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Working Draft

Photonics PPP Photonics21 Research and Innovation topics for the Horizon2020 PPP Work Programme 2014-2015

based on the Photonics21 multi-annual-roadmap

3rd April 2013

Photonics21 Board of Stakeholders

Disclaimer

Photonics topics included in this draft are based on the Research and Innovation topic prioritization conducted within the Photonics21 work groups over the past year.

Please note that at the moment there are many unknowns regarding a. the budget of the Photonics PPP, b. the extent to which Photonics topics can be included in the Cross-KET budget line and c. the extent to which Photonics topics can be included - through joined calls - in other parts of the Horizon2020 work programme (outside the PPP). Thus, a further prioritization may be needed.

Explanatory Notes:

- Cross KET initiatives - All Key Enabling Technologies (KETs) like Photonics will have to shift a share of its budget to a so called Cross KET funding line. Here projects with the involvement of several KETs should be launched.
- PPP Budget distribution: Like in FP7 the budget in Horizon2020 for the Photonics PPP will not be evenly distributed between the years 2014-2020. It will start at a lower level and later on may increase. Thus, some topics have been postponed to 2016/17. For the Horizon2020 Photonics PPP Work Programme 2014-15 the assumed budget is €80-100M/year, incl. Cross-KET.
- Differentiation according to Technology Readiness Levels (TRL): Research actions vs innovation actions (see KET report¹):

TRL	1	2	3	4	5	6	7	8
	Basic Principles Observed	Technology Concept Formulated	Experimental Proof of Concept	Technology Validation In lab	Tech valid. In relevant environment	Demonstration In relevant environment	Demonstration In operational environment	System complete and qualified

Research actions

Innovation actions

- Funding levels: The same funding levels for research and innovation actions in Horizon2020 will also apply to the PPP actions. The funding level for research actions are 100%, the funding level for closer to the market innovation actions are between 30-70%.

¹ http://ec.europa.eu/enterprise/sectors/ict/files/kets/hlg_report_final_en.pdf

Photonics PPP
Photonics21 Research and Innovation topics for the Horizon2020 PPP
Work Programme 2014-2015

WORK GROUP No: 1
Information and Communication

Call 2014:

Innovation action: Pilot deployment of software-defined optics in R&E networks

5 NRENs in Europe will be equipped with novel SDON technologies (component, system, network level) using first commercial hardware and TRL6+ level software, interconnected through GEANT. The pilot serves as a blueprint for an Elastic Optical Cloud and provides a platform and demanding users for the test and development of new use cases & applications.

Instrument	To be defined - either small scale Integrated Project (IP) or Public Procurement Innovation with a given amount of funding from the Photonics PPP
Proposed funding level	Up to 50%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	Yes
Is this topic a candidate for a cross-KET initiative	No

Coordination with DG Connect/Networks

Research action: Optical Technologies for Lighting the Datacentre

For Exascale data centres, radically new architectures with pervasive use of optical interconnect technologies need to be explored. Novel optical switching and interface technologies, a tighter integration of optical and electronic functions, a more programmatic fabric control, and a flexible allocation of networking functions are required to orchestrate resources elastically and at scale.

Instrument	STREP
Proposed funding level	100%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	No
Is this topic a candidate for a cross-KET initiative	No

Coordination with DG Connect/Networks, possible connection also with high-performance computing

Research action: European Photonics Laboratory (EuroLab)

EuroLab is a federation of academia, research institutes and industry that pool their joint expertise. Industrial partners can raise study items that are subsequently investigated by smaller teams in time-limited focus activities with funding for academia (lightweight process). Topics can include forward-looking product ideas, technical feasibility studies, open questions in standards and research.

Instrument	to be defined (1 project)
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Proposed funding level	100%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	No
Is this topic a candidate for a cross-KET initiative	No

Coordination with DG Connect/Networks

Call 2015

Innovation action: Large scale demonstrator of ubiquitous broadband fibre access

Ubiquitous Broadband Fibre Access is the common foundation wireless and wireline networks. A large scale demonstration (“Digital village” with ~50,000 optical access lines & ultra-broadband mobile) using next-generation optical access technologies with first commercial hardware is proposed to foster the fibre rollout in Europe and as platform for value-added services and applications.

Instrument	To be defined (- Structural Funds)
Proposed funding level	Up to 50%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	Yes
Is this topic a candidate for a cross-KET initiative	No

Coordination with DG Connect/Networks

Research action: New approaches for software defined optical petabit networks

Transmission technologies are approaching boundaries set by physics and information theory. Only with extraordinary research effort and disruptive technologies it will be possible to sustain the necessary capacity growth in the core network while at the same time reducing power consumption, footprint and cost. A holistic approach comprising components, system & networks is required.

Instrument	Integrated Project , STREP
Proposed funding level	100%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	Yes
Is this topic a candidate for a cross-KET initiative	No

Coordination with DG Connect/Networks

Research action: New approaches for ubiquitous broadband fibre access

The rapid traffic increase in fixed and wireless networks pushes fibre closer to the end-user. To keep pace with the rapid development particularly in the wireless access domain, where the annual traffic grows by a factor of 10, disruptive new approaches comprising the optical network, system and component level are required along with orchestrated approach to control network & IT resources.

Instrument	Integrated Project , STREP
Proposed funding level	100%

Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	Yes
Is this topic a candidate for a cross-KET initiative	No

Coordination with DG Connect/Networks

Topics postponed to Work Programme 2016/17

Innovation action:

Large-Scale Demonstrator - The Optical Data Center

Demonstration of pervasive optics inside the data center.

Research action:

Architectures & technologies for on-board, board-to-board and rack-to-rack optical interconnects

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WORK GROUP No: 2
Industrial Manufacturing and Quality

Call 2014

Research action: Process chain of ultra-short pulse high-power lasers with remote technologies (flexible beam shaping and deflection)

The ongoing development of ultra-short pulse high-power lasers is essential for the dissemination of these new tools for industrial manufacturing processes. But only in combination with appropriate beam delivery components these systems can be used as an innovative tool, so the process chain from the laser source to the beam deflection shall be addressed here.

Instrument:	STREP
Funding level	100 %
Is this topic a candidate for a cross-KET initiative?	No

Coordination and Support Action: Smart and safe workspaces for laser-based manufacturing

Scope: Explore safe human / machine cooperation systems in laser-based manufacturing

Instrument:	Coordination and Support Action
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Coordination with Factories of the Future PPP

Call 2015

Research action: Efficient lasers and devices

The demand for high power lasers (cw and short pulsed) with high efficiency is still increasing to provide energy efficient production systems. This leads to the need of high efficient components like brilliant diodes, coatings, non-linear materials for high intensity beams, not only for NIR systems but also for VIS and UV wavelengths.

Instrument:	STREP
Funding level	100 %
Is this topic a candidate for a cross-KET initiative?	No

Other Explanatory Comments

The focus still stays in three close connected fields:

- Efficient lasers and photonic devices
- Beam delivery, shaping and deflection systems
- Process control

The following WP (2016/2017) should emphasis different specific topics from the detailed list of research actions.

The proposal for “Towards zero failure production²” (process control) could be placed as a cross KET innovation action between Photonics and FoF in the field of advanced manufacturing. Especially for

² Further description will follow

additive manufacturing this could be an innovation topic as additive manufacturing is defined as an innovation topic in the FoF 2020 Strategic Multi-Annual Roadmap.

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WORK GROUP No: 3
Life Sciences and Health

Call 2014:

Innovation action: Mobile point-of-care screening devices

The objective is to develop mobile point-of-care screening devices for the fast and minimally or non-invasive detection of a wide span of different diseases either in isolation or in combination were appropriate and useful. The research and development should progress until and including **TRL 7**.

Instrument	Integrated Project
Proposed funding level	70 %
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	No
Is this topic a candidate for a cross-KET initiative:	Yes

Research action: Mobile point-of-care screening devices

The objective is to develop mobile point-of-care screening devices for the fast and minimally or non-invasive detection of a wide span of different diseases either in isolation or in combination were appropriate and useful. The research and development should progress until and including **TRL 5**.

Instrument	Integrated Project, STREP
Funding level	100 %
Is this topic a candidate for a cross-KET initiative?	Yes

Coordination and Support Action:

Scope: see “Other Explanatory Comments”

Call 2015

Innovation action: see “Other Explanatory Comments”

Research action: see “Other Explanatory Comments”

Other Explanatory Comments

- The only but important differences are the different TRLs. The different actions can be called either in 2014 or shifted to 2015 depending on budget considerations.
- If there is still budget for Coordination and Support actions available, it could be discussed to bring forward the “Outreach to Health insurance providers and medical device manufacturers” which is currently planned for 2018/19.

WORK GROUP No: 4
Emerging Lighting, Electronics and Displays

Call 2014:

Innovation action: Open System Architecture for SSL

The future of the lighting industry largely depends on its ability to make the transition from light sources to intelligent lighting systems enabled by Solid State Lighting (SSL), that is, LEDs and organic LEDs (OLEDs). This requires close collaboration with the micro-electronics industry to develop new system architectures, including hardware and software architectures and interfaces suited for lighting systems.

