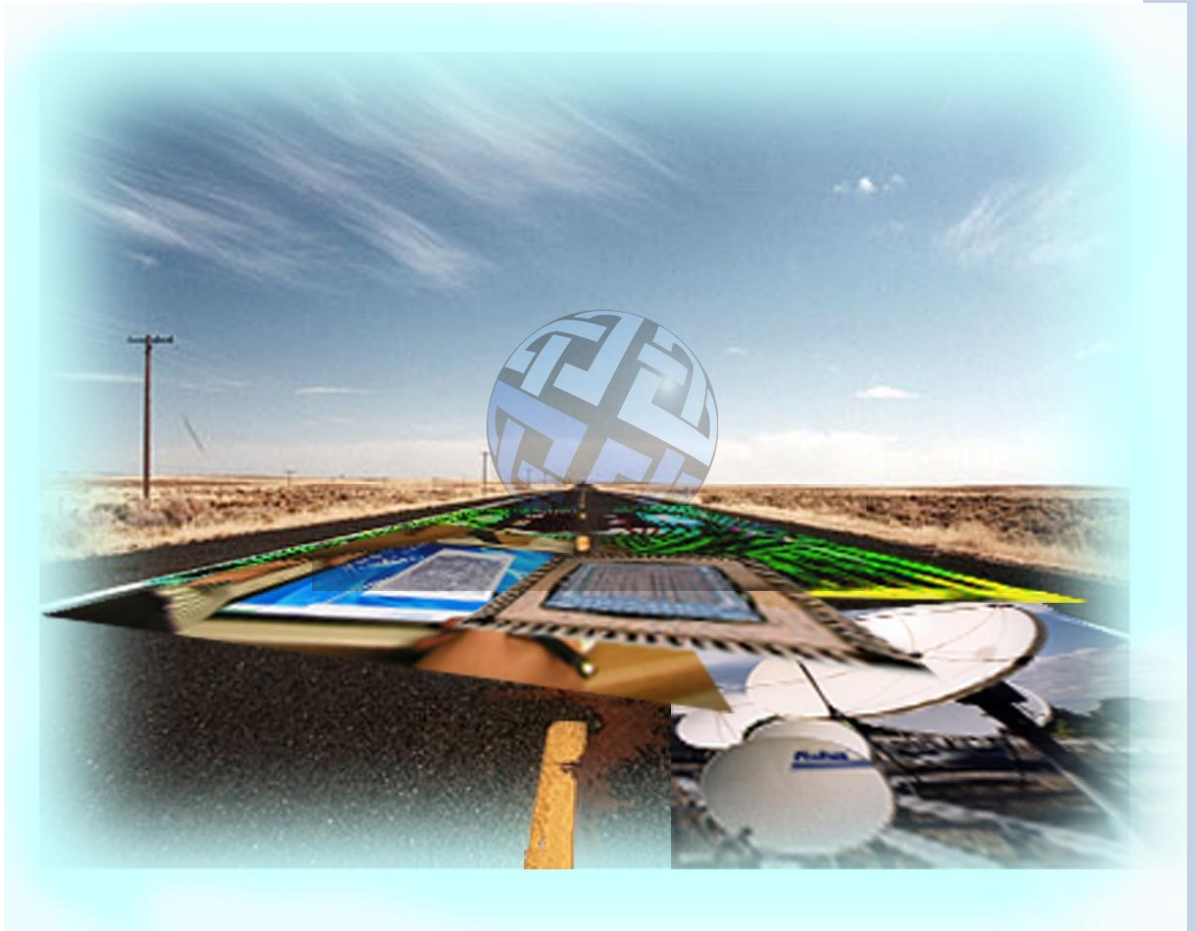# CELTIC
Telecommunication Solutions

The Celtic Initiative

(Cooperation for a European sustained Leadership in Telecommunications)

New Challenges for Celtic

Purple Book
Version 2007

www.celtic-initiative.org

This document is a revised Annex to the Celtic Purple Book. It describes new and revised Celtic work items and objectives that are needed to face the new challenges in the telecommunication sector. The revised Celtic work items and objectives have been aligned with the Strategic Research Agendas of the Technology Platforms NEM, eMobility, ISI , and NESSI.

This document has been prepared by the Celtic "Core Group": Alcatel, British Telecom, Deutsche Telekom, Ericsson, Eurescom, France Telecom, Italtel, Nokia, RAD, Telefonica, Thomson.

EXECUTIVE SUMMARY

Celtic is a Eureka "cluster" project whose objective is to perform collaborative pre-competitive R&D focusing on Integrated System Solutions, including system, sub-system and basic technologies for end-to-end communication solutions. During the past three years Celtic has been a success, becoming the third Eureka project in budget and participation and the first in Telecommunications.

This document explains how Celtic is facing the future. Firstly, Celtic is asking for a three-year prolongation. There are three main reasons for that extension:

1) The need to fully incorporate European participants from countries that could not take part in the initial Celtic phase. 2) Increase the impact by supporting new industrial actions in Telecomms, particularly the new European Technology Platforms related to telecommunications (NEM, NESSI, ISI and e-Mobility) and, 3) To fully develop the PanLab concept as proposed in the Celtic Purple Book in close cooperation with upcoming Panlab Support Action financed by the Commission.

In principle, to justify the new activities, it would be necessary to develop a new version of the "Purple Book". However, the strategic research agendas of the European Technology Platforms (ETP) related to telecommunications establish a very useful framework for Celtic future activities. Nevertheless, a short revision of the main research areas of those ETP and its relation to Celtic activities is required. That is the main objective of the document that follows. Essentially, Celtic will continue the same lines as explained in the present edition of Celtic "Purple book" but taking into account the new focus set by the ETP.

This document is a brief summary of the main reasons for Celtic prolongation and the most important research areas for the following three years.

Rationale for Celtic prolongation

The telecommunications industry, as a key element in the ICT sector is strategic both as a business enabler and as a technology driving force. It contributes to the wealth and employment creation in the economy as a whole and it is one of the fastest growing sectors in the countries of developed nations. When the Celtic initiative was started in 2003, The European telecommunications sector, had in 2002, a turnover of €311 billion. Now (2006) the figure is €346 billion[1] (at constant 2003 rates) and it represents more than 3.3% of European Union GDP. Its direct contribution to the economy is increasing due to growth rates above the increase in GDP, as shown in the Figure 1 below.
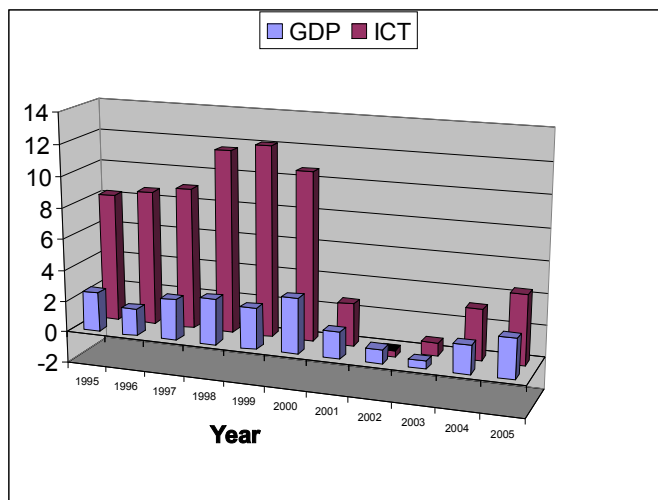

Figure 2. ICT market and GDP annual growth, European Union[2]

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[1] Data from EITO 2005
[2] Data from EITO 2004 (summary)

However, when comparing the investment rates for ICT and telecommunications from EU and USA and Asian countries, there is a clear unbalance (see Figure 2). This is particularly relevant if R&D investment is considered. Therefore, it remains essential to increase the effort, both from industry and government to promote the sector.
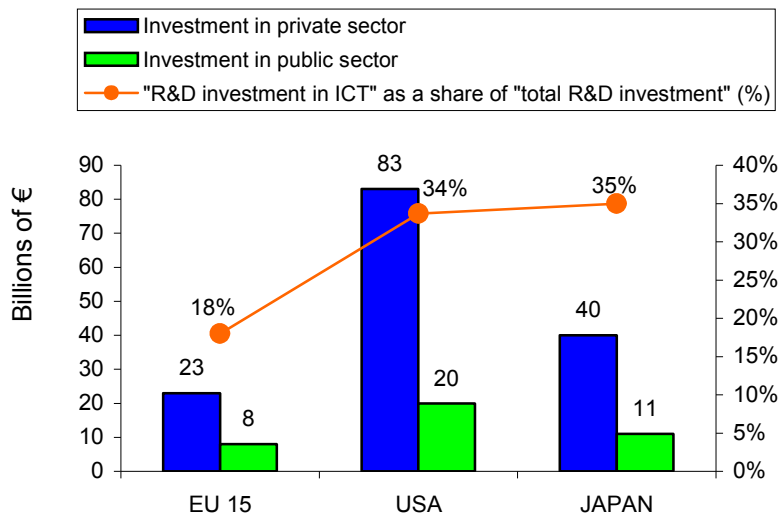

Figure 3 ICT Investment[3]

Celtic is the first R&D EUREKA programme with a strong participation from most major European telecommunications manufacturers and operators. Its emphasis lies in Telecommunication integrated System Solutions, including system, sub-system and basic technologies for end-to-end communication solutions, including platforms & test vehicles.

