SYNCHRONISER

Synchronising the Research Policy Dialogue to the Indian Dimension

POSITION PAPER FOR THE 7th JWG MEETING

EU-India joint ICT research priorities and policy recommendations

SEVENTH FRAMEWORK PROGRAMME

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1 Abstract

The SYCHRONISER consortium strives to strengthen and catalyze the ongoing EU-India policy dialogue cooperation in the area of ICT research through a well structured consultation and consensus building approach by bringing together researchers and stakeholders from both regions under a common platform called the Synchroniser Steering Committee (SSC).

The EU-India Joint Working Group had shortlisted the following joint research priorities in its 6th meeting held on 27th March 2009 at Brussels:
- IPv6
- NGN
- Open Source Software
- RFID, Biometric and Smart Card
- India-EU research network connectivity and e-Infrastructure
- 3G Deployment
- Frequency Management
- Internet Governance
- Universal Service

The SSC members comprise mainly of ace scientists and other prominent experts in various fields of ICT research from both regions. Taking inputs of the JWG inputs as a starting point, these SSC members, in the Think Tank Meetings organized by the Synchroniser project have been discussing, debating and providing their recommendations on various aspects of the EU-India cooperation possible in different areas of ICT. In the process, some new priority areas have also been suggested based on "Top-Down" and "Bottom-Up" approaches. The Top-Down approach includes the following research priorities that are focussed on new, evolving technologies:
- IPv6
- Internet of Things
- Smart Grids
- Satellite Communication
- GNSS – Galileo
- Trust, Security, Privacy & Monitoring
- DNS Security
- Cloud Computing
- Sensor Networks
- Intelligent Transport Systems

The bottom-up approach areas, as suggested by the SSC experts are the ones that address societal concerns, which are common issues with localized needs:
- e-Inclusion
- e-Governance
- e-Health
- Ambient Assisted Living
- Digital Preservation
- Language Technology
- EU-India Regulation & Standardization
- e-Learning

- Spectrum Management
- ICT for Environment

This deliverable provides a brief outline of the Europe's Horizon 2020, India's 12th Five Year plan, with section describing on the priority areas for joint research suggested by SSC members during the 3rd SSC Think Tank Meeting, along with the recommendations and action plan, and also covers other useful inputs that could be immensely useful towards furthering the EU-India cooperation process.

2. Objective

The aim & objective of Position paper 2 **(PP2)** is to propose a mutually beneficial research agenda that could subsequently be taken up through specific initiatives between EU & India.

Since the last EU-India JWG meeting that took place in March 2009, the fast evolving Information and Communication Technologies have a lot new to offer to meet challenges of modern world requirements. While, India has been discussing its future ICT Sector plan for inputs to the country's 12th 5-Year plan, Europe has recently announced Horizon 2020, its biggest ICT research funding framework programme. Scope of opportunities for joint research in several areas of ICT thereby has increased manifold.

The 7th JWG meeting was postponed thrice in the last 2 years and it is expected to be organized in the first quarter of 2012. With one of the main objectives of the Synchroniser project of providing updated inputs to the JWG on potential areas of joint research, it was thought befitting to update information keeping pace with latest advancements and the constantly changing global ICT scenario.

This document is the 2nd Position Paper, which was originally intended for the 8th JWG meeting. It carries the outcome of the discussions and deliberations of the two physical SSC Think Thank meetings, among high level EU-Indian ICT experts, and various points detailed in the 1st Position Paper vis-à- vis minutes of the 6th JWG meeting. The main points of the document are the suggested ICT priority areas of joint research and other useful recommendations. This document can serve as an input for the next EU-India JWG meeting on Information Societies.

3. Europe's Horizon' 2020 in a nutshell

On 30th November 2011, the European Commission launched its proposal for the new research and innovation framework programme for the period 2014 – 2020. Detail information available at: http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=h2020-documents. It main elements are here below depicted.

The name of the Union's new funding programme for research and innovation – Horizon 2020 – reflects the ambition to deliver ideas, growth and jobs for the future. Horizon 2020 will be a key tool in implementing the Innovation Union flagship initiative.

Horizon 2020 brings together all existing Union research and innovation funding, including the Framework Programme for Research, the innovation related activities of the Competitiveness and Innovation Framework Programme and the European Institute of Innovation and Technology (EIT)[1]. This approach is widely recognised by stakeholders as the way forward[2] and has also been supported by the European Parliament in the Matias report[3], the European Economic and Social Committee[4] and the European Research Area Committee[5].

The set of proposals for Horizon 2020 consists of:
- a proposal for Horizon 2020[6], laying down the general objectives, rationale and Union added value, the financial envelope and provisions on control, monitoring and evaluation;
- a proposal for a single specific programme to implement Horizon 2020[7], laying down the implementation modalities and the content in terms of the broad lines of activities;
- a proposal for a single set of Rules for Participation and Dissemination[8], laying down the modes of funding and reimbursement of costs, conditions for participation, selection and award criteria and the rules on ownership, exploitation and dissemination of results; and
- a separate proposal for the part of Horizon 2020 corresponding to the Euratom Treaty[9].

Horizon 2020 has a number of **new features** that make it fit for purpose to promote growth and **tackle societal challenges**. These include:
- Major simplification through a simpler programme architecture, a single set of rules, less red tape through an easy to use cost reimbursement model, a single point of access for participants, less paperwork in preparing proposals, fewer controls and audits, with the overall aim to reduce the average time to grant by 100 days;
- An inclusive approach open to new participants, including those with ideas outside of the mainstream, ensuring that excellent researchers and innovators from across Europe and beyond can and do participate;

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[1] Activities in the field of nuclear energy are an integral part of Horizon 2020, yet they are subject to a separate proposal under the Euratom Treaty. Funding for ITER will be outside the EU Budget and subject to a supplementary programme.
[2] http://ec.europa.eu/research/horizon2020/pdf/consultation-conference/summary_analysis.pdf
[3] EP Resolution 2011/2107(INI)
[4] CESE 1163/2011
[5] ERAC 1210/11
[6] Proposal for a Regulation of the European Parliament and the Council on Horizon 2020 – The Framework Programme for Research and innovation, COM(2011)
[7] Proposal for a Decision of the Council establishing the specific programme implementing Horizon 2020, COM(2011)
[8] Proposal for a Regulation of the European Parliament and the Council laying down the rules for participation and dissemination of research results in Horizon 2020, COM(2011)
[9] Proposal for a Regulation of the Council concerning the Euratom Research and Training Programme (2014-2018) contributing to the implementation of Horizon 2020, COM(2011)

- The integration of research and innovation by providing seamless and coherent funding from idea to market;
- More support for innovation and activities close to the market, leading to a direct economic stimulus;
- A strong focus on creating business opportunities out of our response to the major concerns common to people in Europe and beyond, i.e. 'societal challenges';
- More possibilities for new entrants and young, promising scientists to put forward their ideas and obtain funding.

Focusing resources on key priorities

Horizon 2020 will focus resources on three distinct, yet mutually reinforcing, priorities, where there is clear Union added value and with the overarching aim to contribute to sustainable development. These priorities correspond to the those of Europe 2020 and the Innovation Union.

(1)   **Excellent Science**. This will raise the level of excellence in Europe's science base and ensure a steady stream of world-class research to secure Europe's long-term competitiveness. It will support the best ideas, develop talent within Europe, provide researchers with access to priority research infrastructure, and make Europe an attractive location for the world's best researchers.

This will:
- support the most talented and creative individuals and their teams to carry out frontier research of the highest quality by building on the success of the *European Research Council*;
- fund collaborative research to open up new and promising fields of research and innovation through support for *Future and Emerging Technologies* (FET);
- provide researchers with excellent training and career development opportunities through the *Marie Curie Actions*;
- ensure Europe has world-class *research infrastructures* (including e-infrastructures) accessible to all researchers in Europe and beyond.

(2)   **Industrial Leadership**. This will aim at making Europe a more attractive location to invest in research and innovation, by promoting activities where businesses set the agenda. It will provide major investment in key industrial technologies, maximise the growth potential of European companies by providing them with adequate levels of finance and help innovative SMEs to grow into world-leading companies.

This will:
- build *leadership in enabling and industrial technologies*, with dedicated support for ICT, nanotechnologies, advanced materials, biotechnology, advanced manufacturing and processing, and space, while also providing support for cross-cutting actions to capture the accumulated benefits from combining several Key Enabling Technologies;
- facilitate *access to risk finance*;
- provide Union wide support for *innovation in SMEs*.

Leadership in enabling and industrial technologies: will support the development of technologies underpinning innovation across a range of sectors, including ICT and space. Horizon 2020 will have a strong focus on developing European industrial capabilities in Key Enabling Technologies (KETs). These include:
- Micro- and nano-electronics; photonics
- Nanotechnologies
- Advanced materials
- Biotechnology
- Advanced manufacturing and processing

- Development of these technologies requires a multi-disciplinary, knowledge and capital-intensive approach

(3)   **Societal Challenges**. This reflects the policy priorities of the Europe 2020 strategy and addresses major concerns shared by citizens in Europe and elsewhere. A challenge-based approach will bring together resources and knowledge across different fields, technologies and disciplines, including social sciences and the humanities. This will cover activities from research to market with a new focus on innovation-related activities, such as piloting, demonstration, test-beds, and support for public procurement and market uptake. It will include establishing links with the activities of the European Innovation Partnerships.
Funding will be focussed on the following challenges:
- *Health, demographic change and wellbeing;*
- *Food security, sustainable agriculture and the bio-economy;*
- *Secure, clean and efficient energy;*
- *Smart, green and integrated transport;*
- *Climate action, resource efficiency and raw materials;*
- *Inclusive, innovative and secure societies.*

4. India's 12th Five Year Plan in a nutshell

Information & Communication Technology (ICT) has made a remarkable progress in the last decade. It has transformed the world, enabling innovation and productivity increases, connecting people and communities, and improving standards of living and opportunities across the globe. While changing the way individuals live, interact, and work, ICT has also proven to be a key precondition for enhanced competitiveness and economic and societal modernization, as well as an important instrument for bridging economic and social divides and reducing poverty. The pace of technological advancement is accelerating and ICT is increasingly becoming a ubiquitous and intrinsic part of people's behaviors and social networks as well as of business practices and government activities and service provision. These transformations will continue to move human progress forward by further leveraging ICT's positive social, political, and economic impact on government, enterprises, and civil society alike.

The ICT sector was one of the key drivers for fast and inclusive growth that contributed massively to India's economic development in its 11th Five Year Plan. The country has become a major leader in the software and software services sector in the world today. Various initiatives taken by the government in the ICT sector have delivered very encouraging results in delivery of e-services to the citizens, in promoting innovation, improved business processes as well as working of the Government itself. ICT has tremendous potential for the future of India. The vision and mission for the 12th Five Year Plan is on e-Development of India through a multi pronged approach of e-Infrastructure creation to facilitate and fast track e-Governance, promotion of Electronics Hardware Manufacturing & IT-ITeS Industry, providing support for creation of Innovation/R&D, building Knowledge Networks and securing India's Cyber Space.

