

Table of Contents

Foreword.....	2
Introduction	3
Future Networks.....	5
Cloud Computing.....	9
Trustworthy Information & Communication Technologies.....	12
Networked Media & Future Internet.....	16
ICTs for Public Services.....	19
ICTs for Inclusion.....	23
Horizontal Measures for EU-India ICT Research Cooperation.....	26
Conclusion	28
Euro-India SPIRIT ICT Expert Working Group.....	32



Foreword

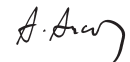
The European Union (EU) aims to be at the forefront of an open, accessible and inclusive worldwide Information Society that champions the free flow of information, ideas and opinions around the globe. International cooperation in Information & Communication Technologies (ICT) research and technological development (RTD) is a priority in Framework Programme 7 (2007 - 2013), with the opening-up of all ICT research activities to third countries and specific international cooperation actions in areas of mutual interest and benefit between the EU and targeted countries, with a particular focus on the emerging BRIC nations.

India and the European Union are already committed to an equal and dynamic dialogue on all subjects of interest and concern to them as major entities in their own regions, and as frontline actors on the world stage. The European Union is India's biggest partner in trade and investment and is a leading player in development cooperation.

Since the signature of a Cooperation Agreement on Science and Technology ten years ago, the EU-India relationship and cooperation has gone from strength to strength. With the commitment of both parties to continue to promote RTD cooperation in the field of ICTs and the shared goal

of a knowledge based economy, India and Europe are together addressing worldwide issues such as the role of science in society, knowledge and bridging the digital divide to enhance the quality of life for both the citizens of India and Europe.

It is my hope that Euro-India SPIRIT's efforts to define the scope of the potential benefits as well as a research framework incorporating specifically targeted areas of collaborative benefit can serve as a vital support to the ongoing dialogue with India that will shape our cooperation in the decade to come.



Alvis Alcans

Euro-India SPIRIT Project Officer & International
Relations Officer
Information Society and Media
Directorate General -
European Commission



Introduction

At a time when Information and Communication Technologies (ICT) are evolving at an unprecedented rate, Euro-India SPIRIT has endeavoured to establish a dialogue between stakeholders from two key global markets, the European Union (EU) and the Republic of India. Our aim has been to formulate a mutually beneficial research agenda that could subsequently be taken up through specific bilateral initiatives.

Euro-India SPIRIT builds on successful cooperation initiatives funded by the European Commission's 7th Framework Programme for Research and Technology Development (FP7) aimed at forging links between the EU and India. To this end, the project has focused on connecting European and Indian stakeholders from enterprise, government, academia and research to promote the strategic advantages of cooperation in areas of mutual interest while working towards mitigating cultural differences and overcoming institutional barriers.

Our recommendations have been built through close interaction with eighteen renowned

ICT experts with an equal balance between Europeans and Indians. Engagement over a two-year period has helped identify key priority areas for collaborative research, defining the scope of the recommendations for each key area presented here.

The recommendations aim to lay the foundations for future ICT research collaboration between the European Union and India as we approach the EC's next Common Strategy Framework (CSF), Horizon 2020. This will be launched in 2013 and will build on the success of FP7, the Competitiveness and Innovation Framework Programme (CIP) and the European Institute of Innovation and Technology (EIT). Underlying these funding streams is the Digital Agenda for Europe (DAE), a major roadmap defining the key roles that the use of ICT will have to play for Europe to succeed in its ambitions for a flourishing digital economy by 2020. The DAE is inextricably bound up with the areas of ICT research that have been assessed by Euro-India SPIRIT and that are of relevance to both the EU and India. EU-India Cooperation must harness the game-changing potential of ICT research and development to tackle grand challenges facing both Europe and India with particular reference to inclusive, innovative and secure societies.



“Both Europe and India are major technology & ICT-rich societies, and it naturally behooves us to pool our resources to leverage the power of ICTs to build a safe and secure digital society where the full potential of ICT can be developed to benefit the global users.”



Neeraj Suri, TUD Chair Professor Dependable Embedded Systems & Software, Department of Computer Science, Technische Universität Darmstadt, Germany.



Future Networks

Research in network technologies is essential and requires very significant investments for enabling the future networked society in an evolving world, where user expectations are continuously growing, overloading the existing infrastructure. While technology development occurs at an increasingly rapid pace, deployment and implementation of the resulting new network infrastructure takes much longer.

The Future Internet requires a rethink of architectures in order to overcome performance bottlenecks, support a wider variety of service types, integrate novel types of edge networks such as wireless sensor networks, and mitigate constraints imposed by new types of media applications such as 3D virtual environments. Mobility and ever higher end-to-end data rates are emerging as important design drivers with more stringent expectations in security and trustworthiness. At the network level, the Future Internet needs to have flexible and ad-hoc management capabilities that have never been part of the 'best effort' paradigm

that underlies the original design. Novel radio and optical systems are also important components of this overall network perspective.

A view from India

India, at the beginning of broadband proliferation, is already witnessing new business opportunities and the reach and ease of access to governance, education, healthcare and a host of economic activities. While more and more Indians are enjoying the true potential of 'always on' Internet, it is not all good news from infrastructure, services deployment and security perspectives with access restricted to urban areas where only thirty percent of the population lives. Indian technological policy imperatives are broad-ranging: provision of affordable and higher speed broadband across the wired network; deployment of 3G networks; and affordable access to the rural population and remote areas through a combination of wireline, wireless and satellite networks.