The major technical domains, that constitute the core and focus of the Celtic programme, are identified as:

- **Services and Applications.**

- **Broadband Infrastructures.**

- **Security**

During the three years Celtic project has been in operation, three project calls have been launched and 25 projects, dealing with all aspects of Telecom industry are already running. Further 14 project that have received the Celtic label will start in 2006. There are more of 300 participants from 23 countries. It has become the 3rd Eureka cluster in size.

However, in the initial phase of Celtic, there were some problems for the full participation of some key European countries (e.g. Germany, France). This delayed the start of some projects. Besides, the existing structure of Celtic projects would not allow for projects started in call 4 to span for more than 2 years. Extending the duration of Celtic for 3 years could double the number of Celtic projects; in addition, the results will be much more useful to the industry since a wider European participation will be assured.

Also, during the three years of Celtic operation, the landscape of research has changed:

- Preparation for the new Framework Program (FP7) of the EC is already underway. Research and innovation are benefiting from this strengthened effort, but the initial projects will not take place immediately and the 7th Framework program is looking into the relatively distant future. The momentum of the existing 6th Framework projects can be materialised in more specific industrial lead, projects such as those of Celtic.

- One of the most significant changes during these three years is the creation of the European technology platforms (ETP). Its objective is to "Provide a framework for stakeholders, led by industry, to define research and development priorities, timeframes and action plans on a number of strategically important issues". Of the 28 ETP proposed so far, four are very closely related to Celtic objectives:

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[3] Source: IDATE, OCDE from EU "i-2010 A European IS for growth and employment"

- o The Mobile and Wireless Communications Technology Platform (eMobility).

- o The European Initiative on NETWORKED and ELECTRONIC MEDIA (NEM).

- o Networked European Software and Services Initiative (NESSI).

- o Integral Satcom Initiative (ISI), the European Technology Platform for Satellite Communications.

Celtic can be very useful to perform some of the activities, particularly those with more specific industrial output, proposed by ETP, serving as a bridge between the long term objectives to be performed during the 7th Framework program and the focused objectives that require more immediate action.

- The role and the added value of Celtic has been the development of pre-competitive comprehensive **'Integrated Communication System Solutions'**. This concept will be at the core of a **Celtic Pan-European Laboratory (PanLab)**, and will enable the trial and evaluation of service concepts, technologies and system solutions. That concept, already outlined in the Celtic book, has started to develop and has been received already with a lot of interest from the EC and many telecom stake holders. This aspect can now be even more extensively progressed in close cooperation with the EU Panlab SSA that has been launched in 2006.

Those reasons justify the need for an extension to cover the full 8-year range (2003-2011).

Celtic prolongation activities

In accordance to the non duplication of effort objectives and the prioritisation of effort put forward by the EC, Celtic includes the objectives of the three ETP (NEM, eMobility, ISI and NESSI) in the Celtic guidelines for the additional three years. The Celtic program shall follow the strategic agendas put forward by those associations, particularly those connected with shorter term research and preparation. The PanLab concept fits perfectly into that scheme and will be used as an additional tool for achieving the Celtic objective.

As during the first phase, the Celtic programme will encompass development and experimentation of broadband and multimedia services, applications and equipment, including their control, operation, administration and management. The objective is to design and perform experimentation on integrated system solutions, which complements the traditional segmented technology trial approach. Those activities will be done, both as independent projects, as during the first three years, as in coordination to the ETP preparatory activities.

Also, as was the objective of the previous three years, Celtic intends to deliver results that, after further specific development, will be directly transferable into products, services and applications that are in line with short-medium term priorities.

The activities to be performed during the following five years are, essentially, those already described in the present version of the Celtic "Purple book". However, to take into account the new ETP, some extra emphasis is given to the following activities:

- A more detailed work plan for content creation, management and diffusion (broadcasting) is given, in accordance to the NEM Strategic Research Agenda.

- More emphasis on the user point of view for mobile and integrated communications is required, as underlined in the eMobility Agenda.

- The added value of satellite to terrestrial infrastructure in the provision of time to market global coverage, cost effective infrastructure deployment and service dependability. This is particularly true for new mobile terrestrial systems (3G and 4G) for which coverage will remain very limited due to economical rationale associated to the infrastructure deployment.

- Some extra effort to fully develop integrated software applications in a telecommunications environment will be required. The telecommunications network of the future will not be restricted just to providing connectivity but will also include processing and storage capability that shall build a virtual market place. That is the objective of NESSI ETP that is supported by Celtic project.

A more detailed explanation of those research areas is given in the rest of the document. Full detail of the research agendas of ETP can be found in their web pages[4].

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[4] NEM: www.nem-initiative.org; eMobility: www.emobility.eu.org, NESSI: www.nessi-europe.com; ISI: http://isi-initiative.eu.org; Celtic: www.celtic-initiative.org

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1   INTRODUCTION

This document is based on the version 2 of the "Purple Book". It explains the need for an extension of Celtic activities based on the changes in the European research scenario.

The importance of the communications sector lies in its impact on all other sectors of the economy as a productivity accelerator. It offers the potential for organisations to make best use of their investment in information technology and to realise productivity gains, fulfil improvements in quality and reach opportunities for greater social inclusion. The sector is of fundamental importance to the full development of the knowledge-based economy

The European Telecommunications industry is already making a transition from an infrastructure and connection driven industry to a service and content driven industry. The amount of work to be done to achieve this by the European Telecommunications industry and the other stakeholders in society is large.

The Telecom industry during the three years of Celtic life has increased its importance in Europe. The role of ICT (Information and communication technology) is increasingly important in most European countries as shown in Figure 1 of the Executive Summary).

That importance of the ICT sector is not only significant in itself but also in other sectors due to its impact on productivity. That effect is shown in Figure 1, where the impact of investment in ICT has become the most significant factor for productivity growth.
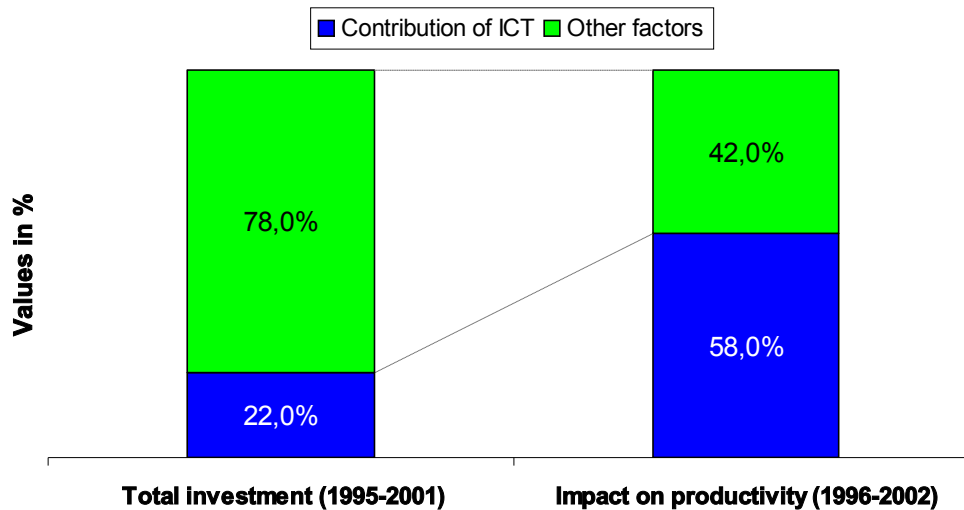

Figure 1 ICT Contribution To Productivity (EUROPE, 1995-2002)[5]

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[5] EIU; European Commission; Groningen Growth Development Centre: Timmer, Ypma and van Ark, van Ark, Inklaar and McGukhin; Bureau of labor Statistics; Monitor Analysis
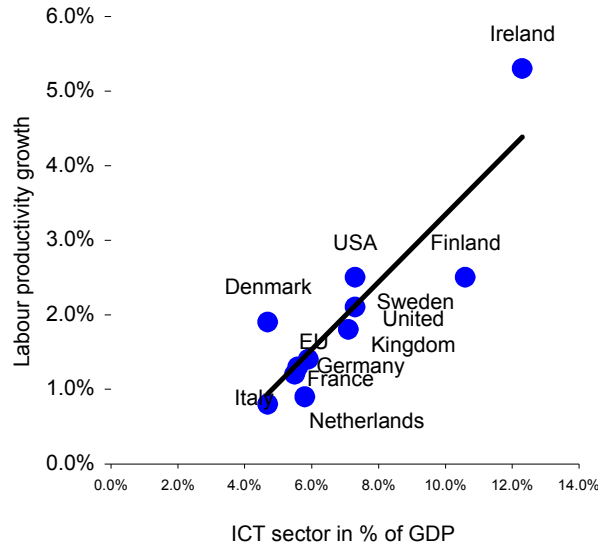
Figure 2 labour productivity growth and ICT sector[6]

That effect is also apparent when comparing different countries, as it is done in Figure 2. There is a clear correlation between labour productivity growth and ICT investment. Figure 3 shows that relationship in a temporal scale.
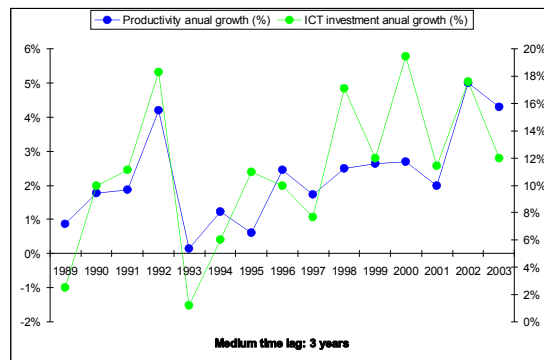

Figure 3 ICT Impact On Productivity (World)[7]

Those correlations underline the importance of telecommunications as a key factor for the development of Europe. If the investment data from USA , Europe and Japan are taken together (see figure 3 in the executive summary), the need for further investment becomes apparent.