Accordingly, the planning commission of India had constituted a working group on ICT under the leadership of Departent of Information Technology (DIT), Ministry of Communication & Information Technology to chalk out its 12th five year plan. To include inputs from a wide range of areas in the plan, the following seven sub-groups were constituted comprising of participants from different Industry Sectors, Industry Associations and Academia, Experts and other Intellectuals:
- e-Government
- e-Learning
- e-Security

- e-Industry (Electronics Hardware Industry)
- e-Industry (IT-ITeS Industry)
- e-Innovation/R&D
- e-Inclusion

Key points of each of these areas w.r.t. the 12th Five Year Plan are mentioned below.

e-Government

The National e-Governance Plan (NeGP) with a vision to make all Government services accessible to the common man in his locality, through common service delivery outlets, and ensure efficiency, transparency, and reliability of such services at affordable costs is an initiative of the Government of India. Major recommendations of the 12th Five Year Plan are:

- Build up a State of the Art Institutional infrastructure comprising of:
  - o National Institute for e-Governance with 25 state level institutions
  - o Chief Information Officers for implementation of large IT Projects
  - o International Collaboratios to showcase India's experience as well as success stories in e-Governance and to learn from the experience of the other Countries
- Enterprise Architecture for an integrated and unified e-Governance Service Delivery Framework (eSDF)
- Open data platform for availability and accessibility of data and information in the public domain.
- Innovation and R&D fund for e-Governance and Mobile Governance
- Business Process Re-engineering for improving the quality of public services
- Electronic Delivery of Services (EDS) Act
- Shared Services Platform
- National APPs Store
- Mobile Governance
- Social Inclusion

e-Learning

e-Learning provides a platform for enhanced learning, cost effective delivery, flexibility of learning at the convenience of the learner. Some of the significant recommendations of the 12th Plan are:

- Specific manpower development programmes in frontier areas based on immediate requirements of the Industry include Multi-core Programming, Cloud Computing, Biometrics, Ubiquitous Computing, pervasive IT security, intelligent information gathering, processing & Services, flexible IT and Green IT.
- Information Security Education and Awareness (ISEA) courses ranging from short-term to long-term covering both formal (certificate level to doctoral level) as well as non-formal education with a focus on operation, design, research & development.
- R&D projects on e-learning tools, technologies and pedagogy inter alia content adaptation, personalized learning, creation of high quality interactive simulation environment, Open Educational Resources (OER) and Adaptable e-Learning,
- 'IT Mass Literacy' movement for inclusion of all the citizens of India (especially the rural and the far flung areas) in the IT revolution. Design of course-ware in multi-lingual format for multi-modal delivery (including through mobiles, CSCs, SRCs, Adult Literacy Centres, etc).

e-Security

Cyber Security strategies proposed to be adopted during the 12th Five Year Plan include:

- Enhancing the understanding with respect to factor such as dynamically changing threat landscape, technical complexity of cyber space and availability of skilled resources in the area of cyber security
- Focus on proactive and collaborative actions in Public-Private Partnership
- Enhancing awareness and upgrading the skills, capabilities and infrastructure
- Improving interaction and engagement with various key stakeholders
- Carrying out periodic cyber security mock drills to assess the preparedness of critical sector organizations to resist cyber attacks and improve the security posture
- Supporting and facilitating basic research, technology demonstration, proof of concept and test bed projects in thrust areas of cyber security through sponsored projects at recognized R&D institutions.

Focus areas identified for implementation of Cyber Security activities are: Enabling Legal Framework, Security Policy, compliance and Assurance, Security R&D, Security Incident – Early Warning and Response, Security awareness, skill development and training and Collaboration.

e-Industry (Electronic Hardware)

The vision is to establish India as a leading global destination for electronics system design and manufacturing (**ESDM**). Main objectives during the 12th Five Year Plan are:

- Promotion of Electronics Manufacturing Clusters
- Special incentives for set up of Semiconductor Fabs
- Preferential Access to Domestic Electronics Goods
- Promote and develop innovation, R&D, Indian IP and manufacturingExport Promotion of ESDM
- Human Resource/Skill Development
- Compliance Framework for Safety and EMC Standards
- Sustainable growth and development-Green electronics & e-Waste Management
- International Collaborations

e-Industry (IT-ITeS)
Information Technology/Information Technology Enabled Services sector (IT/ITeS) has played a vital role in acquiring a Brand Equity for India, and has contributed immensely to the increase in the GDP, employment and exports. The 12th plan policy approach focuses on a five-pronged strategy:
- Build new markets and expand core markets - Access and Outreach.
- Accelerate ecosystem and provide initiatives for small and start-up companies.
- Strengthen infrastructure & eco-system in cities that can emerge as new hubs for industry development as potential centres of excellence.
- Enable policy environment that encourages innovation, employment creation and domestic IT adoption for inclusive growth.
- Leverage India's demographic dividend through skill development.

e-Innovation/R&D

The main objective recommended in the 12th Plan is to make India a hub of research, development and innovation in the area of IT and electronics leading to commercialization so as to contribute to the overall socio-economic growth of the country. Thrust areas identified for promotion of e-Innovation/R&D activities during the 12th Plan period (2012-17) are listed below:

- R&D in Information Technology
    - Innovation Promotion and Nurturing Entrepreneurs
    - IPR Promotion
    - Next Generation Computing Systems
        - Microprocessor development
        - Operating System development
        - High Performance Computing
        - Cloud Computing
    - Ubiquitous Computing
    - Bio informatics
    - Language Technology
- **R&D in Electronics**
    - Nano-technology
    - Microelectronics
    - Electronics Materials and Components
    - Industrial Electronics & Automation Technologies
    - Smart Grid
    - RF/Microwave Electronics
    - Medical Electronics & Health Informatics
- R&D in Convergence, Communication & Broadband Technologies
    - Next Generation Communication & Convergence technologies
    - Green Communication and Scavenging energy from ambient EM radiation
    - Wireless Sensor Network
    - Convergence of wired/wireless and cloud communication networks, fixed mobile convergence Consumer Premises Equipment and converged access devices
    - Wireless Technology deployments for rural connectivity
    - Satcom products for use in distance education, telemedicine and other e-government applications

e-Inclusion

The 12th Plan proposal on e-Inclusion will focus on implementing the following components:

- Using ICT for skill development
- Training for IT Skill Development
- IT infrastructure creation primarily at schools/ colleges
- Development of entrepreneurial skills in the identified target group
- Capacity Building
- Development of electronic products, software tools and e-services.
- Creation of e-Inclusion centres for development and deployment of IT products and solutions for differently-abled persons.
- Conducting studies and advocacy of e-Inclusion initiatives.
- Content creation in Indian languages.
- Application development by Government agencies targeting BPL (Below Poverty Line) households.

• Develop appropriate systems and software for applications in areas like health, education, training and governance, which will facilitate inclusive development.

5. Indian National Telecom Policy

On 10 October 2011 Indian Telecom Minister Kapil Sibal has released the Draft National Telecom Policy, for public consultation.

The draft **National Telecom Policy 2011 (NTP 2011**) targets broadband on demand, increase in tele-density to 60% by 2017 and 100% by 2020. The plan proposes to do away with roaming charges, introduce a stronger customer grievance redressal mechanism, recognise telecom as an infrastructure sector giving it tax concessions and extend preferential status to 'Made in India' hardware products.

A summary of the NTP 2011 is here presented:
- o One Nation-One License to mean removal of roaming charges
- o 300 MHz spectrum to be made available by 2017
- o Aim to make 500 MHz spectrum available by 2020
- o Need seamless delivery on converged policies
- o Convergence of services will cover voice, data, video, internet, VAS
- o To permit resale at retail level
- o Will delink licenses issuances & spectrum allocations
- o Spectrum to be made available at market valuations
- o Seek TRAI recommendation on license framework
- o Will allow trading, sharing, pooling of spectrum
- o Will enact a separate spectrum act
- o New spectrum act to look into spectrum pricing
- o Will work on giving infra status to telecom sector
- o Revenue generation will play a secondary role in NTP 2011
- o Vision is to have broadband services on demand
- o NTP 2011 to increase availability of spectrum
- o Want India to become hub of telecommunication
- o New policy will aim at making India hub of telecom equipment
- o Will put in place a skill development strategy
- o BSNL, MTNL will continue to play important role in penetration in rural areas
- o Mission is to have special coverage of remote, rural areas
- o Aim to have 100% tele density by 2020
- o Affordable and reliable broadband on demand by 2015
- o Promote the domestic production of telecommunication equipment to meet 80% Indian telecom sector demand through domestic manufacturing with a value addition of 65% by the year 2020.

Consequently, SYNCHRONIZER will produce a further version of the PAP (the PAP2) to properly add comments and vision in accordance with this important draft NTP 2011.

6. EU-India ICT cooperation – SWOT Analysis

ICT has played an important role in economic and social development as also in solving major global societal challenges across the globe. Major global challenges such as climate change, poverty,

education, energy, security of the citizen and the digital divide brings the need for effective global ICT cooperation to promote sustainable development.

EU-India relationship began as a diplomatic agreement way back in the 1960s, which was elevated to a higher level in 1994 with the landmark signing of a Cooperation Agreement on Partnership and Development. The progress of this cooperation has delivered a mixed bag of results. While on the one hand, India's bilateral S&T cooperation programmes with almost all the European countries have been quite successful, the country's participation in Europe's Framework Programmes has not yielded good results.

The SYNCHRONISER consortium tied to analyze the factors that could have been responsible for the poor outcome through a SWOT analysis between the two regions in ICT research.

STRENGTHS	WEAKNESS
• Traditional linkages between EU & India • Favorable policies, mutual interest on international cooperation with a good number of S&T cooperation programmes between both the regions • Existing cooperation mechanism such as bilateral programmes, multilateral programmes with India & EU member states • Capacity of ICT R&D in India is almost on par with EU countries • Previous and current FP project experience between both regions • Existence of ICT NCP support for FP projects in both regions	• Limited awareness among Indian scientists and R&D organizations regarding EU's FP opportunities • Inadequate connections amongst researchers between EU & India • Lack of EC projects management skills in India • Language Barrier in both regions • Less mention of INDIA specific calls in the latest EU ICT work programme • Different levels of research and technological development between both regions • Non-reciprocity of Indian S&T programmes to EU researchers
OPPORTUNITIES	THREATS
• Job opportunities between both the regions • Knowledge sharing on FP experiences • Emphasis in cooperation programmes on future opportunities between both regions • Strengthen of foreign knowledge as well as innovation linkages • Maximizing partnerships between both regions have further aided in development of products for world market • Improve efficiency of public funded R&D and motivate private sector effort	• Lack of networking programmes between researchers from different disciplines necessary for co-creation in both regions. • Lack of IPR awareness amongst ICT researchers in both regions. • Gap in expectations between EU & Indian researchers • Problems with understanding the difference between research and application areas and activities • Competition with other cooperation programmes such as USA, UK, China

7. Priority Areas as per deliberations of SSC members

The last (sixth) meeting of India-EU JWG (Joint Working Group) on Information Society was held on 26th and 27th March, 2009 in Brussels. As per the minutes of meeting recorded, the following joint research priorities were identified at the time:
- IPv6
- NGN
- Open Source Software
- RFID, Biometric and Smart Card
- India-EU research network connectivity and e-Infrastructure
- 3G Deployment
- Frequency Management
- Internet Governance
- Universal Service

Taking JWG inputs as a starting point, SSC members, in the Think Tank Meetings organized by the Synchroniser project have been discussing, debating and suggesting new priority areas based on strengths of, and adaptability between the two regions. These inputs have been covered in various documents submitted by the Synchroniser project.

The world has changed over a period of these two years. India is in the process of putting together its 12th 5-Year plan for ICT while the "Horizon 2020" (the new name for FP8) which is EU's biggest ICT research funding framework programme is on the verge of getting launched.

There are several changes envisaged concerning various aspects on both sides, thus necessitating the need to revisit the decisions and directions taken earlier to derive an appropriate strategy that could work effectively in fostering cooperative research and development.

Priority areas identified by India for its 12th 5-Year plan

The Department of Information Technology (DIT) has recently compiled its 12th Five Year plan for ICT, which is currently being discussed amongst the stake holders that include Research Labs, Academia and Industry. New areas for ICT research include the following:
- e-Government
- e-Learning
- e-Security
- e-Industry (Electronics Hardware Industry)
- e-Industry (IT-ITeS Industry)
- e-Innovation/R&D
- e-Inclusion

ICT areas identified for funding by European Union's Horizon 2020

One of the important recommendations made during the 2nd SSC Think Tank meeting was to align the joint priority areas as close as possible to the challenge areas and technologies of the FP8 (Horizon

2020) scheme. The Horizon 2020 themes are not yet available for public consumption, but are largely expected to align to those prioritized by FP7 with a few additional ones. Broad thematic areas that can be explored for cooperation are indicated below.

