

ECC Newsletter September 2017

The road to 5G deployment

5G is the next generation of broadband mobile communication technologies, and is planned to be deployed around the world by 2020. It will provide increased mobile data speeds for users and new opportunities for vertical industries. Examples of 5G usage scenarios are shown in the following figure.

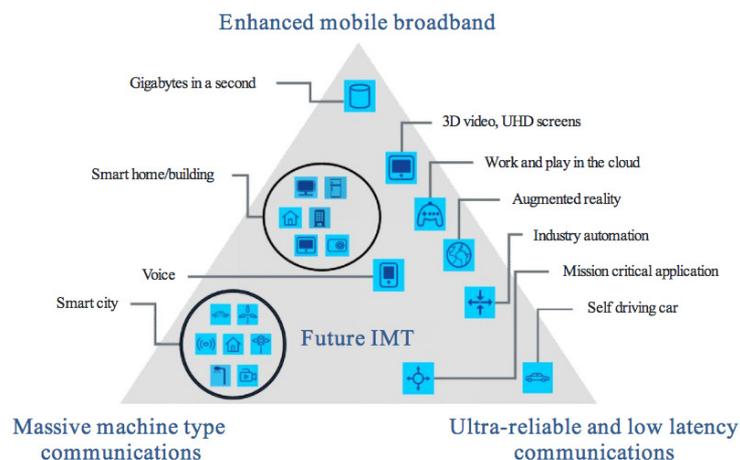


Figure 1: 5G Usage Scenarios (Source: [ITU-R Recommendation M.2083](#))

In a special [5G edition](#) of the ECC newsletter in December 2016, we reported on the recent [CEPT 5G workshop](#), and introduced the [CEPT 5G roadmap](#). Since then, ECC and in particular its Project Team [PT1](#) have been working to achieve the aims of the roadmap, focussing mainly on the 3.4-3.8 GHz band (referred to as 3.6 GHz or “C Band”) and 24.25-27.5 GHz (referred to as 26 GHz).

In this context, ECC agreed to task PT1 to develop guidelines to help administrations on de-fragmentation of the 3.4-3.8 GHz band. This activity also includes a continuous monitoring of the situation within the band with respect to national developments within administrations.

24.25-27.5 GHz: Global and European harmonisation

The 26 GHz band is one of the bands being considered for global 5G deployments under Agenda Item 1.13 of the upcoming 2019 World Radiocommunication Conference (WRC-19). This agenda item considers a range of bands above 24 GHz for possible allocation to the mobile service and/or identification for IMT (International Mobile Telecommunications).

CEPT identified 26 GHz as a pioneer band for early European harmonisation, as it provides over 3 GHz of contiguous spectrum and has the greatest potential to be a globally harmonised band.

Coexistence with various existing services in the same and adjacent frequency bands is under study in PT1 as part of the preparation for the WRC-19. Coexistence with existing and future Earth exploration-satellite service (EESS) and space research service (SRS) earth stations in 25.5-27 GHz is a current area of focus. This comes after the CEPT 5G roadmap highlighted the need for protection of these stations. Studies with Inter-Satellite Service in 25.25-27.5 GHz and with adjacent bands passive usage of radio astronomy and EESS in 23.6-24 GHz are also ongoing. Further studies will be needed to address in-band usage of Fixed Satellite Service (Earth to space) and Fixed Service, and adjacent band usage of amateur, including amateur satellites.

The results of these studies will inform the CEPT position for WRC-19 to support this band for global harmonisation.

In parallel, as the CEPT intends to harmonise the 26 GHz band in Europe for 5G before WRC-19, work has been initiated on the development of an ECC decision to develop harmonised technical conditions for the use of 5G in this band in Europe.

5G characteristics and standardisation

An important element of the studies performed within ECC is to clarify 5G parameters and deployment assumptions. ECC PT1 is therefore working closely with 3GPP and ITU-R to ensure accurate and consistent studies for the various bands under consideration.

In addition to the parameters for use in studies, ITU-R has recently finalised work on technical performance requirements and criteria for evaluation of candidate technologies for 5G (referred to as “IMT-2020” in ITU-R). The evaluation process will start in October 2017 at a [workshop](#) where industry will be invited to present proposed radio interface technologies. The final specifications are planned to be completed in 2020.