A significant characteristic of the Indian environment is the pervasiveness of mobile devices, numbers of which far outweigh PCs influencing how India conceives, innovates and



deploys a whole gamut of applications and services - in eCommerce, eBanking, eLearning, eHealth. This, in turn, will have a critical bearing on how India sees future network infrastructure and technologies.

Current Indian research has a largely functional orientation with focus on maximising returns from infrastructure resources and investments; seamless and ubiquitous wireless connectivity; next generation Wireless Communication Systems and Networks; technologies that lower energy consumption and use of non-conventional energy for infrastructure; interoperability and quality of service; affordable, user-friendly integrated customer devices.

A view from Europe

Europe possesses considerable strengths in communication technologies, equipment, devices, networks and eServices that place the region in an ideal position to play a leading role in shaping and developing the network and service infrastructures of the future. Looking beyond high-speed broadband, which is both widespread and affordable for most Europeans across diverse local ecosystems, Europe is now focusing on the next-generation of networked applications in

order to create new economic opportunities and enrich the lives of citizens, while reducing costs. Advances in current Internet, mobile, fixed and broadcasting networks and the related software service infrastructure, are required to enable the next wave of growth in the online economy and future stage of service offering.

Current European research has a broad technology focus in areas such as wireless and mobile broadband systems; high capacity end-to-end infrastructure technologies; novel Internet architectures, management and operation frameworks; and flexible, resilient, broadband and integrated satellite communication.

Future Networks – Recommendations for EU-India collaboration

India can benefit from the impressive reservoir of European research results and further leverage the rich portfolio of research themes and actions already underway and planned. The future network models and architectures - evolutionary and disruptive, standards and norms, content format and delivery



mode, interoperability, robustness, trust and security are all active research topics in Europe with multiple research projects underway and significant results already achieved.

Indian research on future networks can be substantially boosted by leveraging European achievements and thus avoid considerable early stage exploratory research. This, in turn, would lead to accelerated technology development in this domain which lies at the heart of the future economic engine and social fabric.

Areas of collaborative research:

- Mobile connectivity with a focus on **mixed-mode connectivity** that accommodates the heterogeneity and failure-proneness of both devices and network and sparse coverage.
- Next generation **Wireless Communication Systems** and Networks; targeting new **radio transmission paradigms and system designs** taking into account the need for radical cost and energy per bit reduction and lower electromagnetic field exposure.
 - Enabling technologies for flexible spectrum usage for mobile broadband, including

new ambitious approaches to cognitive radio.

- **Novel radio network topologies**, taking into account the need for autonomy, energy efficiency, high capacity backhaul, low EMF radio exposure, and smaller low power base stations.
- **Ubiquitous fast broadband access:** convergence and interoperability of dynamic heterogeneous broadband and mobile network technologies; seamless transparent end-to-end connectivity using optimised protocols and routing for energy efficiency and cost reduction.
- **Innovative system architectures and technologies** making possible the advent of ultra high capacity satellite communication systems.
- **Novel technologies and architectures** for resilient and flexible networks enabling global, multi service, secure and dependable communication.

India needs to depend primarily on wireless for delivery of its broadband, as it has poor wired infrastructure. This means the wireless bit-rates and usage will keep on growing. It is imperative that we work on new wireless technologies which would reduce



power required and transmitted per bit drastically, both to reduce energy usage but also to reduce the potential adverse impact that higher and higher electromagnetic emission may have.

Ashok Jhunjunwala

Professor, Department of Electrical Engineering,
Indian Institute of Technology, Madras

The Department of Computer Science & Engineering at the Indian Institute of Technology – Bombay is a key partner in the consortium which includes universities, research institutions, SMEs, and manufacturers.

EU-India collaboration success story

GEYSERS - Generalised Architecture for Dynamic Infrastructure Services - www.geysers.eu



GEYSERS provides optical infrastructures and network operators with a new architecture, to enhance their traditional business operations. The project specifies and implements novel optical-network architecture capable of supporting 'Optical Network + Any-IT' resource provisioning seamlessly and efficiently. Energy-consumption metrics for the end-to-end service routing are part of this efficiency.



Cloud Computing

Interest in cloud computing is growing at an incredible pace, gaining fertile ground in the current economic climate. The notion of a simple interface to acquire dynamically provisioned computing resources has taken root in all sectors with SMEs among the primary beneficiaries. The simplified access to resources and the pay-per-use usage model that cloud computing offers fulfils the promise of many previous attempts to provide a true computing utility. As such, cloud computing does not represent a particular technology revolution but rather an evolution of technology with a revolutionary business model that packages existing technology using a new business approach. What business wants from IT is a technical infrastructure that provides service value-add that is fast, scalable, safe and above all cheap and cost-effective.

Cloud computing also has potential benefits for research communities. With access to expensive Grid or supercomputer resources limited to a relatively small number of structured research

communities, public and private cloud services offer compelling, cost-efficient solutions for research such as on-demand pay-per-use compute resources.

A view from India

India is taking incremental steps towards cloud computing and is faced with challenges surrounding standards, interoperability, as well as issues of security and trust with the majority of cloud providers based overseas. Additionally, access and stability of service is also a challenge due to limited access to networks and inconsistent broadband in large parts of the country. Multinational cloud providers see great opportunity ahead in India due to the resource scarcity that prevails and the large number of SMEs that are would be users of on-demand access to unlimited power and resources.

