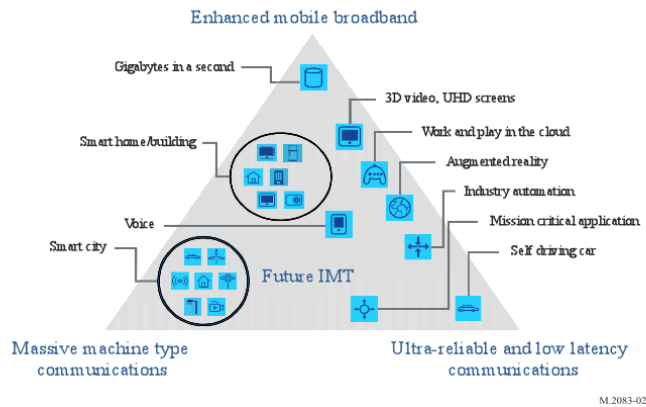


ECC Newsletter December 2016 - Special Edition on 5G

The way forward for 5G in Europe

5G, the next generation of broadband mobile communication technologies, is almost here. After 2020, 5G will be omnipresent in the lives of people around the world.

5G is "not more of the same". 5G aims to provide seamless coverage, high data rates, low latency, low power and highly reliable communications. Use cases under consideration include enhanced mobile broadband communications but also massive machine type communications (M2M), Internet of Things (IoT), home and industrial automation and applications expected to respond to requirements from vertical sectors (e.g. utilities, automotive, railways, public protection...). It is thus seen as a driving factor in innovative areas such as the creation of smart cities, augmented reality, mission critical applications, self-driving cars and industry automation.



Usage scenarios of 5G – IMT-2020 (source: Recommendation ITU-R M.2083)

Before 5G enters everyday lexicon, however, it remains the focus of the world's spectrum managers as they try to establish the best methods for its deployment and its security.

In 2014, the Electronic Communications Committee (ECC) identified 5G as a major challenge in its [five-year strategic plan](#) for the period 2015-2020.

The International Telecommunication Union (ITU) has said 5G is a priority for the standardisation of IMT-2020, the International Mobile Telecommunications system from 2020 onwards. Understandably, 5G will be one of the major [topics of discussion](#) at the 2019 World Radiocommunication Conference (WRC-19), which is approaching fast.

Within the European Union framework, various initiatives have also recently emerged. The Radio Spectrum Policy Group (RSPG) has adopted on 9 November 2016 an [Opinion on 5G](#), which will be complemented by another Opinion soon. The European Commission has published a Communication setting out a 5G action plan.

With all of this in mind, and considering that 5G is coming indeed sooner than expected, the ECC organised a CEPT workshop on 5G Mobile Communications, which took place from 2-4 November at the Federal Network Agency (BNetzA) in Mainz in Germany. The aim of the workshop was to establish CEPT's priorities for 5G, taking into account views from almost 150 attendees - including representatives from CEPT administrations and stakeholders from international organisations, standardisation groups, mobile industry and vertical industries. We collected and summarised [here](#) some of the views expressed during the workshop regarding the requirements from the industry and the developments outside Europe.

Based on the outcome from the workshop, the ECC plenary in Prague, 15-18 November, approved a comprehensive list of actions entitled the "CEPT roadmap for 5G". The roadmap outlines the main targets to be addressed by CEPT: regarding harmonisation of spectrum for 5G; preparation for WRC-19 agenda item 1.13 regarding IMT above 24 GHz; consideration of vertical industry needs, and other spectrum challenges. We tell you more about the CEPT roadmap for 5G [here](#).

Exciting times lie ahead, and the CEPT roadmap will guide the way for 5G to become a reality in Europe.

Per Christensen, Director, European Communications Office (ECO)

CEPT Roadmap - Guiding the way for 5G in Europe

The 43rd ECC Plenary meeting in Prague, 15-18 November 2016, approved a comprehensive list of actions regarding the fifth generation of mobile technology (5G) named "[CEPT roadmap for 5G](#)".

It outlines the CEPT's actions and plans for 5G, grouped in four main categories, taking into account the views from all stakeholders expressed during the CEPT Workshop on 5G from 2-4 November 2016 in Mainz (see more [here](#)).

