ICT-Photonics

FP7 ICT Workprogramme

EXTRACT FROM THE ICT WORKPROGRAMME 2011-2012

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Challenge 3: Alternative Paths to Components and Systems

Challenge 3 covers electronic and photonic components, integrated micro/nanosystems, multicore computing systems, embedded systems and their monitoring & control and cooperating complex systems. It complements the developments undertaken in the ENIAC and ARTEMIS JTIs.

More specifically, Challenge 3 focuses on:

- The deep miniaturisation, energy-efficiency, performance increase and manufacturability of nano-electronic devices using alternative solutions to the traditional miniaturisation path, for information and communication systems and other applications in 2020 and beyond.
- The integration of new functionalities for the next generation of application-specific components and smart systems through the convergence of microelectronics, nano-materials, biochemistry, measurement technology and ICT.
- The design, modelling and operation of systems composed of a large number of independent, heterogeneous and interacting embedded systems as well as their monitoring and control; and the management of interconnected large, yet autonomous systems ("Systems of Systems").
- The parallelisation and programmability methods to allow the adaptation of existing software to multicore computing architectures and systems, from embedded devices to general-purpose and to high performance computing.
- The further development of core and disruptive photonic technologies (lasers, waveguides, photodetectors, amplifiers, LEDs, optical fibres, etc), fundamental in strategic applications such as medicine, biology, communications, lighting, sensing and measurement, and manufacturing.
- The development of advanced, low temperature processing, and potentially printable devices and systems on large area and/or flexible substrates, such as light emitting and sensing devices, photovoltaics, displays, printed electronics for smart tags, or wearable smart textiles.

Research addressing this Challenge in particular will encourage international cooperation under the Intelligent Manufacturing Systems (IMS) scheme[1].

[1] IMS member countries include South Korea, Mexico and the USA, see Agreement under: http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2008:053:SOM:EN:HTML

Objective ICT-2011.3.5 Core and Disruptive Photonic Technologies

Target Outcomes

a) Core photonic technologies

Extending the state-of-the art for application fields where Europe is strong, including notably *application-specific photonic components and sub-systems* (such as laser and other light sources, modulators, transmitters and receivers, multiplexers, cross-connects, detectors and sensors, fibre components) for a given set of application fields. The aim is to provide new opportunities for advanced products, with a view to industrialisation. Priority is given to innovative or 'breakthrough' approaches rather than incremental developments. The interrelated materials, processing and device integration issues including electronics/photonics integration may also be dealt with. *Cross-cutting technology* actions further address device integration in a more systematic way.

Research actions should be driven by user requirements, should include validation of results for the targeted applications, and should cover the supply chain as appropriate (in particular in Integrated Projects).

Application-specific photonic components and subsystems should cover one of the following application fields:

1. *Optical data communications*:
   (i) *Communication networks* that are more transparent, dynamic, energy efficient and faster[2]. For *core networks*, the goal is scalable technology for truly cost-effective transport at 100 Gb/s single-channel rate and beyond, scalable towards 100 Tb/s systems (node-throughput). For *access networks*, the goal is affordable technology enabling 1-10 Gb/s data-rate per client over more than 100 km.
   (ii) *Optical interconnects* aiming at cost- and energy-effective technology for Tb/s optical data links in short range communication. Applications range from on-board and board-to-board links at the smaller scale, to links in data centres and local area networks at the larger scale.

   Further to "digital" optical transmission, "radio-over-fibre" techniques may also be addressed, in particular for local area networks and access networks. Research actions should bring together researchers, component manufacturers and suppliers of communication equipment.
2. *Biophotonics for early, fast and reliable medical diagnosis* of diseases, such as cancer, infectious and eye-related diseases. The applications vary from point-of-care diagnosis to functional imaging. Typical issues are high sensitivity, selectivity, resolution, and depth of penetration, according to the targeted technique and disease. Particular emphasis is on a strongly multidisciplinary approach involving also medical/biomedical end-users. Technical results should undergo preclinical validation, with clinical trials being excluded.
3. *Imaging and sensing for safety and security*:
   (i) CMOS integrated, compact, affordable, high-performance mega-pixel image sensors (with CMOS-compatible detection layer) operating at ambient temperature and low power. Focus is on single-photon detection at video-rate read-out speed and very high dynamic range, and/or functional integration based on smart pixels with sub-picosecond temporal resolution, pixel-level hyperspectral or multispectral resolution, and polarisation sensitivity.
   (ii) Compact, cost effective, widely tuneable, high-performance photonic sources enabling a highly sensitive, selective and reliable detection of hazardous organic and inorganic substances. Emphasis is on advanced technology such as novel quantum cascade lasers and terahertz sources.