Cloud computing research efforts are currently patchy and development is hindered by a lack of strategic implementation in the public domain despite the delivery of eGovernment services on the cloud.



A view from Europe

Cloud computing has profound implications to transform the computing, storage, application provisioning and services delivery landscape in Europe. The European Union cloud strategy identifies three pillars of their cloud strategy approach: a clear legal framework regarding user rights and data protection; definition of technical and commercial fundamentals to boost research efforts, in critical issues such as security and reliability; and pilot projects for cloud deployment encouraging public procurers to take action.

However, cloud provisioning issues need to be addressed. Expertise and results from areas such as Grid, Service Oriented Architectures and e-Infrastructure can be leveraged to help develop the next generation of services on cloud systems. Indeed, European Distributed Computing Infrastructures (DCI) and grid initiatives have started to offer pilot cloud services and resource providers are evaluating virtualisation technologies and services. These developments strongly suggest that cloud computing offerings will become a viable component of a hybrid eInfrastructure landscape that will most likely characterise the European Research Area for the foreseeable future.

European cloud computing goals include harnessing cloud computing to transform the software and the service industry and impact on business ICT strategies; Internet of Services and advanced software engineering that emphasise technologies specific to the networked, distributed dimension of software and the access to services and data; European interoperable clouds; improved trust and security for storage; lower barriers for service providers and users; and common standards for data portability and on interoperability. Open research issues have been presented in The Future of Cloud Computing – Opportunities for European Cloud Computing beyond 2010, a European Commission Expert Group Report which could also serve as a basis upon which to define future Research and Development (R&D) with India.

Cloud computing - Recommendations for EU-India collaboration

With cloud computing expected to play a key role in the future digital economies of both Europe and India it is important that technical challenges such as interoperability and extensibility are



addressed, as well as legal impediments and other non-technical interoperability issues. A collaborative test bed area to pilot strategic adoption techniques of standards-based, interoperable cloud services would play an important part in addressing the challenges faced in both regions and bring new requirements to the standards landscape.

“Cloud computing fits well with the highly distributed nature of India enabling increased access to computer resources and empowering a broad set of users in science and enterprise. Improvements in network infrastructure, solutions for wireless and satellite technologies will enable access to cloud computing resources in India allowing remote access from less developed parts of the Indian sub-continent.”



Fabrizio Gagliardi, EMEA
Director, Microsoft Research
Connections, UK

Areas of collaborative research:

- Intelligent and autonomic management of cloud resources, ensuring agile elastic **scalability**. **Scalable data management strategies, addressing the issues of heterogeneity, consistency, availability, privacy and supporting security.**
- Technologies for **infrastructure virtualisation, cross platforms** execution as required for service composition across multiple, heterogeneous environments, autonomous management of hardware and software resources.
- **Interoperability amongst different clouds, portability, protection of data** in cloud environments, control of data distribution and latency.
- Seamless support of **mobile, context-aware applications.**
- **Energy efficiency and sustainability** for software and services on the cloud.
- Architectures and technologies supporting integration of computing and networking environments; implications of **cloud computing paradigm on networks.**
- **Open Source** implementations of a software stack for clouds.
- **Legal and ethical issues** surrounding data privacy, protection and sovereignty.



Trustworthy Information & Communication Technologies

“Strengthening the trust framework, including information security and network security, authentication, privacy and consumer protection, is a prerequisite for the development of the Information society and for building confidence among users of ICTs.”

WSIS ‘DECLARATION OF PRINCIPLES’, 12
DECEMBER 2003

Security and Trust have always been and will remain essential pillars on which society is built. Today, secure and reliable information and communication systems and network infrastructures, and the trustworthiness of the services they provide, play a key role for the healthy growth of the Information Society.

Trustworthy ICTs are crucial to ensure citizen rights and protect their privacy and personal data while societies are leveraging the power and potential of Information & Communication Technologies in domains as diverse as governance, healthcare, knowledge, inclusion, supply chains, banking, pensions and entitlements etc.

Security, trust and privacy are critical issues that need

to be addressed coherently from a technological, economic, legal and social perspective. ICTs must ensure freedom and security of citizens while triggering innovation and driving economic growth.

A view from India

India is witnessing a large-scale transformation of industrial, manufacturing, logistics, commercial, financial, learning, healthcare and leisure activities and processes affecting almost all aspects of peoples’ lives. Indian policymakers realise that the ICT infrastructure provides processing, transmission, and storage of vast amounts of vital information used in every facet of society, enabling government agencies to rapidly interact with each other, as well as with citizens, businesses and civil society. In addition, there is an international dimension to networks, data and information.

Information security is seen as a vital area of concern and research in order to mitigate existing and emerging threats and provide network and information security so



as to make the IT networks 'Trustworthy' for the large variety of users, from government running the affairs of the country to gamers enjoying an online session on their home computers.

Indian research in Trustworthy ICTs focuses on areas such as cryptography and cryptanalysis; network and systems security; security architectures; vulnerability and assurance; and monitoring, surveillance and forensics.

A view from Europe

The European Union has a legacy of supporting rich collaborative research in Trust and Security areas. European experience shows that this is best done by leveraging the diversity of its constituents (twenty seven member states and close to 500 million people, and a widespread ICT research ecosystem and stakeholders). Cooperation also engages non-EU countries, in order to build a comprehensive approach to identifying issues and problems, pooling technology and resources and crafting solutions that address major existing and potential Trust and Security issues across the vast domains of ICT

infrastructure, platforms, devices, services and solutions in democratic and pluralistic societies.

