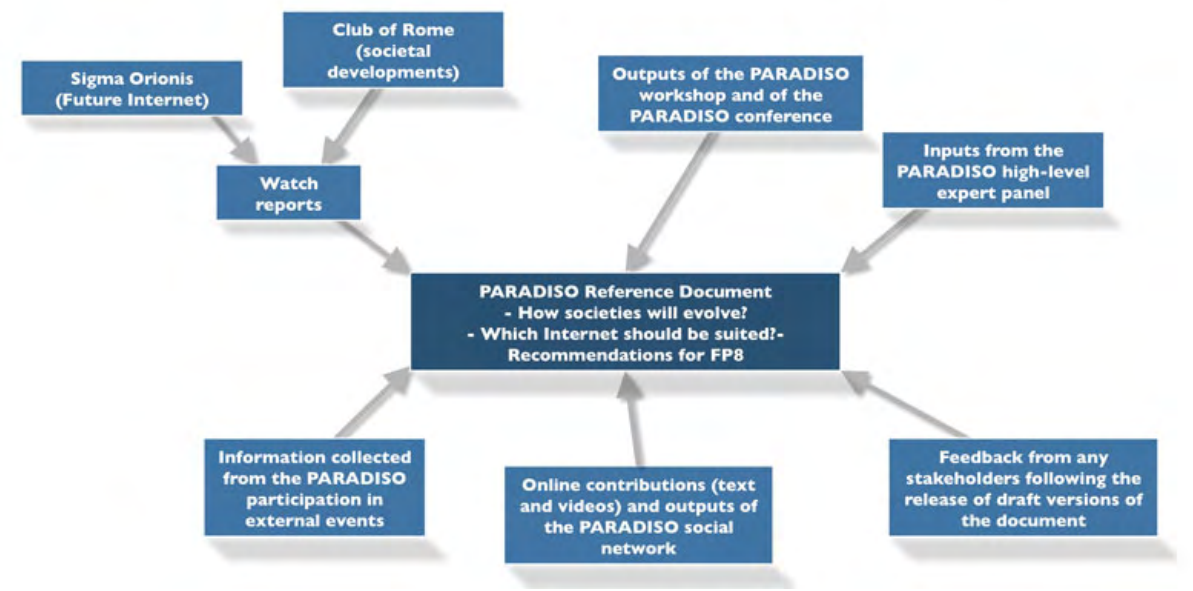
The conclusions we are proposing in this chapter are based on the cross-analysis of the information introduced in the previous chapters, on a careful watch of Internet and societal developments, and on the close interaction that PARADISO has been developing with organisations involved in Internet developments throughout Europe and in the rest of the world.

These conclusions mainly focus on recommendations to the European Commission regarding Internet research, in line with the Digital Agenda for Europe and hopefully useful to all Future Internet stakeholders.

Our intention is not to criticise what is being done. We have prepared these recommendations in the hope of contributing positively, if modestly, to the identification of new innovation paths that can put Europe at the forefront of Internet development.

We also keep in mind these words from William Shakespeare in *The Merchant of Venice*: "If to do were as easy as to know what were good to do, chapels had been churches and poor men's cottages princes' palaces".

These conclusions are only preliminary. The final version of this document will be presented at the PARADISO high-level conference to take place at the European Commission on September 7-9, 2011. In the meantime ***we are opening the present version to a public consultation*** and will be grateful to any individuals or organisations that send us their remarks and suggestions.



PARADISO's methodology for preparing its reference document

ENCOURAGE HOLISTIC APPROACHES

*« **Any study on the Internet should take a holistic approach** »*
Alexander Ntoko, Head of ITU Corporate Strategy Division and member of the PARADISO expert panel

Juan Carlos de Martin is Professor at Politecnico di Torino, Director of the Centre for Internet and Society and a member of the PARADISO expert panel. In a recent presentation he used the parable of the blind men and the elephant (see illustration below) to underline how ***fragmented Internet development*** has become. Too much is being done separately by experts in various parts of the domain, and fewer and fewer people have an overview of what is an increasingly complex 'system of systems'.

Can we truly develop a Future Internet that is 'fit for purpose' without enough systemic vision of what the Internet is today and what it can be tomorrow?

The parable of the blind men and the elephant
(Wikipedia - 2011)

"A group of blind men touch an elephant to learn what it is like. Each one feels a different part, but only one part, such as the side or the tusk. They then compare notes and learn that they are in complete disagreement."

Furthermore, research in ICT in general, and on Future Internet issues in particular largely remain ***technology-driven***, aiming at reaching incremental technological progress.

The fact that ***the Internet not only can contribute to address grand societal challenges but also constitutes a grand societal challenge by itself*** - due to its transformational power on societies - is not widely recognized.