   Technical results should be validated for safety and security applications. Research actions should bring together researchers, component manufacturers and suppliers of safety & security imaging/sensing equipment.
4. *Lighting and displays*:
   High brightness LEDs and 'light engines' (i.e. LED with driver electronics, optics and thermal management for lighting applications; or LED backlighting modules for displays). Focus is on:
   – Improved efficacy at high brightness at LED and light engine level (in particular light engines for warm white light with efficacy above 130 lm/W, CRI at least 90, and consistent colour over 25000 hours);

[2] Photonic components and subsystems for communication networks support the overall vision and requirements of Objective 1.1 "Future networks".

– High brightness, high efficiency green components with intensity peak around 540 nm;
– Novel approaches to white components (e.g. new phosphors, monolithic sources, hybrid approaches).

The relevant system integration issues may also be addressed to some extent. Research actions should demonstrate a potential for significant system and operating cost reduction.

LED suppliers and/or manufacturers should be involved.

Cross-cutting technology covers:

5. *Photonics integration platforms* that enable the cost-effective, automated volume manufacturing of a large variety of complex, compact, high-performance photonic integrated circuits ("PICs") combining active and passive components. Platforms should address a range of different application fields. The technology must be scalable for new technology generations, in particular for higher integration complexities at reduced cost per function. The platforms should address also the relevant design, modelling and simulation tools and generic manufacturing and packaging technology. Research actions should present a credible route to industrial manufacturing in Europe.

b) Disruptive photonic technologies

Technologies at the proof-of-principle stage that offer a potential for breakthrough advances in functionality, performance, component size or cost reduction. They often exploit effects at the limits of light-matter interaction (e.g. plasmonics, controlling the quantum degrees of freedom, sub-wavelength structures and near-field effects, photonic crystals, nano-photonics) or exploit the use of new materials (including meta-materials). The objective here is to bring such technologies from the research lab closer to applications, by demonstrating their industrial potential through a functional component with involvement of industrial players.

Such disruptive technologies could address for instance: New components for high performance (including extreme high power) laser systems, in particular compact, cost-effective high-performance laser sources; Exploiting nano-photonic structures, near-field effects and new materials for enabling PICs of higher performance, functionality or complexity; New photonic functions realised in optical fibres by integrating non-conventional materials; Components for quantum communication; Electro-optic modulation, signal processing and beam steering exploiting alternative materials, novel wave-guide structures or slow-wave effects; New photonic approaches for life sciences, such as biophotonics based tools for investigating bio-chemical and metabolic processes and/or the origins of disease at the cellular level; New photonic approaches for imaging systems, information displays, lighting, memory and storage.

c) ERA-NET Plus action: A joint call for proposals on a photonics topic of strategic interest, to be funded through an ERANET-Plus action between national and regional grant programmes.

d) Development of innovative solutions through Pre-Commercial Procurement (PCP) action: To achieve a significant quality and/or efficiency improvements to public sector challenges through innovative photonics-based solutions. These solutions should be defined and developed by public sector organisations using a PCP approach. PCP shall be implemented according to the conditions outlined in Objective 11.1 and Appendix 6.

e) Coordination and Support Actions

– An ERA-NET action for the coordination of related national, regional and EU-wide R&D programmes/activities and cooperation between the relevant authorities. This action may also cover the field of organic electronics.
– Technology road-maps for high power / high energy laser components and systems and identification of new joint research and industrial opportunities in the field of high power lasers, across different application fields and related high power laser research infrastructures;
– Cooperation and coordination between regional clusters and/or national technology platforms with focus on best practice exchange and promotion of research and innovation;
– Targeted international cooperation activities driven by stakeholders representing the photonics community, aiming at the identification and development of "win-win" cooperative activities, including for example pre-standardisation, with selected industrialised countries;
– Supporting the coordination of the European photonics research constituency in the Photonics21 ETP; this may include specific coordination activities aiming at further defining and promoting joint community structuring efforts towards significantly larger scale future activities;

– Access of SMEs and researchers to advanced technologies, design expertise and/or manufacturing facilities;

– Education and training actions with strong support from industry: Education actions to foster entrepreneurial and interdisciplinary skills at graduate and post graduate level; Training actions for industry (in particular SMEs) that provide state-of-the-art skills and hands-on experience in addressing industrial R&D challenges.

These coordination and support actions should involve the key stakeholders in photonics.

