European Commission

This fiche is part of the wider roadmap for cross-cutting KETs activities

'Cross-cutting KETs' activities bring together and integrate different KETs and reflect the interdisciplinary nature of technological development. They have the potential to lead to unforeseen advances and new markets, and are important contributors to new technological components or products.

The complete roadmap for cross-cutting KETs activities can be downloaded from:

http://ec.europa.eu/growth/industry/key-enabling-technologies/eu-actions/ro-ckets

Potential areas of industrial interest relevant for cross-cutting KETs in the Electronics and Communication Systems domain

This innovation field is part of the wider roadmap for cross-cutting KETs activities developed within the framework of the RO-cKETs study. The roadmap for cross-cutting KETs activities identifies the potential innovation fields of industrial interest relevant for cross-cutting KETs in a broad range of industrial sectors relevant for the European economy.

The roadmap has been developed starting from actual market needs and industrial challenges in a broad range of industrial sectors relevant for the European economy. The roadmapping activity has focused on exploring potential innovation areas in terms of products, processes or services with respect to which the cross-fertilization between KETs can provide an added value, taking into account the main market drivers for each of those innovation areas as well as the societal and economic context in which they locate.

Taking the demand side as a starting point, cross-cutting KETs activities will in general include activities closer to market and applications. The study focused on identifying potential innovation areas of industrial interest implying Technology Readiness Levels of between 4 and 8.

E&C.4.4: Highly resource efficient networks

Scope:

To develop resource efficient networks and infrastructures with a low use of energy (i.e. limited heat dissipation), spectrum and processing power, including through concepts such as multi-hop mesh solutions, multi-criteria routing and cognitive/self-organization, context based sleep/active cycles, low power infrastructure chipsets and modules and a special effort on developing distributed cloud computing and data centre eco-efficiency.

Demand-side requirements (stemming from Societal Challenges) addressed:

- Inclusive society is also about closing the digital divide (according to the Digital Agenda for Europe (DAE), 78% of EU citizens use the internet at least once a week, 20% never used the internet, and 62% of the EU has 30Mbps broadband, but only 18% of rural areas). Skills or network deployment are to be supported, but technological developments are required in broadband wireless communications, very high broadband wireline communications, networks interfacing and systems autonomous connectivity, user-friendliness
- With ubiquitous digitalization, cyber-security and protection of the communications is a crucial contributor to a safe EU secure and free society
- Improved transport and energy services, as well as all sorts of system monitoring services (environment monitoring, homeland surveillance, industrial supply chains, etc.) all rely on ever-growing flows of digital information, increasing the need for reliable high throughput communication networks
- Information and communication technologies consume around 2% of global energy consumption, and this is the sector with the fastest growth over past and probably upcoming years. Increasing energy efficiency in Information and Communication Technology (ICT) is crucial

Demand-side requirements (stemming from market needs) addressed:

- Volumes of data exchanges have been continuing growth in the recent years, while European telecommunication operators have been experiencing a drop. These operators expect improved communication networks to provide them with capabilities for new services and constitute important growth and profitability relays
- Normalization is a very important driver or barrier for telecom-related industrial activities. Being at the top-front of innovation in low layer telecoms often provides a direct competitive advantage
- Concern is growing in society about electromagnetic waves. In the meanwhile, the radiofrequency spectrum is a limited resource more and more intensively exploited. Optimizing wireless networks for minimizing resource use and possible health impacts is getting more and more important

Specific technical / industrial challenges (mainly resulting from gaps in technological capacities):

- Development of intelligent management of energy (power and dissipated heat) all over network systems
- Development of multi-hop mesh solutions, multi-criteria routing and cognitive/self-organization capabilities for reducing energy consumption from the terminals to the base stations and access points
- Development of low power infrastructure chipsets and modules, including for very high frequency / performance communication
- Development of distributed cloud computing supporting a dynamic scalability of computing centralization in the network, depending on the application, terminal capability and context
- Allow network low layers management based on "ordinary" software
- Better management of interferences to increase use of best-scale cells in wireless networks and / or allow dynamic scaling of emissions
- Emit only minimum necessary level of power, depending on actual network conditions, so as to optimize energy consumption, minimize interferences and reduce potential impact on human health
- Increase of the use of context-based sleep/active cycles
- Increase of data management eco-efficiency, including in data-centres
- Development of modelling tools and related techniques to optimize resources management when deploying wireless networks