Technologists, logically key in the process of developing an Internet for the future, should not only start from technological limitations and focus on improving technologies and developing applications addressing (other) grand societal challenges.

They should also, together with specialists from other disciplines, evaluate the issues raised by the Internet as a societal challenge by itself and envision relevant technologies, applications, and services to develop in this context.

In a recent publication, the European Commission's DG Research asked a question: "When considering major societal challenges, who can give convincing answers to questions such as 'what will the world look like in 2025'?" The answer it gave was "researchers in social sciences and humanities". But ***Future Internet researchers should contribute to finding such answers*** as well!

Future Internet developments often include business models, which is relevant, but social and societal models are needed too. We do not see enough of these in current approaches. Not only business-oriented developments but ***socially and societally conscious developments are needed today***.

In the above context, we can only conclude that, considering the level of complexity that the Internet has reached, and the potential significance of the interactions between Internet and societal developments, it is important to encourage systemic, holistic approaches.

Such approaches can only be undertaken by multidisciplinary research teams or consortia, including not only technologists but also specialists in social, economic and political sciences, in environmental and legal issues, etc.

The European Commission should actively encourage and support such approaches. It is only by working together that specialists from various disciplines will be able to build an Internet that is well suited to all the future needs of our societies, contributing to the prosperity of the industry and the well-being of Europe's citizens.

They will probably also pave the way to developing a promising '***Internet science'***.

INTERNET SCIENCE

Multidisciplinary research is, as we have argued, central to developing a suitable and sustainable design for the Future Internet: by elaborating a set of methodologies for addressing, identifying and solving Future Internet problems, it enables cross-disciplinary teams to tackle problems which cannot be solved in isolation.

But is there also a common set of methodologies? Is there a true Internet Science that can be defined and developed? Or should such a science be emerging de facto, and in that case is the issue then to describe it or to contribute to formalizing it? Is it possible to identify and promote an "Internet Scientist" profile, which can define researchers capable of addressing an Internet problem along several axes (technological, legal, social, economic, etc.)?

At the moment, all the ingredients needed for the emergence of this new science seem to be present, albeit scattered across many disciplines, but it is not clear whether they add up to a distinct new area of research. Can we define a truly new science? Can an Internet Scientist be a true scientist or is such a person just someone with a 'basic knowledge' of various fields? And to which extent will he/she be capable of initiating or coordinating a research that, by its nature, must involve true specialists from other disciplines?

The perspectives of this Internet Science will be explored over the period 2011-202014 through the EINS « Network of Excellence », in the portfolio of the FIRE Unit of European Commission's DG Information Society and Media (http://cordis.europa.eu/fp7/ict/fire).

SUPPORT FORWARD-LOOKING APPROACHES

Many of the problems that we have already identified can be largely explained not only by an approach that is too narrowly driven by technology, but also by a tendency to ***short-termism***.

Indeed, ***Internet developments are too often reactive rather than proactive*** in the way they relate to user requirements or societal needs, and the interaction between Internet and societal developments is commonly limited to short-term socio-economic analyses.

We should expect more of a long-term approach from EU-funded research projects, since FP7 is about breakthroughs rather than adaptive solutions for the short term. Moreover, developing short-term approaches when addressing Future Internet issues is rather paradoxical…

In particular, the long-term positive and negative impacts of the Internet are not thought about enough, while the intended and ***unintended consequences of future Internet development are rarely explored.*** Such potential consequences should at least be taken into consideration when defining the objectives and expected outputs of programmes and projects.

While ***rising Asia*** is considered in all foresight exercises to be one of the key challenges to face, its potential impact on Future Internet developments is not examined enough.

Similarly, when the need to limit resource use and environmental impact is seen as a major issue, the concept of a '***green Future Internet***' has not been explored as much as it should be.

Furthermore, technologists and business people alike have a well known inclination towards the comfort of exponential curves and incremental progress. They rarely take into consideration the ***possible occurrence of disruptive events,*** of low probability and high impact ("wild cards"), of potential mega-risks such as huge cyber-attacks. Such disruptive events can be of a societal or technological nature. Taking the risks seriously requires us to go beyond fragmented, technology-driven, short-term approaches.

At a time when potential paradigm shifts and breakdowns are in sight, ***it is necessary to go beyond a 'business as usual' approach to Future Internet development***.

In the above context, we will conclude that the Internet :

- is key in addressing the main economic, social and environmental challenges facing our societies, and this not only in the short term but in the longer term.,
- has become so central in people's lives that it is now a major societal challenge in itself. It has to be adapted, or at least to be quickly adaptable to foreseen or probable paradigm shifts of our societies, major trends in the global landscape, and mega-risks to avoid,
- has the power to truly transform societies and it is essential to anticipate the consequences that the development of technologies or applications may have on our societies in the long term to better set the priorities and efforts we will put on them today.