Expected Impact

- Actions under *Application-specific photonic components and subsystems* should reinforce European industrial leadership, competitiveness and market share in the concerned technologies and application fields; and/or provide significant societal impact with regard to health, safety, or security.
- Actions under *Cross-cutting technology* should secure a European manufacturing basis for components in the concerned application fields, contributing thus also to secure European industrial leadership and market share in those application fields.
- Actions under *Disruptive photonic technologies* should provide clear evidence for a longer-term potential of European industrial leadership or relevant societal benefits in the concerned application fields, or provide significant opportunities for new applications.
- The *ERANET and ERANET-Plus actions* should foster closer cooperation and greater alignment between the participating national/regional/EU-wide research programmes in topics of strategic interest.
- The *PCP action* should accelerate the introduction of advanced photonic technologies and applications on the European market.
- *Coordination and support actions* in high power / high energy lasers should lead to increased knowledge exchange and cooperation and help opening new market opportunities; Cooperation and coordination between regional clusters and national technology platforms should increase their overall effectiveness in promoting research and innovation; Targeted international cooperation activities should lead to greater cooperation between European players and their counterparts elsewhere on common goals for mutual benefit which will further European interests; Supporting the coordination of the European photonics research constituency should facilitate the European consensus building on research priorities and strategies; Access of SMEs and researchers to advanced technologies should foster the broader uptake of advanced photonics technologies; And, education and training actions should foster stronger and more durable collaboration between industry and academia leading to a competitive advantage of European photonics industry at large.

Funding schemes

a): 1-4: IP, STREP; 5: IP;

b): STREP;

c): ERANET-Plus;

d): CP-CSA;

e): CSA

Indicative budget distribution[3]

a): EUR 79 million of which a minimum 50% for IP and a minimum 30% for STREP;

b): EUR 20 million;

c): EUR 10 million (Any remaining funds following the selection of an ERANET-Plus action will be transferred to the target outcome a));

d): EUR 3 million;

e): EUR 5 million

Calls

b), e): FP7-ICT-2011-7

a), c), d): FP7-ICT-2011-8

Objective ICT-2011.3.6 Flexible, Organic and Large Area Electronics and Photonics

Target outcomes

a) OLAE[4] technology and components

Development of advanced OLAE technology, device concepts, processes and materials,

[3] The budget figures are indicative. Further details on possible variations and on the budgetary procedures can be found in the footnotes of the full work programme text.

[4] The abbreviation OLAE as used in this description should be understood to also cover organic photonics technologies such as OLEDs (Organic Light-Emitting Diode) or OPVs (Organic Photovoltaics). It also includes smart textiles based on conformable and stretchable electronics.

considering the full value chain. Addressing technology barriers whilst considering the manufacturing implications[5], component performance, improving materials parameters, and flexible/conformable devices. Improved encapsulation and/or alternative conductors, especially in the areas of OPV (Organic Photovoltaics) and OLED (Organic Light Emitting Diodes). Organic/printed logic and memory components; transparent electronic components; power supplies; polymer-based sensors and actuators; adaptable optical elements for electronics and lighting applications; large area energy scavengers & sensors. Modelling and circuit design, including the combination of OLEDs with CMOS technology, may also be addressed.

- Technology for low-cost production processes for OLEDs, improving external quantum efficiency, reliability and lifetime with targets > 100 lm/W at brightness levels in the order of 5.000 cd/m^2, stable over 10.000 hours lifetime.
- Technology for mass production processes for low-cost OPVs aiming at costs of ~0.7€/Wp, increased device efficiency of 8-10% on module level, improved in-coupling efficiency and a significant lifetime increase of up to 20 years.
- Technology for flexible, tileable and sizeable low-cost colour emissive and reflective displays with good image quality displays even in direct sunlight: for *emissive displays*, focus is on materials and process development; for *reflective displays*, focus is on video-rate performance front- and backplanes, and solid state device integration enabling homogeneous system integration.
- Circuitry with increased functionality and performance, i.e.: complexity up to 10,000 transistors; mobility in organic semiconductors beyond 1 cm^2/Vs; drive voltages down to 3V; circuit frequency up to 25 KHz; integration of analogue building blocks such as A/D converters and rectifiers; and addressing organic and inorganic integration, process variations and process tolerant design, stability, interconnects, multilayers, packaging and encapsulation, modelling, simulation, and novel device and circuit design for OLAE.
- For smart textiles, interdisciplinary work addressing fibre components, heterogeneous integration of multiple functions (such as sensing, actuation, energy scavenging, power management, data processing and communication) and interconnection, device and materials reliability, packaging and encapsulation, washability and durability.