1. Identifying harmonised spectrum in Europe for 5G

From all the views expressed across the last months, in the press or during 5G-related events, such as our CEPT workshop, it became clear that harmonisation and timely availability of spectrum are the cornerstones for the success of 5G.

In this respect, ECC agreed to initiate activities towards the development of harmonisation measures on two specific frequency bands:

- 3.4 – 3.8 GHz band: This band is already harmonised within Europe for Mobile/Fixed Communication Networks (MFCN) through ECC Decision(11)06 and provides 400 MHz of contiguous spectrum. Activities are ongoing within the ECC Project Team 1 (ECC PT1) to assess the suitability to 5G of the harmonised technical conditions contained in ECC Decision(11)06. The main target is to set up the appropriate framework to make the 3.4-3.8 GHz the primary band for early 5G developments in Europe. With the view to further promote the harmonisation of the band, and also taking into account the existing licences (for MFCN or for other use) in many CEPT countries, ECC also intends to develop guidelines to help administrations in solutions for defragmenting the 3.4-3.8 GHz band and for developing plans and intended timescale for the future utilisation of this band.
- 24.25-27.5 GHz: Due to the fact that 5G envisages very high data rates, much larger bandwidths than ever before will be required (up to several GHz), which can only be found in higher frequency bands above 24 GHz. To respond to this demand, ECC has identified the band 24.25-27.5 GHz (called the 26 GHz band) for early European harmonisation, as it provides over 3 GHz of contiguous spectrum and more favourable propagation than the higher frequency bands under consideration.

As a result, ECC PT1 has recently been tasked to start developing a harmonisation decision setting the conditions for the introduction of 5G in the 26 GHz band. Compatibility with all existing services in the same and adjacent frequency bands should be addressed. Specific attention should be brought to the protection of existing and future earth stations of the Earth Exploration Satellite Service (EESS) and Space Research Service (SRS) in the band 25.5-27 GHz.

2. Preparing for worldwide harmonisation of spectrum above 24 GHz for 5G – WRC-19

The 2019 World Radiocommunication Conference (WRC-19) will take place over four weeks, from 28 October to 22 November 2019, in Geneva. The Conference will address a number of questions within the Radiocommunication sector, and consideration of spectrum for 5G above 24 GHz is expected to feature heavily through the resolution of WRC-19 agenda item 1.13

Consequently, as part of the CEPT Roadmap for 5G, it was important to include steps ahead of WRC-19, when it comes to spectrum above 24 GHz for 5G.

As a consequence of the initiative described in the previous section towards the harmonisation in Europe of the 26 GHz band prior to WRC-19, ECC identified the need to promote it and to use the WRC-19 process to widen its scope to reach worldwide harmonisation.

On the basis of a preliminary assessment carried out at the European level on the set of bands above 24 GHz to be considered at WRC-19, ECC identified, in addition to the 26 GHz band, some potential in the bands 31.8-33.4 GHz (32 GHz band) and 40.5-43.5 GHz bands (42 GHz) for future 5G deployment. Therefore, ECC agrees that CEPT should clearly signal its priorities for the 26, 32 and 42 GHz bands to be studied for WRC-19.

Although not on the list of bands for consideration at WRC-19 for 5G, the band 27.5-29.5 GHz (referred to as the 28 GHz band) has recently been the subject of special attention in the context of 5G due to initiatives outside Europe. In the recent years, ECC has put in place a consolidated regulatory framework to promote broadband satellite communications in this frequency range, in particular to reach mobile platforms (see our [article](#) from the October 2016 edition). On the basis of a CEPT proposal, WRC-19 will consider the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion (ESIM) communicating with geostationary space stations in the fixed-satellite service. ECC is therefore supportive of the worldwide harmonisation of the 28 GHz band for broadband satellite communications and for ESIM and does not see any availability for 5G.

On a more general level, and taking into account the experience gained from the previous World Radiocommunication Conferences, ECC identified the need for close cooperation with the other regional organisations on the way to WRC-19. With the view to facilitate consensus at the conference, continuous dialogue between regional groups is therefore crucial.

The success of the WRC-19 activities on spectrum for 5G above 24 GHz will also rely on the involvement from the industry with the ITU-R work and also through the ECC process. In this regard, ECC PT1 is very active, with the participation of the mobile industry, in contributing to ITU-R on the global spectrum needs for 5G and also on the definition of technical characteristics for 5G. This last point is critical since the availability of relevant characteristics is the prerequisite for the development of the necessary sharing and compatibility studies in time for WRC-19.