It is therefore recommended that the European Commission should promote a better understanding of the co-evolution of the Internet and our societies in the decades to come. It should strongly support ***forward-looking approaches that thoroughly explore interactions between the Internet and societal developments***, both within its own programmes and through the Future Internet projects it funds.

INCREASE THE INVOLVEMENT OF USERS

User-centric approaches are more and more commonly followed in Internet developments, and this is a good thing.

However, they typically start from users before widening their focus to community, regional, national and finally global issues. A lot of insights could be gained, in European research programmes and EU-funded research projects, from ***a different user-centric approach*** (complementary to the current ones) that starts from the planet and ends with the user.

In this way, more long term, global, and holistic issues (addressed through the two previous recommendations) could be taken into consideration and probably lead to quite innovative developments.

Two different user-centric approaches

Furthermore, ***a stronger genuine involvement of users, communities, NGOs and other representatives of civil society*** in Future Internet development can only be recommended.

At a time when the Internet has become so central in our societies, it seems indeed important that ***bottom-up approaches*** (based on the involvement of users) could more often complement traditional top-down approaches, on all Internet related issues, and particularly on issues such as Internet governance, Net neutrality, and e-democracy.

Even if some past experiences may have not been totally successful, the potential for ***crowd sourcing and community-based innovation*** in the Internet domain should be for instance thoroughly explored. ***Local pilots*** involving citizens in the development of the « *Internet for their* future » should be encouraged. Initiatives such as "Imagination for people" (http://imaginationforpeople.org), developed by Frank Escoubes, a member of the PARADISO expert panel, can for instance be considered as an interesting one to benchmark.

Moreover, it is likely that an increasing number of societal changes will be based on the power that citizens, acting individually, can have thanks to the connection through social networks to other citizens sharing their expectations or lifestyles, leading to huge networks that can influence political decisions. In order to anticipate possible changes, it is thus important to facilitate the involvement of such emerging ***communities of interest***, or ***communities of practice***.

Last but not least, the term « users » should encompass representatives of various sectors (agriculture, automobile, education, etc.) who could usefully be more involved in Internet design and development at an early stage.

In this context, we recommend the European Commission to play an active role, at programme and project levels, ensuring that there is stronger involvement of users, communities, NGOs and other representatives of civil society in Future Internet development.

STRENGTHEN INTERNATIONAL COOPERATION

The Internet has been designed in the seventies and must undergo important changes in order to be suited to the quickly increasing number of people, devices, and objects connected to it. The theme of « the Future Internet » has therefore logically become, in just a few years, a key European focus in the field of Digital innovation. Designing the Internet for the future is however not only a challenge for Europe but for the other regions of the world.

International cooperation on Future Internet is therefore not only required because the best skills and competencies have to be involved in EU-funded research wherever they are located, and because the widest market opportunities have to be considered. It is required because the Internet has a global dimension and is a global challenge.

Cooperation is needed because major challenges of the Internet, such as security issues, can only be efficiently addressed at a global scale.

It is needed more generally to precisely identify what (norms, legal framework, etc.) can be agreed on between countries and regions, depending on cultures, local situations, etc. and what can't.

It is also necessary because Internet developments are so quick in emerging and even developing countries that industrialized countries can probably benefit from a better knowledge of technologies and services developed under other conditions and that may be of use in their own context (potential offered by "***reverse innovation***").

For these reasons, we want to recommend the European Commission to strengthen international cooperation in the domain of the Internet, in order that the most relevant Future Internet can be developed through EU-funded research.

PROMOTE VALUES-DRIVEN PROGRAMMES AND PROJECTS

In the above context it is particularly important to promote projects driven by common ethics and human values: initiatives based on ***socially and societally conscious approaches***, addressing the ***potential negative impacts of the Internet*** and based on concepts of ***responsible innovation*** and ***corporate responsibility***.

In its conclusions, the recently completed ETICA project supported under the European Commission's FP7 research-funding mechanism (http://www.etica-project.eu) underlined that "***existing ethics review mechanisms are not suited*** for many of the ethical issues that ICT is likely to cause in the future".

Can we include the above-mentioned values in the ***selection criteria for EU-funded research projects*** in the future? Can we extend the present "ethical assessment" of project proposals and reviews to ethical issues that are inherent to Information and Communication Technologies in general, and to the Internet in particular? Can European research programmes put more emphasis on socially and societally conscious approaches? Can we more significantly measure in different, or at least in complementary ways the ***Internet ranking*** of countries and regions (beyond penetration rates)?

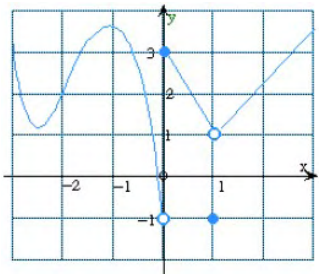
We recommend the European Commission to thoroughly explore the possible ways to take these questions into consideration and implement related decisions.