Celtic is a Eureka "cluster" project. Its main objective is to perform collaborative pre-competitive R&D focusing on Integrated System Solutions, including system, sub-system and basic technologies for end-to-end communication solutions. It is the first R&D programme with a strong participation from most major European telecommunications manufacturers and operators.

The major technical domains, that remain the core and focus of the Celtic programme, are identified as follows:

+ **Services and Applications:** Pre-competitive R&D and testing of services, content and applications are central in Celtic. The challenge of this part of the programme is to develop and realise services, including design and methodologies, that allow early testing and validation of new services, and in particular broadband and mobile multimedia services. In the multimedia domain, many changes are coming from the distributed networked media, the broadcasting of content over broadband networks, the advent of home networking and connectivity, as well as from the possible access to content for nomadic users through wireless networks. European technology platforms addressing

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[6] OECD: "ICT and Economic Growth. Evidence from OCDE Countries, Industries and firms". Data 2003
[7] IDC 2004

this area of work (NEM, ISI, eMobility and NESSI) confirm the interest and relevancy of the research in new services and applications as a key element for the competitiveness of European telecommunications industry.

Broadband Infrastructures: An integrated approach to the diverse broadband infrastructures (both fixed and mobile), including their control, operation, administration and management, is being considered. Pre-development of fixed and mobile terminals and Customer Premises Equipment will need to address a wide spectrum of technologies but this will have to be addressed from a integrated system and service perspective to provide comprehensive terminal and CPE solutions. From the network standpoint (access, edge, metropolitan, core), a wide variety of vertical technologies are to be addressed with the objective of providing full system solutions, capable of integrating various kind of technologies, and able to support the evolving broadband services and applications. Enabling technologies to drive new mobile and wireless services beyond 3G are needed: the existing network and radio technologies will become seamless and secure, and advanced network configurations and air interfaces will emerge. Also, the value of the satellite component as a cost effective solution for extending the coverage of 3G and 4G networks, as well as providing coverage for specific areas has to be considered. In this context, there shall be emphasis on keeping developing solutions that ease the integration between satellite communications systems and terrestrial systems, thus making it far more appealing and ubiquitous for the user. This will necessitate the design and validation of hybrid satellite/terrestrial communication systems that rely on fully open network architectures.

In this broad context, the infrastructure domain will also include new packet-switched and broadband infrastructures, this will include new metro Ethernet and IP/MPLS infrastructures.

Management of services and networks needs a comprehensive full system approach which is not currently present because of the segregated business approach to network and service design. The emphasis will be on a fully integrated system solution as opposed to the existing segmented network management approach. Services, of course, would also be managed over full network solutions and platforms.

+ Security: is a horizontal "technology" which applies to practically all products and technologies. Validating the security aspects in system solutions will require a full system approach, to test end-to-end security solutions from the networks, as well as from the services and applications standpoints.

Even if security can be considered as a "particular" element of services and infrastructure, their particular significance makes it relevant to consider it as an specific end-to-end problem that may be addressed separately.

The following sections describe the new topics on which an increased research effort must be developed in order to meet:

-The new telecommunications scenario: In that section, a analysis of the need for a prolongation of Celtic activities is given. Particular attention is given to the ETP and their relationship to the Celtic work.

-The new scenario for media and content: This section is devoted to an analysis of the relationship of the NEM SRA as related to Celtic. NEM activities are covered in the present version of the Celtic Purple book, since it concerns Services, Infrastructures and Security. However, NEM gives some extra emphasis to content creation and Broadcasting that need to be underlined.

-The challenges of mobility: This section considers the activities of the eMobility SRA. Its priorities are also covering the three Celtic objectives on services, infrastructure and security. Even so, more emphasis to the user experience is given and that is the main objective of the chapter.

- The satellite component: developing solutions that ease the integration between satellite communications systems and terrestrial systems, thus making it far more appealing and ubiquitous for the user. This will necessitate the design and validation of hybrid satellite/terrestrial communication systems that rely on fully open network architectures. In addition, various trends in terms of service convergence and service evolution are developing in which satellite communication will play a fundamental role, such as: Service convergence, Broadcast and multicast services, heterogeneous and ubiquitous Telecom networks .

-New network integrated services for the user: It covers the activities of the NESSI SRA. NESSI activities impact both on services and security aspects of the present Celtic Purple book

Finally, a section on the Pan European Lab will detail the activities expected to implement that concept.

2   THE NEW TELECOMMUNICATIONS SCENARIO

During the three years Celtic project has been in operation, three project calls have been launched and 25 projects, dealing with all aspects of Telecom industry are already running. Further 14 project that have received the Celtic label will start in 2006. There are about 400 participants from 23 countries. Celtic has become the 3rd largest Eureka cluster.

The Telecomms scenario has evolved significantly during those three years. Outside to Celtic the most significant evolution is the development of European Technology Platforms (ETP) with the aim of providing a framework to define research and development priorities, timeframes and action plans on a number of strategically important issues. Celtic core members are playing a very significant role in the preparation of the ETP. For its part Celtic, besides the important results obtained in the projects, has started the development of the European PanLab. That project has become an objective relevant not only to Celtic projects but also to the ETP, to the 7 Framework of the European Commission and to other Eureka Clusters.

The prolongation of Celtic is following those guidelines.

The ETP aim is to provide a framework led by industry, to define research and development priorities, timeframes and action plans on a number of strategically important issues where achieving Europe's future growth, competitiveness and sustainability objectives. Its success depends upon major research and technological advances in the medium to long term.

There is a number of ETP dealing with major aspects of European industry, from hydrogen cells to satellite services. Some of the ETP are naturally related to existing Eureka projects. The figure shows Celtic vision on how some ETP relate with selected Eureka actions.
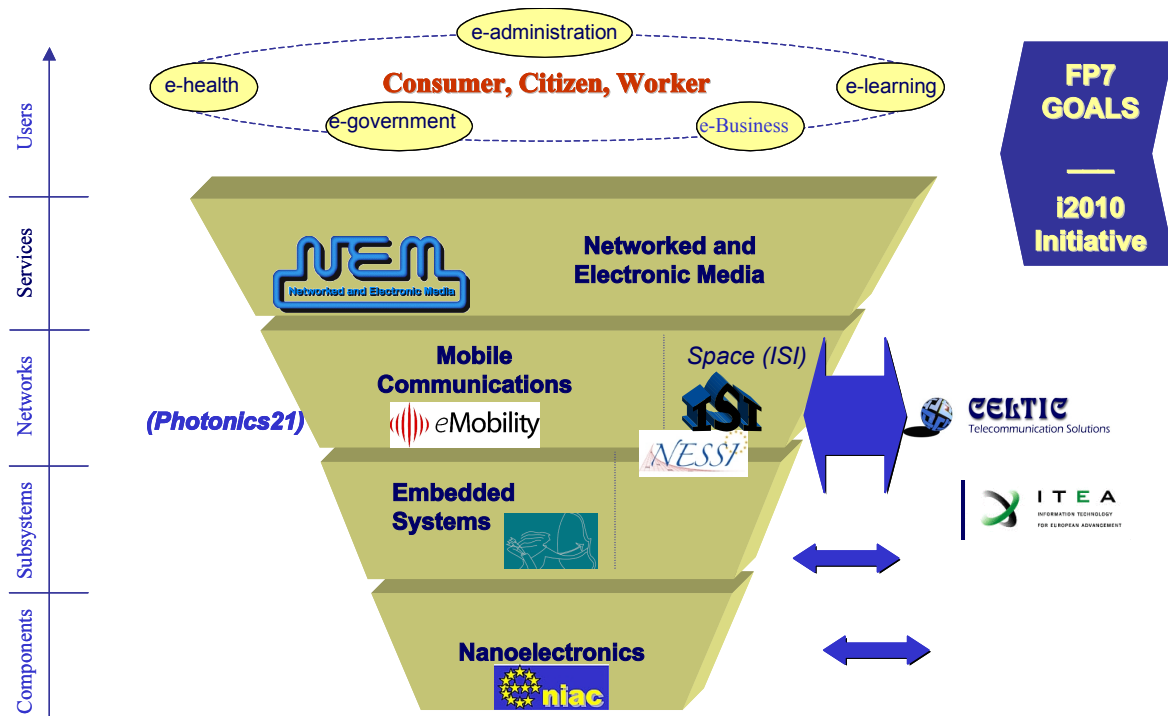
Figure 4

From the figure 4, the ETP that are particularly relevant to Celtic are:

- The NEM Initiative - European Initiative on NETWORKED and ELECTRONIC MEDIA

NEM is defining a *New Scenario for Media and Content.*

The initiative focuses on the offer to the citizen of an innovative mix of various media forms, delivered seamlessly over technologically advanced networks, to improve the quality and value of life*.* All these efforts will bear in mind the evolutionary framework from home and office environments towards broadband extended home and office environments. NEM represents to alliance of service and content providers with Telecom operators and manufacturers and users to define the basis for the transformation towards the knowledge society.