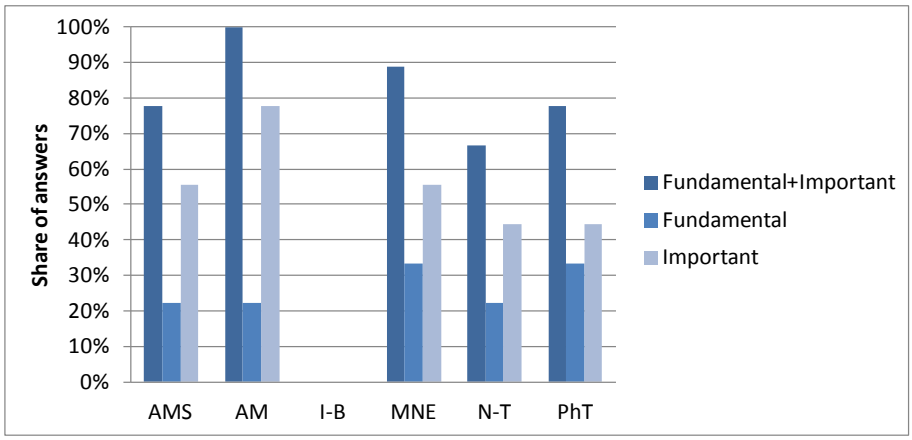
- Integration of a mediation bus between services and network/transport layer, so as to integrate more functionalities in the information transportation service
- Management of aggregated interference in multiuser patterns, including for guaranteeing quality of service and network security
- Development of very efficient cost effective small size device front end power modules

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of resource efficient networks and infrastructures with a low use of energy (i.e. limited heat dissipation), including through concepts such as multi-hop mesh solutions, multi-criteria routing and cognitive/self-organization capabilities, context conscious sleep/active cycles, low power infrastructure chipsets and modules.

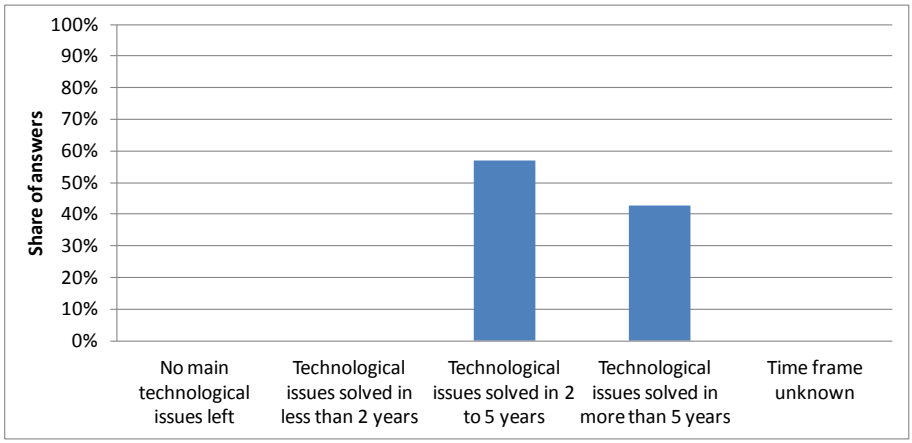
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong interaction of KETs with respect to this Innovation Field, with either fundamental or important contribution mainly by the following KETs:

- Micro- and Nano-Electronics (MNE)
- Advanced Materials (AM)
- Advanced Manufacturing Systems (AMS)
- Photonics (PhT)
- Nanotechnologies (N-T)



Timing for implementation:

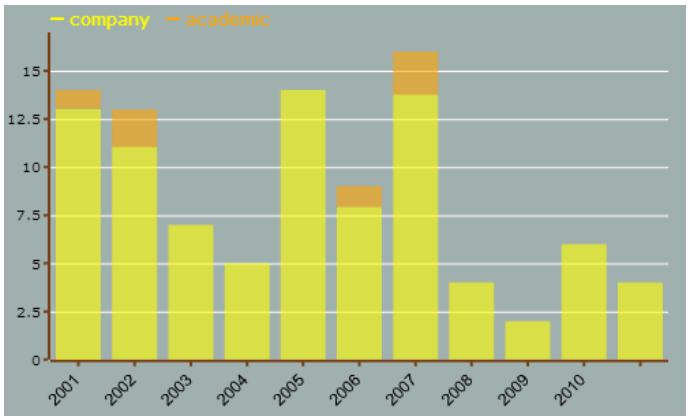
According to the majority of KETs experts' opinions (whose result is depicted in the below bar chart), desk research, and in line with the KETs-related patenting activity in this field, it is considered that the main technological issues holding back the achievement of cross-cutting KETs based products related to this Innovation Field could be solved in a time frame of 2 to 5 years, yet significant consensus by experts indicates also longer periods being necessary:



