



***COMMON RESEARCH PRIORITIES  
BETWEEN RELEVANT ETPs AND THE  
EECA REGION IN THE FIELD OF  
Components, Computing Systems  
and Networks***

***VERSION 4.0 – JANUARY 2014***



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## PICTURE project identity

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<b>Coordinator:</b>	INNO TSD SA, France, <a href="http://www.inno-group.com">http://www.inno-group.com</a>
<b>Project Overview:</b>	<p><b>PICTURE</b> is a support action project aimed at supporting policy dialogue between the European Union and Eastern Europe - Central Asia (EECA) countries and at fostering collaboration opportunities with EECA countries organizations in collaborative ICT R&amp;D both under FP7 and under national/regional EECA programs.</p> <p>The main objectives of PICTURE project are:</p> <ul style="list-style-type: none"> <li>• To enrich and support the policy dialogue between EU and EECA countries, by updating and reinforcing points for convergence of the EU and EECA ICT research and relevant international initiatives and activities; by developing recommendations and roadmap, and by implementing pilot actions and exchanging experience and lessons learnt,</li> <li>• To strengthen strategic partnerships and cooperative research links between European and EECA ICT organizations, e.g., though stronger involvement of IT diaspora and enhancing concrete cooperation initiatives,</li> <li>• To facilitate interactions between EU and EECA ICT communities through organizations of joint events, and facilitate preparation of joint EU-EECA R&amp;D projects.</li> </ul>
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### **Important notice**

This document outlines the PICTURE partners' analysis regarding the common research priorities between selected ETPs (e.g. Net!Works, Photonics21 and ETP4HPC) and the EECA region in the light of HORIZON's 2020 objectives and structure. Initially, this document served as a background document for the Workshop on Components, Computing Systems and Networks, which took place on 25 September 2013 in Yerevan, Armenia. The present revision is based on:

- the outcomes of the above Workshop;
- the analysis of the Work Programmes of the 1<sup>st</sup> period of HORIZON 2020 (December 2013);
- the Commission staff working document - strategy for European Technology Platforms: ETP 2020 (12.07.2013);
- the Net!Works Strategic Research Agenda (July 2012);
- the Photonics21 Multiannual Strategic Roadmap (May 2013);
- the ETP4HPC Strategic Research Agenda (June 2013).

## **1. Introduction**

In the EU, the European Technology Platforms (ETPs) constitute state-of-the-art initiatives bringing together the industrial and research communities. In Russia, similar structures have already emerged (e.g. Russian Technology Platforms). Some EECA countries exhibit a sufficient degree of maturity for the development of such structures in the foreseeable future. Finally, the other EECA countries can benefit considerably of similar good practices in setting up Technology/Knowledge Platforms (e.g. research agenda development, organisational structuring, etc) since they will further facilitate the process of national research structuring.

The increase of visibility of ETPs among similar structures as well as relevant stakeholders from EECA countries will be mutually beneficial allowing reciprocal learning, sharing experience and possibly joining forces. At the same time, it may also trigger more participation of the private sector in EECA (e.g. innovative companies) in ETPs as well as other similar structures. This could further stimulate the engagement of the private sector of EECA countries in research and innovation and, in return, can provide additional strength to the technology platforms in both regions.

This document, attempts to identify research areas of mutual interest between relevant ETPs and the EECA region in the field of “Components, Computing Systems and Networks” to become common ground for future joint activities in the light of HORIZON 2020. The document is based on:

- the Strategic Research Agendas and relevant documents of the selected ETPs (**NET!WORKS, PHOTONICS21 and ETP4HPC**);
- the Commission staff working document - strategy for European Technology Platforms: ETP 2020 (12.07.2013);
- the current EECA ICT priorities as they were outlined in PICTURE project deliverable: “Updated report about the EECA ICT priorities” and
- Horizon 2020 objectives, structure and Work Programmes (as they were adopted on December 2013).

## REMARK

For a more comprehensive analysis, the Eastern Europe and Central Asia region (EECA region) is divided into three sub regions based on common ICT R&D features:

- **Eastern Partnership (EaP)** countries consisting of: Ukraine, Belarus, Moldova, Georgia, Armenia and Azerbaijan;
- **Central Asia (CA)** countries consisting of: Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan and Kyrgyzstan;
- **Russian Federation.**



## **2. ETPs**

European Technology Platforms (ETPs) are industry-led stakeholder fora that develop short to long-term research and innovation agendas and roadmaps for action at EU and national level to be supported by both private and public funding.

ETPs provide a framework for stakeholders, led by industry, to define research priorities and action plans on a number of technological areas where achieving EU growth, competitiveness and sustainability requires major research and technological advances in the medium to long term. Some European Technology Platforms are loose networks that come together in annual meetings, but others are establishing legal structures with membership fees.

They work on developing and updating agendas of research priorities for their particular sector. These agendas constitute valuable input to define European research funding schemes. Since they are developed through dialogue among industrial and public researchers and national government representatives, they also contribute to create consensus and to improve alignment of investment efforts. Avoiding duplication and making the most of poles of excellence and best practices is one of the great challenges of European research, and ETPs are a very good vehicle to improve synergies.

ETPs foster effective public-private partnerships, contributing significantly to the development of a European Research Area of knowledge for growth. Public-private partnerships can address technological challenges that could be a key for sustainable development, for the improved delivery of public services and for the restructuring of traditional industrial sectors.

Recently, the Commission published a document (COMMISSION STAFF WORKING DOCUMENT - STRATEGY FOR EUROPEAN TECHNOLOGY PLATFORMS: ETP 2020) that sets a new landscape for ETPs. The above strategy:

- seeks to maximize the impact of the European Technology Platforms (ETPs);
- recognises the role of ETPs as part of the external advice and societal engagement needed to implement Horizon 2020;
- sets criteria for the recognition of the ETPs by the Commission.

Additionally, according to the above strategy, ETPs will be a key element in the European innovation ecosystem and will help turn Europe into an Innovation Union, by taking a holistic view and:

- developing strategies and provide a coherent business-focused analysis of research and innovation bottlenecks and opportunities related to societal challenges and industrial leadership actions;
- mobilising industry and other stakeholders within the EU to work in partnership and deliver on agreed priorities;
- sharing information and enable knowledge transfer to a wide range of stakeholders across the EU.

The European Commission does not own or manage European Technology Platforms, which are independent organisations. The European Commission did, however, support their creation and remains engaged with them in structural dialogue on research issues.

As of October 2013, 10 ETPs have been recognized by the Commission in the ICT sector:

- ARTEMIS: Embedded Systems.
- EUROP: Robotics.
- ETP4HPC: High Performance Computing.
- ENIAC: Nanoelectronics.
- EPoSS: Smart Systems Integration.
- ISI: Satellite.
- Net!works: Networks Infrastructure.
- Photonics21: Optical.
- NESSi: Software & Services.
- NEM: Networked media.

Recently, ARTEMIS and ENIAC merged to form the new Electronic Components and Systems for European Leadership (ECSEL) Joint Technology Initiative (JTI). The new ECSEL JTI is expected to start in early 2014 and to be fully operational up to 2020 followed by a running down phase to 2024. It will bring together large companies, world-class European research and technology organizations linked with higher education research labs and SMEs providing technology and services

Three of them (e.g. Net!works, Photonics21 and ETP4HPC) are more relevant to the field of **Components, Computing Systems and Networks** and their research priorities are presented in the following paragraphs.

## **2.1 Net!works research priorities**

[Net!Works](#) is the European Technology Platform for communications networks and services. Communications networks enable interaction between users of various types of equipment, either mobile (e.g. mobile phones) or fixed (e.g. PCs); they are the foundation of the Internet. The Net!Works European Technology Platform gathers about 880 players of the communications networks sector: industry leaders, innovative SMEs, and leading academic institutions. The mission of Net!Works is to strengthen Europe's leadership in networking technology and services so that it best serves Europe's citizens and the European economy.

Bridging the gap between research and innovation and the expectations from the European society is critical. Therefore Net!Works is now committing to interact more with actors outside the research community. Decision makers from the various public authorities in charge of economic development or of local and regional policies, for example, will be asked to provide their views and cooperate.

Net!Works supports the basic structure of Horizon 2020 with the three priorities: Excellent Science, Industrial Leadership and Societal Challenges. It is expected that this approach will help to exploit research results faster for new solutions and systems and will increase growth of European economy.

The Net!Works European Technology Platform, which represents more than 800 member organisations, reviewed the Commission proposal on Horizon 2020.

From the perspective of Net!Works, there are a series of issues which should be discussed with the Commission in order to make the implementation of research projects more efficient and to safeguard the interests of stakeholders (e.g.: multidisciplinary research; more holistic, coordinated and strategic approach spanning the research to business spectrum; shortening the process of project start from proposal submission to contract signature to less than 6 months; maintaining current instruments for collaborative research, such as IP and STREPs; co-financing of projects in the current Joint Technology Initiatives in the area of ICT, in which the EC and member states jointly provide funding for projects).

At the end of 2013 a new EU Framework Research Program "Horizon 2020" will be launched. One of the intentions of this program is to start a Public-Private-Partnership on 5G Infrastructure. The Net!Works ETP is playing and expected to continue to play an important role e.g. in the definition of the strategic research agenda of this PPP and therefore support from members to the Net!Works ETP will be crucial in the coming years. At this event several important decisions will be made which will have an impact on the research environment in the coming years.