European research focusses on secure and trustworthy ubiquitous network infrastructures and protection against emerging cyber-threats; protection of critical information infrastructures; trustworthy and secure service infrastructures, supporting applications and end-to-end services; trust, privacy and identity in the digital economy; and enabling technologies for security and trustworthiness of ICT.

Trustworthy ICT - Recommendations for EU-India collaboration

There is a major opportunity for EU-India collaboration in aligning policy and in promoting joint research across Trust and Security topics. Joint research initiatives could pave the way for further articulation of the Indian social vision and implementation strategy, leverage results, and learn from robust research programmes/projects/implementations carried out and trusted ICT solutions already operational in the European Union.



“ICT technologies, and especially cloud computing, have already connected countries to form a global e-village for varied functionalities spanning e-commerce, news, social networking etc. This privilege of ICT interconnectivity unfortunately also exposes all the constituents to the full range of location-agnostic security & privacy issues that detracts the value of ICT usage for all”



Neeraj Suri, TUD Chair Professor Dependable Embedded Systems & Software Dept. of Computer Science, Technische Universität Darmstadt, Germany.

Areas of collaborative research:

- **Usable** security in the mobile world – the basic elements of data integrity and security that lets people “trust” the devices to do transactions on mobile devices, the primary platform for many users in India.
- **Large scale data security** arising from data storage, data privacy, data retention and data governance issues.
- **ID management** - e-ID cards in Europe and India, especially for Mobile ID’s to support financial (banking, e-commerce) transactions.
- **Data liability** and **governance policies**.

EU-India collaboration success story

BIC - Building International Cooperation for Trustworthy ICT: Security, Privacy and Trust in Global Networks & Services –www.bic-trust.eu



BUILDING International Cooperation
for Trustworthy ICT

This project is working to expand the co-operation models of EU researchers and programme management with their peers in new ICT high-growth countries, such as India, Brazil and South Africa, who represent emergent world-impacting information economies through the scale and sophistication of their growing ICT sectors.



“ICT trust and security, or trustworthy ICT, has been an active topic of coverage within the Euro-India Spirit working groups. This included scoping and elaborating a number of research topics to pursue together for mutual benefit including protection against malware when there is a heavy reliance on imported systems; privacy protecting identity management systems; a strong societal approach towards security in both EU and India; and usable and effective security in the predominantly mobile world, amongst others.”



Jim Clarke,
BIC coordinator & Waterford Institute of
Technology, Ireland



Networked Media & Future Internet

“In the near future, everybody and everything will be permanently connected to a network be it fixed, mobile or satellite, irrespective of geographical location. Connected ‘things’ as well as ‘people’ will be able to provide information that will help to create or enrich content. Intelligent objects such as cars, smartphones and everyday appliances gathering real-time information in their respective environments. Connected people will be able to express and share their experience, attitude, or preferences while interacting with the real world. The combination of real time sensing and collective experience enables adaptation, personalisation and contextualization of the relevant content, making it alive, evolutionary and ready to be used in realistic situations (maps & itineraries, movies & news, user & technical manuals, safety & eco-friendly procedures).”

Networked & Electronic Media, Position Paper on
Future Research Directions, September 2011

A view from India

India is not yet on the same plane as Europe in terms of perceptible demand for highly contextualised and personalised rich multimedia information. However, Indian

requirements in the areas of governance, education and inclusion, are driven by a highly diverse range of people - from village farmers to research scientists, from senior citizens with little or no computer skills to social-network-savvy teens - living between remote villages and mega cities. Such diversity warrants contextual, personalized, device-neutral and accessible-from-everywhere rich multimedia information. The speed of propagation of new technologies and the breakdown of behavioural barriers of the past make it all the more probable that there will not only be early adoptors, but rather a critical mass of diverse users whose needs can only be satisfied through information rendered through rich and immersive multimedia. The advent of cloud computing and the rapid proliferation of 3G will, to a large extent, drive this trend. In reality, however, optical fibre to home or a nationwide 4G network are still years away.

A view from Europe

In Europe users will soon be able to use any type of device to access any type of content adapted to their spatial/temporal context, be it at home or on the move. Network bandwidth and quality will



increase significantly with fibre networks reaching closer to the end-user's point of access. Increasing bandwidth capacities of LTE/4G mobile networks will enable users to access high-definition and even 3D/holographic content. In addition, increasing uplink bandwidth will allow for new types of services such as online content storage, 3D videoconferencing and tele-immersion. All these network evolutions will help people share any type of content in real-time within their interconnected social communities, to communicate with remote contacts while feeling as if they are in the same place. This future network paradigm can be summarised as: anything, anytime, anywhere on any device.

Networked Media and Future Internet - Recommendations for EU-India collaboration

Europe is conducting ground-breaking research in the area of networked media and future Internet in parallel with the rapid evolution of networks and network technologies. Applications are being developed that can be deployed on very high bandwidth network and give the user a rich multimedia and interactive experience



whether it is about visiting a museum or to learn the consequences of climate change. Through ICT collaborative research, India has an opportunity to leverage and supplement the reservoir of European knowledge and experience in looking for rich-media solutions across a number of application domains which are highly relevant to both India and Europe.

Future internet PPP (Public Private Partnership) will provide an open infrastructure that should be able to support many use cases. Some of them could be developed together with Indian partners; they should address specific societal challenges mainly using mobile connection.



Pierre-Yves Danet, CTO, ASF Lab, Orange-France Telecom

“European research and achievements on the Future (Media) Internet and the Indian necessity to connect a diverse and widely distributed society seem to fit symbiotically. While in Europe eLearning, or in a broader sense eEducation, has to compete with a dense network of high quality local



education, Indian society will greatly benefit from already available and implementable systems. Joint research and application projects can simultaneously bring societal benefit and serve as a platform for further development of these systems. European research results from projects can be leveraged in the Indian context, further developed and be fed back into the European environment.”

Thorsten Herfet, Director of Research and Operations, Intel Visual Computing Institute, Saarland University, Germany

Areas of collaborative research:

- **eGovernment** access to any administrative form from any device in a secure mode using RTCWeb technologies, HTML5.
- Remote access to any information and forms in a secure mode need to be developed in order to be accessible on any device. With the multi-lingual nature of Europe and India, there is also a voice and video communication with the eGovernment service portals is desired.
- **eEducation:** new interactive content to students accessible on any device including serious gaming.
- Networked media could help in this field using innovative content merging text, video and real-time interaction with tutors. In this field, serious gaming should also be a way to develop new

forms of education.

- **eInclusion:** access for all citizens to any regular information and support (language, literacy, voice interface, translation).
- Citizens are not all equipped with similar connection or devices. There is a need to offer services which give the opportunity to all to access any information on the web. Illiteracy and multiple languages is an added barrier to the ease of access. Automatic voice translation and text-to –speech/speech-to-text in real-time are indispensable for seamless access to information. This is a challenge common to Europe and India, as they both have multiple languages spoken across their territories.
- **eTourism:** using 3D videoconferencing or using virtual content including virtual reality Tourism is a growing industry in India and a dominant economic activity in Europe. Provision of remote visits to an area or monument could be advantageous in attracting visitors. Connected cameras are growing significantly due to networked technology and there is scope for research to develop web applications giving access to those cameras to potential tourists.



ICTs for Public Services

ICTs are already widely used by government bodies to provide better public services to citizens and businesses. However, eGovernment involves much more than just tools. Effective eGovernment requires reassessing organisations and processes, and changing behaviour so that public services are delivered more efficiently, quicker and at reduced costs to the citizens, enterprises and organisations that need them.

A view from India

eGovernment in India remains a daunting task in so far as the government(s) (federal, state and local) aim to ICT-enable and also rearchitect processes (both internal and citizen-facing) to render them efficient, accessible, seamless, cost efficient, and easy to interface with and use. The first ever integrated Indian National eGovernment Plan (NeGP) is attempting to bring together discrete, legacy implementation of solutions and put forth a vision and a strategy to guide future initiatives and funding. Initiatives

are underway to elaborate standards and norms for a nationwide eGovernment service offering, platforms and networks to deliver a range of services to stakeholders. While India needs to address the governance issue internally through institutional and societal mechanisms, the country could benefit by leveraging global eGovernment issues, strategies and implementation to improve its own processes.

eGovernment challenges to be addressed include effective eGovernment policy, policy framework and policy modelling; speed and transparency in administration; promotion and safeguarding citizen rights and entitlements; challenges in connectivity; voice interface with various eGovernment services and solutions; institutional capacity, responsiveness and accountability; trust, privacy and security; and behavioural and contextual research to focus on bottom up co-creation.

A view from Europe

Europe is already exploiting robust and integrated eGovernment platforms and solutions across most member states while continent-wide solutions



are progressively emerging in many domains. Government is one of the biggest sectors for ICT spending in the EU. Government is less driven by operational efficiency, and more by major drivers to reduce cost and save money to pay off debts and reduce government deficits. Programmatic change, such as government seeking 'buy once' benefits, as opposed to purchasing on a silo-ed and departmental basis, and government looking to leverage its buying power, are focusing government efforts on cost. In turn, cost of processing is leading purchasing managers to look at cloud computing because of its significant cost savings over traditional desktop solutions.

This opens the opportunity for Europe to look at the next generation of eGovernment solutions such as cloud computing and also to carry out 'policy modeling' in order to predict policy impacts, development of new governance models and putting in place collaborative tools/mechanisms to solve complex societal problems and provide seamless services to European users across the Union. The DAE sets forth the objective of a new generation of open, flexible and collaborative eGovernment services, which is needed to empower citizens and businesses, reinforce mobility in the Single Market, enable efficiency and effectiveness and create the necessary key enablers and pre-conditions.

eGovernment - Recommendations for EU-India collaboration

Euro-India SPIRIT sees a mutually beneficial opportunity for EU-India collaboration to carry out joint research across eGovernment issues. Joint initiatives could pave the way for further articulation of the Indian eGovernment strategy, factor in results and learning from similar research projects/implementation carried out and solutions already operational in specific domains and segments of governance in the European Union. Furthermore, collaborative research policy and projects would enable bringing Indian experiences, issues, challenges and context on board and challenge EU researchers in articulating the next level of tools, infrastructure and services in the eGovernment domain in Europe. Knowledge exchange on the Indian strategy, innovations and nationwide rollout of services across administrative and linguistic barriers, while dealing with legacy systems, tools and infrastructure constraints, could bolster eGovernment implementations in the European Union.

India's unique position as the second fastest-growing economy in



the world trying to improve the lives of its 1.2 billion people, gives it a proving ground that only one other country can match. This, coupled with the fact that any solutions for eGovernance must satisfy the affordability criterion, implies a huge opportunity for Europe and India to jointly develop accurate yet low-cost biometric and identification and authentication equipment and solutions, affordable, low-power-consuming devices as well as the corresponding application software for easy access to and delivery of eGovernance services anytime, anywhere, and to anyone including seniors and those that are differently abled. Other projects could include (road) traffic management, Very Large Databases, Data Mining, Disaster Management Systems, etc.



Vinay Deshpande, Chairman & CEO, Encore Technologies, India

Areas of collaborative research:

- **Development of tools** that identify emerging societal trends.
- **Modeling and validating the next generation of public**

services as complex service systems taking into consideration needs of the younger generation (learning, mobility).

- **Behavioural and contextual research** to determine how citizens use public services .
- Identification, authentication and recognition for **identity management**.
- Interfacing with **languages/dialects**.
- **User Interfaces** (in particular voice interface).
- Optimising eGovernment applications for **cloud computing**.
- **Trust, Security** and privacy protection.

EU-India collaboration success story

COCKPIT - Citizens Collaboration & Co-creation in Public Service Delivery - www.cockpit-project.eu



COCKPIT aims to define a new Governance model which actively engages and empowers citizens in Public Service delivery decision making process. With IBM India a key partner, Cockpit will combine the research areas of citizens' opinion mining in the context of Web 2.0, enhance Service Science Management Engineering in the context of the public sector and encourage



deliberative engagement of citizens for forming informed judgments on public services delivery. COCKPIT supports the notion of open Public Administrations with which citizens have higher confidence and trust among each other and with the Public Administration itself, resulting in better governance, lower disputes on services delivery priority setting, higher degrees of public service adoption, lower public service delivery costs, better service innovation, and citizens loyalty to the public services.

“As a part of the collaboration initiatives under the EU FP7 projects, IBM India Research Labs has had the opportunity to interact with some of the best research institutes from across Europe. These combined research initiatives has led to significant contribution back to the research community.”



Nidhi Rajshree, IBM India Research Labs, India



ICTs for Inclusion

ICT offers a major opportunity to integrate people at risk of exclusion and empower individuals to fully participate in the emerging knowledge society. ICT also offers an important means to address the challenges associated with an ageing population, including the growing numbers of people with disabilities, fewer family carers and a smaller productive workforce. For many people, in particular for groups at risk of exclusion, the complexity and lack of utility, accessibility and usability of ICT still represents a major barrier.

Societies can effectively respond to these trends by mainstreaming and radically improving the accessibility and usability of new ICT solutions. This should ensure a better adoption and acceptance of ICT by people with disabilities, those with functional limitations or lacking digital competences, which can have positive collateral impact on society at large. Research and technology development requires a multi-disciplinary and user-centred approach combining advanced technology research and systems level integration.



Furthermore, resulting solutions must achieve wide acceptance.

A view from India

eInclusion is a topic which has very broad connotations in India where it is seen as bringing innovative solutions to enhance social and economic inclusion for all as a basic human right with access to services and entitlements through ICTs by the majority of the population. Mitigating disabilities or addressing challenges of inclusion and independent living associated with old age are yet to be appreciated as mainstream inclusion issues in the current Indian context whereas in Europe these are among the leading eInclusion challenges.

India brings into sharp relief a number of specific issues related to the country's large and complex population spread, the rural-urban divide, the variety of languages and the cultures they imbibe. These characteristics make it imperative to consider eInclusion in a much more holistic light.

Indian research currently focuses on areas such as bridging the Digital Divide by enabling access through preferred language, platform, interface

and device; social inclusion through education, community/citizen services and access to data; economic inclusion through livelihood enhancing tools and jobs; demand based delivery of services; and bottom up architecture in eServices.

A view from Europe

Europe is at a different stage where basic access is no longer an issue with the focus now on the inclusion of all citizens (“Every European Digital”). Broader social and economic objectives and the individual’s needs for learning, knowledge and wellbeing are the main drivers behind Europe’s eInclusion objectives and defines research goals. These goals aim to create an inclusive society and deliver ICT solutions that help substantially reduce the 30% of Europeans currently not using ICT. Research is also expected to provide prototypes of systemic ICT-based solutions capable of extending independence and prolonging active participation in society for the ageing population, as well as advanced solutions for other groups at risk of exclusion, notably marginalised young people.

Current Research in the European Union focuses on ICT for smart and personalised inclusion including ICT tools, infrastructures and devices for mainstream accessibility in daily life; intelligent and social computing for social interaction, user empowerment

and learning or skills acquisition; embedded accessibility of future ICT; and ICT restoring and augmenting human capabilities compensating for people with reduced motor functions or disabilities.

eInclusion - Recommendations for EU-India collaboration

“The common denominator for India and the EU is their diversity and range of issues. Also, both communities face the challenge of inclusion (political, social and economic) and improving efficiency (in resource utilisation and processes). ICT tools and systems are indispensable for addressing these challenges and need to be applied to their respective local requirements. Current efforts and interests in both EU and India are ideal to learn from each other’s experiences and also kick-start research collaborations for effective application of innovation.”



P. N. Vasanti, Director
Centre for

Media Studies, India

Areas of collaborative research:

- Advanced ICT-enabled solutions



including **social, affective and persuasive computing** - for the empowerment of people with disabilities or people at risk of social exclusion, including people with low literacy.