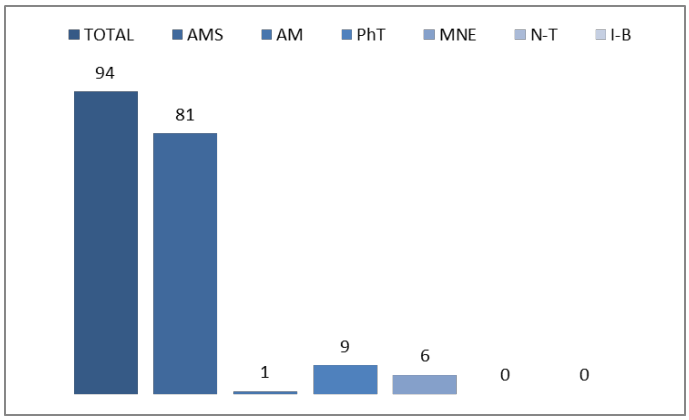
Hence, depending on the specific technical and/or industrial challenges holding back the achievement of cross-cutting KETs based products related to this Innovation Field, the provision of support in the short to medium term should be taken into consideration within this framework.

Additional information according to results of assessment:

- ***Impact assessment:***
  - Nowadays Information and Communication Technology (ICT) energy consumption represents around 2% of global energy consumption, and ICT accounted for 3.9% of total worldwide electricity consumption in 2007, 4.6% in 2012 (source: "Overview of ICT energy consumption" FP7 project). Without significant progress in this innovation field, the energy/carbon footprint of the ICT sector would double on the period.
  - Taking into account the global bit transfer increase, it is however the quickest growing contributor to human energy consumptions. Moreover, current communication networks and technologies have been designed without paying much attention to the energy cost, long considered insignificant. According to the Green Touch ICT stakeholders consortium, there are technical opportunities for huge energy efficiency improvements (in watt per processed bit), up to a factor 1000 for mobile communications, 450 for wireline communications, 60 for core networks. Taking into account the relative weight of mobile, wireline and core networks, traffic evolutions and realistic (yet ambitious) technological achievements, net energy consumption from telecom networks could be reduced by 90% from 2010 to 2020 (source: Green touch Green Meter Research Study 2013).
  - Reducing energy consumption of communication networks is not only a matter of environment footprint, it serves also networks operators energy bill reduction.
  - The Defence sector has traditionally worked on efficient networks and has, in the last years, increased its research in this field towards a safer and faster approach to communication systems. All this know-how and consolidated knowledge is potentially applicable on civilian applications for improved performances and broader autonomous and intelligent communication systems.
- ***Results of patents scenario analysis:***
  - 94 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
  - Decreasing trend curve (number of patents per year)
  - Highest almost exclusive share of industrial applicants:



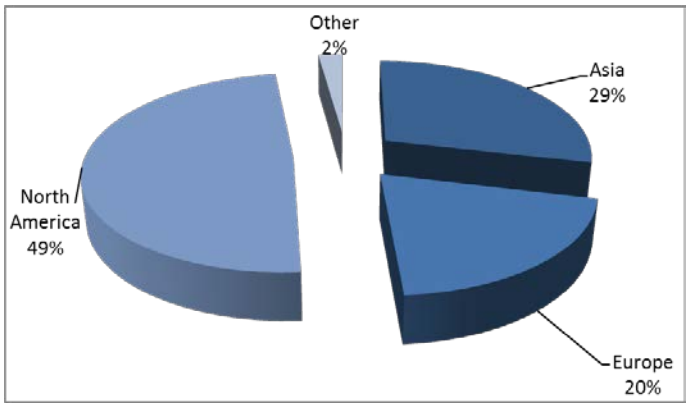
- Patents by KET(s):



- Patents by KET(s) and relevant combinations of KETs:

KET(s)	*Number of patents*
AM	1
AMS	81
AMS / PhT	2
MNE	6
MNE / PhT	1
PhT	9

- Patent distribution by (Applicant) organization geographical zone:
- US industries have a good position in list of top applicants, but innovation is little concentrated in this field and the 17 biggest players have only applied 2 to 5 patent families in the period (8 for 1st applicant, the South Korean LG)



- Patent distribution by geographical zone of priority protection: