European Network Technologies
Connecting the Digital Society

Future Networks EU Research

for the ubiquitous **ultrafast Internet of the future** enabling every European to have a broadband connection to the digital society (Digital Agenda for Europe)
Future Internet in WP 2014-15

Net Innovation
- ICT 10: Collective awareness platforms for sustainability and social innovation
- ICT 13: Web entrepreneurship

Software, services and cloud computing
- ICT 7: Advanced cloud infrastructures and services
- ICT 8: ECP: pre-commercial and joint procurement
- ICT 9: Tools and methods for software development

Experimental Platforms
- ICT 11: FIRE+ (Future Internet Research & Experimentation)
- ICT 12: Integrating experiments and facilities in FIRE+

Network technologies
- ICT 5: Smart networks & novel Internet architectures
- ICT 6: Smart optical & wireless network technologies

Network technologies
- ICT 14: PPP on advanced 5G network infrastructure for the Future Internet

IoT
- ICT 30: Internet of things and platforms for connected smart objects

INCO
- EU-Brazil R&D cooperation in advanced cyber infrastructure
- EU-Japan R&D cooperation in Net Futures
**Deadline 23\textsuperscript{th} April 2014:**

- ICT 5: smart networks & novel Internet architectures (24 M€)
- ICT 6: smart optical & wireless network technologies (30 M€)
- ICT 7: advanced cloud infrastructures and services (73 M€)
- ICT 9: tools and methods for software development (25 M€)
- ICT 11: FIRE+ (31.5 M€)
- ICT 13: Web entrepreneurship (10 M€)

**Deadline 25\textsuperscript{th} November 2014:**

- ICT 14: 5G PPP (125 M€)

**Deadline 10\textsuperscript{th} April 2014:**

- EU-Japan R&D cooperation on Net Futures (6 M€)
ICT 5. Smart Networks and novel Internet Architectures

**STARTING POINT**

*Inherent Internet limitations*

*Host centricity, information centricity*

*Mobility, multi homing*

*Security, QoS, Intesv diffserv; Overlay and patches*

➔ *Vibrant research topic over last years*
Example Work

**Workshops**
- IEEE NOMEN 2012, 2013
- ACM SIGCOMM 2011, 2012, 2013 (ICN-2014 will be a full conference)

Many papers in journals and general conferences

*Special issues (Computer Networks in press, Computer Communications in press, IEEE Networks, cfp)*

**Standardization**: IRTF Information-Centric Networking Research Group (ICNRG)

**Projects**
- TRIAD, DONA, PSIRP, 4WARD, COMET, COAST, CONVERGENCE, SAIL, NDN, PURSUIT, MobilityFirst, GREENICN

→ Shifting a gear up
Novel architectural and networking approaches to information delivery and access

Evolution from a 'host centric' to a more efficient internet architecture able to support a growing number of services, processes and business models.

**Scope (Small Research and Innovation Projects)**
- novel architecture approaches (naming, routing, caching..)
- built-in security and privacy (content vs channel)
- generalised mobility and integration with IT
- Beyond content, IoT
- scalability and migration strategies
- experimental pilots

24 M€
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24 M€
Expected impact:

- Key scientific publications (ACM Sigcomm)
- Contributions to standards (IRTF..)
- FI architecture network of researchers and users
- Links with related International developments, (US, Korea and Japan) ➔ standards
- Migration/deployment strategies and roadmaps
- Closer integration of datacom and telecom industries in EU
- Contribution towards large scale validation trials
ICT 6. Smart optical and wireless network technologies

a. **Research & Innovation actions:**
   - Optical networks
     Small Research and Innovation Actions
   - Wireless networks
     Small Research and Innovation Actions

b. **Support Actions:**
   Coordination and Support Actions

29 M€
1 M€
ICT 6. Smart optical and wireless network technologies

Innovative network technologies addressing the increasing traffic and the multiplicity of usages

