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.4.5: Improved mobile phones and connected mobile devices

Scope:

To develop mobile devices that go beyond current devices as smart phones with improved functionalities, convergence with other devices (supported by virtualization and cloud computing), higher connectivity (through universal systems), weight reduction, more autonomy (with increased energy efficiency, better batteries or micro energy harvesting), long campaign life and damage resistance and recycling by design.

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 off-grid power supplies, micro-energy harvesters using environmental or parasitic power sources, or even wireless power
- Increase of energy storage capabilities of handsets (batteries), combined with optimized handset systems' and architecture power consumption (including advanced sleep/active switch and context-dependent system adaptation), and possibly energy harvesting
- Development of cloud computing and virtual devices to reduce the need to spend handset energy on complex computing operations and limiting the need for complete integrated devices, only interface keeping really necessary, the rest being virtual and in the cloud
- Development of novel materials for better design (“look&feel”) with better properties (e.g. more wear resistant, lightweight), possibly functional materials delivering new capabilities
- Design of devices for recycling, including with planning overall life cycle of products and materials
- Improvement of human-machine-cooperation with including “psychology” of humans for parts of consumer electronics and with supporting devices getting "social"
- Development of usable, scalable and built-in security, trust, dependability and privacy for mobile communications, including with high-performing cryptographic methods
- Allow fast and flexible customization (smaller series, personalization, customization of products)
- Development of highly efficient radio frequency front-end modules, including antennas (active, directional, designed with better understanding indoor propagation, etc.)

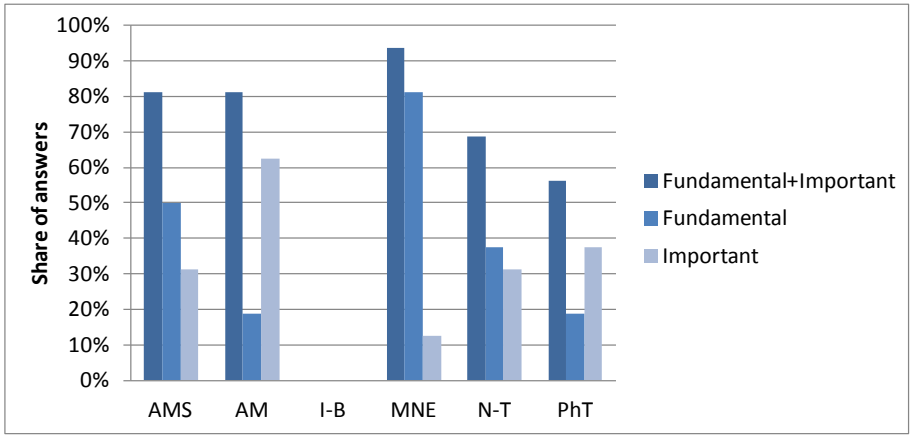
- Development of low power embedded chipsets, modules (including power modules) and/or embedded computation mechanism
- Always chose most efficient connection link (for energy and service), based on multiple network and context-awareness capabilities (positioning, incl. indoor, user authentication and profiling, embedded sensors, etc.) and/or dynamically adapt emission power
- Integration of more and more embedded sensing capabilities (imagers, accelerometry, gyrometry, measurement of pressure, magnetic field, hygrometry, etc.) to allow more situational awareness, whilst minimizing volume, weight, energy consumption and cost
- Adaptation of system interface to user's environment, device or skills, using context data and available data and relying on universal systems (e.g. Universal Serial Bus (USB): data transfer and power supply)
- Development of automated connectivity, supporting terminal roaming and intercell handover with multiple network connection capability, to make ubiquitous network access feasible and invisible to the end user

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development and integration of enhanced off-grid power supplies, micro-energy harvesters using environmental or parasitic power sources, or even wireless power, increased energy storage capabilities, improved human-machine cooperation, enhanced built-in security, trust, dependability and privacy during mobile communications, including thanks to cryptographic methods, highly efficient radio-frequency front-end modules, low power embedded chipsets, sensing capabilities, novel materials for better design and functionalities.

