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.4.1: High autonomy communicating devices

### Scope:

To develop cost-effective and all-size embedded sensors with high connectivity for the Internet of Things, or for airborne or satellite-based Earth / environment observation, with embedded sensor systems and observation/detection instrument chains or autonomous sensors / devices making use of remote power supply/storage and/or micro energy harvesting.

### 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 embedded sensor systems and instrument chains, including miniaturized high stability and reliability systems with accurate pointing for large and/or active optical observation systems
- Miniaturization of communicating modules and devices embedded systems, possibly including sensors and human interface systems, so as to reduce overall size (down to “smart dust”), weight and power consumption of devices
- Development of smart meters with high connectivity for real time operation control
- Adaptation of remote power supply/storage to specific requirements of application (e.g. very long lifetime without recharging, wireless power, etc.)
- Combination of very low embedded system energy consumption, unlimited cycle zero power leakage energy storage and embedded energy harvesting capability (off-grid power supplies using environmental or parasitic power sources) to enable long and very long device autonomy
- “Smartification” (novel smart functions) of classic devices through automated connectivity
- 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
- Increase of resolution and observation range of satellite-based/airborne Earth observation detectors (including sub-mm optical observation, infra-red (IR) & ulta-violet (UV) spectrometry, radar systems, sub-mm radiometry, X-ray detection, fine interferometry, humidity detector, complementary metal-oxide semiconductor (CMOS) imagers, magnetometers, etc.)

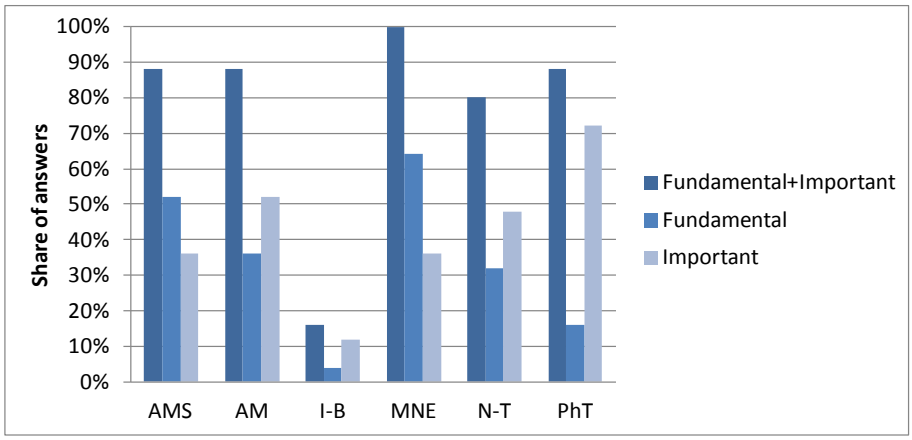
- Minimization of noise on detectors, including with high efficiency zero vibration cryo-coolers, and develop systems to detect and control residual errors
- Increase of performance of embedded computing and enable smartification/data optimization of collected information
- Creation of open networks of embedded systems
- Enable context-dependent scalability of device activity, including dynamic adaptation of emission power to real communication environment, context-based sleep/active cycles and automated low power cost connectivity
- Development of stable, reliable and high power lidar instruments for environment observation, including wind measurements or pollution monitoring

### Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of cost-effective and all-size embedded sensors with high connectivity, including autonomous sensors/devices making use of remote power supply/storage and/or micro-energy harvesting, building on miniaturization of communicating modules and devices embedded systems. The integration of KETs could moreover contribute to minimizing noise on detectors.

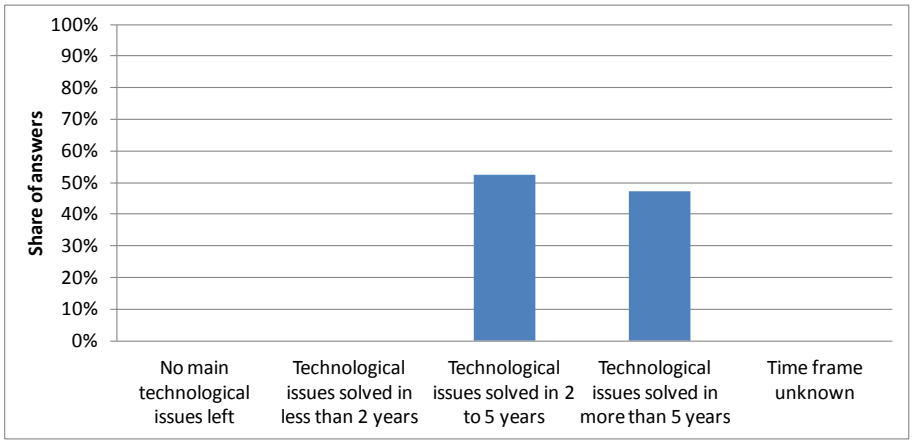
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong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