Instrument	Integrated Project
Proposed funding level	70%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	No
Is this topic a candidate for a cross-KET initiative:	Yes (Micro-electronics)

Innovation action: Large scale demonstration action for deployment of intelligent SSL solutions in European cities

In order to speed up SSL market uptake there is a clear need for market demonstration and validation at a level beyond today's demonstration projects, only covering a limited amount of light points. The major refurbishment of some medium sized European cities would bring compelling evidence of what LED technology can bring to society and would also showcase the commitment to energy efficiency by the public authorities. The vast information gathered in such an action will also act as a springboard to drive energy regulations at the building and district level.

Instrument	Public Procurement Innovation with a given amount of funding from the Photonics PPP
Proposed funding level	70%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	Yes, Public Procurement Innovation
Is this topic a candidate for a cross-KET initiative:	No

Research action: Immersive & collaborative visualization systems

Development of cost-effective, compact & scalable photonics sub-systems for ultra-high viewing experience immersive & collaborative real time visualization, with focus on 3D video capture, glasses-free 3D displays & near-to-eye displays, and multimodal user interaction.

Instrument	Integrated Project
Funding level	100 %
Is this topic a candidate for a cross-KET initiative?	No

Research action: New Materials & Devices for OLEDs for Lighting and Displays

Target of the research project is to increase the cost performance of OLEDs to be equal at least to 100 lm/\$. This will enable these organic electronic devices to become competitive in the long run with the existing technology offers.

Instrument:	Integrated Project
Funding level	100 %
Is this topic a candidate for a cross-KET initiative?	Yes, together with Advanced Materials

Coordination and Support Action fostering the wide uptake of SSL technologies³: a) bringing together European cities to share information, testing facilities and procurement and deployment experiences on SSL; b) networking European SSL test facilities to ensure LED product quality in the European market place; c) training the public procurers in SSL technologies; d) Promoting SSL, analysing its effects in applications where there are benefits for people's health and well-being, and addressing recyclability & disposability of SSL products.

Call 2015

Innovation action: Open access pilot production on flexible substrates of OLEDs

Accelerate the industrialization of OLED production on flexible substrates and realizing the cost-performance breakthrough in order to become competitive with existing LED based solutions.

Instrument	Integrated Project
Proposed funding level	70%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	No
Is this topic a candidate for a cross-KET initiative:	No

Topics postponed to Work Programme 2016/17

New materials for OPV

Under the last FP7 NMP call related projects will be funded

Building Integrated Photovoltaic BIPV

Technology maturity still needs to increase before successful integration will be feasible

Other Explanatory Comments

Off-grid OPV is no longer considered as being of interest to the Photonics PPP. BIPV is pulled forward from the 2020 to the 2016 timeframe.

³ These actions are in line with the Green Paper "Lighting the Future", COM(2011) 889 final.

WORK GROUP No: 5
Security, Metrology & Sensors

Call 2014:

Research action: Breakthrough MIR light generation and detection⁴

Photonic multi-band sensing techniques in the mid infrared (MIR) wavelength range ($\lambda = 3 \dots 50 \mu\text{m}$) offer huge opportunities in stand-off “fingerprinting” analytics and diagnostics. The goal is to invent and develop novel devices and sub-systems for MIR light generation and detection, whose volume production cost should be no more than ten times the cost for visible-domain components. High-impact application areas include medical/biochemical diagnostics, environmental sensing, food and water safety/security, green transport/mobility, anti-counterfeiting, recycling and public security.

Instrument:	Integrated Project, STREP
Funding level	100 %
Is this topic a candidate for a cross-KET initiative:	Yes

Call 2015

Innovation action (Title): Pilot line for high-impact analytical MIR micro-sensors

Mainstream silicon technology is dominated by large companies. Yet in the MIR spectral range, many European SMEs are active, whose production of lower-cost, more reliable and efficient MIR materials, components and sub-system we aim to support. The goal is to provide a pilot line for processed wafer and mounted/packaged chips, bringing the TRL of the MIR micro-sensor systems currently under development in the EU to a higher level (typically from 3-5 to 6-7).