As the main focus of Europe's Seventh Framework Programme (FP7) is to increase European competitiveness, special attention needs to be paid to those areas where India can offer more benefits; of special relevance are the Information Technology sectors, mostly software related.
In addition, for a better understanding of the common ICT fields where Europe and India could cooperate, SSC experts considered that it would be useful to differentiate the priorities and approaches depending on the type of entity participating: SMEs, large companies, research centres and universities/other academic institutes.

After evaluating the significance and relevance of several technology areas, the SSC experts during the First Think Tank meeting came out with the following list of common priorities for both the regions (EU & India):
- **IPv6**
- **Internet of things**
- **Smart grids**
- **Satellite communications**
- **GNSS - Galileo**
- **Security, Privacy and Monitoring**
- **DNS Security**
- **Digital Preservation**
- **Cloud computing**
- **Sensor networks**
- **Intelligent Transport Systems**
- **EU-India Regulation and standardization**

Further the list proposed by SSC members were classified into "Top-Down" and "Bottom-Up" approaches. **Top–down** and **bottom–up** are strategies of information processing and knowledge ordering, mostly involving software, but also other humanistic and scientific theories. In practice, they can be seen as a style of thinking and teaching.
In this scenario of classifying the priority areas, the experts considered the "core ICT technology domains" that determine the future novel technological evolutions as the top-down priorities. Consequently, in the process of elaborating the priority areas, SYNCHRONISER has taken the list of priorities identified by the SSC and further processed them into a two axis approach: Top-Down and Bottom-Up priorities:

- **Top-Up** represent the priorities identified because the European and Indians do have specific **skills in certain fields of the technology** and consequently, cooperation in these fields do represent enhance competitive position of Europe and India, through research and technology cooperation. Example of this priority identification is the ICT nanotechnologies, which can help the development of the corresponding industrial sectors in Europe and in Spain.

- **Bottom-Down** are the priorities identified because they represent **challenges of the society** for which technology development is needed. For example, a top-down priority is the societal challenge derived from ehealth needs derived from the factors due to ageing population; to respond to this, a number of research areas are needed to provide solutions from the ICT technologies. These are:
  - **E-Inclusion**
  - **E-Governance**

- o **Healthcare**
- o **Culture & Heritage/Digital Preservation**
- o **Multimedia & language technologies**
- o **EU-India regulation and standardization**

Additional areas suggested by the SSC during deliberations of the Third Think Tank meeting

The Synchroniser Steering Committee members discussed and analyzed the selected research priorities listed consisting of technical & horizontal recommendations. The experts gave their opinion and some new recommendations were proposed.

The additional priority areas include:
1. e-Learning
2. e-health
3. Spectrum Management
4. Ambient Assistance Living (AAL)
5. ICT for Environment

Together with these additional areas suggested, all priority areas have been discussed at length in the Perspective Action Plan 1 submitted by the Synchroniser project in December, 2011. The following table depicts a snapshot of the revised list of priority areas thus arrived at, and suggested modes of cooperation. Each of these areas comprise of sub-areas/fields that are at different stages of design, development and/or deployment. Some of the areas may have technologies at a nascent stage that offer opportunities for EU and India to start together with the basic design and proceed further with development. Areas such as Sensor Networks, Internet of Things and Cloud Computing fall in this category. With EU having gained a headstart in many areas, some of the technologies are at an advanced stage where joint RTD (Research & Technology Development) projects are possible in technologies where both sides can contribute to hasten up usable outcomes. Smart Grids and Satellite Communications are examples of such areas.

There are yet other areas such as IPv6, which has reached a maturity state while Spectrum Management is more of a process to regulate and promote efficient use of available radio frequencies. The table accordingly shows these areas only under the "Deployment" category.

Priorities areas for EU-India cooperation in ICT Research

A. Research priorities focusing on new and future technologies				
Priority area (Top-Down Approach)	**Design**	**RTD**	**Technology uptake**	**Deployment**
IPv6				√
Internet of Things	√	√	√	√
Smart Grids		√	√	√
Satellite Communication		√	√	√
GNSS – Galileo			√	√
Trust, Security, Privacy & Monitoring		√	√	√
DNS Security			√	√
Cloud Computing	√	√	√	√
Sensor Networks	√	√	√	√
Intelligent Transport Systems	√	√	√	√

B. Priorities addressing societal concerns that are common issues with localized needs				
Priority area (Bottom-Up Approach)	**Design**	**RTD**	**Technology uptake**	**Deployment**
e-Inclusion				√
e-Governance				√
e-Health				√
Ambient Assisted Living		√	√	√
Digital Preservation	√	√	√	√
Language Technology	√	√	√	√
EU-India Regulation & standardization	√			√
e-Learning				√
Spectrum Management				√
ICT for Environment	√	√	√	√

7.1 Top-Down Approach

The list includes research priorities focusing on new and future technologies:

7.1.1 IPv6

The Internet Protocol version 6 (IPv6) is the new version of the protocol realizing the Internet. It replaces the old version, IPv4. The main reason for the IPv6 deployment is the need for more IP addresses. Developed in 1981, IPv4 was primarily designed for research networks. New requirements arose with the emergence of the Internet connecting anyone to a worldwide network. IPv4 s able to provide 4.3 billion IP Addresses. With a worldwide population of 6.4 billion people and an increasing network the address space is running short. IPv6 provides 56.9 billion IP addresses. With a large address space it is possible to make an arbitrary number of devices per user available over the Internet.

IPv6 will have a great impact in research as large scale networking test beds are easy to deploy with this protocol, due to the auto-configuration and mobility enhancements. Research prototypes can now be tested in real world scenarios and the gap between simulated theory and reality can be closed. In addition, there is a big public interest in deploying this protocol for emergency communications and wireless internet access for citizens. IPv6 allows the possibility of peer-2-peers communications within these networks, allows seamless communication handovers and satisfies the requirements for identity management within these networks. The deployment of IPv6 by network operators and content/application providers is an increasing priority for all Internet stakeholders. In terms of public policy, IPv6 plays an important role in security, interoperability and competition.

EU-India cooperation in new developments of technologies and services based on IPv6 deployment will enable the growth of the Internet to support further innovation. IPv6 converts itself into a two-fold goal: enabler for further research and innovation based on a more powerful infrastructure of internet, and objective to develop advanced Internet applications, among others, those contained in the European Public Private Partnership of Future Internet

7.1.2 Internet of things

The Internet of Things concept is described as a self-configuring wireless network of sensors with a purpose to interconnect all things. The Internet of Things will likely be a non-deterministic and open network in which auto-organized or intelligent entities and virtual objects will be interoperable and able to act independently depending on the context, circumstances or environments. It will host Ambient Intelligence built upon Ubiquitous computing.

The system will be an example of event-driven architecture; bottom-up made and will consider any subsidiary level. Therefore, model driven and functional approaches will coexist with new ones able to treat exceptions and unusual evolution of processes. In an Internet of Things, the meaning of an event will not necessarily be based on a deterministic or syntactic model but would instead be based on the context of the event itself: this will also be a semantic web. It being made up of billions of parallel and simultaneous events, time will no more be used as a common and linear dimension but will depend on each entity. It will accordingly have to be based on massive parallel IT systems.

The Internet of Things will therefore be considered and studied as a Complex system due to the huge number of different links and interactions between autonomous actors, and its capacity to integrate new actors.

EU-India cooperation in this area can yield substantial useful results for mutual benefits.

7.1.3 Smart grids

The smart grid is an electrical network that integrates digital components to optimize the distribution of grid energy. Through mechanisms of a two-way communication, the smart grid reduces costs and

increases reliability and transparency of the network in the delivery of electricity.

The main objectives of the smart grid are to respond intelligently to different conditions of supply and demand; responding quickly to changes in the network at the fall of a node, providing smart energy demand, improving the availability, trying to reduce peak demand and optimizing the use of off-peak hours. Also, providing megabits, kilobits with power control and selling the rest (reselling the excess bandwidth provisioned on the smart grid). Also addressing scale and scope; thanks to the smart grid, scaling obtained robustness and fault-proof so that if the backbone network goes down the smart grid can keep on supplying power to consumers in island mode. Home Area Network; try to create a home network to control electrical consumption of various household electronic devices offering more information on what you consume each device at every moment and even off automatically if necessary.

EU Directive 96/92/EC led to a restructuring of the electricity sector across Europe, through the establishment of rules for a single internal market. This change was motivated by economic factors, looking for increased competition through the liberalization of the electricity market as well as environmental factors. The European Directives on electricity and gas in 2003 have replaced the aforementioned Directive 96/92/EC. This led to the emergence of various research projects and pilot installations in Europe, such as the ones by EDP (Portugal), MW Energie (Germany) and Tecnalia (Spain), as well as the European R & D microgrids with 22 companies and research centers from 11 countries are a few other examples.

This experience on the field could be very interesting for EU and India to develop the energy grid of the future, seeking solutions for services and devices reaching large economies of scale and immersive applications.

7.1.4 Satellite communications

Satellite broadband is a reality in all regions of the world since 2005. Success comes from coverage performance of satellite technology combined with drastic reduction of prices, which is a consequence of the introduction of high throughput satellites.

Satellite communications are the ultimate connecting means when the ground network is not or poor operating. Satellite communications is a strategic domain within the European ICT sector and a very relevant asset of India. Telecoms markets account for about $2/3^{rd}$ of the European satellite industry turnover (up and down stream revenues) and employment, and for 90% of all European commercial launches. Therefore, the European satellite communication industry is a fundamental element to sustain the whole European space industry and its strategic independent access to space.

Satellite communications are essential elements of any global network providing strategic applications in the domain of Information and education via cost effective broadcast networks (more than 77 Millions European homes), True service continuity anywhere (inland, overseas and in the air), Digital inclusion as well as Security, defence and disaster management.

In Europe, ESA (the European Space Agency) and its Member and Cooperating States is developing space technologies and systems, supporting innovation and global competitiveness and preparing for the future. Their activities are focused on exploration of space and on the basic tools: access to space, scientific knowledge and technologies. In addition, Europe needs to remain an indispensable international partner providing first-class contributions to global initiatives and leadership in selected domains in accordance with European interests and values. According to ESA principles, Europe assesses opportunities for cooperation according to the access they bring to complementary capabilities or to markets and a fair sharing between partners of efforts, costs and risks.

Internationally, India is viewed by space faring nations as an emerging space power capable of achieving its goals in a more cost effective and time-efficient manner. Countries look to India for assistance in building up their capabilities to derive benefits of space technology. The scope of international cooperation has become wider and diverse, as ISRO (Indian Space Research Organisation) has made tremendous progress in recent time. Formal cooperative arrangements in the form of either Agreements or Memoranda of Understanding (MoU) or Framework Agreements have

been signed with European Centre for Medium Range Weather Forecasts (ECMWF), European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), European Space Agency (ESA) and with specific European Countries (such as France, Germany, Hungary, Italy, Spain, Sweden, The Netherlands, United Kingdom, etc) with a massive scope for further cooperation.

Therefore, joint cooperation between European and Indian researchers in the field of Satellite Communications offer a very promising landscape. The European Integral SatCom Initiative (European Technology Platform ISI) can be used as an instrument to channel the cooperative research between Europe and India on SatCom related technologies.

7.1.5 GNSS – Galileo

The most important European project in the field of navigation and position location is the Galileo system (fully civilian owned and managed as opposed to GPS that is fully owned by the US military). Aiming to satisfy both European and non-European markets, Galileo can be used to provide security in traffic and transportation, from engineering surveys, through construction to the maintenance of roads, to accident studies, navigation and mapping. In addition, Location Based Systems (LBS) nowadays are an important aspect for Galileo.

India has a great interest on European collaborations and on space research and there is a strong demand in India for international cooperation in the framework of Galileo technology. Areas of cooperation could be:

• Road: construction and maintenance of roads, navigation and mapping, road monitoring, traffic management and control, traveler information systems and parking management, accident studies.

• Aviation.

• Location Based Systems: e-commerce, entertainment, emergency and mobility applications.