### Timing for implementation:

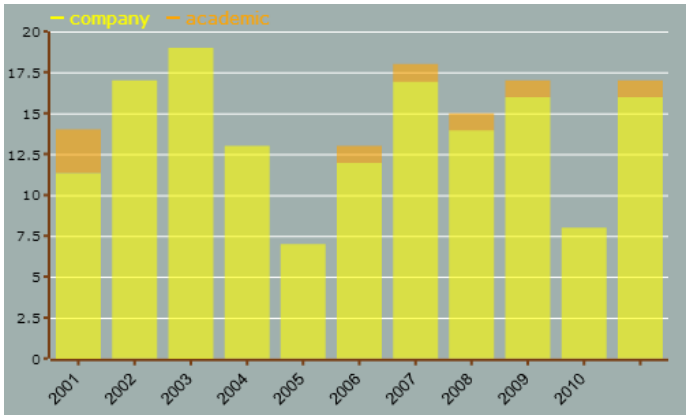
According to the majority of KETs experts' opinions (whose result is depicted in the below bar chart), desk research, and in line with the KETs-related patenting activity in this field, it is considered that the main technological issues holding back the achievement of cross-cutting KETs based products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



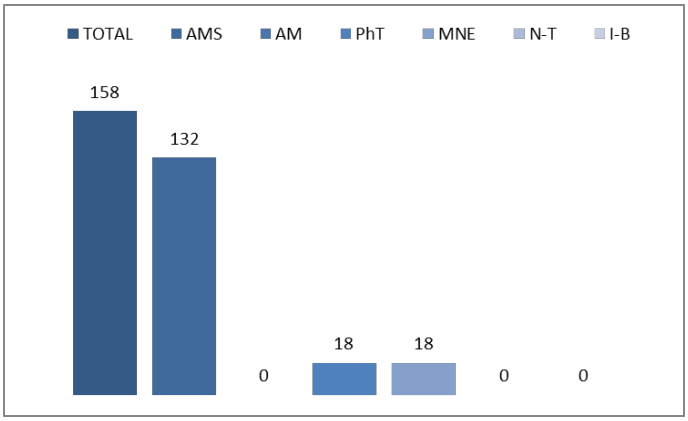

Hence, depending on the specific technical and/or industrial challenges holding back the achievement of cross-cutting KETs based products related to this Innovation Field, the provision of support in the short to medium term should be taken into consideration within this framework.

### Additional information according to results of assessment:

- ***Impact assessment:***
  - Communicating devices, in particular but not limited to sensors, are direct contributors to the "Smartification" of our everyday environment. Converged with the capability for autonomous operation – energy storage and management, minimal consumption, energy harvesting or simply passive communicability – they are enablers to the "Internet of Things", advanced production and supply chains, "Smart Cities" and all forms of wide spread information enrichment of our environment. They contribute to efficient management of distributed resources, cargo or baggage management, area surveillance for unauthorized intrusion detection and identification or environment protection, infrastructure, buildings or vehicles health monitoring, tourist information, etc.
  - A specific case of these autonomous communicating devices, based on passive and near-field radio-frequency identification (RFID) and data exchange, is the RFID set of technologies, including tags, readers and software/services for RFID cards, labels, fobs and all other form factors. In 2014, the total global radio-frequency identification (RFID) market was worth 7 billion Euro, up from 6 billion Euro in 2013 and 5.4 billion Euro in 2012, forecast to rise to 23.2 billion Euro in 2024 (source: IDTechEx 2014). With the help of active communicability, other solutions in this field are expected to open even bigger market opportunities.
  - Sensing or monitoring system which may include a vehicle or vehicles (submarine, water surface, land, air, space) which is operated autonomously (or capable of being operated autonomously) has been developed for defence sector. Thus the contribution of this technology to civilian applications can be really significant in the near future.
- ***Results of patents scenario analysis:***
  - 158 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
  - Quite stable trend curve (number of patents per year)
  - Highest almost exclusive share of industrial applicants:



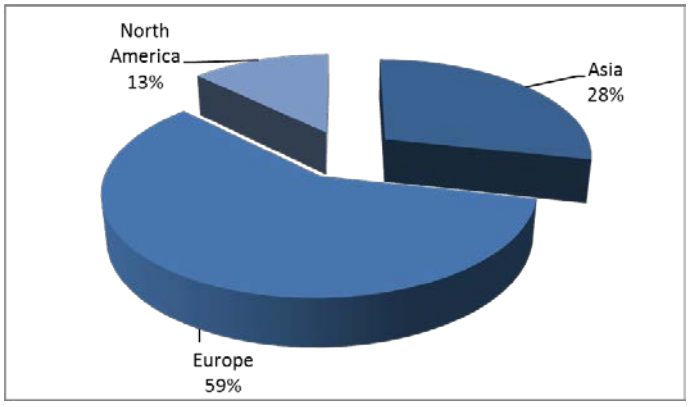
- Patents by KET(s):




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

| *KET(s)* | *Number of patents* |
|---|---|
| AMS | 132 |
| AMS / MNE | 1 |
| AMS / PhT | 1 |
| MNE | 18 |
| MNE / PhT | 8 |
| PhT | 18 |

- Patent distribution by (Applicant) organization geographical zone:
- Strong position of the European applicants on this field, 14 out of the 19 top applicants are European (9 German) and Siemens alone applied 18 patent families in the period (11% of the global total)




- Patent distribution by geographical zone of priority protection: