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[17]. 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-

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

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);
- 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) **ERANET-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[10]

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