The Strategic agenda of NEM enhances the relation between new content and services to the future Networks and terminals and how they relate to satisfy users expectations.

NEM's aims are closely related to Celtic's. Service and applications and secure infrastructures are a key element of future multimedia services. Content production was not originally foreseen as an element in Celtic agenda but its importance and relevancy are becoming more important to the future vision both of Telecom operators and manufacturers and they should be considered together.

- The Mobile and Wireless Communications Technology Platform (eMobility)

E-mobility objective is to realise the challenges put forward by the mobility dimension.

It focuses on innovative applications centred on user requirements and drawing on a range of technologies and services, relying on a grid of communication resources. The wireless environment will accommodate a range of technologies and services including mobile communications, W-LAN (Wireless Local Area Network), broadcasting and home networks. Citizens will benefit from the "always with you" quality of services and applications and social contact will be enhanced and extended and services and applications become intuitive and easy to use.

E-Mobility aims are very much in line with Celtic agenda. The emphasis on the new user experience of ubiquitous connectivity and services in a secure environment is fully shared between the two initiatives. Celtic focused vision will help to realise the objectives and serve to pave the way to the ambitious long-term vision.

- Integral Satcom Initiative (ISI), the European Technology Platform for Satellite Communications.

Satellites provide both direct access to, and the foundations of European and worldwide digital information networks. Satellites provide the platform for Direct-to-Home analogue and digital TV, as well as interactive and subscription TV services, mobile services to ships, aircrafts and land-based users, and data distribution within business networks. Satellites are also a key element in the Internet backbone, and enable both broad and narrowband Internet access services from remote and rural locations. Satellite services offer extremely wide, homogeneous coverage and accessibility, and thus the ability to communicate simultaneously with a wide range of geographically distant users. Also, satellite services provide the unique capability to distribute very large data volumes to many users simultaneously, much more cost-effectively than via terrestrial networks. Thanks to open standards (such as DVB-S and DVB-S2), the industry has been able to provide low-cost satellite receiver equipment at prices usually associated with consumer products through multiple vendor productions in extremely high volumes, making it possible to provide satellite TV at affordable prices. In the mobile broadcast area, the satellite is starting to play a new role which is to complement the service coverage of terrestrial mobile broadcast transmitter network in a seamless manner from the user point of view.

Those objectives are covered in the ISI platform and lie also in line with Celtic objectives both from the user perspective and for the new infrastructure related issues

- Networked European Software and Services Initiative (NESSI)

NESSI mission is to propose a strategy for software and services development, providing European Industry and the Public Sector with efficient services and software infrastructures to improve flexibility, interoperability and quality.

To perform the challenge, it will be necessary to master complex software systems and their provision as service oriented utilities. It will be required also, to establish the technological basis, the strategies and deployment policies needed to speed up the dynamics of the service eco-system. Finally, it will be needed to develop novel technologies and strategies through the adoption of open standards and open source software, as well as for the provision of open services.

NESSI agenda is very wide. It covers not only part of the Celtic agenda on service and application development, but also will be essential to the transformation of Telecom Operators and manufacturers into service providers for the new IT landscape. Celtic vision cannot ignore those tendencies and methodologies, even if they are applicable not only to telecommunications but also to all IT industries.

Celtic can therefore provide a framework for the development of those technologies, particularly as they relate to Telecomms. Certainly, that framework will be necessarily coordinated with other Eureka clusters.

Particular attention will be given to activities related to Network Infrastructure, which are common to the four ETP. Celtic'S objective will be to assists to ETP's by running projects (1) related to the ETP's,

and (2) related to complementary infrastructures areas, not covered by the ETP's. This particularly applies to the recent most recent infrastructure tendencies, such as:

- Widespread use of broadband access for residential and business services.

- FTTx solutions

- Metro Ethernet

- New packet-switched infrastructures (IP/MPLS)

- Migration to "All-IP" Networks (as exemplified by Bt's 21 CN, Telenor's "All-IP 2010" etc.)

- Increased requirements for end-to-end control in hybrid networks (such as metro Ethernet and core MPLS)

- Satellite solutions

In more general terms, Celtic aims to analysing infrastructure related items such as:

- Convergence

- Overlay networks (P2P y Content Distribution Networks)

- New access technologies (including new radio technologies)

- End to end operation (interconnection standards)

- Customer owned networks

- Small networks

Besides those activities, the development of pre-competitive comprehensive 'Integrated Communication System Solutions' has shown the relevancy of further development on the Pan European Laboratory concept (PanLab). That proposal was outlined in the first edition of Celtic Purple book. During these three years the concept has started to develop and has already received a lot of interest both from the EC and from many telecom stake holders.

The PanLab objective is to enable the trial and evaluation of service concepts, technologies, system solutions and business models to minimise risks with launching commercial products. To do this, a decentralised structure, joining R&D facilities of different stakeholders will be set up providing access to test platforms and to a multitude of technologies, platforms, networks, etc. assuring high flexibility in usage and configuration. The PanLab concept is still being developed, not only from the core members of Celtic project, but also from other interested parties. A major advance has been the approval from the European Commission of a specific project for the concept development and initial activities. The results of that project will be closely related to PanLab future activities.

The following sections describe in more detail the research areas proposed by the ETP and Celtic PanLab. They constitute the research agenda for the proposed Celtic prolongation. The descriptions that follow are an enlargement of the existing version of the Purple book, which remains a full basic description of Celtic activities. They are based on the research agendas of the ETP that can be used as a full reference of the contents proposed here.

3 THE NEW SCENARIO FOR MEDIA AND CONTENT

The Telecom world is becoming more and more connected to the media and content sectors. The network is used to transmit content and that content is transforming the way the network is thought. That tendency is so important that the industrial platform dealing with Telecom broadband networks has considered necessary to include media providers. That is the origin of the NEM (Networked and Electronic Media) platform.

But that tendency is also changing the way media is produced and communicated (broadcasted). The old preponderance of a few sources of information in the hands of a reduced number of enterprises is being challenged. There is an evolution to a new model, sometimes labelled as Web 2.0, where content creation is becoming much more distributed and where citizens, non specialised enterprises and administrations are taking the lead in the new content creation.

All those tendencies make it necessary to enlarge the existing objectives put forward in the Celtic Purple Book to a more complex scenario where content and the way it is created take a more important role. A significant number of partners of Celtic are also in NEM and, therefore, there is a common convergence towards that objective.

In the following, short summaries of the most significant changes in the present version of the Celtic purple book are given.

3.1 Content

The new scenario described in the NEM technology platform gives a great importance to research activities related to content. As indicated, those research areas are not only devoted to providing tools for more effective and economical content creation for existing broadcasters and service providers but will also empower users to facilitate easy content creation, personalization, manipulation, protection indexation and adaptation.

Even if the existing version of the Celtic purple book devotes some sections to the development of technical solutions related to content, such as new services, new coding schemes (with higher quality and smaller network requirements), etc. (see chapter 4, particularly 4.3 and 4.4), it is considered that more attention should be given to new tendencies such as:

- Content production

    The objective is to enhance the use of collaborative tools in order to have more economical and usable solutions. Content in this context includes not only traditional images and sound but also computer programs and games and testing. This includes trials with user groups, (which has been one of the main objectives of Celtic).

    In order to facilitate the process, the use of open content formats will be supported. However, its use requires a new business model. Developments of that aspect are considered in more detail in the section "*New network integrated services for the user*".

- Content storage

    Significant effort has to be devoted to develop architectures and technologies to provide cheaper storage, especially for high scale deployments of IP-TV and VoD services. This has also significant impact on the Network infrastructure.

- Content adaptation

    The personalization information process implies that the information has to be adapted to the terminal the user is employing at each moment. That could be a Laptop, a PDA, a mobile terminal, etc. Some automatic processing has to be performed to adapt the required information to the user to have truly multi-network multi-terminal information services. This, in turn, may require further work on existing standards.

    This aspect is particularly relevant when considering the new ad-hoc networks based on NFC and RFID as it is explained in the section dealing with "*The Challenges of Mobility*"

- Content personalization, context awareness and ambient intelligent filtering.

    The information provided to the end user has to be relevant and related to the user's circumstances at a current moment. Informations relative to tele-work, for instance, have to be separated from information regarding more personal issues. Also, particular attention

should be give to emergencies. This requires relevancy filters and personalization software that has to be developed and implemented.

- Content indexation and summarising

    In order to serve the personalization and context awareness objectives mentioned above, it would be necessary to develop and enhance existing tools for semantic manipulation of the information. This aspect is relevant, not only to the information itself, but also to the information on applications, as it is described in the section dealing with *"New Network Integrated Services For The User".*

- Content protection

    That area has been already considered in the existing version of the Celtic purple book but its importance is enhanced when considered in the production and content manipulation. The proper implementation of DRM *Digital Right Management* techniques, that should be interoperable, multiplatform and fair to the content owner and the user.

- New formats

    There is significant ongoing work to help on the creation of content services that will make the maximum of the existing media and network solutions. In turn those new formats could eventually shape the way the networks are deployed and managed.