**Optical networks, Scope:**

- Dynamic mgmt for lower cost and more flexible use of resources, flexible BW across domains;
- VHSA at $\geq 10$ Gbps per user (in 10 years) and 100 Gbps later (including VLC);
- Intra and inter data centre connectivity;
- Optical transmission technologies;
- Attention must be given to legacy and regulation, cost- and energy-efficiency.
ICT 6. Smart optical and wireless network technologies

Wireless networks, Scope:

- Dynamic control of resources through disruptive new paradigms ("femtocell"-like) – prosumers;

- Optimised spectrum use (cognitive radio, spectrum aggregation, higher bands -90GHz-, advanced mods/cods, beamforming);

- Energy efficiency and new usages;

- Hybrid combination of terrestrial and satellite infrastructures to address coverage, optimised spectrum use and network resilience.
Support Actions

- Technological roadmaps;
- Dissemination (incl. annual conference);
- Standardisation;
- Integration of results;
- Operational and economic metrics;
- Strategies for validation and demonstration.

Type of actions: Coordination and Support Actions
ICT 6. Smart optical and wireless network technologies

Expected Impact
- Optical NW industrial capability in Europe: ≥ 20% of the global market;
- Energy consumption of basic infra reduced by a factor of ~10;
- Spectral radiation exposure decreased through low-EMF technologies;
- 10 Gbps/user in 10 yrs; 100 Gbps/user in longer term (fixed accesses);
- Support metro and core NWs with Pbps throughput and Tbps i/f speeds;
- Reach higher spectral efficiency; targeting a 10-fold increase;
- Enable new apps through the efficient use of higher spectrum bands;
- Achieve ubiquitous access to critical/societal applications;
- Open standards for w'less and optical comms and associated SEPs;
- Cooperation with US, Japan and Korea as priority countries (win win)

Type of Actions: Research and Innovation – Small projects

29 M€
Inducement Prizes
Network Technologies

1 M€

a) Breaking the optical transmission barriers (core NW)
Maximise the fibre transmission capacity per channel

b) Collaborative sharing of spectrum
Novel methods for decentralised spectrum management

Expected Impact:
- Stimulate high-level scientific work;
- Attract new organisations;
- Create ICT awareness on public and young researchers.

Type of action: Prizes
ICT 14 – Advanced 5G Network Infrastructure
Introduction to the proposed "pre-structuring"

• **Objectives:**
  ✓ Achieve more than a group of standalone or loosely coordinated projects
  ✓ Avoiding gaps, "hype" issues,…
  -> **Optimising overall project portfolio but leaving space for flexibility**

• **Principles:**
  ➢ Ensuring an optimum set of projects, working together, no discrimination!
  ➢ Model focused on outcome / projects, not proposals as such.
  ➢ Ideally, broad agreement on of project scopes, their interfaces and the possible cross-issues between projects + gap analysis
  ➢ Example of Energy Efficiency to be seen as “by design”

• **Open issue:** How to take advantage of pre-structuring in the selection process (challenging, still under consideration)

**Source:** 5G-PPP / **Contact:** didier_arnaud.bourse@alcatel-lucent.com
ICT 14 – Advanced 5G Network Infrastructure

a. Research & Innovation

a.1. Strand Radio network architecture & technologies

- **Network architecture**: focus on access speed, low latency, spectrum efficiency, usage of higher frequency bands, traffic prioritisation / QoS / QoE, address new cloud networking requirements, low energy,
- **Versatile ubiquitous radio access infrastructure**: support low rate IoT, fixed/mobile seamless access access continuum (wireless, fixed, satellite)
- **Flexible backhaul solutions** + backhaul/fronthall integration
- Architecture for 5G "transceivers" and micro-servers, HW building blocks
- **Preparing for large scale demonstrators and test-beds** (possibly leveraging existing experimental facilities)
ICT 14 – Advanced 5G Network Infrastructure

a. Research & Innovation

a.2. Strand Convergence beyond last mile
- **Integration wireless/optical** to support the ubiquitous access continuum (obj.: reach 10 Gb/s access speeds)
- **Addressing management complexity/heterogeneity**
- **Architectures**: optimise functionality reuse (via virtualisation)

a.3. Strand Network Management
- **Approaches to reduce Opex** (simplify, SON, "feed" big data, SDN + autonomic resource management, net security across virtualised domains)
- **Increase user perceived QoS / QoE / trust**