• Agriculture: topographic reports, farm management, Crop yield monitoring, build maps with historical review of the field areas etc.

• Land and maritime navigation systems could provide a dramatic improvement in the quality of life in India in a more sustainable manner.

7.1.6 Trust, Security, Privacy and Monitoring

The new forms of interaction via social media, mobile communication, internet-of-things technologies can give more autonomy to media users. Since the boom of new mobile technologies and social networks, one of the major concerns of businesses, governments and users is to ensure the security of the information contained in these new media. The vulnerability of people engaging in mass self- communication will change and will possibly increase. This notion of 'vulnerability' refers to issues like privacy, surveillance, trust and security.

Government of India has mandated implementation of ISO27001 ISMS (Information Security Management) by all critical sectors, that has mainly three components; Technology, Process Incident Reporting and Monitoring. Out of 7735 certificates issued worldwide, 296 certificates have been issued in India that mainly belongs to IT/ITES/BPO sector. In 2004, the DIT had created CERT-In (the Indian Computer Emergency Response Team) which is a government-mandated information technology (IT) security organization. The purpose of CERT-In is to respond to computer security incidents, report on vulnerabilities and promote effective IT security practices throughout the country.

According to IDC, the income of the Security Application Market in Western Europe reached $ 390 million in the second quarter of 2009. Information security remains a matter of priority and security market will increase its volume of business to the 7,300 million dollars by the end of 2010, which means an average annual growth of 11%.

7.1.7 DNS Security

The Domain Name System (DNS) is vital to the Internet, providing a mechanism for resolving host names into Internet Protocol (IP) addresses. Insecure underlying protocols and lack of authentication and integrity checking of the information within the DNS threaten the proper functionality of the DNS. The DNS plays a critical role in supporting the Internet infrastructure by providing a distributed and fairly robust mechanism that resolves Internet host names into IP addresses and IP addresses back into host names. The DNS also supports other Internet directory-like lookup capabilities to retrieve information pertaining to DNS Name Servers, Canonical Names, Mail Exchangers, etc. Unfortunately many security weaknesses surround IP and the protocols carried by IP. This could expose Internet users to attacks by allowing hackers to redirect users to fake website addresses. So, when users type in the name of a legitimate website, they are taken to a fraudulent one instead, putting them at risk of phishing and other scams. Therefore, researchers are working on DNS security extensions to increase security within the DNS. The majority of the weaknesses within the DNS fall into one of the following categories: Cache poisoning, client flooding, dynamic update vulnerability, information leakage, and compromise of the DNS server's authoritative database.

DNSSEC is an Internet standard that prevents spoofing attacks by allowing Web sites to verify their domain names and corresponding IP addresses using digital signatures and public-key encryption. It is being deployed across the Internet infrastructure, from the root servers at the top of the DNS hierarchy to the servers that run .com and .net and other top-level domains, and then down to the servers that cache content for individual websites. Afilias, an organization which operates info and more than a dozen other website extensions is in the process of deploying DNSSEC on 13 of the domains it operates, including info, India's in, and the Hong Kong-based in Asia.

Under ICANN's new development program on IDN (Internationalized Domain Names), the number of gTLDs (Generic top-level Domains) at the end portion of an Internet address name, such as ".com" or ".org", that are not associated with any specific country will eventually be expanded from its current 21 to include almost any word, in almost any language.

International Cooperation on DNS security therefore is of vital importance to avoid possibility of a breakdown in order to maintain a healthy DNS system for continuity of a single, interoperable and reliable Internet.

7.1.8 Cloud computing

Cloud computing is a paradigm for large-scale distributed computing that makes use of existing technologies such as virtualization, service-orientation, and grid computing. It offers a different way to acquire and manage IT resources on a large scale.

Some of the most important features of the cloud computing are agility, API access, reduced cost, device and location independence, centralization of infrastructure in locations with lower costs, peak-load capacity increased, utilization and efficiency improvements for systems, reliability improvement if multiple redundant sites are used, dynamic scalability, improved security by using a centralized security-focused resources, easier maintenance and metering of usage.

Cloud computing is in a period of realization from speculation and hype to widespread adoption by the ICT community. The market research firm Gartner has published a study that predicts an imminent explosion of cloud computing market. According to forecasts, the sector achieved a turnover of 68,000 million in 2010, which represents an increase of 17% over 2009, despite the crisis and the reduction in business investment in information technology. Over the next five years, it is expected that over 100,000 million dollars will be invested in the segments of Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IAAS). According to India based research firm Zinnov, the Indian cloud computing market is going to experience a tenfold growth by 2015. According to the firm, the current cloud computing market is $110 Million today with,

approximately, 66 Million in the SaaS market dominated by applications such as collaboration apps, CRM and ERP. The remaining $ 44 Million is shared by the PaaS and IaaS. By 2015, the cloud computing market in India will reach 1 Billion with SaaS capturing 650 Million dollars while PaaS and IaaS cumulatively get around 440 Million dollars. This data sort of mirrors the understanding about the Indian market.

Cloud computing is expected to reshape the Indian IT market by generating new opportunities for IT vendors and driving in traditional IT offerings. Chances are high that companies that are not adopting IT today and don't have major investments in data centres and server farms will directly move into the cloud model. Collaboration on e-governance via cloud technologies will help speed up the roll-out of more Citizen Services, which is the key priority of government IT spend today and also help to increase access to these services. Currently, IT/ITeS contributes to 19 percent of the total cloud market in India, followed by Telecom at 18, BFSI at 15 per cent, manufacturing at 14 percent and government at 12 percent.

Considering the wide opportunity for cloud computing research in India, this is one of the obvious priority areas for EU-India collaboration.

Green Computing: Perspective with respect to Indian Scenario: In India, there is hardly any commercial production of indigenously built equipments. Almost the entire hardware is sourced from foreign companies who either import the equipments or produce part of them in Indian subsidiaries. Due to tax relief given by the Government for importing computer hardware, many small and medium scale industries were induced to procure hardware at low prices and venture into the building of IT infrastructure. With price being the most important criterion, the basic objective was to build basic infrastructure without considering the principle of green computing.

Most of the large companies nowadays gone for implementation of Enterprise Resource Planning package or at least started using large customized software coupled with use of Database Management Systems and eventually having very large distributed database in different servers. They may also have massive networking infrastructure or Client Server Architecture and at this stage it is really not easy to switch over to new equipments and reinstate the operation without any effect to the soft resources and data communications at different level.

The need for green computing is considered as a tool to enable solutions leading to more sustainable lives in both the regions and collaboration in this area has to be recognized.

7.1.9 Sensor networks

Smart environments represent the next evolutionary development step in building, utilities, industrial, home, shipboard, and transportation systems automation. Like any sentient organism, the smart environment relies first and foremost on sensory data from the real world. Sensory data comes from multiple sensors of different modalities in distributed locations. The smart environment needs information about its surroundings as well as about its internal workings. The information needed by smart environments is provided by Distributed Wireless Sensor Networks, which are responsible for sensing as well as for the first stages of the processing hierarchy.

Research on Wireless Sensor Networks is focused on aspects like efficient energy motes designs, mesh routing protocols or sensor integration. Research in this area is also intended to be a support for physicist, chemists, farmers…, those who have ideas about how to use data acquired by sensor networks but lack of the technical knowledge required for electronic design.

In India, Sensor Network Technology is currently a research area mainly for applications such as Wildlife Research and Planetary Exploration. In Europe several projects have been initiated such as ESNA (European Sensor Network Architecture), CRUISE (Creating ubiquitous intelligent *sensing* environments) and LOIS (LOFAR Outrigger in Scandinavia). India can take advantage of the European experiences to fast track its ventures in this area.

7.1.10 Intelligent Transport Systems

National Highway Authorities in India are looking for Intelligent Traffic Systems (ITS) solutions for

Traffic on Roads and Tunnels.

ERTICO - ITS Europe is a multi-sector, public-private partnership pursuing the development and deployment of Intelligent Transport Systems and Services (ITS).

Common areas of concern on which both sides can work together are:

- Optimization of data concerning roads, traffic and travel through an information service on traffic and travel in real time.
- Continuity of traffic and freight management ITS services on transport corridors and in conurbations through a common framework.
- Promotion of good practices in road safety and security through the promotion of the deployment of advanced Driver Assistance Systems and ITS systems for safety and security.
- Integration of vehicles in transport infrastructure, for example through a platform of ITS services and applications.
- Personal data protection.

7.2 Bottom-up Approach

The list includes research addressing societal concerns that are common issues with localized needs:

7.2.1 e-Inclusion

e-Inclusion ('e' standing for electronic, e-Inclusion is also referred to as 'digital integration') is a concept centered on involving people in the Information Society through facilitating access to and use of ICT. The objective of e-Inclusion is to achieve a truly inclusive Information Society by reducing the digital divide at home, at work, in education and in public provision through e-Government and e-Health services, e-Education, e-Agriculture, e-Business, etc.

e-Inclusion policies are aimed at:

- Removing barriers that prevent access to tools and services of the Information Society for people who cannot afford ICT, people with functional restrictions and people who lack required skills
- Avoiding exclusion, forms of which can be directly linked to ICT, including risks of social and economic deprivation among people who do not use ICT as more e-Services are established
- Harnessing opportunities offered through ICT in order to support exclusion-prone communities in terms of better access to education and employment, and
- Exploiting ICT for the purposes of empowerment, motivation and networking among individuals and utilizing technologies that contribute towards the development of social capital.

e-Inclusion policies consist of a range of measures. Measures include legislation and regulation, institutional development, support and subsidy, and fiscal policy.

In India, the Approach to Twelfth Five Year Plan has set the goal ***"Faster, Sustainable and More Inclusive Growth"*** Going by this broad objective of the Twelfth Five Year Plan the strategic plan on e-Inclusion aims at more Inclusive Growth enabled by e-Inclusion to ensure – social justice and alleviation of poverty to the extent possible with the help of ICT during the Twelfth Five Year Plan.

e-Inclusion has the ability to improve the society as a whole by social inclusion. Expanding access to ICT for marginalized groups is likely to reduce their social exclusion simply through facilitating access and participation, while the potential of the internet as a vehicle for expression and easier communication often translates to individuals who are more involved and communities that are more integrated.

e-inclusion will be one of the potential areas for collaboration between Europe and India.

7.2.2 E-Governance

e-Governance in India has steadily evolved from computerization of Government departments to initiatives that encapsulate the finer points of Governance, such as citizen centricity, service

orientation and transparency. Lessons from previous e-Governance initiatives have played an important role in shaping the progressive e-Governance strategy of the country. Due cognizance has been taken of the notion that to speed up e-Governance implementation across the various arms of Government at National, State, and Local levels, a programme approach needs to be adopted, guided by common vision and strategy. This approach has the potential of enabling huge savings in costs through sharing of core and support infrastructure, enabling interoperability through standards, and of presenting a seamless view of Government to citizens. The National e-Governance Plan (NeGP), takes a holistic view of e-Governance initiatives across the country, integrating them into a collective vision, a shared cause. Around this idea, a massive countrywide infrastructure reaching down to the remotest of villages is evolving, and large-scale digitization of records is taking place to enable easy, reliable access over the internet. The ultimate objective is to bring public services closer home to citizens, as articulated in the Vision Statement of NeGP.

eGovernment on the fast track: eGovernment has developed significantly in recent years and is now seen as a tangible reality by millions of citizens. The impact of eGovernment is being felt by citizens and companies well beyond government services, with tools such as electronic identity helping citizens and business in everyday activities across society. However, much more still needs to be done. In May 2010, the European Commission revealed its Digital Agenda for Europe (DAE), a major roadmap defining the key roles that the use of ICT will have to play if Europe wants to succeed in its ambitions for a flourishing digital economy by 2020. ICT systems are now at the heart of government processes, but efforts are still needed to ensure they continue to improve the delivery of government services.

ICT research in eGovernment is focused on the underlying technologies that lead to a simplification of services – from the end-user's point of view to the public organisations. European Commission is currently funding 9 FP7 research projects in the field of eGovernment.

7.2.3 Healthcare

ICT adoption in Healthcare industry comprises of the implementation of various ICT solutions which facilitate efficient, enhanced & high quality healthcare operations. Some of the healthcare industry segments are hospital & infrastructure, biotechnology & pharmaceuticals, medical equipments & supply, diagnostic & pathology. Rapid growth in the healthcare industry and need for overcoming the rural-urban gap in service availability will drive the ICT adoption in healthcare industry in India.

India is perched to witness additional growth in its economy as a result of positive trends within the healthcare sector. Reports clearly suggest that healthcare sector is going to be one of the major sectors that would fuel the economic growth and will contribute to the increased revenues, along with IT Services and Education sectors in the country.

Indian healthcare sector is poised to reach US$ 280 billion by the year 2020, thereby contributing an expected Gross Domestic Product (GDP) spend of 8 per cent by 2012 from 5.5 per cent in 2009, according to a report by an industry body. Increasing population, higher expenditure on lifestyles, rising market of health insurance, government initiatives for better medical infrastructure, and focus on Public Private Partnership (PPP) models are some of the driving factors for the growth of healthcare sector in India.

Major players in the Indian healthcare sector include Apollo Hospitals Enterprise Ltd, Fortis Healthcare Ltd, Max Hospitals and Aravind Eye Hospitals. In May 2010, Apollo Hospitals, Asia's largest health care provider, and Cisco announced an alliance to help transform health care through information and communications technology (ICT).

Healthcare systems are becoming increasingly dependent on Information and Communication Technologies (ICTs) to deliver top-quality care to European citizens. There are currently more than 70 FP7 projects under ICT for Health.

The introduction of e-Health represents the promise of information and communication technologies to improve health and the healthcare system. To work towards the goal "Good Health Care Services Round the Clock for Everyone, Everywhere", the Ministry of Health & Family Welfare (MoH & FW), Government of India had proposed to facilitate expansion of e-health initiatives in all states of the country over its eleventh 5-year plan in a comprehensive manner:

a. **Computers, Software and Networking:** All primary health centers in villages should be equipped with computers and patient management software to give quality treatment at the grass root level. The software can help in the diagnosis as well as in the treatment of the patient.

b. **Health Card:** A health Card should be issued to a household which would bear health record of all members of the family.

c. **E-consultations/E-prescription:** The software should have latest evidence based treatment protocols for common diseases which can be boon to a doctor working in PHCs & CHCs helping him deliver quality treatment at patients door-step as well as maintaining complete patient & disease database, which could be priceless in policy making & disease preventions and other health related objectives. Complicated patients who need specialist's opinion can be taken up for E-consultation over the net with distant doctors through the software without leaving the consultation chamber of a remote PHC.

d. **Hospital Management Software:** A hospital & patient management software can be installed at bigger district/multi-specialty hospitals for increased quality of clinical work and work efficiency. Both the software can be linked together vide internet for transfer of data & work efficiency.

e. **E-Governance in Health Sector:** Health Informatics is implemented to tone up the administration, facilitate accounting and enable effective management control. It also deals with collection, storage, retrieval, communication and optimal use of health related data, information and knowledge base.

Major Implementing Agencies of e-Health infrastructure in India
- Ministry of Health and Family Welfare
- Department of Information Technology, Ministry of Communication & IT
- Indian Space Research Organization
- State Governments
- Medical Institutions

Research & Development (DIT Initiatives)
- Center for Development of Advance Computing
  - HIS, SGPGIMS
  - Telemedicine Software
- Media Lab Asia Initiative in collaboration with many premier medical and technical institutions.

At EU level, the introduction of eHealth services is facilitating access to healthcare, whatever the geographical location, appreciating innovative telemedicine and personal health systems. eHealth is also breaking down barriers, enabling health service providers (public authorities, hospitals) from different Member States to work more closely together. e-Health refers to the use of modern information and communication technologies to meet needs of citizens, patients, healthcare

professionals, healthcare providers, as well as policy makers.

eHealth tools – such as databases for patient records, mobile monitors which transmit data automatically, or handling systems for patient call centres – also benefit from the development of a European market in the sector, which has enabled them to build a strong base from which they can tackle the global market. The EU's eHealth action plan sets out a clear road map for this sector. European Union has supported research efforts in the field of eHealth for more than two decades now. The technologies developed in hundreds of successful projects have contributed to improving healthcare provision in many and varied areas. eHealth is a priority for EU research funding in the current Framework Programme (FP7) which runs until 2013.

7.2.4 Ageing

EU Action Plan for Ageing Well in the Information Society: In response to challenges and opportunities, the European Commission has launched an Action Plan for Ageing Well in the Information Society with the following measures:

- **Raising awareness**, and building consensus via stakeholder cooperation and the establishment of a best practice internet portal and European award scheme for smart homes and independent living applications; Status: A best practice portal has been established at http://www.epractice.eu where a number of ICT & Ageing related cases can already be found. In addition a multi-stakeholder innovation platform with an associated Research and Innovation roadmap has been set up through the AALIANCE project (http://www.aaliance.eu/) and two ministerial events were held in Lisbon in 2007 and Vienna in 2008. Furthermore annual conferences were held by the AAL Joint Programme in Austria and Denmark with participation of the European Commission, see http://www.aal-europe.eu.
- Overcoming **technical and regulatory barriers** to market development, through market assessments, studies and benchmarking and by facilitating the exchange of best practice between Member States; Status: A major study was completed in 2008 to provide an overview of the usage of ICT products and services by elderly people, Another study analysing the current market conditions and barriers in 10 representative European countries, the US and Japan has been completed, see http://www.ict-ageing.eu.
- **Accelerating take-up through**, for example, a set of pilot projects under the ICT Policy Support Programme and use of Structural Funds; Status: 11 large pilot projects related to ICT & ageing have so far been launched with involvement of more than 40 European regions and 10,000 users. Collaboration has been started with DG REGIO to disseminate good practice on ICT & Ageing solutions, e.g. through the annual Regions for Economic Change conferences. An investment forum has been established to promote public and private investments in ICT for Ageing Well solutions jointly with the AAL Joint Programme and with participation of the European Investment Bank. The first event was held on 14-15 September 2010 in Denmark, see: http://www.aal-invest.eu/.
- Boosting **research and innovation to foster the emergence of innovative, ICT-based products, services and systems for Europe's ageing population**. This includes a dedicated action in the 7th Framework Programme and EC support to the new Ambient Assisted Living Joint Research and Innovation programme involving 23 European Countries. Status: More than 30 ageing related R&D projects have been launched under Framework Programme 6 and 7 until now.

7.2.5 Ambient Assisted Living (AAL)

Ambient assisted living (AAL) is the use of information and communication technologies (ICT) in a

person's daily living and working environment to enable individuals to stay active longer, remain socially connected and live independently into old age.

ICT can help authorities meet the needs of growing numbers of elderly people. Ambient Assisted Living (AAL) solutions mean ageing citizens can continue to live in their preferred environment for longer. AAL users gain increased autonomy, self-confidence and mobility. AAL saves valuable resources in the health and care communities; it also presents new challenges and opportunities for researchers, companies and policy-makers alike.

Although because of the joint family culture in India, the need for AAL has not yet been recognized as an important priority area, there is no denying the demand owing to the gradual increase in the number of older adults living independently. The Indian government has yet to work out a plan to deal with this need of the country's aging citizens, but the private sector has recognized its gradual growing demand and has been promoting the concept of retirement homes. The target market for retirement homes is mainly retirees whose children live outside India or elderly couples and singles who do not have children or live separately. Some of the developers of these retirement homes can now also be observed targeting elderly non residents, who visit India for a few months to meet their relatives or manage ancestral properties that they may have. A retirement home is designed on the concept of a smart home. A "smart home" is a residential setting equipped with a set of advanced electronics, sensors and automated devices specifically designed for care delivery, remote monitoring, early detection of problems or emergency cases and promotion of residential safety and quality of life. Information and Communication Technologies (ICTs) are utilized to allow individuals to live independently in their preferred environment. Thus, systems are patient-centered rather than institution-centered as they are designed to address the needs of individuals, their families and caregivers rather than for health care facilities.

These new smart home based retirement communities are however available only for the affluent so far. A resident pays a fee of around 350 Euro per month, which is a bit unaffordable to the common man in a country where the average worker earns hardly 90 Euro a month. An undercurrent is slowly becoming visible in the Government corridors and DIT is expected to take this gradually increasing need into focus soon and draw out its policy for identifying AAL as a priority area for research and development. This in turn, is expected to promote innovation in the industry for development of low cost solutions to help elder individuals improve their quality of life at an affordable cost.

Europe's population is ageing rapidly: between 2010 and 2030, the number of people aged from 65 to 80 will rise by nearly 40%, posing enormous challenges to Europe's society and economy. ICT can help the elderly to improve their quality of life, stay healthier, live independently for longer and remain active at work or in their community. A wide range of services could be offered to address daily needs such as:
- Social communication: easy and continuous access to phone and video conversations, overcoming social isolation;
- Daily shopping: easy ordering of goods online for home delivery;
- Safety: security systems to lock/unlock entrance doors and windows or to check for water and/or gas leaks, etc or installation of user friendly interfaces for domestic and other appliances;
- Health: telemedicine from home, wearable systems for monitoring and diagnosis of individuals with a chronic disease (such as heart disease and diabetes).

In many EU countries where over half of people aged 65+ live alone, such technologies can significantly extend the time that elderly people live independently in their own house, while at the same time avoid costs for hospitalisation and provide a basis for additional applications in the future

(smart homes, telemonitoring, robotics, embedded systems, biosensors, etc. Ageing Well in the Information Society, the Commission has supported ambient assisted living (AAL) joint research programme of Member States within FP7.

This forward-looking Action Plan is designed to create political and industrial momentum for developing and deploying user-friendly ICT tools and services. One plan, three 'life situations':

- Ageing well at work – staying active and productive for longer, with better quality of work and work-life balance with the help of easy-to access ICT, innovative practices for adaptable, flexible workplaces, ICT skills and competencies, and ICT enhanced learning (e-skills and e-learning).
- Ageing well in the community – overcoming the isolation that many elderly people experience by keeping up social networks and reducing loneliness with ICT solutions (publicly and privately supplied).
- Ageing well at home – where technology helps people enjoy a better quality of life for longer while maintaining a high degree of independence, autonomy and dignity.

7.2.6 Culture & heritage and Digital Preservation

The communications and media industries are among the most promising sectors in Europe's economy thanks largely to digital convergence, which grants consumers of audiovisual content unrivalled power in choosing what they want to see, and when and where they want it to see it. Europe's cultural industries - audiovisual, media, publishing, libraries, museums and more - are well placed to supply that content, but they must evolve in this rapidly changing world. Information and communication technologies provide a whole range of opportunities for using Europe's rich cultural and scientific resources. EU-funded research (ICT programme) will contribute to improving digital libraries and digital preservation technologies. Digital libraries make cultural resources more easily accessible and open new ways for people to experience their cultural heritage, and digital preservation helps keeping the past and the present for the future. Also Europe's cultural, telecommunications and IT industries need to work together if they are to develop advanced, interoperable technologies and services. And because the Internet does not notice national boundaries, finally, harmful and illegal Internet content needs to be defined and tackled at a European and global level.

The culture of India is an amalgamation of these diverse sub-cultures spread all over the Indian subcontinent and traditions that are several millennia old. Ministry of Culture plays a vital role in the preservation and promotion of art and culture. Its aim is to develop ways and means by which basic cultural and aesthetic values and perceptions remain active and dynamic among the people. It also undertakes programmes for the promotion of various manifestations of contemporary art. The Department is a nodal agency for commemorating significant events and celebrating centenaries of great artists. Ministry is engaged in a variety of activities, ranging from protecting and encouraging cultural endeavors at the grassroots level, to promoting cultural exchanges internationally; from programs to preserve India's ancient heritage to encouraging an array of contemporary creative arts. The Ministry's task is to develop and sustain ways and means through which the creative and aesthetic sensibilities of the people remain active and dynamic. Ministry of Culture is also responsible for implementation of various UNESCO conventions in the field of Culture.