3.2 Network infrastructures.

The research guidelines into infrastructure requirements were basically already described by the existing version of the Celtic purple book (see chapter 8)

Those areas include the full development of the Converging network model, the new Multimedia ready broadband networks that should take into account fully security and privacy requirements, and the need for continuously better planning and optimisation tools.

As indicated section 2, Network infrastructure activities are very significant within Celtic and should receive attention not only in its relation to NEM and eMobility but as an independent issue.

3.3 Services and applications

In the present version of the Celtic purple book there is a description of new services and applications for the Telecom community performed from the architectural point of view. Platforms and requirements are described and the desired performance characteristics explained (see chapter 2).

In the NEM Strategic Agenda, a description from a user point of view is undertaken. This is complementary with Celtic purple book description and very much in line with the approach of the NESSI platform, outlined in section *"New integrated services for the User".* Emphasis is given to the description of the new services that will be required to accomplish the aims of eEurope 2005 and i2010 initiatives, including:

- eServices

    This includes the development of new and modern services for the eGovernment, eHealth, eLearning, eTourism, and eBusiness. Those services impose a number of interoperability constraints in the networks that support them in order to support the convergence and adaptation requirements to be used in the different telecommunications networks.

- Personal Service creation

    Including the development of tools for enabling individuals personal media and application creation.

- Service and content discovery

    To be useful, content and services have to be known by the user. This requires the development of tools and other elements that will help in the process. The current version of the NEM SRA addresses specifically the problems faced by the broadcasting industry, but the concept is extendable to other types of content.

- Games

    Besides more conventional games, includes the new concept of pervasive gaming defined as "a game that is always present, available to the player. Those games can be location

sensitive and use several media to convey the game experience". Special attention is to be given to network interoperability issues and the requirements over transport networks. Also, personalization and persuasiveness of the gaming experience is putting extra burden on the networks and platforms required.

- Telepresence

    This ambitious objective is already being considered by some Celtic projects, but needs much more effort to become a reality. Numerous issues remain to be solved, including more realistic interfaces and displays and effective networks with less latency time.

- Remote processing, storage and management

    Those three elements are central to the fulfilment of the e-marketplace whose realisation is key for the future of telecommunications and content industries. In the NEM SRA, emphasis is given to the remote processing, storage and management of content and the required software (clients) in the user premises. The concept is expandable and its full implications are analysed in the NESSI SRA.

- Advertising

    Developing new and more informative advertisement solutions and including audience measurement

- Payments

    Payment over the net, and micro payments in particular, are an enabler of the future e-marketplace so its management becomes a core part of network capabilities. They should be easy to use, secure, auditable and economical.

- Social networking

    Including all the possible ways to person to person, person to group etc.

- Service and application usability

    The NEM SRA recognises the importance of this element, crucial to the final service adoption. The issue is further discussed in the eMobility SRA.

3.4 Terminals

Terminal development is implicitly addressed in the Celtic Purple book, particularly when considering services and their related equipment (see chapter 2, especially chapter 2.5) However, in the new scenario put forward by the NEM Strategic Agenda, terminals become one key element in the development and deployment of new services.

Terminals should be able to operate into a multi-network scenario and the user terminal will have to bear a significant part of the operation required for new multimedia services. Therefore, the service terminal becomes a key element in the user experience.

Most of the requirements for new terminals are further described in the section dealing with "*Challenges of Mobility*". There are, however, other terminals types such as those related to *residential gateways* whose function is to make the interface between access and home networks. Its function is key to the convergence of applications, integration of appliances to systems and development of in-house infrastructure.

Also, gaming terminals will need particular attention. Gaming poses a number of challenges. This is particularly important as some consider the gaming terminal as "the" key terminal in the integrated world of networked electronic media. New display technologies for virtual images, similar to sunglasses are being considered.

Other aspects include identification systems compatible with DRM; user identification example by an extended SIM card approach.

3.5 Enabling technologies

NEM Strategic agenda indicates a number of technologies that would be needed to perform the requirements put forward in the pervious sections and further explained in the NEM SRA. Those include:

- Digital Right Management tools.

- Identity management

- Metadata

- New media formats including flexible compression

- Multimedia search engines

- Tools to efficiently make the transition between analogue to digital TV/radio

- Natural and multimodal user interfaces

- Human language technologies

- Multimedia analysis and computer vision

- Mixed reality

- Animated computer graphics

- Intelligent agents

- Display technologies

- Acoustic and sound generation

- Group management awareness

- Interactive and Mobile Digital TV

All those technologies belong, in different ways, to the previous sections, and here are repeated for reference. Since their development is essential for those objectives, they can be considered part of Celtic activities.

4   CHALLENGES OF MOBILITY

The scenario put forward by the e-mobility technology platform is based on the change form the existing paradigm of mobile communications "anywhere, anytime" to a new paradigm of "any network on any device, right content in the appropriate context, in a secure manner". Also the objective of the platform goes beyond the mere technical achievements as summarised in the sentence (from the e-mobility SRA):

"The improvement of the individual's quality of life, achieved through the availability of an environment for instant provision and access to meaningful, multi-sensory information and content".

This extends mobile communications beyond radio and computer science into new areas of biology, medicine, psychology, sociology, human sciences and nanotechnologies.

Even taking this ambitious vision into account, the research areas indicated in the e-mobility SRA can very well fit into the present version of the Celtic Purple book, except that some emphasis is needed to change the perspective from the technical into the user point of view.

Those areas, as taken from the e-mobility SRA, are the following:

4.1   Seamless user experience

Seamless experience between networks and terminals is recognised in the Celtic purple book as one key factor to the success of mobile technologies for services B3G (see chapter 7). The new vision put forward by e-mobility gives extra emphasis to the user experience, pointing out the possibilities that will bring new technology solutions such as foldable displays and printable electronics that will offer opportunities for new innovations, as current physical restrictions are gradually disappearing.

There are three areas where more effort is needed:

• Understanding of user experience and acceptance

This would include more work on accessibility for all, and better understanding of the needs of users in their daily interactions.

• Provision of smart user interfaces and interactions

This area will be further enhanced by new technological developments and shall use multi-modality and context awareness to enhance user experience. Learning capabilities and adaptation on the user interface will also be required. This has to be performed with the minimum effort (ideally zero configuration) from the user's side.

The new sensor networks will require simplified mechanisms and technologies for context capturing and sensor communication.

• New Mobile form factors

It is recognised that new manufacturing materials and methods – including foldable displays and printable electronics and the disappearing computing paradigm– open new doors not only for innovation, but also for new ways of enhancing the user experience.

Those aspects are also very relevant to the Networked and Electronic Media service development.

4.2   New Business infrastructures modelling

As recognised in the Celtic purple book (see for example chapter 6, particularly 6.4 and 6.7), the business ecosystem is rapidly changing, moving towards a more multi-network, multi-service provider scenario. New stakeholders are now appearing, mainly providing value added services for enabling efficiency and system interoperability, network monitoring and management, customer-care support and device management.

In order to analyse that new scenario it would be necessary to improve the knowledge of business models and its different alternatives and possibilities. That can be done using new software tools suitable for the task.

4.3 Security and trust

This aspect is already mentioned in Celtic purple book (see chapter 10) and underlined in the NEM strategic agenda, technology convergence will be a key driver of the evolution of communications. The converging sectors of the industry (e.g., Internet and IT, infotainment, mobile communications, consumer electronics) carry a different history on security perspectives and technical solutions. Therefore, security should integrate and evolve the existing security technologies through open standards in order to meet the requirements of the future advanced service products.

4.4 Ubiquitous services

The future new business scenario can be characterised by a differentiation between access and service provision. That was recognised in chapter 7 of the current version of the purple book. User access to the services will be done through different networks. The user's communication environment will be generally composed of various terminals (e.g., PDA, Laptop, PC, mobile, embedded computer in vehicles, communicating objects) that may vary dynamically depending on the user's context. That put new challenges, not only in the interface and user terminal, but also into the service provision platforms, that should be able to provide:

- Gateway automatic configuration mechanisms

- New data management and synchronisation mechanisms.

- Intelligent customer care

- Proactive capabilities

Multimodal and augmented reality mechanism

This has an impact in the service creation environments and into the media and content management protocols. Those aspects are essentially mentioned in chapter 2 and, in more detail in chapter 7 of the present Purple book. The eMobility agenda recognises the effect over the following elements:

Service creation and execution environments

In order to fulfil that ubiquitous experience, the research should be focused towards open mobile service creation and deployment concepts and environments that do not depend on specific execution platforms. This is essentially mentioned in chapter 2 of the present purple book, but the eMobility SRA provides extra information and suggests some solutions.

For example, to solve the problems posed by the existence of different platforms and solutions, the potential of overlay network technologies for bridging and bringing inter-operability between different platform solutions from different vendors have to be considered.

Research is also needed into network support functions that would permit the creation of situation-aware services, while still keeping the mobile service logic slim and suitable for mobile devices with their limited processing capabilities.

Other related areas include:

- Explore how Web Services technologies, automated code generation tools, XML based data, interface and interaction description languages can be enhanced to permit on-the-fly integration of platform features, services, access networks and devices

- Generalised user interface description methods and languages for fixed and mobile services that permit an automated and on-the-fly generation of mobile device specific clients.