Call 1: ICT 14 – Total 125 M€
ICT 14 – Advanced 5G Network Infrastructure

b. Innovation

c. Support Actions

b. Strand Network Virtualisation & Software Networks
(centre of gravity on innovative solutions, additional research must be secondary)

- Network Functions Virtualisation
- Orchestration ergogeneity
- Architectures: optimise functionality reuse (via virtualisation)

25 M€

2 M€

c. Support Actions
- Programme integration
- Monitoring
- International activities
- (Pre) Standardisation
2nd EU-Japan Coordinated Call

Call Conditions

- EU and JP proposals submitted to the respective coordinated calls
- EU-Japan: balanced effort, genuine cooperation
- Contribution to international standards
- Each proposal should include a coordination agreement
- Duration: 3 years
- Max. funding (EU): 1.5M€
EU-Japan Research and Development Cooperation in Net Futures

EUJ2 – 2014: Optical Communications

European Commission
DG CONNECT
Network Technologies
Focus on research activity on technologies of optical transport networks.

Cope with the expected significant traffic growth.

Meet the flexibility requirements imposed by major trends in the evolution of network usage, in particular, cloud computing.
Optical Communications

The Scope

The proposed research should target at least one of two following topics:

- **Programmable optical hardware**
  Development of flexible/programmable optical hardware to increase flexibility in the control and management of optical networks and enable the advent of software defined optical networking.

- **Super-capacity optical transport networks**
  New approaches to transmission over optical fibres to meet the increasing traffic demand, and allow progress of several orders of magnitude in the capacity of transport networks. Amongst these new approaches, one can notably mention Space Division Multiplexing.
Optical Communications

Expected Impact

• Key enabling technologies that contribute to the emergence of new generations of optical transport networks, to cope with the expected significant traffic growth and meet the flexibility requirements.

• Joint contributions to International Standardization and/or Forum activities.

EU 1,5M € + equal amount from Japan
Small project; R&I Actions
EU-Japan Research and Development Cooperation in Net Futures

EUJ3 – 2014: Access Networks for Densely Located Users

European Commission
DG CONNECT
Network Technologies
Access Networks for Densely Located Users

The Challenge

• Focus on technologies and system approaches to realize high speed/high capacity dense local networks, as may be encountered in very high density locations where many users use high-capacity broadband applications.

• Develop high-performance heterogeneous access network systems which have dynamic resource allocation capability.
Access Networks for Densely Located Users

The Scope

Access technologies of future network systems would comprise various broadband transmission media such as optical fibres, millimetre-wave links, etc. The topic scope covers the following research activities:

- Optimize link performance from points of view, such as CAPEX, OPEX, radio-wave resources and environmental constraints without compromising the applicability in wide variety of use cases such as dense business districts, conference sites, evacuation sites, schools, railway stations, etc.
- Research should include network architecture using service centric network control.
- Technological focus would be also on low-cost broadband link technologies designed for cross-layer control, and on reduction of power consumption in access networks.
- Life cycle assessment of hardware in the network would be a target in the topic.
Access Networks for Densely Located Users

Expected Impact

- Better exploitation of new broadband links for short range, very high capacity communication applications in dense environments.
- Key enabling technologies for the future generations of integrated/heterogeneous access network systems with improved economic, spectral and energy efficiency.
- Joint identification of standardization requirements and contribution to standardization bodies and fora.

EU 1.5M € + equal amount from Japan
Small project; R&I Actions