3. Addressing the requirements from the vertical industries

From a spectrum management point of view, one of the main innovations brought by 5G is its capacity to handle not only broadband mobile communications as the previous generations do, but also to cover the needs from a range of sectors, the so-called 'verticals'.

When it is deployed, 5G technology is expected to become ubiquitous in a number of industries throughout the world, from utilities to railway networks to automotive industries and automation. It is also envisaged for public protection and disaster relief (PPDR) and to support applications in the audio-visual sector. However, it remains unclear to which point the communications will be accommodated through 5G mobile networks, through dedicated network or spectrum, or through hybrid solutions. Today, some bands are designated for PPDR, railway networks, automotive or audio-visual sectors. The future models which will be implemented in a 5G world are still subject to passionate debate.

Due to the broad range of resulting spectrum requirements from each of these sectors, it is quite a challenge, both from technological and regulatory points of view, to determine how to respond to those needs within the overall 5G framework.

Having that in mind, ECC discussed its possible role in this area and agreed to outline a set of topics to consider in relation to verticals.

One of the essential actions to be carried out is the definition of common use cases for requirements of verticals, which would need spectrum harmonisation measures. ECC identified the need to monitor relevant activities within relevant industry groups. In this context, ECC welcomes the emerging initiatives where various industry sectors

(e.g. telecoms and automotive) work together to specify use cases and also to assess how verticals' requirements could be addressed in 5G standardisation. ECC also expects to receive, through its close and effective working relationship with ETSI, a range of valuable information and, if appropriate, requests to help in fulfilling the needs of the vertical industries.

Although seen from a different angle in the 5G context, the need for vertical industries to have access to spectrum is obviously not new. ECC has been developing a comprehensive set of spectrum regulations applicable to the various sectors. These regulations will have to be reviewed to assess whether they are "5G compatible". Such considerations are for example expected in the current activities within the ECC Working Group Frequency Management ([WG FM](#)) on the review of the regulations for private/ professional land mobile radio systems ('PMR/PAMR') in the 400 MHz range and on the streamlining of the framework applicable to the 57-66 GHz band.



Eric Fournier, ECC Chairman, leading the session gathering the main elements towards the CEPT roadmap during the CEPT workshop on 5G

On top of these general considerations, and having heard the views from industry during the CEPT workshop on 5G, ECC also identified the need to specifically address the following three items related to vertical industries:

- Platform sharing: ECC agreed to investigate, where appropriate, the possibility for verticals to share common platforms. This would for example cover the scenarios where different verticals share a common private network or where verticals are hosted by mobile operator networks or any hybrid model.
- Spectrum redundancy: For critical applications, such as for automated driving, where high quality of service and low latency are required, the idea of spectrum redundancy has recently emerged. This would consist of the identification of two different frequency bands with different propagation characteristics for one single application in order to ensure, through correlation, a better reception. Such a need

would obviously have an impact on spectrum management with the consequential increase in spectrum needs and requires further justification.

- Licence exempt regime for critical applications: The frequency bands targeted by some industries are generally licence exempt bands not subject to individual authorisations. Considering the growing needs for the verticals in terms of reliability, for example, the impact of the use of a licence exempt regime for critical vertical applications should be assessed.

4. Investigating other challenges related to spectrum

The workshop on 5G mobile communications gave its attendees much food for thought, and while various themes emerged around the challenges 5G will bring, not everything fell into one of the previous categories. However, some challenges were identified by ECC as deserving special attention as part of the CEPT roadmap.

Spectrum sharing will be an important element to facilitate the requirements of 5G and the development of new technological solutions in higher frequency ranges, such as the more extensive use of MIMO (multiple-input and multiple-output) technique, may provide more opportunities for sharing but also challenges for regulators.

When it comes to higher frequency bands (above 24 GHz), it is anticipated that discussions will arise around the most suitable authorisation regime for 5G. Specifically, the possibility to consider the use of some of these bands for 5G under a general authorisation regime should be investigated as opposed to the individual authorisation which prevails in the currently harmonised bands for MFCN.

With the expected increase in capacity and applications for 5G, the requirements for sufficient backhaul solutions need to be properly handled. In this respect, it is envisaged that the deployment of infrastructure networks in frequency bands such as the 92-105 GHz and 130-175 GHz may provide additional support for 5G communications. Therefore, activities are planned for the development of channel arrangements and associated guidelines for the deployment of fixed networks in these bands.