- Study techniques for semi-automated composition of services, based on pre-existing sub-services and network support functions

Those aspects are further analysed in the section devoted to new service development, which is the objective of NESSI Technology platform.

Content and media

- This area is already covered in this document in chapter 3.

4.5 Ubiquitous connectivity and networks

Celtic Purple book recognises that the networking world will be likely characterised by a situation where several networks are present, both in the wide area and in the local domain (see chapter 6 and 7) .

That is also the assumption of eMobility SRA. In the future, terminal devices should be able to scan the environment to provide the best connectivity at the adequate level of service quality. This requires further research into areas such as:

- Design of network architectures and definition of functional requirements for self-configuration, auto-connectivity, self-organisation and self-management of heterogeneous devices in heterogeneous and dynamic (access) networks.

- Scalability of network and service control technology which can deal with all sizes of network.

- • Fixed and mobile convergence with focus on service, device convergence, and network convergence where both the fixed and the mobile network use the same multi-service layered architecture that improves efficiency and flexibility.

- Ability to cope with a wide range of radio technology as well as application middleware to support applications of all kinds.

- Network-driven transmit diversity to find suitable (access) networks that can be used simultaneously to transmit and receive data.

- Multi-layered mobility support, which enables ad hoc cluster mobility, as well as, user mobility across networks.

- Integration of sensor networks, which efficiently use the resources of larger networks (from PANs to WANs) for communication.

- •Delivery of information and media flows to users, adapted to their current access situation, location-dependent interests.

Specific research is proposed into the following areas As indicated in chapter 7 of the Purple Book.

- **Radio access and opportunistic communication**

- **Platforms and implementation**

4.6   Enlarging existing research areas

Besides the list of new research initiatives, indicated in the previous sections, significant work has to be performed into active research areas identified in the present version of the purple book.

It is worthwhile making specific mention of full development of DVB (H-T) protocols and solutions, short range communications solutions (Zigbee, UWB, NFC) and in the development of the 3GPP LTE (Long Term Evolution). Contribution to the standardisation bodies is considered an important aspect of future activities.

5   NEW NETWORK INTEGRATED SERVICES FOR THE USER

The present version of the Celtic purple book devotes a chapter to describe the future telecommunications services that shall be required in the coming years. Those services and applications will constitute the main revenue of Telecom operators and service providers and their development and implementation will play a significant part of the business of equipment manufacturers.

Most of the chapter dealing with services and applications in the Celtic purple book is devoted to an outline of the architecture of those services, in terms of functional blocks. It includes a description of the service platforms and the service creation environments from the architectural point of view. It also includes an indication of some of the expected characteristics of the services to be developed. Finally, a number of possible areas for new service development are given, mostly as examples.

However, there is no specific indication on the characteristics of the software tools that will be used to develop those new services. There is a growing awareness of the importance of creating a methodology for that tool development. New services and applications are growing in complexity and its development is no longer made from scratch. New programming and testing techniques are needed, that would allow more and better software element re-use, will provide much more effective and fast programming and assure a much higher reliability and applicability.

Certainly, it is not Celtic main objective to fully develop those methodologies. They can be applied not only to Telecom but also to many industrial areas and many other actors will be interested. But there is a clear and very important telecommunication aspect that needs to be analysed. Celtic has to be present in that analysis, not only because the process requires knowledge of telecommunication networks and services, but also because the future of services and business will be based upon those foundations. Aspects such as semantic web, grid computing, etc. are going to play a key role in future telecom scenarios and have to be closely followed not only for their results but also in its development methodologies.

That is the reason why Celtic considers it very important to take some of the elements of the NESSI technology platform. According to the NESSI vision of future telecom and services scenarios, telecommunications plays a key role in the future distributed systems that constitute the platform vision:

"*Future scenarios will be characterised by large distributed systems with many data collection points, services, and computers that evolve data into knowledge and help humans coordinate the execution of complex tasks. Large amounts of data will be generated by sensors, transmitted via wireless channels to ground stations, then moved through fast optical technology to powerful computational infrastructure and the results will be visualised on different devices according to the context of use. A crucial missing piece is a software infrastructure middleware facilitating a seamless and cost-effective composition of services in this new era of the web. This software infrastructure should support pervasive and ubiquitous application scenarios where machines dissolve across the net into a set of special purpose and domain-specific appliances*"

The attention Celtic is going to pay to NESSI activities cannot be exclusive. Other EUREKA projects (particularly ITEA) can and should play a significant role for the development of short and medium term NESSI objectives. However, the future of Telecom services and business will be at risk if no attention is given to the way new telecom service software is developed.

In the following, a brief summary of the main areas where Celtic can help to the development of NESSI strategic research areas is given:

5.1   Understanding the business landscape

The market and business analysis is an important aspect in itself (besides the relationship to the final service characteristics). It is considered to analyse the problem in some specific studies that can be undertaken within Celtic, dealing with Service & System Science & engineering and also with the development of Open Source Science. Those studies and projects will have to be connected to that telecommunications to be considered within the Celtic area of interest.

Service science

Business ecosystems are an important research topic and the full development of telecommunications networks will play a significant role in its full maturation and organisation. It is considered that the concept of services provided via digital means is still not well understood. Particularly there are challenges with regard to governance, commercial viability and sustainability over a longer period,

which require new and more specific studies. That includes further studies in *service science* and *service engineering*. The definition of those new concepts, according to the NESSI SRA is:

"*Services science deals with the foundations of complex business services, which are seen as advanced business capability offered by businesses to their ecosystem consisting of customers, partners in the supply and demand chains, and to the end-consumers. In the ecosystem, complex services can be created and formed for transforming the production and distribution of goods and services*"

"*Services engineering is a disciplined way of ensuring that services are created, instantiated, supported, invoked and gracefully dismantled based on complex requirements from businesses on services design, implementation and deployment. Services engineering provides the foundations and rigorous framework for enabling the formation and delivery of services. This involves the execution strategy of defining, building and deploying business services for one or more businesses for wide use across the industrial supply-chains for enabling business transactions and consumer benefit*"

Systems Science

Close connected with *service science* are the concepts of *system science.* Complex systems are an integral part of our constructed world. As we come to rely increasingly on these systems for all aspects of our lives we must be able to claim a solid understanding as to how these can be specified, constructed and controlled.

The primary purpose is to advance the development and integration of the sciences that underpin the successful analysis, design and control of complex systems characterised by the requirements of services.

Open-Source Science

Software is fundamental to the development of new services. Open Source is a very interesting alternative and it plays a very important role in NESSI agenda. Among the alleged advantages of Open Source are the increased competition and the possibility of new opportunities for the software industry players. Commercial suppliers are broadening their support and deployments are increasing.

- Open Source Science is complemented and impossible to dissociate from open standards. The objective is to study that paradigm shift from a technical and business perspective so as to let the European industry benefit from it. The number of issues is very large, including all type of challenges from strategic and economic to legal and social. Business aspects are particularly relevant.

5.2 Service Elements Framework

NESSI Strategic research agenda gives the following picture to explain their activities:
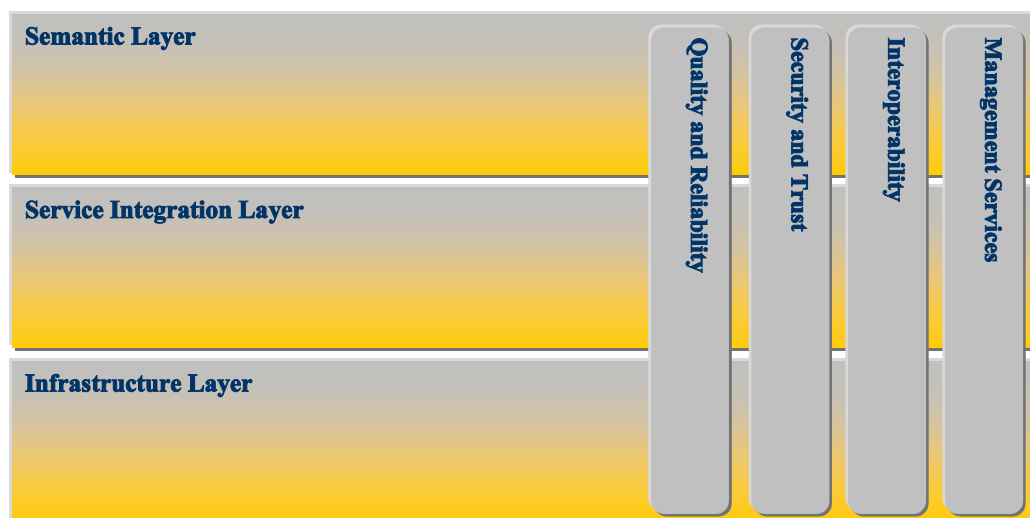
Figure 5

This figure is difficult to relate directly to the conventional structure of telecommunication services, because it follows a different perspective. It starts from the point of view of software service components and the different elements required to their implementation and management.

In the following, an explanation of the different elements is given and their relation to the Celtic working areas are identified:

Infrastructure

According to NESSI SRA, the infrastructure domain aims at the virtualisation of resources across servers, storage, distributed systems (including Grid) and the network. New foundation core layers including the development of Grid-aware network-oriented operating systems are necessary to cope with new challenges in providing such an infrastructure.

The objective is to support and enable the customers to migrate their software applications to new virtualised infrastructure models, for which a structured methodology will be required.