WELCOME RESEARCH EXPLORING THE LIMITS OF THE INTERNET

Most recent foresight studies lead to the conclusion that major risks of economic, social and environmental breakdowns are in sight, and that in order to release current tensions, some radical (and not incremental) changes should quickly be implemented.

Therefore, beyond the recommendations introduced so far, we would recommend that specific research could be supported focusing on an Internet that would be more suited to a future characterized by a true sustainable development, more sustainable economic models, and more equally shared resources.

In order to go beyond incremental solutions that would not meet the objective, we recommend, similarly to the typical approach in mathematics when trying discovering the evolution of a function, to ***study the limits of the Internet***.



Exploring the limit of a function, identifying discontinuities, being able to understand its overall shape

Let's envision ***a radical next step in research*** and explore which Internet would be required (in terms of architectures, equipment, services, business models, etc.) if:

- It has to be affordable to 100% of the population (beyond business models, do we need a "good enough" Internet, or measures of "digital poverty")?
- It would aim at 0 impact on the environment,
- It would lead to 0 depletion of resources,
- It would have 0 negative societal effect,
- It would be fully owned and operated locally (by citizens at a community, city, or region level),
- It would be based on the minimum of standards,
- etc.

Of course, these limits cannot be reached or may not even be at all relevant but the idea is to explore what technological, business, social solutions and models can be found when approaching these limits, to identify discontinuities, to think outside the box, to eventually enter highly innovative research.

Experimental research and pilots (encompassing a community, a city?) will be useful to explore these limits and other ***limits or thresholds or conditions leading to "changes of state":***

- infinite bandwidth, graphics resolution,
- 0 impact of distance, response time, price,
- 100% secure communication and reliable identity of users, etc.

We recommend the European Commission to pay attention to the potential of research exploring the limits of the Internet and welcome in particular proposals addressing such issues.

CALL FOR ACTION

This document will be opened up to public consultation until June 30, 2011 and widely disseminated, both in this present form and when the final version is released in September 2011 at the PARADISO high-level conference to take place at the European Commission in Brussels on September 7-9, 2011. .

In order that the impact of the final recommendations can be as high as possible, we plan to present them in the form of a 'call to action' from the PARADISO expert panel at the September conference.

To keep in touch with developments, do not hesitate to contact us, subscribe to our newsletter, and join the PARADISO LinkedIn community (all details can be found on the ***www.paradiso-fp7.eu*** web site).

Members of the PARADISO expert panel as of May 2, 2011

CHAIR

- Roberto Saracco, Director of the Telecom Italia Future Centre and co-Chair of the Edge-Core group of the Communications Future Program at the Massachusetts Institute of Technology (MIT)
- Ziga Turk, Secretary-General of the Reflection Group on the Future of Europe; Former Minister for Growth in the government of Slovenia

MEMBERS

- Adriano Gasperi, Secretary-General of the Scientific Committee, Expo Milan 2015
- Afonso Ferreira, Scientific Coordinator for international relations, CNRS – INS2I
- Akihiro Nakao, Professor, University of Tokyo
- Alexander Ntoko, Head of ITU Corporate Strategy Division
- Alvaro Duarte de Oliveira, President of the European Network of Living Labs (ENoLL)
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- Dirk Trossen, University of Cambridge Computer Laboratory
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- Juan Carlos de Martin, Professor at Politecnico di Torino and Director, Center for Internet and Society
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- Luis Neves, Head of Corporate Responsibility, Deutsche Telekom, Chairman of the Global e-Sustainability Initiative
- Lynn St Amour, President and CEO, the Internet Society
- Martin Curley, Director of Intel Labs; Global Director of IT Innovation at Intel
- Max Ott, Program Leader of the NPC Program and of the CAMP and StarCom projects, NICTA, Australia

- Peter Madden, Chief Executive of Forum for the Future
- Philippe Quéau, Former Director, UNESCO Information Society Division, UNESCO's representative to the Maghreb
- Roberto Peccei, Vice-Chancellor for research, UCLA; President of the Italian chapter, Club of Rome
- Ruben Nelson, Executive Director, Foresight Canada
- Serge Fdida, Head of the Network and Performance Analysis group of the LIP6 Laboratory (CNRS-UPMC)
- Sergey P Kapitza, Russian Academy of Sciences, winner of the Russian state prize for science
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"The internet represents a formidable challenge to the research community, as for the understanding of its different and deeply inter-related technological and non-technological aspects"

FP7 ICT WP for 2011 (FIRE objective)

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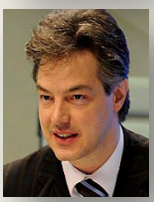

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