EU India cooperation in culture and heritage will bring enriching results.

Digital preservation: It is the set of processes and activities that ensure continued access to information and all kinds of records, scientific and cultural heritage existing in digital formats. Some of the strategies on digital preservation are: refreshing, migration, replication, emulation, metadata attachment and trustworthy digital objects that are digital objects that can speak about their own authenticity.

According to India's former culture minister and current Minister of Information and Broadcasting,

Ms. Ambika Soni, the National Database of Manuscripts is a world record of five million documents. In India, which is the country that has ancient manuscripts, it is estimated that only 20% of the country documents have been digitized. Other spheres where there is a need for long–life data are Medical Records, Satellite & Earth Service Data, Land Records, etc. To address these needs, DIT has embarked on the ambitious National Digital Preservation Programme (NDPP) with participation of whole lot of stakeholders and researchers. A project "Tools for digital preservation management of Heritage Archives" executed by C-DAC Pune is focused on development of software tools to address the long-term digital preservation issues related to Heritage Archives like management of digital content, management of preservation metadata, resource management, auto extraction of technical metadata, interface design for curators of heritage archives et al. C-DAC has also signed a MoU with the National Archives of India (NAI), New Delhi which is an attached Office of the Ministry of Culture responsible for the preservation of all official records of the Government of India. This MoU has been signed as part of the project of 'Centre of Excellence for Digital Preservation' sanctioned by the Department of Information Technology. The implementation of the MoU will enable the NAI to develop the technical capabilities for digital preservation and acceptance of records.

Cooperation in this area can result in building collaborations to support the preservation of the collective digital memory.

7.2.7 Multi language and Language technology

India is a country with 452 individual, recognized languages out of which 438 are living languages. The Indian constitution recognizes 22 official languages that include English, which is used by less than 10% of its population. The IT domain is developing at a massive speed but information is available mostly in English and is not actually reaching the masses. Only 4.2 crore people in India are conversant with IT, which is hardly 4% of the total population. For this percentage to increase substantially, it is necessary to be able to use computers in local languages. Language Technology is a very important focus area of research and development recognized by the Department of Information Technology, Government of India. The TDIL Programme initiated by the Department of Information Technology (DIT), Ministry of Communication & Information Technology (MC&IT), Govt. of India has the objective of developing Information Processing Tools and Techniques to facilitate human-machine interaction without language barrier; creating and accessing multilingual knowledge resources; and integrating them to develop innovative user products and services. The Programme also promotes Language Technology standardization through active participation in International and national standardization bodies such as ISO, UNICODE, World-wide-Web consortium (W3C) and BIS (Bureau of Indian Standards) to ensure adequate representation of Indian languages in existing and future language technology standards.

In India, target areas for R&D in Language Technology

Target areas of R&D projects funded by the department include the following:

- Speech Processing
    - Speech Recognition
    - Speech Synthesis
- Natural Language Processing (NLP)
    - Machine Translation
    - Information Extraction & Retrieval (IR)
    - Semantic Search
- Optical Character Recognition (OCR)
    - Indian Languages OCR
    - Indian Language On-Line Handwriting Recognition (OHR)
- Localization
    - Fonts (TTF & OTF) for Indian Languages
    - Data Processing Tools
    - Standardization in Localization benefiting e-governance

- Localization of Middleware
- IDN & E-mail Id in local languages
- Transliteration amongst Indian Languages

In Europe, Human Language Technologies or HLT, cover many research groups and disciplines including natural language processing, speech technology, machine translation, information extraction, and so on. The European Commission has supported HLT for some 40 years now. European support has been stepped up, starting with the publication of the Communication "Multilingualism: an asset for Europe and a shared commitment", and being followed by the creation of our Unit: Language technologies, machine translation. Europe, with its people and skills, and variety of languages accounts for 50% of the worldwide language services market, and the experience and expertise is there to provide tangible results.

In Europe, target areas for R&D in Language Technology
- Speech Processing
  - Speech Recognition
  - Speech Synthesis
- Natural Language Processing (NLP)
  - Machine Translation
  - Information Extraction & Retrieval (IR)
  - Semantic Search
- Optical Character Recognition (OCR)

Europe and India as multi lingual regions can bring out solutions to challenging issues related to language technology.

7.2.8 Spectrum Management

Spectrum management is the process of regulating the use of radio frequencies to promote efficient use and gain a net social benefit. The term radio spectrum typically refers to the full frequency range from 3 kHz to 300 GHz that may be used for wireless communication. Increasing demand for services such as mobile telephones and many others has required changes in the philosophy of spectrum management. Demand for wireless broadband has soared due to technological innovation, such as 3G and 4G mobile services, and the rapid expansion of wireless internet services. Since the 1930s, spectrum was assigned through administrative licensing. Limited by technology, signal interference was once considered as a major problem of spectrum use. Therefore, exclusive licensing was established to protect licensees' signals. This former practice of discrete bands licensed to groups of similar services is giving way, in many countries, to a "spectrum auction" model that is intended to speed technological innovation and improve the efficiency of spectrum use. During the experimental process of spectrum assignment, other approaches have also been carried out, namely, lotteries, unlicensed access and privatization of spectrum.

Spectrum management is a growing problem due to the growing number of spectrum usage:
- Over the air broadcasting (that started in 1920).
- Government and Research which include defense, public safety (maritime, air, police), resource management, transport, radio astronomy, etc.
- Commercial services to the public (voice, data, home networking)
- Industrial, scientific and medical services which include Telemedicine, remote control, etc.

In the 80s, the only concern was about radio and television broadcasting; but today mobile phones and wireless computer networks are more and more important as fewer than 15% of US households

rely on over the air broadcasting to receive their TV signals. The spectrum is divided into different frequency bands, each of them has a specific application. For instance, the frequency band that covers 300 kHz to 535 kHz is reserved for aeronautical and maritime communications and the spectrum from 535 kHz and 1605 kHz for AM radio. The next step is to assign frequencies to specific users or classes of users. Each frequency band has a specific assignment that depends on the nature of the application and the numbers of users. Indeed, some applications require a wider band than others (AM radio uses blocks of 10 kHz where FM radio uses blocks of 200 kHz). In addition, "guard band" are needed to keep the interference between applications to a minimum.

With the digital transition, spectrum management has entered to a new age. Full conversion to digital TV by 2/17/2009 (Digital Transition and Public Safety Act of 2005) allows broadcasters to use spectrum more efficiently and save space for the possibility of sharing spectrum. Nowadays, spectrum sharing is under heated discussion. Exponential growth of commercial wireless calls for additional spectrum to accommodate more traffic flows. Secondary market is allowed to emerge and licensees are encouraged to lease use of spectrum to third parties temporarily. More alternatives are underway.

Spectrum scarcity has emerged as a primary problem encountered when trying to launch new wireless services. The effects of this scarcity is most noticeable in the spectrum auctions where the operators often need to invest billions of dollars to secure access to specified bands in the available spectrum. In spite of this scarcity problem, recent spectrum utilization measurements have shown that the available spectrum opportunities are severely under-utilized or left unused. This artificial "access limitation" based scarcity is often considered to result from the static and rigid nature of the command and control governance regime. Interested parties have now started to consider possible improvements in the governance regime by relaxing the constraints on spectrum access. Two prevailing models are the "spectrum commons" and the "spectrum property rights" approaches.

Authority for Spectrum Management in India: The WIRELESS PLANNING & COORDINATION (WPC) wing of the Department of Telecommunications, Ministry of Communications & Information Technology, created in 1952, is the National Radio Regulatory Authority responsible for Frequency Spectrum Management, including licensing and caters for the needs of all wireless users (Government and Private) in the country. It exercises the statutory functions of the Central Government and issues licenses to establish, maintain and operate wireless stations. WPC is divided into major sections like Licensing and Regulation (LR), New Technology Group (NTG) and Standing Advisory Committee on Radio Frequency Allocation (SACFA). SACFA makes the recommendations on major frequency allocation issues, formulation of the frequency allocation plan, making recommendations on the various issues related to International Telecom Union (ITU), to sort out problems referred to the committee by various wireless users, clearance of all wireless installations in the country etc.

Radio spectrum is an essential resource underpinning one of Europe's most dynamic sectors: wireless communications as well as telecommunications, wireless technologies support services in areas as diverse as transport, security and environmental protection. But the spectrum is a finite resource so its allocation requires effective and efficient coordination at European (and global) level.

The technologies and applications which make use of radio spectrum are amongst the most innovative and essential for economic growth. The EU has a key role in ensuring the best use of radio spectrum through provision of an optimum regulatory framework. The framework must ensure that appropriate spectrum is available for new and existing users, avoid potential interference between applications and support innovation and enterprise. European Commission regularly checks the status of national implementation of agreed European initiatives by requesting detailed information on frequency allocations.

At present, a number of 'hot topics' are the focus of policy-makers: Reorganization, Transport, Electronic communications services. The total volume of services which depend on radio spectrum availability is estimated to be worth at least €200 billion annually in Europe.

The allocation and management of radio spectrum in Europe is administered by national regulatory authorities. European radio spectrum policy, working with national authorities and international regulatory bodies, sets the framework and boundaries for the 'how, what and when' of spectrum management in Europe. This ensures that radio spectrum use is coordinated nationally, regionally and globally and that its regulation is appropriate and relevant to today's technical and societal challenges and demands. Radio transmissions do not respect international borders, so international co-operation is a vital element of radio spectrum management and development. In addition to close liaison with European national and regional authorities, the Commission has close connections with international bodies that develop global regulations and guidelines for radio spectrum management.

Spectrum Management is becoming important one of the priority areas in both the regions and cooperation in this area has to be enhanced.

7.2.9 ICT for Environment

The impact of human activities on the environment, and climate change in particular are issues of growing concern confronting life on Earth. At the same time, information and communication technologies (ICTs) are being rapidly deployed around the world. Although ICTs require energy resources, they also offer a number of opportunities to advance global environmental research, planning and action. This includes monitoring and protecting the environment as well as mitigation of and adaptation to climate change.

Today, a broadband Internet connection is probably the most important tool to support environmental research, learning and decision-making. There is a need to strengthen the capacity of developing countries to benefit from the use of ICTs for managing the environment to help countries mitigate the impact of and adapt to environmental and climate change, all while helping them to achieve the Millennium Development Goals.

There is a clear need for a more comprehensive and integrated approach to global environmental action through access to ICTs and the use of information technologies and management practices to eliminate duplication of efforts. ICTs provide a unique opportunity to do so while assisting in building local capacity to use these tools and practices. There is also a need to assign the environment a more important profile in ICT strategic planning initiatives at the national level and, in particular, in e-Government initiatives so that the use of ICTs for the environment is integrated into planning processes from the beginning, along with other national priorities and initiatives.

The National Environmental Engineering Research Institute (NEERI) under Council of Scientific & Industrial Research (CSIR), Ministry of Science and Technology, Government of India recognizes the need for using ICT for e-Environment. Established in 1958, it is devoted to research and innovations in environmental science and engineering besides solving a range of problems posed by industry, government and public. Head quartered in Nagpur, It has a nation-wide presence with five zonal laboratories at Chennai, Delhi, Hyderabad, Kolkata and Mumbai. The Ministry of Environment & Forests, Government of India hosts the Environmental Information System (ENVIS) network of about one hundred organizations in India, on various dimensions of environmental protection, management and education. The ENVIS network covers the areas of pollution control, toxic chemicals, central and offshore ecology, environmentally sound and appropriate technology, bio-degradation of wastes and

environment management, etc. which also includes using ICT for e-Environment as a major thrust area.

ICT can provide a range of tools to better manage climate change, environmental data and risks. The Commission co-finances a number of research projects in this area through its research framework programmes. The effective management of water is becoming more and more important as the world's supply of clean, fresh water is steadily decreasing. ICTs are an important enabler to help improve the management of this valuable natural resource.