[5] The focus here is on the technology development, whilst Objective "PPP manufacturing solutions for new ICT products" under Challenge 7 (the Factories of the Future PPP) will concentrate on demonstrating the feasibility of industrial manufacturing processes.

b) OLAE systems and applications

Advanced technology development and integration of components through new or improved systems and devices targeting wider applications to facilitate rapid and extensive exploitation, particularly:

- Lighting systems with high quality white CRI (Colour Rendering Index) > 90, stable over a 10 year lifetime with reasonable costs;
- OPV modules with costs of ~0.7€/Wp, external efficiency of 8-10% and a lifetime of up to 20 years for mobile and fixed applications;
- High quality emissive and reflective colour displays and signage;
- Flex/foil-based organic and printed electronics for mass market/low cost applications;
- Integrated Smart Systems for a range of applications including health monitoring and diagnostics, large area sensing, smart labels and packaging. Smart textiles in higher added value products and applications, particularly for health.

Actions under a) and b), IPs but also STREPs as far as possible, should address the full value chain, from material to devices and from researchers to component manufacturers. End-of-life/disposal/recyclability issues should also be addressed.

c) ERA-NET Plus action: A joint call for proposals on an OLAE topic of strategic interest, to be funded through an ERA-NET Plus action between national and regional programmes.

d) Coordination and Support Actions

- Cooperation and coordination between the OLAE competence centres. This may include their research and innovation-related activities, training, manufacturing, (pre)standardisation, etc.
- Access to OLAE technology and facilities for industry, especially SMEs, and researchers.
- Targeted international cooperation activities particularly with Japan, South Korea, Taiwan and the USA, aiming at the identification and development of "win-win" cooperation.
- Focused education and training actions aiming at keeping industry (in particular SMEs) abreast of OLAE state-of-the-art

knowledge and tools, and promoting entrepreneurship.

– An ERA-NET action for the coordination of related regional, national and EU-wide R&D programmes/activities and cooperation between the relevant authorities[6].

These coordination and support actions should involve the key stakeholders in OLAE.

Expected Impact

- Actions under *OLAE technology and components* should yield increased European competitiveness through having OLAE and smart textiles expertise and manufacturing capability in Europe, covering the full technology value chain as far as possible.
- Actions under *OLAE systems and applications* should yield greater expertise and capability over the full value chain and the accelerated emergence of new devices, products and applications, leading to increased market share of European players in each of the key applications and/or the creation of new markets. Innovative systems and products for high value-added applications should establish or reinforce EU lead markets.
- The ERA-NET and/or ERA-NET Plus Actions should foster cooperation and alignment between participating states'/regions' research activities in topics of joint interest.
- Improved coordination of the OLAE competence centres, creating synergies, common strategies, and pooling of resources. Access actions should foster broader take-up of OLAE technology, and transfer OLAE expertise across Europe. International cooperation activities in OLAE should lead to greater cooperation between European players and their counterparts elsewhere on common goals for mutual benefit which will further European interests whilst safeguarding European Intellectual Property. Education and training actions should increase knowledge and expertise across Europe in OLAE.

Funding schemes

a), b): STREP, IP;

c): ERA-NET Plus;

d): CSA

[6] If an ERA-NET action is intended to address both Objectives 3.5 and 3.6, it should be submitted to Objective 3.5.

Indicative budget distribution[3]

- IP/STREP: EUR 40 million of which a minimum of 50% to IPs and a minimum of 30% to STREPs

- ERA-NET Plus: EUR 6 million (Any remaining funds following the selection of an ERA-NET Plus action will be transferred to target outcomes a) or b))

- CSA: EUR 4 million

Call: FP7-ICT-2011-7

Challenge 7: ICT for the Enterprise and Manufacturing

The Factories of the Future (FoF) initiative is part of the European Economic Recovery Plan launched in November 2008 to respond to the global economic crisis. This Public-Private-Partnership (PPP) aims at helping EU manufacturing enterprises, in particular SMEs, to adapt to global competitive pressures by improving the technological base of manufacturing across a broad range of sectors. The ICT contribution to this initiative aims at improving the efficiency, adaptability and sustainability of manufacturing systems as well as their better integration within business processes in an increasingly globalised industrial context. Challenge 7 is fully dedicated to supporting the FoF PPP.

The Challenge includes the areas:

- 'Smart factories' including application experiments of control and sensor-based systems, laser systems and industrial robots.
- 'Manufacturing solutions for new ICT products' addressing manufacturing processes for Organic Large Area Electronics (OLAEs) and organic photonics.
- 'Virtual factories and enterprises' addressing end-to-end integrated ICT allowing for innovation and higher management efficiency in networked operations and supporting the emergence of 'smarter' virtual factories and enterprises.
- 'Digital manufacturing' including products life cycle management, modelling, design and optimisation.