Net!Works priority topics are:

1. Smart Cities, including following 4 areas:
  - 1.1 E-Government
  - 1.2 Health, Inclusion and Assisted Living
  - 1.3 Intelligent Transportation Systems
  - 1.4 Smart Grids, Energy Efficiency and Environment
2. Spectrum Crunch
3. Networks for the Next Generation of Wireless-Optics Communications
4. Architectures and Management of Future Networks
5. Networks as National Critical Infrastructures
6. Networks for Cloud Computing and Service Platforms

The strategic technologies and research areas that are deemed to collectively address Grand Societal Challenges, users' requirements for communications, telecom industry challenges and market requirements, thus offering the promise of greater economic and societal impacts for Europe are:

- Smart communication systems - defined as self-organising/planning and cognitive communications and operation at radio access, fixed network and service layers and enabling of software-defined networking.
- Context-based networking - including user context, device context, radio environment context and network context, requiring research into technologies for capturing of all the above context information and suitable mechanisms for their combined use for efficient operation of smart communication systems.
- User profiling mechanisms and technologies - for user-centric services, thereby minimising complexity in services and networks access for a user.
- Machine-to-machine communications - Internet of Things, including UE-to-UE (User Equipment), requiring research into protocols and techniques for autonomous and self-organising operation, ubiquitous connectivity, interoperability, context awareness.
- Small cell technologies- enabling very high area capacity, energy and spectrum and cost per bit efficiencies.
- Infrastructure sharing - mechanisms and technologies for a flexible universal core network with network virtualisation.
- Support of a fully multi-dimensional approach – research into multi-service providers, multi-RATs, multi-services, multi-networks technologies and multi-cell topologies, with evolution capabilities towards a universal platform for Future Internet, providing IaaS (Infrastructure as a Service), NaaS (Network as a Service), and ultimately, SaaS (Service as a Service) in support of different business models, interfaces and sizes.
- Information centric networks –new architectures and protocols for overcoming service inter-operability across different and heterogeneous network technologies.
- Hybrid of optical fibre and wireless technologies - radio over fibre (RoF) subsystems and components, optical network switching/routing and implications on protocol stacks.
- Optical networks - multi-granular, flexible, scalable transparent and adaptive optical networks, supporting channel rates of Tbps.
- New communication technologies – new approaches should be explored, namely visible light communications, and new communication waveforms, post-OFDM.
- Systems co-design – different levels of systems should be taken into a co-design approach, in particular, radio access and wireless backhaul, for high capacity small cells.
- Energy efficient systems – a holistic and end-to-end area that comprises of terminals, infrastructure, networking, deployments, and energy-aware system operation.
- Standard interfaces – universal and common standard Interface between services to networks, enabling proliferation of services and applications, and services interoperability across different networks.
- Trust, security, and privacy - mechanisms and protocols for trust, security and privacy, taking a holistic approach, and encompassing the various stakeholders, hence, encompassing technologies for monitoring and lowering of electromagnetic fields.

The above mentioned technologies and research areas are not listed in any particular order of priority. They are all considered to be strategically important and their realisation should pave the way for a progressive transition to the Future Internet.

## **Key Messages**

The desire of individuals to influence decision making by leaders has grown continuously in recent years. Never before has communications and IT technology provided individuals with such a range of opportunities to make their opinions heard. From Twitters to Web fora, the choice of communications options is growing every day. This change in the role of the individual in society is happening.

*ICT is essential for our continued economic growth and job creation in Europe!*

Information and Communications Technology (ICT) is one of the industrial sectors set to grow in the coming decade generating lots of exciting new jobs and economic activity. Europe is excellently positioned to lead this growth based on the established leadership of European industry in communications technologies addressing societal challenges such as transport, energy, environmental and health applications. All of the new applications involve integrating the latest mobile and fixed communications networks and services directly into the application. This gives users the instant information and control they need to optimize their services to the specific needs of the individual as well as to the needs of society as a whole. We need to maintain R & D on ICT in Europe to have the experts needed to exploit the market opportunities for the new applications.

Communications networks will be a part of every application and is an absolutely key enabling technology across all sectors in the society and economy.

*Research on new networks and services has to start now to be ready to support the mass market use of new applications!*

Already, the trend towards increasing use of communications technology to support all aspects of everyday life is clear. Predictions show that the current networks and services will reach the limits of the capabilities in coming years. The volume of users and transported information will rapidly increase demanding new levels of network performance while and society depends increasingly on reliable and secure services.

Major challenges lie ahead in overcoming the limitations of current networking technology. Physical limits are being approached in several key technologies while security and privacy issues have captured the attention of individuals and governments around the world. Innovation and multi-disciplinary research will be needed to develop flexible and adaptable solutions. We need to motivate our students to become technology researchers and invent the future, securing knowledge leadership for Europe! To secure and improve our leadership for the future, we need to take action now.

The collaborative projects, such as Integrated Projects, in the Cooperation area of the Framework Programme, have shown that excellent results can be achieved when industry, research centres and SMEs work together. We should build on this success!

## 2.2 Photonics21 research priorities

Photonics21 is the European Technology Platform for photonics – one of those technologies which the European Commission in 2009 nominated as “Key Enabling Technologies (KET’s). The platform represents photonics research & innovation priorities at European level and aims to implement a common photonics strategy for Europe.

Photonics21 is a voluntary association of industrial enterprises and other stakeholders in the field of photonics in Europe. It unites the majority of the leading Photonics industries and relevant R&D&I stakeholders along the whole economic value chain throughout Europe. Presently, Photonics21 has about 2000 stakeholders.

Photonics21 undertakes to establish Europe as a leader in the development and deployment of Photonics in six industrial areas (Information and Communication, Industrial Manufacturing, Lighting, Displays, Organic Electronics, Life Science & Health, Security, Metrology & Sensors, Optical Components and Systems) as well as in Education and Training.

Its mission is the coordination of the research, development and innovation activities in Europe among all the contributing partners from education, basic research, applied research and development to manufacturing and all relevant applications.

The entry into the "photon century" requires a shared European initiative that enables industry and research to uphold their outstanding initiatives to explore the nearly limitless future applications of light and to reap the expected benefits in terms of creating both jobs and wealth. Many important European industries, from machinery equipment manufacturing, lighting, health care and life sciences, semiconductors to space, defence and the transport and automotive sectors rely on the same fundamental mastery of light. Without strong European leadership in photonics technologies, these industries will be left vulnerable to strong competition from the USA and Asia.

To achieve this leadership for the benefit of Europe and our citizens, an ambitious programme is required to:

- Supply the necessary research environment capable of supporting the visionary and industrially relevant R&D activities for photonics components, systems and their application over a broad range of industry sectors;
- Establish strategic links between mainly SME-based photonics industries and principal user industries to share their long term vision and to mobilise a critical mass resources;
- Foster co-operation and smooth out the current fragmentation of national and European R&I activities.

- **Workgroup Level - Outline actions how to treat**

- Technological Challenges
- Research Actions – which solutions should be investigated
- Innovation Actions
- Research & Innovation requirements
- Cross cutting Key Enabling Technology Issues

Telecommunications and machinery equipment (Lasers), Optical Measurement and Machine Vision have traditionally been the industrial areas where photonics played a role. But photonics is increasingly driving innovation in many other application areas. The Multiannual Strategic

Roadmap identifies these application areas and list for each of them a seven years Roadmap with the key technological challenges and appropriate research and innovation actions and requirements to achieve and secure a leading position for European photonics.

The Roadmap is grouped into five application sectors: information and communication; industrial production and manufacturing and quality; life sciences and health; lighting and displays; security, metrology and sensors. Additionally two cross-cutting topics have also been defined: design and manufacturing of photonic components and systems, and photonics education, training and research infrastructure.

In the frame of Horizon 2020 and the “Key Enabling Technology Report” the Multiannual Strategic Roadmap makes a number of recommendations mainly focussing what needs to be done to overcome the “Valley of Death” in Europe and to faster drive innovations towards the market resulting in growth and jobs for Europe

- Disruptive and Road-Map based Core Photonic Technologies
  - Roadmap-based research – value chain approach, involvement of end users
  - Disruptive technology - breakthrough advances for disruptive research
- Demonstration Programmes
  - Deployment programmes to leverage EU infrastructure to create jobs..
  - Coordinated market pull/push measures seed and accelerate market penetration
- Photonics Manufacturing Platforms – Manufacturing in Europe
  - Generic photonic foundries – improve infrastructure for photonics manufacturing
  - Establish public-private pilot production facilities for industry/research
- Innovative Photonics SMEs & Mid Sized Companies
  - Light touch’ open schemes
  - Fast-track funding allowing prototyping & short-term commercialization
- Public Procurement
  - Life Cycle cost approach by public procurement
- Support Actions
  - Education, training and skills development
  - Standardization & International Cooperation & Outreach.

Today, about 2,000 representatives of industry and science from most European countries are members of the Photonics21 platform to jointly further advance Europe’s position in optical technologies. The current global photonics market is exceeding 350 billion Euros and demonstrated growth about twice time global GDP growth in the current past Europe’s share of this world market is approximately €65 billion, representing nearly 20% of the total market. Photonics is expected to grow also in the future faster than GDP reaching a 615 billion Euro level in 2020.

The European photonics industry has many market-leading industrial players and more than 5000 highly innovative SMEs. It employs ~ 300,000 employees directly, with subcontractors employing many more. It has string core segments where the market share of European companies indicates a global leading position:

- Production technology 55%
- Optical components & systems 40%
- Measurement & automated vision 35%
- Medical technology & life sciences 30%

The Secretariat activities, initially carried out on a voluntary basis, have been supported since mid-2008 by the EC project Phorce21 under the seventh framework programme.

Over the year 2008 Photonics21 has cooperated actively with the ETPs ARTEMIS, Net!Works, ENIAC, EPOSS, ERTRAC, eSAFETY, EUROP, ISI, Manufuture, NEM and NESSI.

Following the establishment of a number of national platforms, a Photonics21 Mirror Group was set up to develop a stronger partnership between the Member States and better coordinate European and national funding strategies. The group brings together representatives of national funding bodies of 15 European countries and met five times during the past year.