- **Smart, customised and personalised information**, in particular for groups across the digital divide in rural areas to support their activities, vocations and needs (agriculture, basic healthcare, low to medium skill professional training, farmers, rural youth, unemployed).
- **Personalisable assistive solutions** optimised for low bandwidth access, responsive to the user's physical, cognitive and mental capacities, and preferences, both in exercising professional activities and in a richer day-to-day living and leisure.

“Europe and India can share experiences, learning and a rich repertoire of existing European research results in order to jointly craft increasingly

personalised and versatile tools and solutions that make eInclusion a game-changer, as much across the digital divide in India as for the ageing population in Europe.”



Mounib Mekhilef, Professor in ICT at the University of Orléans & Director France, Ability Europe, UK/France

EU-India collaboration success story

eSANGATHAN – Collaborative Working Environment for Ageing Workforce

ICTs play a major role in conceiving novel solutions for organisations in order to mitigate the impact of dwindling demographics and scarcity of skilled professionals in given industries and/or geographical regions. The eSangathan project, in which Indian organisations Mahindra & Mahindra Limited and Tech Mahindra Limited participated, examined the inclusion of the ageing workforce in the information society, addressing how innovative approaches based on the use of ICT and Collaborative Working Environments (CWE) can generate ideas, models and new work environments for e-Inclusion of the ageing workforce.



Horizontal Measures for EU-India ICT Research Cooperation

Research cooperation between India and the European Union needs commitment from both sides over the medium and long term. Besides agreeing on common themes, there is need for institutional mechanisms and horizontal measures to be put in place and animated.

The major shortcoming seen in conducting collaborative research is the lack of reciprocity in terms of research themes, funding and administering joint research projects and active joint advisory/supervisory structures.

Euro-India SPIRIT recommends a number of measures which emerge from stakeholder views to address these gaps:

1. A dedicated multi-year EU-India **Bilateral ICT Research Programme**.

The short term expression of this would be to set up joint calls for research proposals across a limited number of mutually agreed topics with participation of research organisations from India and the EU. Projects must be selected, funded and administered jointly. Several successful examples of joint calls exist between the EU and emerging

countries, notably Brazil and Russia.

The longer term expression of this would be a **Joint Indo-EU ICT Research Programme** that could be elaborated for a five-year period and that would have a series of joint calls for research proposals on specific themes at regular intervals. While this suits the EU research structure (consolidated framework programmes that last five years and more), India needs to come up with its own multi-year research programme in order to make this work.

2. **Technology Platforms** - Industry-led Stakeholder Forums

Europe boasts the successful example of European Technology Platforms (ETPs) which are industry-led stakeholder forums charged with defining research priorities across a broad range of technological areas where achieving growth, competitiveness and sustainability requires major research and technological advances



in the medium to long term. This constitutes valuable input to define European research funding schemes. ETPs foster effective public-private partnerships to address technological challenges that could be the key for attaining economic and social goals and citizen well-being.

There is a need to put in place a stakeholder dialogue and collaboration process across specific research and technology themes between the India and the EU. This brings to the fore the need to create Indian Technology Platforms (ITPs) along similar lines with the backing of the Government of India, the European Commission and with the support of the ETPs. To start with, public authorities from India and the EU could provide official endorsement to setting up ITPs or encourage ETPs to extend their reach by bringing Indian industry stakeholders on board.

A number of successful ETPs in the ICT area can serve as examples to build the Indian Technology Platforms (NEM for new media content and networks, NESSI for Software & Services, Net!Works for mobile applications, EPoSS for smart systems integration.).

Most of all, the dialogue between the Technology Platforms from both sides would be extremely useful in producing medium to long term cooperation roadmaps between India and the EU in specific ICT areas.



Conclusion

Europe and India have complementarities in ICT research which should be leveraged to address challenges common to both regions. India has a young population. It is the world's fourth largest economy with a strong and resilient domestic industry base and the world's leading service hub for ICT and IT Enabled Services. With the fastest growing mobile telephony subscriber base in the world, yet lacklustre broadband penetration, India presents novel research challenges in building networks of the future and creating content and designing access devices. Europe on the other hand, has achieved the remarkable feat of building a Union around 27 large and small Member States that have succeeded in setting a common research and innovation agenda, collective funding and seamless administration. The strength of Europe's diverse research base lies in its longstanding tradition of innovation with the involvement of academia, R&D institutions and labs, as well as large and small enterprise across the continent. The European Union has been successful in setting collective economic, technological and social goals to be attained through research, for the benefit of citizens across all Member States and for businesses.

The time is ripe to chart a course for a collaborative R&D programme to take EU-India cooperation to the next level and work towards ensuring that societies in both regions are inclusive, innovative and secure. Through a consultative process, Euro-India SPIRIT has identified collaborative R&D potential in key priority areas ranging from future networks, cloud computing and trustworthy ICT to networked media and future internet, ICT for public services and ICT for Inclusion.

Research on the **Future Internet** requires significant investments in order to address current shortcomings. Shared investment through collaborative research programmes would reduce the cost burden on both regions. Europe's significant achievements in future network research could be leveraged to boost innovation in areas such as system architectures and technologies, ultra-high capacity satellite communications systems, ubiquitous fast broadband access, novel radio network typologies and resilient and flexible networks.

Cloud computing promises to transform



the way business and research are conducted coupled with the potential to enhance current public services and bring about new ones. Collaborative research should focus on intelligent and automatic management of cloud resources, scalable data management strategies, infrastructure virtualisation support for mobile and context-aware applications as well as energy efficiency and sustainability of software and services. Addressing current impediments to mainstream adoption, such as interoperability, legal, data and security issues is high on the European Agenda and Europe is gaining a stronger collective voice around standards implementation, which presents important opportunities for effective cooperation in this area. Developing a collaborative test bed to pilot the adoption of standards-based, interoperable cloud services would pave the ground for a level playing field of mutual benefit.