Research addressing this Challenge in particular will encourage international cooperation under the Intelligent Manufacturing Systems (IMS) scheme.

Objective FoF-ICT-2011.7.1 Smart Factories: Energy-aware, agile manufacturing and customisation

The capability to produce large varieties of sophisticated products requires manufacturing sites to be flexible, fast and reactive. Lean and easy-to-implement ICT enables those sites to be resource efficient, safe and cost effective.

Target outcomes

Please note that we present here only the part of the objective 2011.7.1 that is related to photonics (parts a, b and c are not relevant).

d) Lasers and laser systems for manufacturing and materials processing with the following focus: i) High-brilliance active fibre and diode lasers (laser arrays) with nearly diffraction limited beam quality: simultaneous targets are multi kW continuous wave output power, efficiency of 40% or more, coupling into small diameter fibres (100µm or less for fibre lasers and 300µm or less for diode lasers); ii) New wavelengths and on-line adaptation of beam properties: novel lasers and laser systems opening-up new process windows and/or contributing to optimised process efficiencies. This includes widely tuneable lasers, ultra-short pulse lasers, versatile frequency conversion systems and photonic components enabling the on-line adaptation of essential beam parameters in order to produce stable beams of sufficient power and quality for the intended process.

Projects are expected to be industry-driven and to contain a strong validation element with quantifiable targets.

Expected Impact [7]

- Reinforced European leadership and industrial competitiveness of laser component and system producers and users and substantial improvement of manufacturing processes.

Funding schemes

d): STREP

[7] The part that is again related to photonics

Indicative budget distribution[3]

EUR 40 million with a minimum of 50% to IPs and 30% to STREPs[8]

Call: FP7-2012-NMP-ICT-FoF

Objective FoF-ICT-2011.7.2 Manufacturing solutions for new ICT products

Organic Large Area Electronics (OLAE)[9] is based on a combination of new materials and uses large area production processes to provide completely new applications and products that are generally thin, cheap, lightweight and flexible. Key to realising the potential is developing low cost, high volume and high throughput manufacturing technologies of electrical, electronic and photonic components. This objective aims at a "from lab to fab" approach i.e. bridging the gap between research prototypes and low-cost mass production methods. Applications range from OLED lighting, organic photovoltaics and printed batteries, to signage and displays, organic and large area sensor arrays, organic and printed electronics as well as flex/foil-based integrated smart systems.

Target outcomes

Feasibility demonstrators for industrial, low cost, high volume and high throughput manufacturing processes and production of organic and large area electronics and photonics products. Solutions should in particular make use of roll-to roll wet deposition, but could also address evaporation, hot-embossing, laser processing and other low-temperature processes. R&D will focus on addressing the main roadblocks such as patterning processes, resolution and registration accuracy, process stability, multilayer lamination, encapsulation, automation, in-line quality control, and architectures to cut production costs. Standardisation and end-of-life/disposal/recyclability issues should be addressed as appropriate.

Projects are expected to be industry-driven and the proposed work should include strong quality control, testing and validation elements

[8] These figures apply to the whole objective 2011.7.1 including also the parts a, b and c.

[9] OLAE covers organic electronics as well as organic photonics technologies.

in order to demonstrate the feasibility of the manufacturing at an industrial scale.

Expected Impact

- New market opportunities for European manufacturing industry in new low cost, high volume and high throughput manufacturing processes for OLAE products tailored to meet key societal and economic needs; and, extending the range of applications of "conventional" industries (e.g. printing and plastic), into the OLAE field.
- Availability of European-produced OLAE products tailored to meet key societal and economic needs.

Funding schemes

IP

Indicative budget distribution[3]

EUR 20 million

Call

FP7-2012-NMP-ICT-FoF

Timing of the Calls:

ICT call 7 (FP7-ICT-2011-7)

- Date of publication[10]: 28 September 2010
- Deadline [11]: 18 January 2011
  at 17:00.00 Brussels local time

ICT call 8 (FP7-ICT-2011-8)

- Date of publication[10]: 20 July 2011
- Deadline[11]: 17 January 2012
  at 17:00.00 Brussels local time

FoF 2012 call (FP7-2012-NMP-ICT-FoF)

- Date of publication[10]: 20 July 2011
- Deadline[11]: 1 December 2011
  at 17:00.00 Brussels local time

[10] The call may be published up to one month prior to or after the envisaged date of publication.

[11] The call deadline may be delayed by up to two months.

For further information:
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