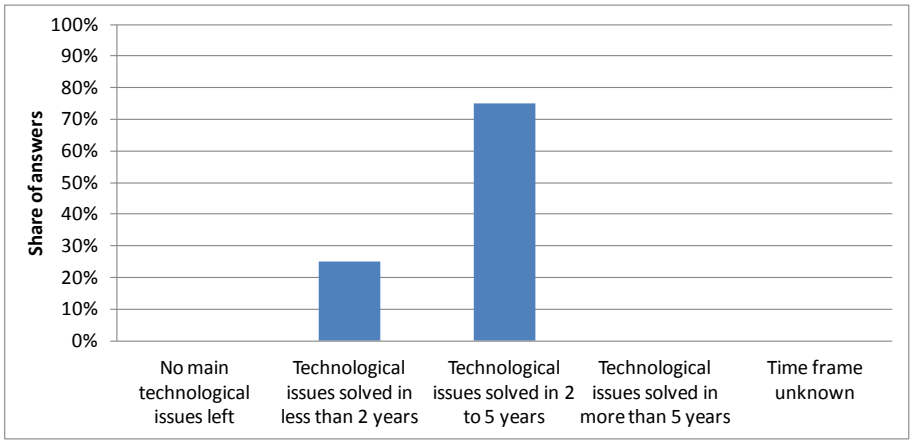
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong 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 Manufacturing Systems (AMS)
- Advanced Materials (AM)
- To a lesser extent Nanotechnologies (N-T) and Photonics (PhT)



Timing for implementation:

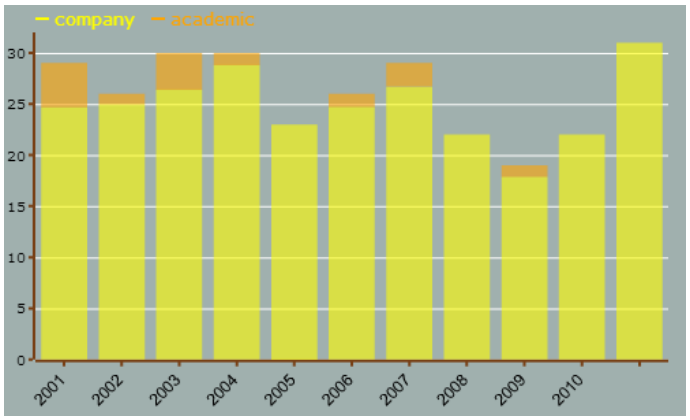
According to the majority of KETs experts' opinions (whose result is depicted in the below bar chart), desk research, and in line with the KETs-related patenting activity in this field, it is considered that the main technological issues holding back the achievement of cross-cutting KETs based products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



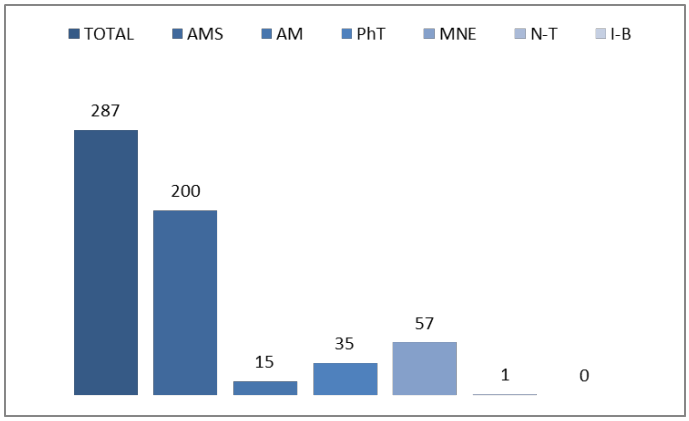
Hence, depending on the specific technical and/or industrial challenges holding back the achievement of cross-cutting KETs based products related to this Innovation Field, the provision of support in the short term should be taken into consideration within this framework.