In addition, as already pointed out in the previous section on verticals, ECC recently initiated a review of the regulations for the 57-66 GHz band. This process should also contribute to provide less restrictive conditions for the potential backhauling solutions for small cells in this band.

Last but not least, although most of the considerations on 5G are given to terrestrial options, there are also some investigations on the possible role that satellite communications can play for the 5G developments. This will be further considered by ECC.



With this CEPT Roadmap, ECC is looking forward to actively guiding the way for 5G to become a reality in Europe. It will be reviewed at each ECC Plenary meeting (three times a year) with an assessment of the related activities.

Eric Fournier, Chairman ECC

Bruno Espinosa, Deputy Director ECO

CEPT workshop on 5G - Useful food for thought

The CEPT Workshop on 5G was organised by the Electronic Communications Committee and took place over three days from 2-4 November 2016 at BNetzA, Mainz, Germany. It gathered approximately 150 participants, including delegates from CEPT members, from mobile industry, from vertical industries and from administrations outside Europe. It was organised in [seven work sessions](#) surrounded by the opening keynotes and a final panel session.

While the primary goal of the workshop was to contribute to the development of the CEPT roadmap for 5G as outlined in our [previous article](#), it also offered the opportunity to gather in one single event a range of valuable information and views on the "healthy hype" around 5G.

This article focuses on industry views and information from outside Europe.

1. Listening to industry requirements

The introduction of 5G is set to revolutionise key industries throughout the world, from critical services to mobile communications and smart transport. 5G will bring multimedia into our everyday lives. It will improve augmented reality and automate industrial processes.

It was essential that the CEPT Workshop on 5G heard from industry. The second day of the workshop was mostly dedicated to hearing from a selection of providers, manufacturers and operators, who gave a fascinating insight into their requirements for 5G and how it will assist them in expanding their services. "5G is building on previous mobile communication generations but it will help in evolution of certain industries," said Michele Zarri, a representative of the mobile operators (GSMA).

Technology requirements and standardisation - status and challenges:

The first 5G specification in 3GPP Release 15 is planned to be available by September 2018, and will address the more pressing commercial needs. The second release, 3GPP Release 16, planned for March 2020, will address all-use cases and requirements.

There is already some progress, with new radio access technology targeted for completion by June 2017.

It's not just industry that is making progress. Dr Werner Mohr of Nokia and the 5G Infrastructure Public Private Partnership (5GPP) said the deadline of 2020 has "created huge momentum globally in research and standards bodies" and encouraged "consensus building". "In our consortia, we have involved vendors, network operators, the research community, small and medium sized enterprises. These projects are not only involving European partners. We have partners also from North America, China, Japan and North Korea. That means these regions which have the biggest impacts in standards and regulatory bodies are also involved in these projects."

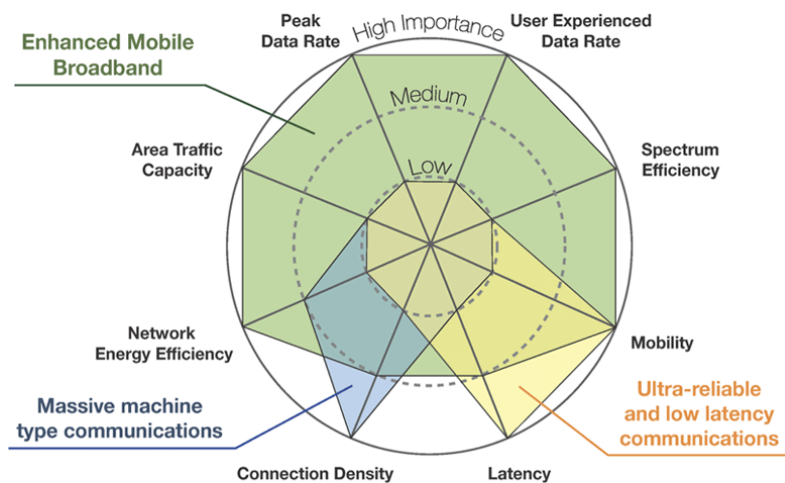
There are a number of technological challenges for both devices and infrastructure to achieve the performance aims of 5G. In 5G, the network will need to adapt to the application, so flexibility and configuration is key.