An important outcome of the work of this group was an agreement to proceed with a joint funding activity – called ERA-NET Plus – by creating a common pot of money to fund research (of which two thirds will come from participating States and one third from the EU). The main areas under discussion for future funding under this activity are next generation broadband and bio-photonics.

Photonics21 has also been active in the field of international research cooperation. In order to strengthen cooperation between the European Union and Russia, which has world leading researchers in the area of photonics and modern optics, the platform, in cooperation with the European Commission, organised a matchmaking event with 60 European and Russian experts to identify partners for FP7 photonics projects, which resulted in the definition of 10 possible joint projects.

Next to the annual updating of the SRA in 2007 saw a number of other important developments that helped to raise the profile of the platform. Firstly, Photonics21 was given a high profile in the seventh framework programme resulting in a 40 % increase of research funding, which will reach EUR 90 million for 2007–08. Moreover, the European Commission established a dedicated photonics unit in the Information Society and Media DG.

On its way to Horizon 2020 Photonics is invited to become one of the Public Private Partnerships (PPP) “where all the partners concerned commit to support the development and implementation of R&I activities of strategic importance to the Union's competitiveness and industrial leadership or to address specific societal challenges” (quoted EU Commission, article 19, COM (2011) 809 final of 30 NOV 2011). Currently photonics21 is setting up the appropriate papers and governance structure of this PPP which should ensure the continuous involvement of the entire EU community on the one side – and a formalized “eyes-on partnership” with the EU Commission on the other side.

The table below shows Major Application Fields of Photonics21 and Socio-economic and R&I challenges that each of them are facing.

<b>Major Application Fields</b>	<b>Socio-economic challenges</b>	<b>Research and innovation challenges</b>
Information & Communication	<ul style="list-style-type: none"> <li>• ensuring sustainable development,</li> <li>• securing energy supply,</li> <li>• addressing the needs of an ageing population,</li> <li>• ensuring human and environmental health</li> <li>• employment</li> </ul>	<ul style="list-style-type: none"> <li>• Broadband terrestrial backbones</li> <li>• Optical network and IT convergence</li> <li>• Broadband fibre based access</li> <li>• Optical interconnects lighting the datacentre</li> </ul>

Major Application Fields	Socio-economic challenges	Research and innovation challenges
Industrial Manufacturing & Quality	<ul style="list-style-type: none"> <li>• Sustainable development</li> <li>• Reduction in energy consumption</li> <li>• Zero-fault production</li> <li>• Green manufacturing</li> <li>• Addressing needs of healthcare sector and aging population</li> <li>• Employment</li> <li>• Provides competitive advantage to manufacturing industries</li> </ul>	<ul style="list-style-type: none"> <li>• Extending laser processing capabilities</li> <li>• More efficient lasers</li> <li>• Longer-lasting components that can be recycled</li> <li>• Maintenance-free manufacturing equipment</li> <li>• New photon transmission systems</li> <li>• incorporation of adaptive reconfigurable beam delivery networks capable of high power and intensity</li> <li>• high-speed beam deflection technology</li> <li>• improvements in quality control and sensors</li> </ul>
Life Science & Health	<ul style="list-style-type: none"> <li>• Pandemics caused by contamination</li> <li>• Public health</li> <li>• Ageing societies</li> </ul>	<ul style="list-style-type: none"> <li>• Preclinical research</li> <li>• Oncology</li> <li>• Infectious diseases</li> <li>• Ophthalmology</li> <li>• Neuro-monitoring and imaging</li> <li>• Environmental monitoring, food and drug quality and safety</li> </ul>
Emerging Lighting, Electronics & Displays	<ul style="list-style-type: none"> <li>• Health</li> <li>• Clean and efficient energy</li> <li>• Climate action, resource efficiency</li> <li>• Smart, green transport</li> <li>• Inclusive, innovative and secure societies</li> </ul>	<ul style="list-style-type: none"> <li>• LEDs</li> <li>• OLEDs</li> <li>• OPV (Organic Photovoltaics)</li> <li>• Flexible Electronics based on OLAE devices</li> <li>• Displays</li> </ul>
Security, Metrology & Sensors	<ul style="list-style-type: none"> <li>• Safe and healthy food and water</li> <li>• Clean air</li> <li>• Clean and safe environment</li> <li>• More secure society</li> <li>• Smart transport systems</li> </ul>	<ul style="list-style-type: none"> <li>• EIR (Extended Infrared) sources</li> <li>• EIR photodetectors</li> <li>• CMOS-based single-photon NIR image sensing</li> <li>• Low-cost, high-performance micro-coolers</li> <li>• Passive optical devices</li> <li>• Optical fiber light-guides and sensors</li> <li>• Measurement techniques for processes and production lines</li> <li>• Complete integrated photonic microsystems</li> <li>• Comprehensive photonic solutions for high-impact applications</li> </ul>
Design and Manufacturing of Components & Systems	<ul style="list-style-type: none"> <li>• No specific applications addressed, but numerous of general aspects</li> <li>• Strengthening European industry</li> </ul>	<ul style="list-style-type: none"> <li>• Photonic integration</li> <li>• Integration of photonics with microelectronics</li> <li>• Technologies for cost-effective manufacturing of components and subsystems</li> <li>• Semiconductor optical device technology</li> <li>• Exploitation of new materials</li> </ul>

<b>Major Application Fields</b>	<b>Socio-economic challenges</b>	<b>Research and innovation challenges</b>
Education, Training & Disruptive Research	• All above challenges in general	• Research • Education and training

## 2.3 ETP4HPC research priorities

High Performance Computing (HPC) plays a pivotal role in stimulating Europe's economic growth. HPC is a pervasive tool allowing industry and academia to develop world-class products, services and inventions in order to maintain and reinforce Europe's position on the competitive worldwide arena. HPC is also recognized as crucial in addressing grand societal challenges. "Today, to Out-Compute is to Out-Compete" best describes the role of HPC.

### Strategy: A MULTIDIMENSIONAL HPC VISION

There is demand for R&D and innovation in both extreme performance systems and mid-range HPC systems. Almost all scientific domains and some industrial users want to achieve extreme-scale performance systems as soon as possible. At the same time, there is need particularly expressed by industrial users and ISVs for more flexible, easier-to-use, more productive and more cost-effective HPC systems delivering mid-range performance.

### Membership

All the actors participating in the European HPC technology ecosystem are:

- Technology providers
- ISVs facing the manycores/new architectures disruption
- Users looking for advanced technological HPC systems
- Research centers contributing to HPC research
- Computing center working on HPC technology or innovative HPC system operation

### Vision

- To build a European world-class HPC technology value chain that will be globally competitive.
- To achieve a critical mass of convergent resources in order to increase the competitiveness of European HPC vendors and solutions.
- To leverage the transformative power of HPC in order to boost European competitiveness in science and business.
- To expand the HPC user base, especially SMEs (through facilitating access to HPC resources and technologies) and to open the possibilities for SMEs to participate in the provision of competitive HPC technology solutions.
- To facilitate the provision of innovative solutions to tackle grand societal challenges in Europe such as climate change, better healthcare, predicting and managing large scale catastrophes and energy-efficiency.
- To foster international cooperation in research and industry.

### Mission

- Designing and updating a Strategic Research Agenda (SRA) to provide decision makers with relevant advice and expertise for the long term development of HPC in Europe.
- Providing recommendations and support to the implementation of the SRA.
- Facilitating coordination between the HPC ecosystem and public authorities (EU and Member States) responsible for HPC research and dissemination programs.
- Fostering joint initiatives among ETP members and other stakeholders in the area of research and innovation programs.
- Facilitating the emergence of start-ups and the growth of existing SMEs.
- Supporting Europe and Member States authorities by reinforcing Europe's position in the worldwide HPC arena.
- Representing the voice of the European HPC industry in the worldwide HPC arena.

## **HPC and European Industrial Competitiveness**

The competitiveness of a number of European industries depends on the availability of, and easy access to HPC resources:

- **Medicine and life sciences.**

Genomic therapy and personalized medicine are now recognised as powerful tools. The explosion of biomedical information requires a huge increase in the processing capability to analyse these data. Identification of potential drug candidates for disease targets will be fuelled by the next generation of supercomputers.

- **Materials science, Chemistry and Nanoscience.**

The incessant demand for new materials in domains, such as the consumer electronics industry (relying heavily on nano-electronics), medicine (enabling new diagnosis methods), chemistry (facilitating the development and use of products with lower environmental impact), is strongly dependant on HPC evolution.

- **Aeronautics.**

HPC is already a key technology for aircraft manufacturers. It allows the design and modelling of aircraft components and subsystems with superior performance characteristics, energy efficiency, and greatly reduced environmental impact. The challenge for future aircraft design is to test fly a virtual aircraft with all of its multi-disciplinary interactions in a computer environment.

- **Automotive.**

The automotive industry has profited strongly from their take-up of HPC: product development cycles and costs were significantly reduced by adopting virtual design, simulation and testing, and the efficiency, safety and eco-friendliness of products could be significantly increased. This industry already foresees the need for EFlops-class systems to address the following challenges: long-range vehicle lifetimes without repairs, full-body crash tests, which also include potential soft-tissue damages, longer-lasting batteries (in particular for electrical and hybrid cars).

- **Energy.**

Here HPC demand is strongly driven by the need for improved safety and efficiency of facilities and also for optimising the overall energy infrastructure to reduce waste and continuously match offer with demand. HPC is also required in the development of new energies, such as wind power, solar energy, or nuclear fusion.