7.2.10 EU-India Regulation and standardization

This is a horizontal priority that should be taken into account when approaching research in the previous priority research areas mentioned.

Effective regulation has proven to result in greater economic growth, increased investment, lower prices, higher quality of service, higher penetration, and more rapid technological innovation in the ICT sector. ICT standardization produces benefits for all stakeholders in society: individuals, businesses and public administrations. European public authorities strongly support open standards in ICT because they can help to ensure open competition in the electronic marketplace and meet the basic requirements of the single market.

ICT standards provide a level playing field on which companies can compete, by using common platforms that ensure freedom of user choice. New entrants to the market can offer new and attractively priced products, promoting the competition upon which international trade depends and which the European single market requires.

Standardization allows end users to have greater ease of access to more than one choice of system; the result is extra competition between manufacturers and service providers. In addition, companies benefit from economies of scale, higher consumer confidence in products or services bought from enterprises observing industry standards and therefore, higher sales.

It is proven that regulation and standardization are impacted by a variety of factors, including legal traditions, multilateral and regional commitments, other legislation and the nature of the marketplace. Thus, while the design of the regulatory framework may vary, certain critical elements should be included in an effective regulatory framework.

In this context, the cooperation towards the exploitation of research results and convert them into new standards is of high value for the EU-India cooperation.

ICT standardisation is part of the general standardisation activities and contributes to the policy objective of improving European competitiveness and industrial innovation while balancing industry expectations with societal needs.

Public authorities are interested in complementing European legislation and policies by references to standards. Standards established by the private sector can help create a level playing field for competition and their referencing can be a means of promoting an effective partnership between the private and public sectors

ICT standardisation work programme of the European Commission covers following priority domains:
- · Domain 1a: eHealth
- · Domain 1b: Standardisation in the field of regulated medicinal products
- · Domain 2: eInclusion
- · Domain 3: Intelligent transport
- · Domain 4: RFID
- · Domain 5: Electronic signatures
- · Domain 6: eInvoicing
- · Domain 7: eSkills and eLearning

- · Domain 8: ICT for sustainable growth
- · Domain 9: Internet of things
- · Domain 10: ePublishing
- · Domain 11: eSecurity
- · Domain 12: eBusiness
- · Domain 13: eGovernment
- · Domain 14: Support to standards implementation
- · Domain 15: Emergency Communications
- · Domain 16: Digital content

7.2.11 E-Learning

e-Learning has found acceptance to a large extent in the Indian market scenario. Advancements in digital electronics have made e-learning a very amicable way of imparting education, given the fact that information can be accessed randomly, retrieved fast and manipulated with minimum storage space requirements. Various digital tools available can be effectively used to enrich courseware contents with multimedia features that can include audio, video, graphics and 3D-animation resulting in better visualization, better grasp of the subject and hence, retention of information. There are four stages of e-Learning programme viz. Technology, Tools, Standards and Content. e-Learning supplements the conventional delivery of instructions in the class-room and helps in quality improvement of content using ICT tools i.e. Computers, Mobiles, Television, Multimedia and the Internet.

e-Learning is one of the important areas identified by the Department of Information Technology for imparting education. The main thrust of the e-Learning programme is to effectively integrate e-Learning methodology and approach with the conventional classroom system to maximize the benefits and increase its reach to more and more learners and spread e-Learning from teaching of IT related subjects to other subjects in the school curricula.

A number of academic institutions/R&D Labs have been financially supported by DIT to carry out R&D projects in the field of e-Learning. Important areas in which projects have been awarded include:
- • Real time video compression and decompression techniques
- • Developing Authoring Tools in Indian Languages
- • Developing content independent of platform & environment
- • Quality Assurance in e-learning

In the private sector also, e-Learning is catching up as a preferred mode of imparting training and enhancing skills of employees, particularly in organization that are spread across multiple locations. With the added advantages of flexibility in terms of timing, completion of the course and trainees learning at their own pace, e-Learning has been adopted by the corporate sector to achieve organizational goals and motivating employees.

In Europe, e-Learning has integrated the advance information and communication technologies (ICT) into the education system. e-Learning is making significant contribution with both workers and organizations transforming the way they learn, interact and work. e-Learning has promoted social integration and inclusion, opening access to learning for people with special needs and those living in difficult circumstances (marginalised groups, migrants, single parents, etc. Modern e-learning solutions recognise the importance of learning as a social process, offering possibilities for collaboration with other learners, for interaction with the content and for guidance from teachers, trainers and tutors. Several EU initiatives have been created for a 'critical mass' of resources to leverage e-Learning development and use by launch the e-Learning Programme, analyzing the

European market for e-learning, Grids for e-Learning etc.

e-Learning is one of the thrust areas identified by European Commission and Department of Information and Technology (DIT) in both the regions for instructing education using educational tools and communication media.

8. Key points of Trend Study & Roadmap Paper

A trend study on India's ICT roadmap for the next ten years on priorities identified by 30 visionaries of India was carried out as part of the Synchroniser project deliverables. This study aims at identifying Indian future priority topics for ICT research aims to augment the EU-India political dialogue in the ICT domain, and most importantly, the mission of the ICT Joint Working Group. The study has identified Indian focus areas in the next 2, 5 and 10 years with regard to technology priorities in ICT R&D. It is envisioned that the data from this study, amongst others, will serve as a planning input for European Commission, in order to identify technology priority calls for India. Thirty Indian ICT technology experts with an average experience of 20 years in the Indian ICT industry were interviewed using the Delphi method. These experts called 'visionaries' in the study, provided insights into the technology priority areas India must focus on, shared their views on European Commission's Framework Programme and provided valuable suggestions to enhance EU-India collaboration.

Two specific areas that India will show R&D trends in clearly emerged through the content analysis of the interviews: Core technology development & Sectorial applications of ICT.

Core technologies pointed out by the visionaries include (a) Internet access: allocation of bandwidth, last mile connectivity, convergence of mobile and internet technologies; (b) Networking technologies: large networked systems, machine to machine communication, cloud computing, wireless networks and smart networks; (c) Monitoring systems, sensors for measurement & remote diagnostics, integrated with wireless networks, generic and mobile devices; (d) Cloud Computing Applications & (e) Security algorithms for various systems and devices.
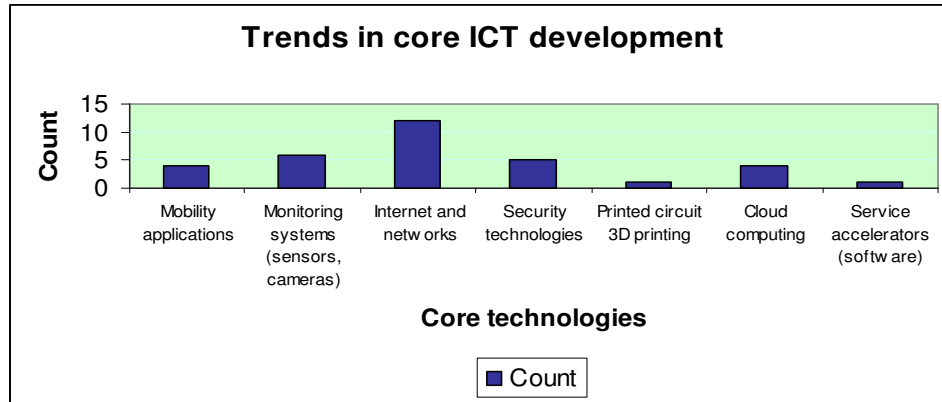With regard to sectorial application of ICT, healthcare, energy, governance and education emerged as important sectors that will need ICT integration.

Technology Priorities for ICT R&D in India

A content analysis of the interviews of the 30 visionaries revealed two distinct areas that India is expected to show R&D trends in
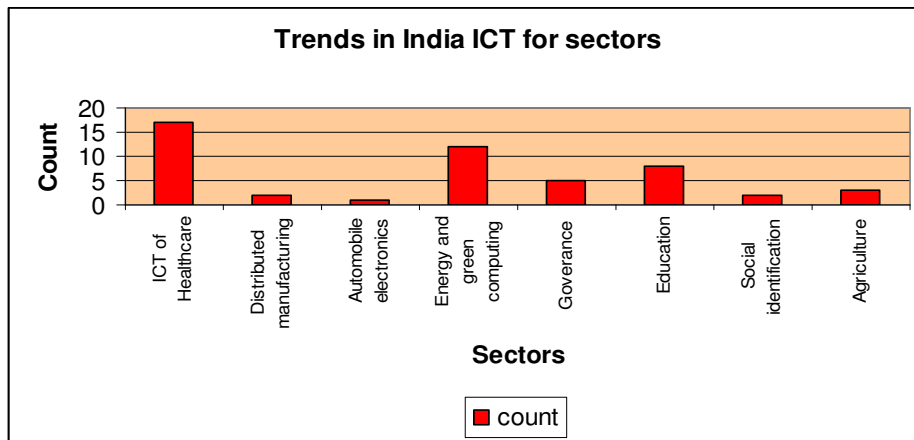
Core technology development: Basic and applied R&D activities in core technologies as shown in figure 1 below.

Fig 1: Trends in core ICT development

Trends in core ICT development

[Bar chart showing Count on y-axis (0 to 15) for Core technologies: Mobility applications (~4), Monitoring systems (sensors, cameras) (~6), Internet and networks (~12), Security technologies (~5), Printed circuit 3D printing (~1), Cloud computing (~4), Service accelerators (software) (~1)]
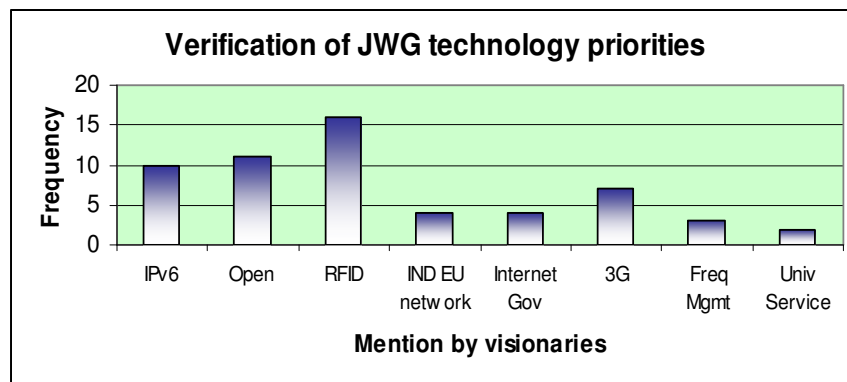
Sectoral applications of ICT: Technology development activities that involve customizing solutions for various sectors as shown in figure 2 below.

Fig 2: Trends in India ICT for sectors

Trends in India ICT for sectors

[Bar chart showing Count on y-axis (0 to 20) for Sectors: ICT of Healthcare (~17), Distributed manufacturing (~2), Automobile electronics (~1), Energy and green computing (~12), Goverance (~5), Education (~8), Social identification (~2), Agriculture (~3)]

Visionary views on the EU-India ICT JWG List are shown below.

Fig 3: Visionary views on EU-India ICT technology Priorities

Verification of JWG technology priorities

[Bar chart showing Frequency on y-axis (0 to 20) for Mention by visionaries: IPv6 (~10), Open (~11), RFID (~16), IND EU network (~4), Internet Gov (~4), 3G (~7), Freq Mgmt (~3), Univ Service (~2)]

EU-India collaboration in ICT R&D: The views of all visionaries on EU-India collaboration in ICT R&D were taken into consideration at two levels. Their awareness on EU was assessed followed by their

intentions to collaborate. A rating scale is used to assess this. The trend that emerged after analysis of their responses to a set of questions is illustrated in the following figures 4, 5 & 6:

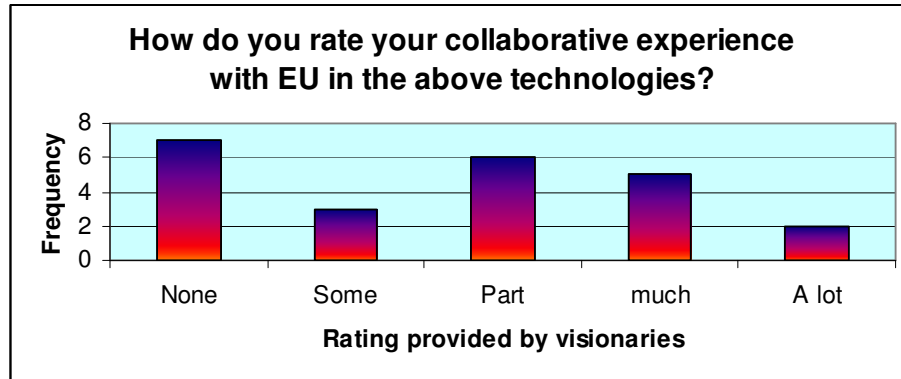Fig4: Showing the experience of visionaries with EU technologies

How do you rate your collaborative experience with EU in the above technologies?