Infrastructure analysis and distributed applications will involve a full knowledge of existing and future network solutions and Celtic program can fit very well into those future studies.

Service Integration

Service integration, as understood by NESSI, refers to the interaction between different software elements that together, provide a service. This is usually accomplished through use of middleware that let users build composite services or execute business processes by proprietary engines that, at most, support standard service definitions (web services) and basic standard transport protocol (HTTP, JMS), used sometimes in conjunction with proprietary components (adapters, connectors). That area is already mentioned in chapter 4.4 "Service creation and execution environments" and also mentioned in chapter 2 of the present Purple book.

Semantics

Semantics will be a key element for the transformation of information to knowledge. Semantic Web technology will enable far more effective machine to machine communication about the nature and the manipulation of data they hold and actions based on that data.

As an element that will be decisive in future services over telecom networks, semantics is an area of interest to Celtic, particularly when considering communications aspects.

Security and trust

NESSI recognises that concern over security is possibly the most significant barrier to acceptance of IT services. Security and trust can only be achieved by an end-to-end perspective that is addressing all layers involved. Those aspects are fully recognised in chapter 10 of the exiting Celtic Purple book and also mentioned in chapter 4.3 of this document.

Process and system quality and reliability

Service quality and business processes execution and the correct functioning of devices are increasingly dependent on software. As a result, poor software design or software errors may cause significant damage. Tools that help to improve software development processes, measure quality, and predict reliability, will be required and must deal with the globally distributed systems and services of the future.

To have software quality considered within Celtic, a communications perspective will be needed. Not all process processes require interaction with a communication network.

Management Services

NESSI uses "service" in a broad sense, including network connectivity, computing hardware, application environments, data and information as well as application components.

Automated and autonomic management techniques for efficient and effective management of large, dynamic systems are required. Two levels of management are considered

a) Managing the infrastructure used to implement the services. The major concerns are to ensure availability and performance of key elements that supply the service description, the messaging and the network. This encompasses management of network layer, XML messaging layer, service registries, and service implementations.

b) Management of the services themselves, including:

- Service provision, creation, configuration, and deployment
- Service integrity and security
- Service monitoring
- Service availability
- Management, including configuration management, performance management, fault management, security management and cost management

Again, since a significant number of those services will be deployed using telecommunication networks they will form part of Celtic activities.

Interoperability and open standards

NESSI understands systems and applications need to be interoperable in order to achieve seamless interaction across organisational boundaries and thus realise networked organisations. Interoperability, defined as "the ability of two or more systems or components to exchange information and to use the information that has been exchanged", needs to be addressed in respect of all layers of an enterprise

The challenges of that activity include:

Organisation (Business/Knowledge). Interoperability at business level is the organisational and operational ability of an organisation to factually cooperate with other, external organisations, whether these organisations are enterprises or public institutions.

Semantics and Ontologies. To overcome the semantic barrier, which emerges from different interpretations of syntactic descriptions, precise, computer processable meaning must be associated with each concept across the business, knowledge and ICT layers. It has to be ensured that semantics are exchangeable and based on a common understanding to be indeed a means to enhance interoperability.

Systems research. Interoperability at Systems level should be seen as the ability of a solution to allow an organisation to operate, make decisions, exchange information within and outside its boundaries.

Interoperability domain. A number of different approaches exist in order to structure more holistic approaches to interoperability – including both standardised frameworks and industrial frameworks and architectures.

That approach is fully supported by Celtic. However, it is recognised that some of the work areas and challenges, particularly organisation, system research and interoperability domain may result in activities that are very theoretical in nature, not directly related to Telecommunications and could also be analysed in other Eureka projects.

6   THE SATELLITE COMPONENT

Satellite systems can provide almost worldwide global coverage, with a unique capability to reach remote locations all over the world and to distribute huge amount of data to users spread over large geographical areas. In the forward link, the cost per transmitted bit is almost independent of the number of subscribers and of their precise location inside the satellite coverage area.

For these reasons, it is considered that the inclusion of a satellite segment fully interoperable with terrestrial wireless and wired technologies can bring very significant added value towards the achievement of Celtic vision of an "integrated telecommunications systems approach".

As will be detailed in the rest of this section, in most concrete cases the presence of a satellite component is of paramount importance in order to complement terrestrial components by extending the achievable coverage, increasing the net available capacity and supporting new applications and services, also in crisis situations.

6.1   Satellite Services and Applications

In the field of new services and applications, the following project initiatives can be started within Celtic in the following fields:

High-Capacity Demanding Multimedia Services to Handhelds, Mobile Platforms, Home Receivers, Kiosks, etc…

Huge amount of data can be downloaded and cached using satellite inherent broadcasting capabilities. Personalisation of content (location-based and/or context-aware) can take place at the terminal side. Either terrestrial or satellite links could be used to convert a purely broadcasting approach into a multicast approach, i.e. to ensure reliability and set-up selective and efficient retransmission strategies.

Massive Update of SDR and Firmware of Cars

As pointed out in Celtic Purple Book, Software-Defined Radio (SDR) enabled terminals are a key element to achieve the desired flexibility and reconfigurability. A major problem is however constituted by the distribution of the updates and potentially critical patches. Also in this case, a low cost receive-only satellite terminal could reduce the risk of congestion of the terrestrial networks, by broadcasting the required updates to a large number of users.

Global Alert

Recent dramatic events have unfortunately raised the importance of a global alert system capable of reaching a number of different devices (handhelds, PDAs, laptops but also TVs and radio receivers) located in a certain geographical area. Spacecrafts are clearly more robust against catastrophic events like flooding, tsunami or earthquake. The global alert features could be additionally complemented by the possibility to send SMS-like messages via satellite from each consumer mobile device in case of emergency and lack of terrestrial coverage.

Relay Services to Collect Data and Broadcast

Improvement of image resolution leads to data rate increase for data collection from EO   satellites or future UAVs. Associated impact on direct downlinks congestion and higher requirement to reduce the ageing of the information to create new services, in particular for GMES applications, will lead to implement in Europe a relay infrastructure and associated services following Artemis successful demonstration.

Integrated navigation and communication services

The great majority of GNSS/Galileo services and applications are not purely based on the navigation SiS ("Signal-In-Space"), but require the integration of the satellite navigation with complementary communication functionality. Some examples of the broad range of applications with high growth potentiality, based on the Nav-Com integration concept, are the following ones: global tracking and tracing of mobile assets, fleet management, transport and logistics related applications, location based services, emergency services, search & rescue applications, marine applications.

Integrated Earth observation and monitoring

A primary objective of ISI is to foster the integration of satcom with GMES by demonstrating that satellite communications are essential elements to exploit Earth Observation and monitoring systems to their fullest, and to provide integrated applications fully meeting user demands.

6.2   Broadband Ubiquitous Infrastructures

In the field of broadband ubiquitous infrastructures, project initiatives can be started within Celtic in the following fields.

Broadband Access Networks

It has been demonstrated that satellites can be an effective mean to provide broadband access wherever cabling and/or cellular networks are scarcely present. To support this operational goal, significant R&D effort has to be devoted to the following key items:

1) Increase the Spectral Efficiency of Current Satellite Systems

Developing satellite and ground segment technologies, techniques and system designs that improve radio transmission efficiency and spectrum utilisation to maximise the exploitation of the available spectrum. E.g. satellite payloads generating multiple narrower spot beams with high level of frequency re-use, multi-user detection, more efficient coding and modulation schemes and access techniques, robust and efficient video/audio compression technologies, innovative spectrum sharing technologies, satellite and ground segment technologies for the utilisation of Ka-band (20/30 GHz) and of the 40/50 GHz frequency band.

2) Reduce the Cost per Terminal and per Bit

Developing high-performance, high-throughput, low-cost solutions in order to provide services with affordable costs for the end user. Investigating relevant aspects such as:

- Satellite payload technology (e.g. antenna, flexible power allocation, on-board routing and processing,…) necessary for high performance multiple spot beam satellite infrastructures enabling low cost per bit and low cost ground terminals

- Cost and performance of antennas; new antenna technologies allowing an easier installation

- Optimal use of transponder bandwidth.

- Techniques to limit the transmission power hence the cost of small terminals.

- Flexible QoS strategies at access and IP layer.

- Active management of services to optimise bandwidth usage.

3) Increase Satellite Broadband Systems Flexibility

Developing satellite technologies and techniques, enabling flexible allocation of the satellite capacity over time according to market demand (reconfigurable active antenna technologies, flexible power allocation, flexible uplink and downlink frequency allocations, and capacity allocation over time). This is important to secure economic viability of large scale broadband satellite infrastructures and operators/investors return on investment.

4) Foster Open Standards

Fully participating in relevant standardisation activities as a mechanism to foster reaching of economies of scales at affordable prices. The current existing standards should be considered for new developments and when necessary, new standards should be developed. The frame work of ETSI, CENELEC, DVB and other standardization and specification bodies should be exploited at most. Also, adoption of terrestrial standards should be done where appropriate, and co-operation on standards with terrestrial stakeholders should be stimulated. Facilitating heterogeneous systems development by studying adaptation of terrestrial standards to satellite, as well as ensuring that new terrestrial standards incorporate a satellite dimension when necessary.

Global Mobility

Global and ubiquitous connectivity can only be achieved with a hybrid terrestrial/satellite system architecture ensuring seamless connectivity and interworking.