Instrument	Integrated Project
Proposed funding level	50%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	Yes
Is this topic a candidate for a cross-KET initiative:	Yes

Other Explanatory Comments

Acceleration of the critical path from science to market for European components and sub-systems in the MIR spectral range: Bringing forward the innovation action “Pilot line for high-impact analytical MIR micro-sensors” to 2015, and pushing back the demonstration action “EIR system concepts with high application potential. In the original roadmap, the ramp-up of EIR component and sub-system production was planned only for 2018/2019.

⁴ Spectral range still under discussion

WORK GROUP No: 6
Design and Manufacturing of Components & Systems

Call 2014:

Innovation action: PIC Platform Introduction (III-V/Dielectric Technologies)

Roll-out of first generation PIC platforms in III-V semiconductor and dielectric technologies, including platform qualification, manufacturing capabilities and provision of open access.

Instrument	IP
Proposed funding level	70%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	No. Co-funding will be investigated for follow-on projects.
Is this topic a candidate for a cross-KET initiative:	No

Research action: Electronic-Photonic Integration

Development of technologies to combine photonic and microelectronic functionality in a highly integrated and efficient manner, thereby permitting the full performance potential of CMOS electronics and state of the art photonic circuits to be realized. Monolithic, heterogeneous and hybrid approaches may all be considered, employing silicon and III-V elements as appropriate. Advances in PIC technology related to electronic integration, such as high-density, micron-scale emitters/modulators fully compatible with CMOS electronics, may also be addressed.

Instrument	IP, STREP
Funding level	100 %
Is this topic a candidate for a cross-KET initiative?	Yes, Electronic-Photonic Integration may be considered for cross-KET with Nano/microelectronics

Call 2015

Innovation action: PIC Platform Introduction (Silicon Photonics)

Roll-out of PIC platforms in silicon photonics, including platform qualification, manufacturing capabilities and provision of open access. Electronic-photonic integration through hybrid approaches or heterogeneous integration may also be addressed.

Instrument	IP
Proposed funding level	70%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	No. Co-funding will be investigated for follow-on projects.
Is this topic a candidate for a cross-KET initiative:	Yes: Nano/Microelectronics

Research action: Next-generation photonic device and circuit technology

Semiconductor and dielectric device and PIC technologies offering significant increases of performance and functionality in discrete and integrated form. Whilst generic in nature, technology

development should address clearly identified needs within key application domains, e.g. communications, industrial, biomedical, consumer, magnetic storage. Developments based on new semiconductor and dielectric materials and emerging technologies such as micro/nanostructuring, heterogeneous integration and plasmonics are encouraged. PIC technology developments should be compatible with the creation of second-generation generic integration platforms for open access.

Instrument	STREP
Funding level	100 %
Is this topic a candidate for a cross-KET initiative?	No

Research action: Assembly and Packaging

New concepts for economic packaging and assembly of high-performance, high-functionality devices and PICs. Development of generic low-cost approaches in packaging, applicable to a wide range of PICs and applications, compatible with volume manufacturing in Europe. This action should prepare the way for a pilot-line innovation action in subsequent phases of the Horizon 2020 work programme.

Instrument:	IP, STREP
Funding level	100 %
Is this topic a candidate for a cross-KET initiative?	No (though a possible link to Advanced Manufacturing should be investigated).

Topics postponed to Work Programme 2016/17

In line with the Multi-Annual Roadmap, the topic on establishing a pilot line for next-generation assembly of high-volume, high precision discrete devices and PICs is presently scheduled for 2016/7. Preparatory work should however be conducted in 2014/15 through IP actions as noted above.

Other Explanatory Comments

The topic on **Technologies for Electro-Optic Circuit Boards, circuit packs and high functionality photonic subsystems** is now covered within the priorities of WG1, where it forms part of the effort on **Lighting the Data Centre**.

Research on high power lasers and related optical components is now specified under WG2, whilst effort on source technology for sensors (particularly mid-IR devices) is now included within the priorities of WG5.

Planning and coordination actions mentioned in the multi-annual roadmap will be included within the referenced IPs.

WORK GROUP No: 7
Photonics Research, Education and Training

Call 2014:

Coordination and Support Action: Strategic coordination and networking of photonics stakeholders and other relevant communities (e.g., industrial or professional users) in Europe for reinforcing value chains and accelerating the deployment of photonics technologies in many application areas. This includes: the coordination of the European photonics research constituency in the Photonics21 ETP; the further development of a European photonics strategy towards end user oriented roadmaps; the further coordination with national and regional photonics activities; relevant market analyses and targeted international cooperation actions; and, improving access to financing of Photonics stakeholders (especially SMEs and entrepreneurs).