Additional information according to results of assessment:

- ***Impact assessment:***
  - Mobile communication is a marker of a dynamic, communicative, mobile, innovative society. Future mobile phones will have to enable broadband seamless connectivity everywhere, supporting ubiquitous access to high performance online or "in the cloud" services, offering increased autonomy, all sorts of sensing capability including biometric identification enabling secured banking services, precise geolocation and high usability personal assistance and guidance, whatever the environment and at affordable costs. They will also have to be designed for recyclability and minimal or zero health impact.
  - At the end of 2012, the penetration rate of mobile communication services was 123.3%, versus 91.7% at end 2005. 1.8 billion mobile phones were sold in the world in 2013, including more than 1 billion smart phones, 120 million just in Europe. Since September 2013 and the buyout of Nokia mobile terminals division by the American Microsoft, there is no longer a large European mobile phone integrator. Yet, mobile phones are complex systems and many components and subsystems are still delivered by European manufacturers. The success encountered by companies selling their own mobile phone brands as Wiko, NGM, Mobistel or Jolla, even though not necessarily assembled in Europe, also highlights the real consumer interest for the "made in Europe" in this field.
  - A major issue in the mobile communicating devices industry is the need for critical materials as coltan, indium or various rare earths, often extracted in unstable regions and/or under poor environmental conditions. To prevent and reduce international risks and dependencies, future mobile phones and connected mobile devices will use less of these resources, or from secondary (recycled) source, or rely on substitutes.
- ***Results of patents scenario analysis:***
  - 287 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
  - Quite stable trend curve (number of patents per year), recovering from a slight downturn in 2008-2009
  - Highest share of industrial applicants especially in the most recent part of the period:



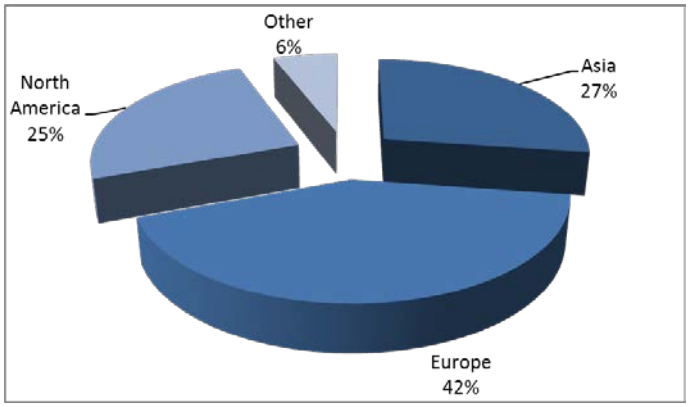
- Patents by KET(s):



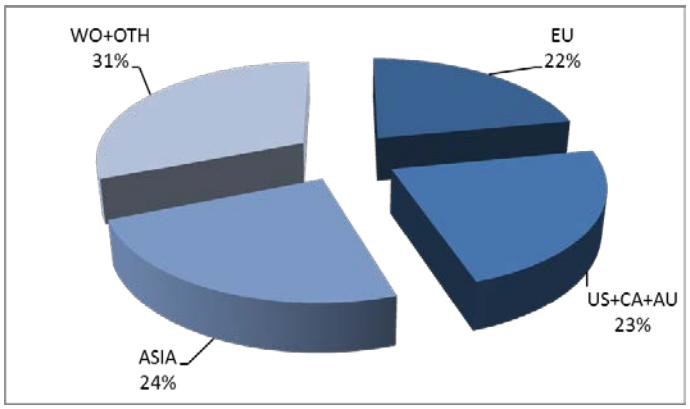
- Patents by KET(s) and relevant combinations of KETs:

KET(s)	*Number of patents*
AM	15
AM / MNE	1
AM / MNE / PhT	1
AM / PhT	3
AMS	200
AMS / AM	1
AMS / MNE	3
AMS / MNE / PhT	2
AMS / PhT	2
IBT	1
MNE	57
MNE / PhT	15
N-T	1
PhT	35

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection:



- Patent application with regard to this field is little concentrated and the 38 top applicants have only applied 111 patent families in the period. Out of these 111 families from top applicants, 42 are from Japanese players, the rest being split between US and European players, plus a few South Korean (6), Chinese (2) or Canadian (2).