- **Oil and Gas.**

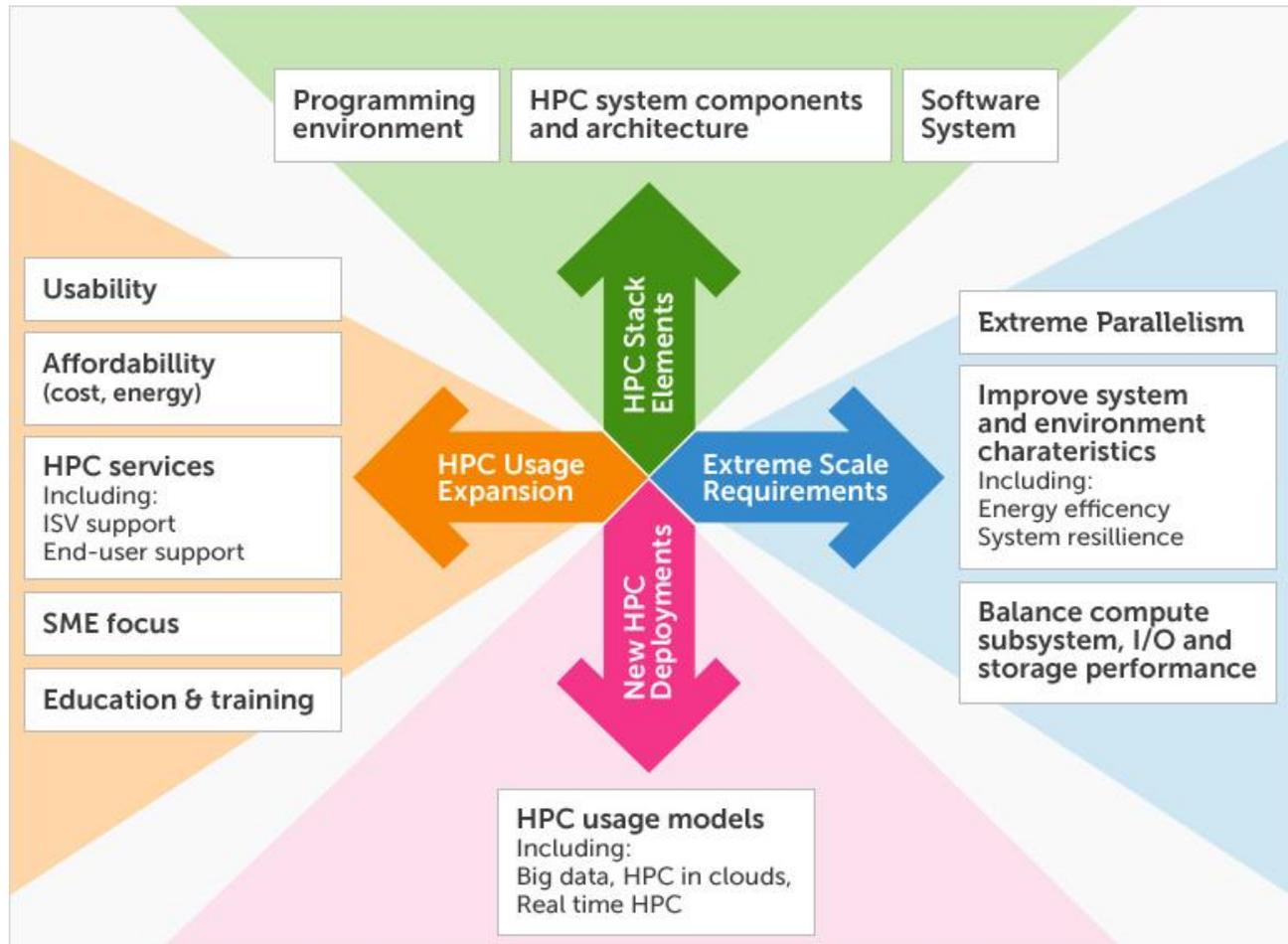
HPC demand in this industry is mainly driven by exploration for new resources and is typically used in the process of identifying underground oil and gas resources using seismic methods.

In addition to the direct contribution of its supply chain, HPC is also a prime catalyst of growth on a macroeconomic level through its technological interaction with science and other industrial and technological areas. Because of the high levels of return on investment achieved, there is a correlation between investment in HPC and leadership in industry and science. HPC is also able to stimulate innovation in other ICT sectors by the provision of novel computing technologies that subsequently are likely to be re-used in other applications (as has been the case with parallel programming). In turn, the growing requirements of HPC system may be satisfied by solutions developed in other areas such as the consumer product domains.

## **Addressing Grand Societal Challenges**

The growth of the European economy as well as the prosperity and security of the European citizens depend to a large extent on the resolution of the Grand Societal and Economic Challenges. While HPC will enable end-user applications to tackle these problems, it will also be the source of new technologies that may, for instance, enable new levels of energy efficiency or smart, embedded systems.

## Major challenges addressed



The ETP4HPC's SRA focuses on specific challenges within the four dimensions shown in the figure above. They are the drivers underlying the research topics:

- **At the System Architecture level:**
  - Future HPC platform architectures
  - Energy cost and power consumption
  - I/O latency and bandwidth (memory, interconnect, and storage)
  - Concurrency and data locality
  - Extreme scale from sub-component to total system
  - Resiliency, Reliability, Availability, Serviceability (RAS)
  - The "storage gap" between storage and compute performance
- **At the System Software level:**
  - Scalability, modularity, robustness
  - Capability for virtualisation
  - Extensive system monitoring
  - Increased system heterogeneity
  - Awareness of data-movement cost
- **For the programming environment:**
  - Hierarchical models
  - Data distribution and locality
  - Performance analytics
  - Emergence of new parallel algorithms
  - Awareness of data-movement cost
  - Application code migration and re-writing

- **Related to new HPC usage models:**
  - Explosion of data volumes (“Big Data”)
  - Increasing heterogeneity of data
  - HPC workloads in cloud computing

### 3. ICT research priorities in EECA countries

The following EECA ICT priorities have been identified by PICTURE project (deliverable D2.1a: «Updated report about the EECA ICT priorities»). The report was based on the findings of the EECA cluster project<sup>1</sup>, on review of new national ICT policy documents (up to January 2013) and on interviews/ contacts with national ICT policy stakeholders.

#### Russian Federation

##### **Identified Priority topics:**

- **Topic 1: Advanced Software Engineering.** Rational for selection: Russia has profound background in both applied software development and systems development. Latest initiatives of the Russian Government on Software Engineering, including creation of the National Software Platform, manifest the intention to replace imported software in state governance and enterprises with open-source alternatives. Selection of open-source products opens the way to unique mutually beneficial cooperation between EU and Russia. Open-source software does not have borders, it easily allows for collaborative development and reuse in various scenarios. Establishment of the National Software Platform provides an opportunity to set up cooperation at the level of big industrial/research consortia that ETP actually are. Such cooperation might result in further clarification of Strategic Agendas and Implementation Plans.
- **Topic 2: Embedded Systems Robotics / Intelligent Systems.** Rational for selection: Embedded systems are widely used to control complex systems. Russian research bodies and private companies are active at development of new hardware and software embedded systems; focus is on the real-time control systems and extreme conditions of operations. EU-RF R&D collaboration in the field of embedded electronics components will contribute to increasing the share of the ES value in the final product especially in sectors such as Industrial, Telecommunications, Consumer Electronics, Smart Homes and Health/Medical Equipment. This domain is supported by the National Platform on Mechatronics, Embedded Control Systems, RFID and Robotics.
- **Topic 3: GRID and Cloud computing / High-performance computing.** Rational for selection: Russia has developed an outstanding expertise in key fundamental research domains such as micro/nanoelectronic, aerospace and other scientific domains making strong use of mathematical background. All of these require intensive modeling and computations. High Performance Computing (HPC), including Grid computing, cloud computing, supercomputers, is the major research tool in physics, chemistry, biology and other sciences. HPC is one of the driving forces of the modern technology; it is used in automobile, aerospace, microelectronics and other industries. Russia has a critical mass of competences in HPC systems design and implementation and its applications to various needs of natural sciences and national industries.
- **Topic 4: Network of the Future.** Rational for selection: The vastness of the territory of Russia gives a unique opportunity for large scale networking infrastructures, providing access to new and next generation services for more than 10% of the Earth's land. It calls for new communication media, new security challenges and trust infrastructures. There are some valid reasons to raise the importance of EU-RU joint projects in this field. Firstly, this area has a great potential related to growing

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<sup>1</sup> EECA cluster project was the joint effort of 3 complementary FP7-ICT support actions (ISTOK-SOYUZ, SCUBE-ICT and EXTEND) that were running from January 2009 until June 2011 with the common mandate of strengthening the cooperation between EU and EECA countries in the field of Information and Communication Technologies (ICT). One of the cluster's achievements was the identification of ICT R&D priorities for cooperation between the EU and the EECA countries.

interoperability between infrastructures. Secondly, EU scientists attesting very strong theoretical background need to reinforce the “proof of the concept” level and validation of research results. Russian IT researchers possess very strong software engineering skills, which has a great impact on rapidly proving the conceptions in applied research areas. Finally, the joint next generation IT projects can incite a huge interest of business investors requiring for quite obvious demonstrations of success and for rapidity of technology commercialization. This ICT domain correlates with the National Software Platform.

- **Topic 5: Nanoelectronics.** Rational for selection: Nanotechnologies are included into the list of the critical technologies of the Russian Federation. State Corporation “RosNano” was established to fund fundamental and applied research in this area. Several leading research centers including Kurchatov Institute were oriented towards research in nanotechnologies. It is reasonable to launch collaborative action relevant to the entire topic of nanoelectronics. Russia has critical scientific mass and advanced technological competences in the entire nanoelectronics area. These domains are supported by the National Platform “Innovative Laser, Optical and Optoelectrical Technologies – Photonics” and ROSNANO State Corporation.
- **Topic 6: Digital Libraries.** Rational for selection: The research EU-RF project will boost the development of new digital library centers (academic library, law library, medical library, etc.). R&D joint projects will contribute to achieving excellence for digitization and preservation processes. They will integrate knowledge access for technology-based and traditional companies increasing their competitiveness. A particular challenge that joint EU-RU projects should address is the need to develop stronger and more varied forms of privacy protection. A new integration initiative “Scientific Heritage of Russia” was launched in 2010 that embraces libraries of the Russian Academy of Sciences, universities and research centers and sets and ambitious goal of providing united access to the whole body of scientific texts in the Russian language.
- **Topic 7: ICT for Health.** Rational for selection: Health research is positioned as one of the three strategic areas for cooperation with the European Union. The health market in Russia offers important potential and is set to grow quickly. The Russian market for medical technology is worth 2 billion \$ a year and is growing by about 15% per annum. European IT providers can strengthen their presence in Russia’s healthcare market. In 2011 the government approved creation of “Medicine of the Future” Technology platform as well as two RTPs on biology and related sciences. Rapid advance in the area of ICT for Health is expected, thanks to new level of cooperation and integration in Russia that RTPs should provide.
- **Topic 8: Security Trustworthy ICT.** Rational for selection: Security is a specific topic in Russian ICT since its primary customers are law enforcement and defense agencies. As a result, it is notably closed for cooperation. Still in 2011 the initiative of the National Software Platform proclaimed security as one of the key objectives of the platform, with stress on open-source and redistributable hardware and software systems. This gives a perspective of opening R&D in security for international cooperation. This ICT domain is covered by National Software Platform.

## **Eastern Partnership (EaP) countries**

### **Identified Priority topics:**

- **Topic 1: GRID and Cloud Computing.** Rational for selection: EaP countries are actively developing their own Grid infrastructures, and close collaboration and interaction with the European Grid Infrastructure is foreseen. It is reasonable therefore to envisage developing interoperable solutions and standards as well as pilot actions for cooperation around the topic of advanced programming techniques for supercomputing. Some countries are members of EGI, most EaP countries are connected to the Pan-European GÉANT network and are willing to develop further this cooperation with EU.
- **Topic 2: ICT for e-learning and digital information services.** Rational for selection: Universities, research institutes, libraries and cultural centres could be involved in activities on information digitizing as well as new technologies for digital information access development. The development of such sub-priorities as digital libraries, e-services for access to cultural heritage and technology enhanced learning, such as E-learning resources are amongst the most important priorities.
- **Topic 3: Nanoelectronics, Microelectronics.** Rational for selection: the EaP countries possess a high level expertise in this topic and a critical mass of high-level researchers. Common scientific programmes are being implemented within the EECA countries cooperation activities, and some shared infrastructure has been developed. The new generation of components and systems development is also of great importance nowadays.
- **Topic 4: Electronic governance (e-governance), including intelligent information management.** Rational for selection: EaP countries are planning to create new services for home and international citizens (as well as for business, simplifying regulatory procedures) with the help of new ICT solutions. The joint development of agreed solutions is an important task.
- **Topic 5: ICT for Health.** Rational for selection: this topic is one of the most significant societal challenges in EaP countries, as well as in the EU. It is important to develop interoperable solutions and standards within this field as well as to foster technical solutions implementation in EaP countries that would be in line with the best European practices.

## Central Asia (CA) countries

### **Identified Priority topics:**

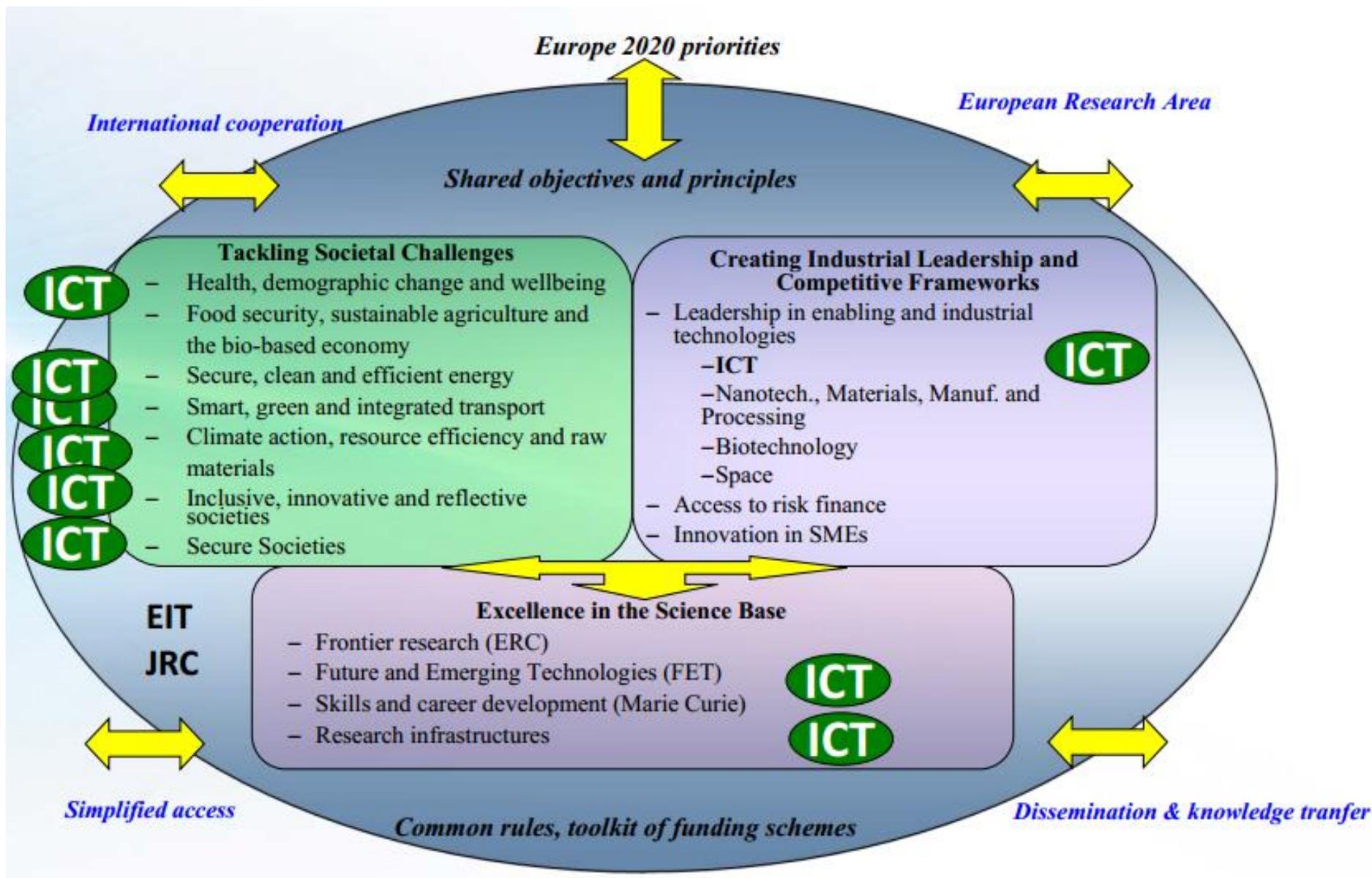
- **Topic 1: Advanced Networking.** Rational for selection: Communication infrastructure and services are developing very rapidly in Central Asia countries. The development of cooperation with EU countries will result in a decrease in the technology gap with the CA countries and an increasing level of their own R&D activities. It is reasonable to envisage the Grid and Cloud computing as pilot actions for the training of local researchers & engineers, with the aim to develop shared regulations and use of interoperable standards in EU and CA countries.
- **Topic 2: ICT for e-governance, e-learning and digital information services.** Rational for selection: Providing citizens and industries with an access to information via new technologies is recognised as a key tool of democratic development in CA countries. As for now, an active integration of new digital services is taking place. The development of such sub-priorities as corporate systems and networks supporting digital libraries, e-services for access to cultural heritage and scientific and educational knowledge are among the most important. These services can be developed for cultural heritage preservation, digital libraries and education projects. Many R&D organizations of CA countries area are already adapting current technologies and have started developing their own applications.
- **Topic 3: ICT for Health, including telemedicine and interoperability of patient summary between EU and CA countries.** Rational for selection: This topic is one of the most significant societal challenges in CA countries, as well as in the EU. It is important to develop interoperable solutions and standards within this theme as well as to foster technical solutions implementation in CA countries that would be in line with the best European practices.
- **Topic 4: Process automation in resources management trials,** (*note: this is not considered a "priority R&D topic" in Central Asia for the moment, but this is the topic that corresponds to the local needs/demand; the relevant technologies are currently acquired abroad*). Rational for selection: CA countries concentrate on the engineering of new infrastructures and development of locally tailored applications. As such they are eager to incorporate new R&D advances in their deployments and as such offer testbeds and trial environments, especially in the fields of resource management (energy, water).