Trustworthy ICT is a core research area for India, which, as many other democratic and pluralistic societies, is facing a number of issues around network and data security, dependability and privacy protection. Europe has supported and benefited from

large-scale collaborative projects in this field and has set benchmarks in trustworthiness of ICTs for individuals and businesses and with regard to security and privacy. Considerable potential exists to build collaborative partnerships for sharing research results and build common approaches across topics such as usable security for mobile devices, large-scale data security and governance, identity management, data liability and governance policies.

Cooperation on **Networked Media and Future Internet** could play an important part in reducing the technology gap that currently exists between India and Europe in this area. Governance, education and inclusion are driven by a broad group of Indian stakeholders; from village farmers and senior citizens with rudimentary computer skills to researchers and social-network-savvy teens. The need for rich and immersive multimedia is expected to build a critical mass underpinned by the advent of cloud computing and the rapid proliferation of 3G. Europe is conducting ground-breaking research in this area in parallel with the rapid evolution of network technologies. Euro-India collaboration could therefore both leverage and supplement the reservoir of European knowledge and experience across a number of application domains such as eGovernment, eEducation, eInclusion and eTourism,



which are highly relevant to both regions.

“Networks of the future need to address issues of very high capacity (fixed wire & mobile), flexibility, heterogeneity, resiliency and energy efficiency while providing seamless end to end infrastructure, security and dependability. The Future Internet framework throws added challenges : While India is caught up with near term concerns such as broadband provisioning and rural area connectivity, selective collaboration with Europe on medium to long term themes and issues would help India maintain technological edge in this rapidly evolving domain. Europeans would not only find in the Indians high calibre researchers as partners, but also a series of challenges which would expand their horizon and challenge their understanding of network architecture, topology, design skills, energy efficiency, heterogeneity and flexibility.”



Pierre-Yves Danet, CTO, ASF Lab,
Orange-France Telecom, France

ICT plays a crucial role in ensuring that Public Services are delivered more efficiently, faster and at reduced costs to citizens and organisations. The Digital Agenda for Europe places emphasis on a

new generation of open, flexible and collaborative eGovernment services by 2020 as key enablers for citizens and businesses. Achieving eGovernment in India remains a daunting task given the heterogeneity of its population spread and the need to address specific issues at an institutional level. Much could be gained from assessing global strategies and implementation in order to further articulate India's eGovernment strategy. In particular, joint initiatives with Europe could identify social trends, undertake policy modelling and validate next-generation infrastructures, services and tools to optimise public service delivery and language portability.

Inclusion is only achievable through a multi-disciplinary, user-centric approach combining advanced technology research and systems integration to empower all citizens, particularly those most at risk of exclusion, by improving accessibility and usability of ICT. Inclusion is associated with different connotations in India and Europe with emphasis on bridging the digital divide across a high disparity within the population on the one hand, and on addressing the challenges of an ageing population and driving mainstream



smart and personalised inclusion on the other. Yet this diversity and range of issues represents a common ground on which to address economic, social and political inclusion of global significance by improving ICT utilisation that lowers barriers across the board. Areas for Euro-India collaborative R&D could include social, affective and persuasive computing; smart, customised and personalised information; personalisable assistive solutions.

The consultative process, through which these key research priorities have been identified, has laid a durable foundation to further Euro-India cooperation by ensuring consensus on both sides. Together, these areas of ICT research will shape the pillars upon which inclusive, innovative and secure societies can be built and produce mutual impact. Addressing horizontal issues through reinforced consultative mechanisms involving actors from all relevant stakeholder groups is paramount to translating this promising research potential into concrete initiatives founded on Euro-India collaborative work benefitting citizens, enterprise and government in both regions.

“The Euro-India Spirit was effectively captured as the project began with a clash of cultures and priorities, but in the end, the project team arrived as one at common concerns affecting the relationship between ICTs and societies.”



Usha Reddy, Independent Consultant, India



Euro-India SPIRIT ICT Expert Working Group

Name	Organisation	Country
Sarat Chandra Babu	Centre for Development of Advanced Computing (C-DAC)	India
Suresh Chande	Nokia Research Centre	Finland
Jim Clarke	Waterford Institute of Technology	Ireland
Pierre-Yves Danet	Orange Lab - France Telecom R&D	France
Vinay Deshpande	Encore Software	India
Fabrizio Gagliardi	Microsoft Research Connections	United Kingdom
Hiranmay Ghosh	Tata Consultancy Services - Innovation Lab	India
Subu Goparaju	Infosys Technologies	India
Anita Gurusurthy	IT for Change	India
Thorsten Herfet	University of Saarland	Germany
Ashok Jhunjhunwala	Indian Institute of Technology - Madras	India
Mounib Mekhilef	Ability Europe Ltd.	UK/France
T.V. Prabhakar	Indian Institute of Technology - Kanpur	India
Ganga Prasad	Centre for Development of Advanced Computing (C-DAC)	India
Usha Reddy	Independent Consultant	India
Nicole-Turbé Suetens	Distance Expert	France
Neeraj Suri	Technische Universität Darmstadt	Germany
P.N. Vasanti	Centre for Media Studies	India