Fig 5: Shows whether Indian visionaries monitor change in EU

Does your work experience involve monitoring changes occurring in the EU-ICT industry ?
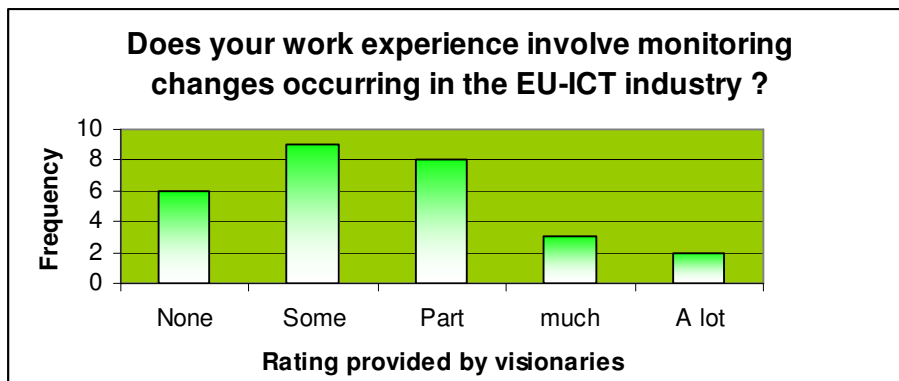
Fig: 6 Shows the reading about EU ICT activity on the part of Indian visionaries

Do you read EU trade journals, magazines, attend EU-ICT related conferences?
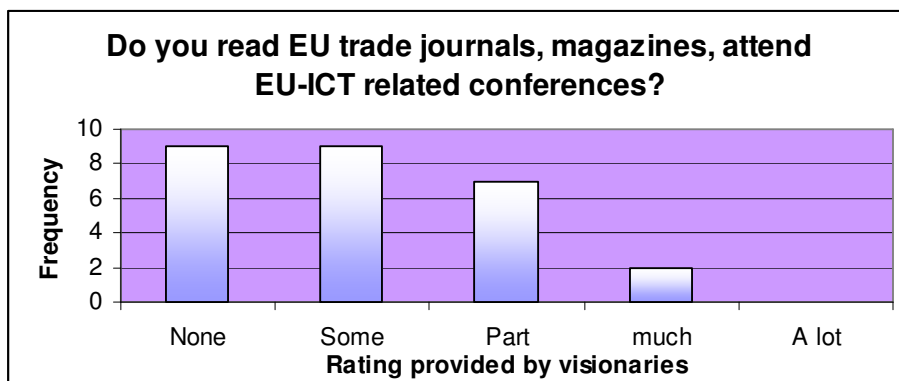
From the visionary interview, we could conclude that the following research topics are of interest for India with reference to ICT for sectors and will develop further in Indian ICT

- ICT for Healthcare

- ICT for Energy and green computing

As far as core ICT technology priorities are concerned, India will mainly focus on the following areas

- internet and networks
- monitoring systems
- security technologies
- cloud computing and
- mobility applications

Specific Joint Call with India targeting concrete sectors may be fostered and will follow Indian development trends. Topics of such calls might be generic as it has been noticed by the visionaries, the JWG technology Priorities are inflexible.

9. Recommendations

Based on the position papers 1 as well as the debates held by the SSC Members, an action plan is proposed to foster the achievement of the goals of enhanced EU-India cooperative research in the ICT technologies domain. A number of specific actions are here proposed.

9.1 Short term

- Creation of web-site for dissemination of information on EU calls with information bullets specific to Indian audience.
- A directory of potential EU partners willing to collaborate with India and Indian partners willing to collaborate with EU, including their project ideas. This specific recommendations will include a sort of Indian channel to facilitate the cooperation among different EU researchers, from several ICT expertise fields, with Indian researchers
- Organization of workshops in India to present and brainstorm project ideas with participation of EU organizations.
- Organization of awareness & problem solving workshops to demystify EU FP processes in major Indian towns. This could immensely help in breaking notional barriers as well as understanding ground level difficulties faced by stakeholders on the two sides.

9.2 Medium Term

Concurrently, SSC experts also recommended studying in detail the already established joint calls between Europe and other countries such as Brazil and Russia. The rules and governance of such joint calls will be extremely useful in defining a **co-funding scheme between Europe and India**. The main objective of this co-funding approach is to create a win-win cooperation between both countries.

Other documents, such as the *EC-Australia S&T COOPERATION ROADMAP 2009-2010*[10] *or the EU-Latin America Strategic Research Agenda3* can serve as references to define a **common Research Roadmap for Cooperation between EU and India**. This Cooperation Roadmap could include the development of a Work Programme in which the common priorities in the ICT field for both regions are clearly explained. According to the priorities stated in that Work Programme, new project proposals for cooperation between EU and India should be submitted for a co-funded scheme.

Due to the high expenses that travels from/to each region may imply, under this co-funded initiative, it is suggested to **allocate part of the budget for *pre-proposal* interaction and physical networking**. It is undoubtedly demonstrated that cooperation is more effective when partners meet face to face and joint interests are shared. Personal relationships are key amongst researchers and we need to encourage events and exchanges to foster these contacts. In addition, workshops focused on specific

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[10]http://ec.europa.eu/research/iscp/pdf/australia_ec_roadmap_2009-2010.pdf
3 http://www.salamas.eu

domains and information dissemination infrastructure (e.g. websites, newsletters, workshops, etc.) should be supported to create awareness about ICT needs and available resources (R&D capabilities and technology solutions). The example of the Spanish AMETIC-Aprotech Office, which supports the participation of Spanish industries (notably, SMEs) in the European framework programme could serve as an inspiration for a similar tool, which the Indian NCP ICT could launch having the support of the Indian Ministry responsible for research on ICT themes.

In addition, **collaboration with ETPs and xETPs initiatives** was suggested.ICT-related ETPs address complementary technology fields. Each ETP (NEM for electronic media, NESSI for Software & Services, eMobility (renamed Net!Works) for mobile applications, etc.) has its own Strategic Research Agenda (SRA) that defines short, medium and long-term research challenges and identifies future important trends in their specific technological fields. The cross-European Technology Platforms (X-ETPs) group also has a SRA that takes as starting point the X-ETPs Future Internet (FI) Vision Document (VD). This SRA reflects a comprehensive collection of active and upcoming developments in the Future Internet research world, while clearly aiming towards the realization of the FI Vision. The main objective of this SRA is to provide a well structured and consistent publication that reflects and covers a broad set of FI aspects. This action should also be extended to the initiatives on the Private Public Partnership, notably those focused on the ICT domain, like the Future Internet PPP.

ETPs are also overlapping in addressing general ICT innovation issues towards the European Commission. ETPs are discussing a cross-ETP initiative (similar to the Future Internet cross ETP initiative that has led to the EFII spin-out) so that the ETPs messages on innovation become stronger if shared by the ICT ETPs in a "cross ETP innovation initiative".

An interesting opportunity for India and EU is to use the ETPs as an instrument to produce a roadmap for cooperation between EU and India, both in specific technology fields and also in ICT innovation issues. If successful, possible promotion of Indian technology platforms should be part of the future work in order to enhance the India-Europe cooperation.

9.3 Long term

The IST Advisory Group (ISTAG) has been set up to advise the European Commission on the overall strategy to be followed in carrying out the IST thematic priority under the European framework programme for research. The ISTAG reflects and advises on the definition and implementation of a coherent policy for research in ICT in Europe. This policy should ensure the mastering of technology and its applications, and should help strengthen industrial competitiveness and address the main European societal challenges. SSC experts' suggestion was briefing ISTAG on the potential cooperation with India, as a significant part of the overall EU FP7/ Horizon 2020 strategy on international cooperation.

SSC experts also suggested that reinforcing the ISTAG by involving Indian gurus could be another tool to promote EU-India cooperation. Moreover, the formation of an EU-India ISTAG was suggested.

A second recommendation that could be implemented by the European Commission and DIT is the setting up of a JWG action group The Action Group would be a sort of executive body that would undertake the decisions adopted by the JWG. This group would also assist JWG members in their activities and work in close relation with the JWG members for the implementation of the JWG outcomes. The Action Group could be flexible with nomination of officers/representatives by both, EU and India.

10. Conclusion

The progress of EU-India cooperation in ICT research has been quite poor. The seventh JWG meeting originally scheduled for March 2010, which could have paved way for some serious EU-India joint research programmes was postponed thrice in the last 2 years.

Since the last (sixth) meeting of India-EU JWG (Joint Working Group) on Information Society held in March 2009, the global ICT scenario has changed significantly. EU's new Framework Programme for Research and Innovation "Horizon 2020" is on the anvil while India's 12th five year plan is being discussed on the table of the decision makers. With the seventh JWG meeting scheduled to be held in the first quarter of 2012, this appears to be the right opportunity to revisit decisions taken in the last JWG meeting, following which, precise areas of ICT can be prioritized for collaboration, bottlenecks that have so far come in the way of joint proposals can be identified and effective mechanisms can be put in place to minimize them in order to encourage collaboration.

Both the EU and India can mutually benefit from a growing participation in joint ICT research programmes, thus cooperation on ICT Research with India is a priority for the European Commission. While Indian experts feel there is a great interest from Indian side to cooperate with Europe, much need to be done to lower administrative burdens accessing European Programmes by Indians. Also Europeans would need to demonstrate a greater willingness to cooperate with India as Americans do.

In her statement made on June 21, 2011, EU Research, Innovation and Science Commissioner Máire Geoghegan-Quinn said that red tape shall be minimized and participation made simpler in the "Horizon 2020" framework programme. Furthermore, there seem to be quite a few ideas brewing on the possibility of co-funding research projects based on a few existing successful models in other areas of Science & technology between the two sides. This is bound to ease out a major bottleneck that Indian researchers have been facing in earlier funding programmes including FP7, and may effect in making participation simpler and easier for them.

11. SYNCHRONISER STEERING COMMITTEE (SSC) experts

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Mr. Hiranmay GHOSH	Tata Consultancy Services, India
Mr Debashis DUTTA	DIT - Ministry of Communication & Information Technology, India
Mr. Vinay L DESHPANDE	Encore Software Limited, earlier Ncore Technology Pvt. Ltd, India
Mr. Albert SITJÀ	CTTC- Centre Tecnologic de Telecomunicacions de Catalunya, Spain
Mr. Stuart CAMPBELL	TIE Research Development & Innovation, Chairmen of ETP on Software & Services, UK
Mr. Latif LADID	President, IPv6 Forum, Trustee, Internet Society, Luxembourg
Mr. Barry EVANS	University of Surrey, Faculty of Engineering & Physical Sciences, UK
Mr. Pierre-Yves DANET	Research labs CTO at Orange Labs, France

SYNCHRONISER project partners

Partners	Partners' short name	Country
Technical Support for European Organisations Sprl.	TESEO	Belgium
Euro-India Research Centre	EIRC	India
Rose Vision, S.L.	ROSE	Spain
Centre for Development of Advanced Computing	C-DAC	India
Software Technology Park of India	STPI	India
Indian Institute of Science, Bangalore	IISc	India
Fraunhofer Gesellschaft	FhG	Germany

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