## 4. Horizon 2020

Horizon 2020 is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness. Running from 2014 to 2020, the EU's new programme for research and innovation is part of the drive to create new growth and jobs in Europe. Horizon 2020 will focus resources on the following key priorities (ICT-related topics are written with bold characters):

1. Excellent Science:
  - Frontier Research (ERC);
  - **Future and Emerging Technologies (FET);**
  - Skills and career development (Marie Curie);
  - **Research infrastructures.**
2. Industrial Leadership:
  - Leadership in enabling and industrial technologies:
    - **ICT:**
      - ✓ **New generation of components and systems:** Developing new generation of components and systems including smart embedded components and systems, micro-nano-bio systems, organic electronics and complex systems engineering;
      - ✓ **Next generation computing:** Advanced computing systems and technologies;
      - ✓ **Future Internet:** Network infrastructures, technologies and services for the future Internet;
      - ✓ **Content technologies and information management:** including ICT for digital content and creativity;
      - ✓ **Advanced interfaces and robots:** Service robotics, cognitive systems, advanced interfaces and smart spaces;
      - ✓ **Key Enabling Technologies: Micro- nano-electronics and photonics,**
        - Advanced materials, advanced manufacturing and processing;
        - Biotechnology;
        - Space;
  - Access to risk finance;
  - Innovation in SMEs.
3. Societal Challenges:
  - **Health, demographic change and wellbeing** (e-health, self-management of health, improved diagnostics, improved surveillance, health data collection, active ageing, assisted living);
  - Food security, sustainable agriculture, marine and maritime research and bio-economy;
  - **Secure, clean and efficient energy** (smart cities, Energy efficient buildings, smart electricity grids, smart metering);
  - **Smart, green and integrated transport** (smart transport equipment, infrastructures and services, innovative transport management systems, safety aspects);
  - **Climate action, resource efficiency and raw materials** (ICT for increased resource efficiency; earth observation and monitoring);
  - **Inclusive, innovative and secure societies** (digital inclusion; digital skills; social innovation platforms; e-government services; e-learning; e-culture; cyber security; ensuring privacy and protection of human rights on-line).

The structure and the objectives of Horizon 2020 are better illustrated in the next figure.



**Horizon 2020 – Objectives and Structure**

## 5. Common research priorities

In the following paragraphs we try to illustrate the identified common research priorities between the relevant ETPs (i.e. Net!works and Photonics21) and the EECA region following the objectives and structure of Horizon 2020. This mapping is based only in literature review (SRAs, relevant PICTURE project deliverables, etc.) and is must be finalized, fine-tuned and expanded after a consultation procedure with all the relevant stakeholders.

### 5.1 Mapping H2020, selected ETPs and EECA region (Industrial Leadership)

#	TOPICS	<u>Net!works</u>	<u>Photonics21</u>	<u>ETP4HPC</u>	<b>RUSSIA</b>	<b>EaP</b>	<b>CA</b>
1.	A new generation of components and systems: engineering of advanced and smart embedded components and systems				Real-time control systems, extreme conditions of operations, Consumer Electronics, Telecommunications, Medical Equipment	Cognitive systems, Robotics, Components, Systems, Engineering	Remote control and management, Control and automation systems for energy/gas production companies
2.	Next generation computing, Advanced computing systems and technologies			<b>Future HPC platform architectures, energy efficiency, cloud computing, heterogeneous systems, virtualization</b>	<b>Design, installation and application of Supercomputers, Energy-efficient software platforms for high-performance computing, Hybrid programming models and tool-chains for heterogeneous systems</b>	<b>Computing systems, Cloud computing, Internet of services, Advanced Software Engineering</b>	<b>Cloud computing, Internet of Services, Advanced Software Engineering, Supercomputing</b>

#	TOPICS	<u>Net!works</u>	<u>Photonics21</u>	<u>ETP4HPC</u>	<u>RUSSIA</u>	<u>EaP</u>	<u>CA</u>
3.	Future Internet, network infrastructures, technologies and services	<b>Wireless communications and networks, 5G, Multiple Input Multiple Output (MIMO) channel, Hybrid of optical fibre and wireless technologies</b>	<b>Optical high-speed broadband networks, WDM</b>	<b>I/O latency and bandwidth for interconnections</b>	<b>Large scale networking infrastructures, Research Networking</b>	<b>Internet of Services, Future Internet, Future Networks, Software and virtualization</b>	<b>Advanced Networking, Telecommunication, Internet of services</b>
4.	Micro- nano-electronics and photonics	New generation optical networks	Edge isolation for c-Si and patterning for thin-film panels, <b>OLAE, Photonics</b>	<b>Computational science for creation of new materials and components</b>	<b>next generation nanoelectronics and components, organic and large area electronics, photonic component and subsystems, micro- and nano-systems, nanodevices, nanomaterials</b>	<b>Microelectronics, Microsystems and smart miniaturised systems, Nanoelectronics technology, Microelectronic components, Photonics</b>	

## 5.2 Mapping H2020, selected ETPs and EECA region (Societal Challenges)

#	TOPICS	Net!works	Photonics21	ETP4HPC	RUSSIA	EaP	CA
1.	Health, demographic change & wellbeing; e-health, self management of health, improved diagnostics, improved surveillance, health data collection, active ageing, assisted living	<b>Lifestyle monitoring, inclusion, assisted living, biosensors, new medical technologies</b>	<b>Medical technology, public health, medical devices industry, optical diagnostic systems</b>	Analysis of biomedical data, <b>new drugs discovery</b>	<b>ICT in healthcare sector</b> , Advanced patient-specific computer modelling and simulation, Security of patient-specific data	<b>e-Health</b> , ICT for patient safety. <b>Personal health systems</b>	<b>e-Health, Personal Health Systems</b> , ICT for smart and personalised inclusion, Telemedicine
2.	Secure, clean and efficient energy; Smart cities; Energy efficient buildings; smart electricity grids; smart metering	<b>Smart cities, Smart grids, Energy efficiency, environment, smart meters, intelligent home energy management devices, demand side/response management</b>	<b>Organic Photovoltaics, solid-state lighting, photovoltaic solar cell industry, LEDs, OLEDs, photovoltaic cells, power-efficient optical communications</b>	<b>Optimizing energy infrastructure, match offer with demand, development of new energies: wind, solar, nuclear</b>	<b>Energy efficient electronic components, smart homes, energy efficient lighting</b>	<b>ICT systems for Energy Efficiency</b>	<b>ICT systems for Energy Efficiency, Water management</b>
3.	Smart, green and integrated transport; Smart transport equipment, infrastructures and services; innovative transport management systems; safety aspects	<b>vehicle-to-vehicle or vehicle-to-infrastructure communication networks</b>	<b>Photonics sensors for driver assistance systems</b>	virtual design, simulation and testing, long-range vehicle lifetimes, full-body crash tests, longer-lasting batteries	<b>Smart systems for traffic management in cities, GLONASS</b>	<b>Automated control systems for cargo transportation</b>	GIS and GPS applications

#	TOPICS	Net!works	Photonics21	ETP4HPC	RUSSIA	EaP	CA
4.	Climate action, resource efficiency and raw materials; ICT for increased resource efficiency; earth observation and monitoring	<b>Carbon-neutral environment, environment monitoring and alarm</b>	<b>'Green photonics': photovoltaic energy generation, highly efficient SSL, advanced sensing and instrumentation for environmental monitoring</b> , new energy-efficient communication technologies and clean manufacturing using laser processing, <b>Environment protection</b>	<b>Reduce of wastes, exploration of new resources using seismic methods</b> , modeling of productions to increase safety and efficiency	<b>Environment friendly electronic components, energy efficient lighting</b> , satellites for weather and climate monitoring	<b>Geo-Spatial Technologies, optimization of use of nature resources, organic photonics</b>	<b>ICT systems for resources management</b>
5.	Inclusive, innovative and secure societies; Digital inclusion; social innovation platforms; e-government services; e-skills and e-learning; e-culture; cyber security; ensuring privacy and protection of human rights on-line	<b>"Trust in eGovernemnt", Mechanisms and protocols for trust, security and privacy</b>	Photonic technologies (camera, sensors, computing)		<b>Personal digital certificates, ensuring privacy, portals for state and social services</b> , e-learning, Secure open-source and redistributable hardware and software systems, <b>Trustworthy IT</b>	<b>e-governance</b> , ICT for governance and policy modelling, Technology-Enhanced Learning, Software and hardware security, <b>Trustworthy ICT</b>	<b>ICT for e-governance, e-learning, Governance and Participation Toolbox, Cybersecurity, Internet Security</b>

<b>Core</b>		<b>Large interest</b>		<b>Minor interest</b>	
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## 6. Conclusions from the Workshop on Components, Computing Systems and Networks

The PICTURE and INARMERA-ICT (Integrating Armenia into ERA: Information and Communication Technologies) Joint Workshop on Components, Computing Systems and Networks was held in Yerevan on 25th September, 2013 at the National Academy of Sciences of Armenia premises.

The Workshop brought together representatives from European and Russian Technology Platforms, high level ICT stakeholders from the EECA region in the field of “Components, Computing Systems and Networks”, and PICTURE and INARMERA-ICT project partner teams.

The Workshop was attended by 53 participants:

- Representatives from two European Technology Platforms, Net!works and Photonics21, and one Russian Technology Platform, RTP Photonics;
- 25 high level ICT stakeholders from the EECA region selected and supported by EC for participation in Horizon 2020 Information day in Armenia;
- INARMERA-ICT project partner teams of IIAP (AM), IRIT (FR), SzTAKI (HU), and EuroTex (BG) and Research Partners of this project (EU);
- Representative participants of the hosting CSIT conference;
- Members of PICTURE Working Group on “Components, Computing Systems and Networks”.

During the Workshop, a Memorandum of Understanding was signed between the Coordinators of the two projects PICTURE and INARMERA-ICT and the agreement was reached between ETP Photonics21 and RTP on Photonics on future cooperation and joint activities in R&D work.

The WORKSHOP was held in the Conference Hall of the National Academy of Sciences of Armenia.

The agenda included:

- Presentation of the ETPs and RTP including their research priorities under the Horizon 2020 programme.
- Presentations of R&D ICT potential of EECA region (Russia, EaP countries and CA countries) in the area of “Components, Computing Systems and Networks”.
- Presentation of a map connecting ETPs research priorities with those of the EECA region in light of Horizon 2020.
- Presentation of the INARMERA-ICT Pilot Projects Roadmap in light of HORIZON 2020’s Science Excellence, Industrial Leadership, and Societal Challenges.
- Presentations of INARMERA-ICT example Pilot Projects.
- Open discussion section regarding the validation of common research priorities and the identification of potential joint activities for future cooperation between the involved ETPs and the EECA region.

In general, the Joint Workshop on Components, Computing Systems and Networks has become an important step towards:

1. Increasing the visibility of EU and EECA key research and industrial communities in the field of “Components, Computing Systems and Networks”.
2. The development of EU–EECA strategic cooperation in the field of “Components, Computing Systems and Networks”.
3. The strengthening of the Academia – Industry relationship in the EECA region.

Based on presentations made during the Workshop and the issues tackled in an Open discussion it became clear that the action plan for the implementation of Pilot action for

WG2 "Bridging the European and EECA knowledge networks in the field of Components, Computing Systems and Networks" to give a joint response to global challenges is well designed and positioned. Corrections and justifications are related to the changes from terms of FP7 to Horizon 2020.

## **7. Common research priorities in EU (HORIZON 2020 2014-2015 Workprogramme) and EECA**

According to the outcomes of the Workshop on Content Technologies and Information Management, the collaboration between the selected ETPs and the EECA region can be built around research project and initiatives funded by the European Union under HORIZON 2020. In the following sub-sections, the PICTURE partners analysed the Work Programmes of the HORIZON 2020 for the period 2014-2015 with a view to highlight the most relevant topics to the Components, Computing Systems and Networks domain, which are outlined below.

### **7.1 HORIZON 2020 – WORK PROGRAMME 2014-2015, LEIT – Information and Communication Technologies**

The “Information and Communication Technologies” (ICT) Work Programme is the most relevant with the Components, Computing Systems and Networks field. On December 2013, a final version of the above Work Programme was adopted, in which topics related to Components, Computing Systems and Networks take center stage in five areas.

#### **Area: A new generation of components and systems**

Electronics, microsystems and embedded systems underpin innovation and value creation across the economy. The objective is to reinforce Europe's stronghold positions in these areas and to capture opportunities arising in new growth markets driven by advances in relevant technologies. This area addresses the broad range of systemic integration from smart integrated components to cyber-physical systems. It covers technology-driven R&D, which is mostly application-independent, complemented by more application-driven R&I, where components and systems are demonstrated, instantiated, integrated and validated.

The first specific challenge addressed is to reinforce and expand Europe's leading industrial position in embedded systems and cyber-physical systems. The other two are driven by the vision that the heterogeneous integration of micro / nanotechnologies and materials into smart microsystems will deliver affordable high performance functionalities for a broad spectrum of use. Research and innovation in the various topics will also contribute to the implementation of the Strategic Research Agenda of the Public Private Partnership on Energy Efficient Buildings.

All the topics in this area are relevant:

- **ICT 1 – 2014: Smart Cyber-Physical Systems**
- **ICT 2 – 2014: Smart System Integration**
- **ICT 3 – 2014: Advanced Thin, Organic and Large Area Electronics (TOLAE) technologies**

### Area: Advanced Computing

With the wider diffusion of embedded ICT and cyber-physical systems and the advent of the Internet of things, customised heterogeneous low-power computing systems delivering high performance functionality under real-time constraints will drive a large part of computing development in the next decade.

Combined with the need for more energy efficient cloud computing systems and data centres, the same key low-power technologies will underpin progress across the whole computing spectrum. The strategic focus is to reinforce and expand Europe's industrial and technology strengths in low-power ICT. Different market segments should be addressed through an integrated cross-layer (hardware, system, programming, algorithms) and cross application/ cross-market approach.

One topic is identified under this area:

- **ICT 4 – 2015: “Customised and low power computing”**

### Area: Future Internet

Over the last 30 years, the Internet has become a major infrastructure for growth, job creation, and social progress. Internet must continue to foster and support development and to accommodate all the diverse usages for which it was not initially foreseen. The aim is therefore to address the most critical technical and use aspects for the Internet to be apt to support the huge future expectations of society at large.

The Future Internet topics will therefore i) address the limitations of an Internet not designed to support the very large set of requirements imposed by an ever more diversified usage; ii) support the advent of more efficient computational and data management models responding to the challenges posed by increased device / object connectivity and data-intensive applications; iii) leverage the Internet to foster innovative usages of social and economic value also benefiting from the geospatial capabilities of the Future Internet. The area strategy is based on a complementary set of technology push – usage pull actions.

From our perspective, the most relevant topics under this area are the following:

- **ICT 5 – 2014: Smart Networks and novel Internet Architectures**
- **ICT 6 – 2014: Smart optical and wireless network technologies**
- **ICT 7 – 2014: Advanced Cloud Infrastructures and Services**
- **ICT 14 – 2014: Advanced 5G Network Infrastructure for the Future Internet**

### Area: Micro- and nano-electronic technologies, Photonics

Topics in this area address research and innovation in the two ICT Key Enabling Technologies (KETs), micro- and nanoelectronics and photonics. The objective is to take

advantage of Europe's S&T excellence in these two ICT KETs to strengthen the competitiveness and market leadership of the related industries and develop innovative solutions to societal challenges. The challenge also includes activities enabling the cross-fertilisation of the ICT KETs, with particular focus on photonic pilot production lines paving the way to the manufacturing of ICT KETs in Europe. The activities will address the whole research and innovation value chain – from materials through equipment and devices, to manufacturing and to products and services, and from advanced RTD to pilot lines.

The following topics were identified under this area:

- **ICT 25 – 2015: Generic micro- and nano-electronic technologies**
- **ICT 26 – 2014: Photonics KE**
- **ICT 27 – 2015: Photonics KE**
- **ICT 28 – 2015: Cross-cutting ICT KETs**
- **ICT 29 – 2014 Development of novel materials and systems for OLED lighting**

**Area: ICT Cross-Cutting Activities**

In this area, the most relevant topics are the following:

- **ICT 30 – 2015: Internet of Things and Platforms for Connected Smart Objects**
- **ICT 32 – 2014: Cybersecurity, Trustworthy ICT**

## **7.2 HORIZON 2020 – WORK PROGRAMME 2014-2015, Health, demographic change and wellbeing**

The Horizon 2020 societal challenge of 'health, demographic change and wellbeing' (SC1) for the years 2014 and 2015 includes 34 topics in the 'personalising health and care' focus area call and 16 topics in the 'co-ordination activities' call. 8 other actions designed to support the implementation of the challenge are also included and are not subject to competitive calls for proposals. The choice to focus on personalising health and care is informed by the ageing of the European population, an increasing communicable and non-communicable disease burden and the fall-out from the economic crisis.

The Components, Computing Systems and Networks field is a key enabler for solutions to the societal and economic challenges set by the ageing of the European population.

Following is a list of selected topics for the years 2014-2015 that are relevant to the Components, Computing Systems and Networks domain.

### **PHC 10 – 2014: Development of new diagnostic tools and technologies: in vitro devices, assays and platforms**

Projects may include approaches based on high-throughput screening, nanotechnologies or microfluidics, data analysis methodology, or technologies for point-of care diagnostics.

### **PHC 16 – 2015: Tools and technologies for advanced therapies**

For their successful application, new therapies, such as gene or cell therapies, tissue engineering or regenerative medicine often require technological innovation in the form of development of specific component tools and techniques such as isolation and multiplication of a cell or development of a scaffold, delivery of the therapy to the patient and for following-up the effect of the therapy in the patient.

Specific attention needs to be given to aspects such as miniaturisation, automation, biomaterials and scaffold construction while advanced methods and devices for targeted and controlled delivery, and monitoring technology, are needed to bring these innovative treatments to the patient.

### **PHC 19 – 2014: Advancing active and healthy ageing with ICT: Service robotics within assisted living environment**

The challenge is to develop new breakthroughs for active and assisted living based on advanced ICT solutions.

### **PHC 20 – 2014: Advancing active and healthy ageing with ICT: ICT solutions for independent living with cognitive impairment**

The challenge is to deploy innovative and user led ICT pilot projects in support of independent living with cognitive impairments and translate promising results into scalable practice across Europe.

**PHC 21 – 2015: Advancing active and healthy ageing with ICT: Early risk detection and intervention**

ICT based solutions are sought which support active and healthy ageing by enabling early detection and minimisation of risks associated with ageing, including (but not limited to) cognitive impairment, frailty, depression and falls.

**PHC 25 – 2015: Advanced ICT systems and services for Integrated Care**

The objective is to go beyond the current state of art in tele-health and tele-care systems by developing new approaches for integrated care supported by ICT systems and services.

**PHC 27 – 2015: Self-management of health and disease and patient empowerment supported by ICT**

This topic requires research into socio-economic and environmental factors and cultural values, behavioural and social models, attitudes and aspirations in relation to personalised health technologies, mobile and/or portable and other new tools, co-operative ICTs, new diagnostics, sensors and devices (including software) for monitoring and personalised services and interventions which promote a healthy lifestyle, wellbeing, mental health, prevention and self care, improved citizen/healthcare professional interaction and personalised programmes for disease management.

### 7.3 HORIZON 2020 – WORK PROGRAMME 2014-2015, Energy Challenge

The activities included in the first work programme of the Horizon 2020 Energy Challenge contribute to the three focus areas: "Energy Efficiency", "Competitive Low-Carbon Energy" and "Smart Cities and Communities". These activities cover the full innovation cycle – from 'proof of concept' to applied research, pre-commercial demonstration and market uptake measures. They also exploit synergies with other relevant areas, e.g. information and communication technologies. In addition, the Energy Challenge contributes to the 'Blue Growth' focus area as well as to the Public Private Partnerships Energy-efficient Buildings and Sustainable Process Industries (SPIRE).

Following is a list of selected objectives for the years 2014/2015 that are relevant to the Components, Computing Systems and Networks domain.