Unlimited Mobile TV

The provision of mobile TV is indicated by many market experts as the killer application of the next decades. Satellites have a very successful history in the provision of digital TV to fixed users and of digital radio to vehicular and today also handheld terminals in the US and Canada. Last but not least, they are the best candidate for the introduction of HDTV services.

The satellite system for the provision of mobile broadcast services currently being studied pursue horizontal and vertical convergence between mobile, wireless, and satellite applications and

technologies, for the efficient and seamless provision of multimedia interactive mobile services broadcast to handheld devices. The overlay network is a real beyond-3G extension of terrestrial networks, whereby interworking is not only a wanted feature, but an intrinsic and unavoidable asset. The design of such systems aims at identifying a set of enhancements to 3G networks that might be easily and transparently integrated into operational networks to improve service delivery and pave the way for further technical enhancements and increased business opportunities in mobile telecommunications. Furthermore, the large umbrella cell can effectively connect the islands created over wide, local, and personal areas by terrestrial means.

The key associated R&D issues are:

·   Achieving truly global coverage by integrating satellite and terrestrial transmission

·   Evolution towards higher data rates

·   Optimised routing between satellite and terrestrial 3G and B3G network implementing Multicast/Broadcast Multimedia Services (MBMS)

·   Resource management in the hybrid terrestrial/satellite network

·   Global roaming and seamless horizontal and vertical handover

·   Terminal reconfigurability

6.3 Security

Satellites, by nature, play an essential role in all typical security and emergency scenarios, in full integration with terrestrial networks. Therefore, in the field of security, project initiatives can be started within Celtic in the following fields:

SatCom Supporting Surveillance Networks

Satellite Communications are essential for providing connections between sensor networks and decision making centres. This service requires integration of different surveillance systems (in situ, aerial, satellite, GMES, GALILEO), satellite communications networks and terrestrial networks. Typical scenarios in this area are: Border Control, Transport Control floats, Homeland Security or Infrastructure Protection.

SatCom Supporting Warning Scenarios

Communications is by far the most critical component of warning infrastructures. Space communications should be used to send warnings to citizens and specific remote areas and coastal zones likely to be affected, in order to ensure timely notices are given. In this scenario, satellites can play a role by:

1.   monitoring threats: detection of a potential danger and transmission of an alert notice to a warning system

2.   disseminating the warning through communications networks, where the satellite is the ideal solution to efficiently spread the warning information over large areas

3.   disseminating the information about the actions to be taken in response to the warning or in the aftermath of the disaster.

For this application it is necessary to connect warning centres to alert systems. Satellite communications must be considered as the main network to assist people after a disaster where terrestrial communication infrastructures could have been damaged. Satellite Broadcast Systems should allow authorities to address the entire nation in an emergency case. This system should be also usable for regional and local emergencies.

SatCom for Crisis Management

One of the most important scenarios within security regards disaster management. When natural or man-made disasters occur, it is necessary to resort to an integrated disaster management system that has access to the full potential of observation resources to respond in a timely and coordinated way.

In case of major crisis, the access to satellite data is needed with top priority to provide accurate and timely information. Different phases can be considered:

•   Damage assessment: remote sensing information must be collected to making decision centres. It is the most critical element of disaster management and consequently less dependent on timely

revisits of the affected area. This damage assessment could be extended during the days following the disaster.

- Support to disaster relief: the damage assessment should be made as fast as possible in order to support disaster relief. Satellite can be the only way of communications in areas that have suffered from a disaster.

SatCom for Restoration

From a communication point of view, timely observation information must be communicated to the disaster restoration workers. Often maps made before the disaster cannot be properly used, as the landscape may have changed and hazards are not properly identified. In these scenarios, terrestrial communication are often down and space communications offer a unique means of communicating between workers.

The key associated R&D issues for all these scenarios are:

- To design efficient ground communication stations to adequately operate with observation and navigation systems in a co-ordinated and efficient way.

- To validate enhanced data relay between different aerial platforms (UAV, HAPs) and decision making centres.

- To evaluate open interfaces with GMES and GALILEO to support security scenarios.

- To offer high levels of security of the information over satellite network: Security protocols and key management such as IPSec, DVB-RCS, etc.

- To design encoding procedures for sensitive information transmitted in the system.

- To ensure authenticity, confidentiality and integrity of global information where or when needed.

- To evaluate end to end security of the information across heterogeneous networks: WIFI over SatCom, WIMAX over SatCoM, 4G over SatCom, etc.

7   DEVELOPMENT OF THE PAN EUROPEAN LAB [8]

The Pan-European Lab (PanLab) is a concept that has been already introduced in the present version of the Celtic Purple Book. Its aim, as declared there, is: An "European Laboratory, which will enable the trial and evaluation of service concepts, technologies, system solutions and business models to the point where the risks associated with launching of these as commercial products will be minimized". The accomplishment of this objective, is an important step to the establishment of a truly pan European collaboration network and its realization will be one significant result of the Celtic project. In close cooperation with the EU Panlab SSA the development of the Panlab in particular, the implementation and operation of the Panlab can be progressed more extensively.

Activities related to the PanLab development have been divided into three phases:

a)   Developing a common technology vision of the Telecom future

b)   Defining the virtual laboratory

c)   Implementing that definition.

7.1   Common technology vision

The first stage in the PanLab will be the development of the "Common Technology Vision". That document should serve both as a "Technology Roadmap" and as a "Strategic Development Guideline" for European and global Telecommunications. This includes the long-term milestones that need to be set on the ICT industry agenda and guidance on how to best reach them. The focus of the "Common Technology Vision" is the integration, testing, validation and certification requirements of the industry in the mid-term to long term. Specifically it would target relevant projects in the European Framework programs, the Technology platforms (particularly NEM, eMobility. ISI and NESSI) as well as the Eureka community. The document may be structured according to a layered approach, ranging from components, core and access networks to service platforms. Particular attention should be given to key aspects such as security and fixed to mobile integration.

Activities related to the elaboration of this document are going to be performed in a "Pan European manner". This means the involved experts should be truly trans-national and effective interaction is expected. To achieve this goal, it is proposed to set up a frequent number of joint meetings, either via electronic means or through physical meetings. The purpose would be, not just to achieve the objective of the "Common Technology Vision" document, but also to establish a truly "integrated group" working in an interconnected manner. This group should include experts not only from Celtic core companies but also from other interested parties, particularly of the NEM, NESSI, ISI and eMobility platforms and its national mirror groups.

7.2   Laboratory definition

The second phase includes the detailed definition of the laboratory in terms of technical infrastructure, as well as in terms of legal and operational general conditions. The result of this phase is a framework under which the PanLab shall operate.

7.3   PanLab implementation

The third phase is the implementation of the physical infrastructure (interconnection facilities, remote management capabilities, etc.). The implemented physical infrastructure would consist of a number of different labs, belonging to the core partners of the consortium and other selected companies, with the aim of establishing integration, testing, validation/verification and possibly certification services for product prototypes of European collaborative projects. This facility would be useful, both as a "shopping window" for the project achievements and as a first step towards commercialization of the different pre-competitive results of European collaborative projects.

The ultimate goal of the project is the establishment of a fully operational and long-term self-sustainable Pan-European laboratory through the incubation of the project prototype laboratory, including also a business model that would advise on the continuation of the action as an independent and self-financing entity. This phase can be seen as the "Commercialization phase", in which the services of the PanLab will be offered on a commercial basis, which include in this case also technology vendors that want to integrate, test and validate their products against the state-of-the-art. The main

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[8] Panlab SSA: www.panlab.net

benefit of technology vendors in this phase must be a certificate that their products adhere to certain industry standards, and that the PanLab is accredited to award such certificates.

Users and customers and also lab providers may be e.g.:

- Eureka clusters (Celtic, ITEA, MEDEA+)

- ETP (eMobility, NEM, NESSI, ARTEMIS, ISI, etc)

- Other IST or national projects/ programmes

ABBREVIATIONS

2G/2.5/3G	x Generation Mobile System
B3G	Beyond Third Generation
Celtic	Cooperation for an European sustained Leadership in Telecommunications
CPE	Customer Premises Equipment
DMB	Digital Multimedia Broadcasting
DRM	Digital Rights Management
DSP	Digital Signal Processor
DVB	Digital Video Broadcasting (T- terrestrial H-handheld)
eMobility	European Mobility Initiative
ENIAC	European Nanoelectronics Initiative Advisory Council
ETP	European Technology Platform
GDP	Gross Domestic Product
Http	Hypertext Transfer Protocol
ICT	Information and Communication(s) Technology
IP-TV	Television over Internet Protocol
IT	Information Technology
ITEA	Information technology for European Advancement.
JMS	Java Message Service
LTE	(to 3GPP) Long Term Evolution
MEDEA+	Pan-European Programme for advanced co-operative Research and Development in Microelectronics
MIMO	Multiple Input Multiple Output transmission
NEM	Networked and Electronic Media
NESSI	Networked European Software and Services Initiative
NFC	Near Field Communications
PAN	Personal Area Network
PanLab	Pan European Laboratory
RFID	Radio Frequency Identification
SOA	Service Oriented Architecture
SRA	Strategic Research Agenda
UWB	Ultra Wide Band
VoD	Video on Demand
WAN	Wide Area Network