Luigi Arditio of Qualcomm said there were many challenges for devices but that chipsets are already being produced for millimetre Wave (mmWave) frequency bands. This, he said, is good news for industry. However, Mr Arditio emphasised that 5G is not just mmWave; lower frequencies are also needed.

Debora Gentina from Huawei discussed the backhaul challenges and evolution trends, and the role of mmWave. Shorter networks and shorter hops are becoming more prevalent with 90% of link distances less than 10 km. Options include increasing channel width, carrier aggregation or going to mmWave bands. A major overhaul of infrastructure for 5G will be needed, including fixed links backhaul over longer distances.

Regulatory requirements

5G covers a range of potential usage scenarios, which have different operational and technological requirements, as shown below.



The importance of key capabilities in different usage scenarios. (Source: Recommendation ITU-R M.2083)

These operational and technological requirements will lead to different regulatory needs. For example, some vertical industries would like to possess their own spectrum due to the fact that their businesses involve mission critical aspects.

For the most part, industry would prefer harmonisation of tuning ranges as it allows businesses to operate across markets, overcoming regional differences.

Ludwig Winkel of Siemens and ZVEI, the German electric and electronic manufacturers' association, said unified world-wide access to spectrum is the practical solution for industry, as manufacturers and vendors tap into worldwide markets. "It is absolutely necessary to have a regulations as well as spectrum that are worldwide available," he said.

Ulrich Rehfuess of Nokia and Digital Europe, the body that represents the digital technology industry in Europe, said harmonisation "really is key for the supply industry to be able to provide on large ecosystems efficiently across products". He believes that regulators should keep the global picture in mind.

Quan Yu from Huawei and GSA said: "Most stakeholders agree we need a global standard. It is very important to maximise economies of scale." Therefore a sub-30 GHz tuning range should be the most proficient for manufacturers as it could encompass Europe's preferred 26 GHz band while having a possibility of using equipment developed for the 28 GHz band which is not available in Europe but is used in the USA and some Asian countries. Similarly, a 40 GHz tuning range could encompass the USA 38 GHz band and the 42 GHz band.

Alexander Geurtz from SES, one of the world's largest commercial satellite operators, said that satellite could go some way to strengthen the overall 5G value proposition, and satellite capabilities can be incorporated seamlessly into 5G. Major advantages of satellite technologies are coverage of any area in the world and rapid deployment where needed.

Requirements emerging from vertical industry needs

During the workshop, views on 5G requirements were presented by representatives from various vertical industries, including automotive, railways, media and broadcast, utilities, home automation, industrial automation and public safety.

A recurring theme was that the majority of vertical industries would like 5G to be available as soon as possible in order to cover their growing spectrum needs, based on ongoing technology developments in order to improve their services. There are commercial pressures to be the first past the post. Several speakers recognised the importance of collaborating with other sectors and standardisation bodies. While different industries might focus on different requirements, some common views emerged:

- **Timescale:** Some verticals cannot wait long for 5G deployment, and see the ultimate four-year timescale to 2020 as too long. If other technologies emerge or progress enough to meet the requirements from the verticals before 5G is available, they could end up substituting 5G.
- **High throughput:** All industries have various levels of technical requirements, therefore 5G needs to support different traffic profiles. In some industries, such as the media sector, high throughput is needed, up to 7 gigabits per second for uncompressed 4K video.
- **Reliability:** A theme to emerge from various presentations was the requirement for high reliability. When it comes to public safety in emergency situations, for example, reliability as high as 99.999% or even 100% must be achieved. Reliability is also a must in the railway industry, which is responsible for the safety of millions of passengers each day. For the cab radio of a train, 100% reliability is desired over 20,000 hours. It must be available 24//7 and have a 15-year life cycle. Any system must have maintainability, offering a modular design, easy handling and remote access. This requirement for near 100% reliability is the reason that many trains are still using 2G. On this basis it is questionable if 5G needs to be implemented in the rail sector, according to Dirk Schattschneider from the German rail operator Deutsche Bahn. Nevertheless, 5G applications could bring some benefits for rail – such as automatic train operation and better access to passenger broadband, even while moving at high speed. Robert Heiliger from E.ON, the home energy provider,

outlined that, in the utility industry, reliability is important as it must be blackout resistant.