Coordination and Support Action: EU-wide outreach actions for promoting photonics to young people, entrepreneurs and the general public (including through exhibitions in high schools, dedicated "open days" in museums or other public spaces and based on dedicated high-quality professional material and demo kits).

Call 2015

Coordination and Support Action: Access services⁵ enabling the wider adoption and deployment of photonic technologies in innovative products, in particular by photonics or user SMEs and driven by their business needs. The action should be driven by photonics **RTOs in close cooperation with** national and regional photonics or user related **clusters**. Close synergies should be sought with existing similar services developed in regional / national research and innovation strategies for smart specialisation. It includes dedicated **photonics training programmes** aiming at transferring state of the art photonics skills and hands-on experience to industry (in particular SMEs). They should be carried out by industrial and research stakeholders in close cooperation with regional/national photonics innovation clusters. Close synergies should be sought with existing similar training programmes and regional / national research and innovation strategies for smart specialisation.

Topics postponed to Work Programme 2016/17

No major topics for outreach and training are being postponed to 2016/2017. However it has to be kept in mind that coordination and support actions for outreach on one side and lifelong learning for SMEs will need to be maintained also in future WPs, possibly widening target populations and implemented models.

Other Explanatory Comments

Mention any significant deviations from roadmap document previously approved by BoS
Coordination actions to increase the presence of university curricula in photonics and of photonics modules in non-photonics curricula have always been considered as a further topic to be addressed, but with lower priority as compared to outreach and professional training: the insufficient number of students and the need of maintaining SME competitiveness through professional training are far more

⁵ **Access services** provide fast access to knowledge, training, prototyping, testing, manufacturing, design or engineering services for first users and early adopters, in particular SMEs. The objective is to reinforce the competitiveness of users by enabling them to exploit innovative photonics technologies

urgent problems to be addressed. However university education strengthening will be addressed in future WPs.

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Call 2014: Bottom-up (disruptive) Research

Research action (Title): Photonics technologies for high sensitivity and specificity in sensing

New materials and concepts are needed to overcome limitations of present photonics technologies, thus achieving a real step forward in photo-sensing applications rather than merely incremental performance improvement. Three main areas have been identified as those most likely to make a breakthrough for future innovation: nanophotonics, quantum optics/quantum information, and “extreme” light (extreme meaning non conventional wavelengths, or temporal characteristics, etc.). Strong impact can be foreseen for future applications in biophotonics, environmental monitoring, security, etc.

Instrument	STREP
Proposed funding level	100%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	No
Is this topic a candidate for a cross-KET initiative:	Yes (with advanced materials, nanotechnologies, micro and nanoelectronics)

Coordination and Support Action: Open access of Researchers and SMEs to advanced fabrication and characterization facilities (up to TRL 4) fostering the development of novel photonics approaches through the use of new materials, unconventional processes and light-matter interaction.

Coordination and Support Action: Inducement prize

Inducement prize is designed to foster team working on a specific topic and to increase the visibility of Photonics through suitable communication and advertisement of the initiative.

Possible topics should be suggested by the BoS keeping in mind the following aspects: it should address aspects related to “popular” societal challenges; the outcome of the work should be of interest for future industrial application; it should be feasible for teams both from universities/research centres and from industries.

Call 2015

Research action: Low cost, energy saving integrated photonic devices

The possibility of exploiting photonic technologies for energy production (photovoltaic) and saving (LEDs) has been widely demonstrated. However photonics potential is much stronger. By exploiting new “disruptive” materials, processes, and technologies, photonics is likely to allow the realization of low-cost, energy-saving integrated devices and microsystems for different applications (e.g. disposable lab-on-a-chip for point-of care diagnosis in biomedical applications). The research action should reach TRL 4.

Instrument	STREP
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Proposed funding level	100%
Co-funding through Public Procurement Innovation, Structural Funds, European Investment Bank?	No
Is this topic a candidate for a cross-KET initiative:	Yes (with advanced materials, nanotechnologies, micro and nanoelectronics)

Other Explanatory Comments

The roadmap document was focusing on general disruptive research topics (i.e. nanophotonics, quantum optics/quantum information, extreme light) as those most likely to provide a real breakthrough for future innovation and for each topic a general time evolution had been foreseen. However, there are no sufficient elements to prioritise one of the topics as compared to the others, since it is impossible to foresee which of them (if any, new approaches might arise) will give the real push forward to photonic technologies. It seems much more realistic to identify key limitations of the present technologies that might be overcome with future approaches. Due to the change in the approach, the topic to be addressed, especially concerning WP 2015, might change following discussion with the BoS.

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