#### **EE 11 – 2014/2015: New ICT-based solutions for energy efficiency**

The focus will be on the creation of innovative IT ecosystems that would develop services and applications making use of information generated by energy consumers (e.g. through social networks) or captured from sensors (e.g. smart meters, smart plugs). These applications range from Apps for smart phones and tablets to serious games to stimulate consumers' participation in the market.

#### **EE 13 - 2014/15: Technology for district heating and cooling**

One of the objectives of this topic is to develop and deploy intelligent systems using smart metering and control solutions for optimisation and consumer empowerment and exploiting multiple energy resources as well as IT supervision systems capable of delivering real-time performance indicators, which are likely to modify consumption behaviour.

#### **EE 14 - 2014/15: Removing market barriers to the uptake of efficient heating and cooling solutions**

One of the objectives of this topic is to use ICT technologies for Inspection of heating and cooling systems.

#### **EE 16 – 2014/15: Organisational innovation to increase energy efficiency in industry**

One of the objectives of this topic is to devise methods and tools including ICT to compare and benchmark the energy performance of industrial systems.

#### **LCE 6 – 2014: Transmission grid and wholesale market**

One of the objectives of this topic is to develop ICT technologies to increase transmission network flexibility, capacity and operational security.

**LCE 7 – 2015: Distribution grid and retail market**

One of the objectives of this topic is to prepare the development of the next generation ICT infrastructure for smart metering and smart grids.

**SCC 1 – 2014/2015: Smart Cities and Communities solutions integrating energy, transport, ICT sectors through lighthouse (large scale demonstration - first of the kind) projects**

The objective of the topic is to identify, develop and deploy replicable, balanced and integrated solutions in the energy, transport, and ICT actions through partnerships between municipalities and industries.

## **7.4 HORIZON 2020 – WORK PROGRAMME 2014-2015, Smart, green and integrated transport**

The “Smart, green and integrated transport” Challenge includes three calls: “Mobility for Growth”, “Green Vehicles” and “Small Business and Fast Track Innovation for Transport”. From the above three calls only the first one seems to have topics that are relevant to the Components, Computing Systems and Networks domain.

### **CALL “MOBILITY FOR GROWTH”**

#### **RAIL**

**MG.2.1-2014. I<sup>2</sup>I – Intelligent Infrastructure**

**MG.2.2-2014. Smart Rail Services**

#### **ROAD**

**MG.3.5-2014. Cooperative ITS for safe, congestion-free and sustainable mobility**

**MG.3.6-2015. Safe and connected automation in road transport**

#### **WATERBORNE**

**MG.4.2-2014. Safer and more efficient waterborne operations through new technologies and smarter traffic management**

#### **LOGISTICS**

**MG.6.3-2015. Common communication and navigation platforms for pan-European logistics applications**

#### **INTELLIGENT TRANSPORT SYSTEMS**

**MG.7.1-2014. Connectivity and information sharing for intelligent mobility**

#### **INFRASTRUCTURE**

**MG.8.2-2014. Next generation transport infrastructure: resource efficient, smarter and safer**

**MG.8.4-2015. Smart governance, network resilience and streamlined delivery of infrastructure innovation**

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## **7.5 HORIZON 2020 – WORK PROGRAMME 2014-2015, Climate action, environment, resource efficiency and raw materials**

The “Climate action, environment, resource efficiency and raw materials” Challenge includes three calls: “Waste: A Resource to Recycle, Reuse and Recover Raw Materials”, “Water Innovation: Boosting its value for Europe” and “Growing a Low Carbon, Resource Efficient Economy with a Sustainable Supply of Raw Materials”. Following is a list of selected topics for the years 2014/2015 that are relevant to the Components, Computing Systems and Networks domain.

### **Call - Waste: A Resource to Recycle, Reuse and Recover Raw Materials**

**WASTE-3-2014: Recycling of raw materials from products and buildings**

### **Call - Growing a Low Carbon, Resource Efficient Economy with a Sustainable Supply of Raw Materials**

**SC5-16-2014: Making Earth Observation and Monitoring Data usable for ecosystem modelling and services**

**SC5-17-2015: Demonstrating the concept of 'Citizen Observatories'**

**SC5-18-2014/2015: Coordinating and supporting Earth Observation research and innovation in the EU, and in the North African, Middle East, and Balkan region**

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## **7.6 HORIZON 2020 – WORK PROGRAMME 2014-2015, Inclusive, innovative and reflective societies**

Following is a list of selected objectives from the “Inclusive, innovative and reflective societies” Challenge that are relevant to the Components, Computing Systems and Networks domain.

### **Call - Overcoming the Crisis: New Ideas, Strategies and Governance Structures for Europe**

**EURO-6-2015: Meeting new societal needs by using emerging technologies in the public sector**

### **Call for New Forms of Innovation**

**INSO-1-2014/2015: ICT-enabled open government**

**INSO-6-2014: Platform for ICT for Learning and Inclusion**

**INSO-9-2015: Innovative mobile e-government applications by SMEs**

## **7.7 HORIZON 2020 – WORK PROGRAMME 2014-2015, Secure societies**

Following is a list of selected objectives from the “Secure societies” Challenge that are relevant to the Components, Computing Systems and Networks domain.

### **Call - Disaster-resilience: safeguarding and securing society, including adapting to climate change**

**DRS-1-2015: Crisis management topic 1: Potential of current and new measures and technologies to respond to extreme weather and climate events**

**DRS-2-2014 Crisis management topic 2: Tools for detection, traceability, triage and individual monitoring of victims after a mass CBRN contamination and/or exposure**

**DRS-12-2015: Critical Infrastructure Protection topic 1: Critical Infrastructure “smart grid” protection and resilience under “smart meters” threats**

**DRS-18-2014: Communication technologies and interoperability topic 1: interoperable next generation of broadband radio communication system for public safety and security – Pre-commercial Procurement (PCP)**

**DRS-19-2014: Communication technologies and interoperability topic 2: Next generation emergency services**

### **Call – Fight against crime and Terrorism**

**FCT-1-2015: Forensics topic 1: Tools and infrastructure for the fusion, exchange and analysis of big data including cyber-offenses generated data for forensic investigation**

**FCT-3-2015: Forensics topic 3: Mobile, remotely controlled technologies to examine a crime scene in case of an accident or a terrorist attack involving CBRNE materials**

**FCT-4-2015: Forensics topic 4: Internet Forensics to combat organized crime**

**FCT-5-2014: Law enforcement capabilities topic 1: Develop novel monitoring systems and miniaturised sensors that improve Law Enforcement Agencies' evidence- gathering abilities**

**FCT-6-2015: Law Enforcement capabilities 2: Detection and analysis of terrorist-related content on the Internet**

**FCT-7-2014: Law enforcement capabilities topic 3: Pan European platform for serious gaming and training**

**FCT-10-2014: Urban security topic 1: Innovative solutions to counter security challenges connected with large urban environment**

**FCT-11-2014: Urban security topic 2: Countering the terrorist use of an explosive threat, across the timeline of a plot, including the detection of explosives in a flow**

**FCT-12-2014 Urban security topic 3: Minimum intrusion tools for de-escalation during mass gatherings improving citizens' protection**

**Call – Border Security and External Security**

**BES-1-2014: Maritime Border Security topic 1: radar systems for the surveillance of coastal and pre-frontier areas and in support of search and rescue operations**

**BES-2-2015: Maritime Border Security topic 2: Low cost and "green" technologies for EU coastal border surveillance**

**BES-3-2014: Maritime Border Security topic 3: Light optionally piloted vehicles (and sensors) for maritime surveillance**

**BES-4-2015: Maritime Border Security topic 4: Detection of low flying aircraft at near shore air space**

**BES-5-2015: Border crossing points topic 1: Novel mobility concepts for land border security**

**BES-8-2015: Supply Chain Security topic 1: Development of an enhanced non-intrusive (stand-off) scanner**

**BES-9-2014: Supply Chain Security topic 2: Technologies for inspections of large volume freight**

**BES-10-2015: Information management topic 1: Civilian humanitarian mission personnel tracking**

**BES-11-2014: Information management topic 2: Information management, systems and infrastructure for civilian EU External Actions**

**Call – Digital Security: Cybersecurity, Privacy and Trust**

**DS-2-2014: Access Control**

**DS-3-2015: The role of ICT in Critical Infrastructure Protection**

**DS-4-2015: Secure Information Sharing**

**DS-5-2015: Trust eServices**

**Other action topics on Galileo Public Regulated Services (PRS)**

**1 - PRS item 1: Use of Galileo PRS in Professional Mobile Networks receiver, provision of an Early Service**

**2 - PRS item 2: Remote PRS processing server**

## **8. Conclusions**

This document highlights ICT-related topics of HORIZON 2020, selected ETPs' and EECA countries' research priorities in the scope of Components, Computing Systems and Networks. In addition, it maps together all of the above mentioned in an easy-to-read tables which can and will be used in the further work of the PICTURE project and upcoming relevant projects (e.g. EECA-2-HORIZON). These tables show that EU and EECA share several common ICT priorities that can become the basis for collaboration and joint initiatives under HORIZON 2020.

The above analysis shows that there are significant opportunities for cooperation between the European Technology Platforms (namely Net!Works, Photonics21 and ETP4HPC) and similar structures and interested stakeholders from the EECA countries (e.g. RTP on Photonics) in the field of "Components, Computing Systems and Networks". The cooperation between the three ETPs and the EECA region should be built around common societal challenges (e.g. e-Health, ageing population, energy efficiency, Smart Cities, intelligent transport systems, e-Government, Cybersecurity) and specific problems / topics.

The current priorities map can serve as a starting point in the development of successful joint proposals for HORIZON 2020 in the ICT area and will be used and updated in the next relevant EU projects.