- **Coverage:** Wide area coverage is important for many industries. For example, public protection and disaster relief (PPDR) is rolled out in emergency situations and is typically organised in groups, so one-to-many and many-to-many communications are vital. Coverage for voice services is paramount, but data is also becoming increasingly important. As PPDR deals with life-threatening situations, coverage should aim to be provided to 100% of the population.
- **Low latency:** In some areas, such as the automotive industry and home sector, very low latency is needed. This can go as low as less than 10 ms for cars or less than 5 ms for media and public safety.
- **Long life-cycle:** As 5G becomes embedded in various industries, a challenge for manufacturers is creating products that have a long life-cycle – up to 20 years in some cases. This is particularly important in automation industries, for railway providers and those in the automotive sector. Sustainability is an important factor as well.
- **Spectrum redundancy:** According to Niels Peter Skov Andersen of the CAR 2 CAR Communication Consortium, spectrum redundancy is needed in the automotive sector for short-range communications. The current available bands of 5.9 GHz and 63 GHz are too far apart which presents difficulties due to the Doppler effect.



The CEPT workshop on 5G gathered approximately 150 participants

2.Looking beyond borders:

Another interesting element of the workshop was the session that heard different perspectives from beyond Europe. A number of international speakers shared their experiences with 5G. They included those from: the Inter-American Telecommunications Commission (CITEL); the Asia Pacific Telecommunity (APT); the Regional Commonwealth in the Field of Communications (RCC); the African Telecommunications Union (ATU) and the Arab Spectrum Management Group (ASMG).

The preparations for WRC-19 are in the early stages in the different regional groups, and most do not have preliminary positions agreed yet. CITEL stressed the importance of working together and developing propositions which will lead to international solutions that make sense to everyone.

5G developments are also ongoing in individual countries. Trials of 5G technology are expected to begin worldwide in 2017, though China has already started to carry out trials and sees large opportunities for outdoor deployment in the 24 to 40 GHz range. Initially, many trials will focus on spectrum below 6 GHz. Japan will examine spectrum both below 6 GHz and above 24 GHz. While 2020 is the headline year for 5G deployment, pre-5G deployment will take place over the next four years. By the end of next year the stage will be set "with a vision of spectrum and technology agreed".

Large sporting events like the 2018 Winter Olympics in Pyeongchang, South Korea, the 2019 Rugby World Cup in Japan and the 2020 Summer Olympics in Tokyo provide the perfect opportunities to showcase the power of 5G. In a fast-moving, impatient industry, many tech businesses don't want to hold out until 2020.

Presentations, photos, and a summary from the workshop are available on the .

ETSI outlined the support and tools available in the ETSI Centre for Testing & Interoperability. In fact, work in this area for BB-PPDR protocol conformance and interoperability specifications is already on-going, and it will also include 'plug-testing' in the future. This news was welcomed at the workshop, and several countries indicated that they see the need for standardised solutions supported by multiple vendors.

It didn't end there. Other issues of interest included a discussion around the feasibility of linking the BB-PPDR network to government IT networks and BB-PPDR terminals roaming on commercial mobile networks.

Status reports and national case studies from various countries (France, Nordic countries, United Kingdom) were also presented. Roadmaps and the main expected challenges were reported to give a good overview of what can be expected for national implementation of BB-PPDR networks:

- In France, a national framework is in place for the roll-out of BB-PPDR in the 700 MHz range (2x3 MHz and 2x5 MHz). In addition, France confirmed its interest in 450-470 MHz;
- In the United Kingdom, BB-PPDR services will be provided by a commercial operator;
- For all countries, migration concepts are needed for moving towards BB-PPDR. For early BB-PPDR adopters, this may even include using 'pre-standards' before some publicly available specifications become available;
- Some countries will not auction parts of the 700 MHz spectrum for public mobile networks but use the spectrum for BB-PPDR. At the same time, some countries consider using commercial 'hardened' networks for BB-PPDR services;
- There are some considerations to find synergies with other networks with 'mission critical communications', e.g. in the energy and transport sectors.

The workshop also provided a platform for industry and stakeholder associations to provide their perspective. This allowed some reflection on the CEPT spectrum harmonisation approach and standardisation activities. It also identified challenges which are still to be solved:

Stella Lyubchenko and Peter Faris, spectrum experts ECO