Detailed Timeline & Process for IMT-2020 in ITU-R

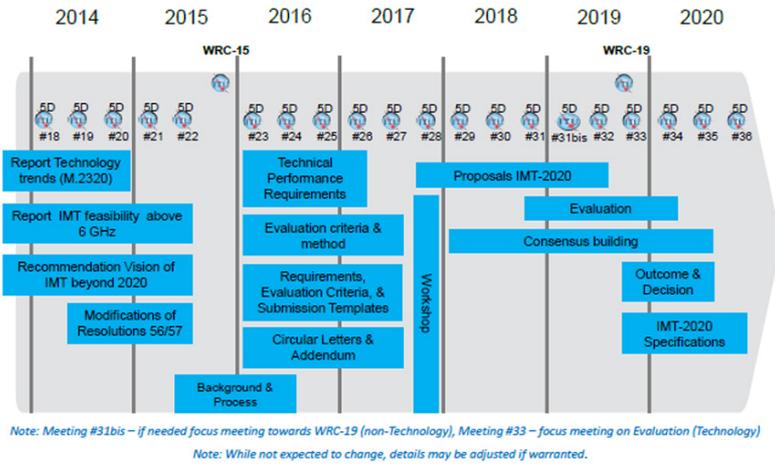


Figure 3: ITU-R timeline for IMT-2020 (5G) specifications (source [ITU-R](#))

3GPP has been working to standardise the 5G-NR (New Radio) specification. In March 2017, 3GPP decided to accelerate the timescale in order to finalise the “non-standalone” mode by March 2018. This mode will operate in parallel with 4G LTE (referred to as an “LTE anchor”) to provide boosted data-rates. The “standalone” 5G mode is planned for completion in September 2018.

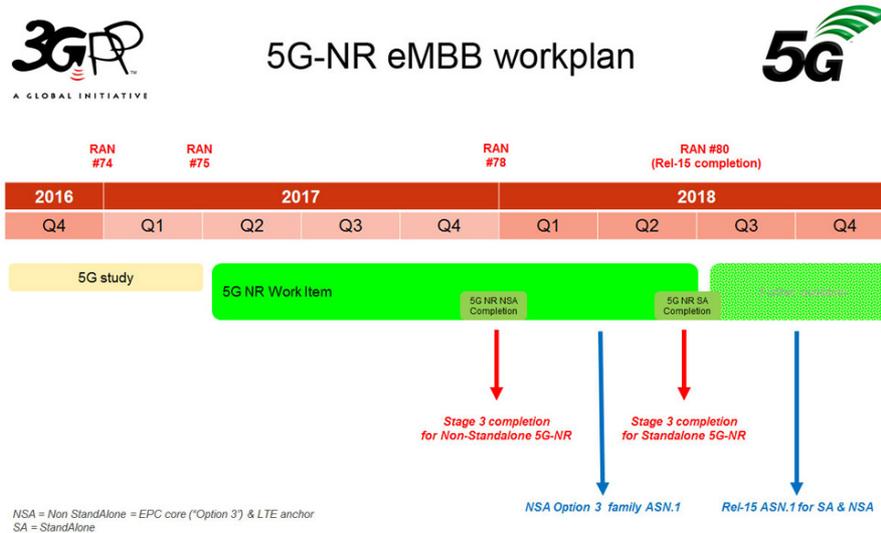


Figure 4: 3GPP 5G New Radio workplan (source [3GPP](#))

This accelerated timescale will facilitate 5G network trials in early 2018, which will in turn allow rapid commercialisation of 5G devices in 2019.

Next steps

The studies mentioned above on the 3.6 GHz and 26 GHz bands are planned to be completed by ECC PT1 in April 2018 in order to meet the deadlines set by the EC Mandate. In the case of the 26 GHz band, this will also provide a common European framework to feed into discussions to support global harmonisation at the WRC in 2019. Ultimately this will facilitate deployment of 5G networks within CEPT by 2020.

In addition, ECC PT1 will carry on its activities to study and develop positions on the other frequency bands under WRC-19 Agenda item 1.13.

The 31.8-33.4 GHz (referred to as 32 GHz) and 40.5-43.5 GHz (referred to as 40 GHz) bands were also identified as priority bands for study in the CEPT 5G roadmap. Initial studies on sharing with radar are ongoing for the 32 GHz band, and PT1 has recently started its activities for the 40 GHz band. There has also been recent interest expressed in the 66-71 GHz band within CEPT. Relevant studies are expected to start soon.

The CEPT 5G roadmap additionally identified the possibility for satellite to play a role in providing 5G connectivity, in particular to provide wide area coverage in rural areas. Within ECC, Project Team [FM44](#) is currently developing an ECC Report to identify satellite 5G use cases and solutions, aimed to be published in May 2018.

Additional information

[ECC Newsletter December 2016 - special 5G edition](#)

[CEPT 5G roadmap \(reviewed at each ECC meeting\)](#)

[Spectrum for wireless broadband – 5G](#)

[ECC PT1](#)

Peter Faris, Spectrum Expert, European Communications Office

Making way for autonomous driving

More comfort, more safety and finally, the driverless car

Up to one third of all new cars sold worldwide will be partially or fully automated by 2025, according to car manufacturers. In addition, road traffic crashes are a major global challenge - so the search is on for ways of improving road safety.

More and more applications are being deployed in cars in order to assist and to increase the comfort of the driver, or even to provide fully automatic driving support. Technological advances now permit proactive safety features such as collision mitigation systems and vulnerable road user detection. The list of features is extensive, and includes: assist functionality such as blind spot detection; lane change assist; rear cross traffic assist; exit assist; rear collision warning; forward collision warning; adaptive cruise control; Assisted Emergency Braking (AEB); front cross traffic assist; parking assist, and pedestrian or bicycle detection.

Work on developing the technology required to provide greater driver assistance and comfort, as well as autonomous driving features, first started some years ago but was only implemented in premium car models. In more recent times, such technology is gradually being introduced into standard models by major car manufacturers.

There has been significant progress in developing the technology that enables driverless cars in certain environments such as for fully automated parking, motorway and city autopilots. However, some key questions still require resolution before additional driver assistance and semi-automated driving can become a reality. This is due to the fact that the precise interaction with the driver needs to be defined. This may often be an even more difficult scenario than automated operations that don't require interaction with the driver.

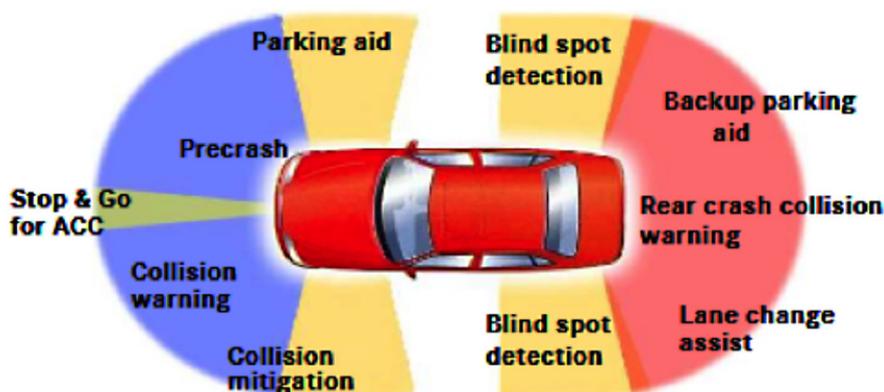


Figure 1: Sensors' view and supported example applications

Sensor platforms

Many cars have now been installed with sensor platforms, which are the enablers for the above applications. A sensor platform may host up to 16 radar sensors (five at the front, two by three at the sides and five at the rear). A large variety of sensors and a redundant sensor layout make sure that obstacles in the car's surroundings are reliably detected. Optical components also play a crucial role with the use of cameras being most common. Light radars and optical scanners provide viable alternatives. Since optical components can fail in certain situations, an all-optical solution without radars is currently not envisaged by car manufacturers and seen as unlikely in the future (see figure 2 below).

Once radar solutions in cars are available, they will replace other technical solutions such as ultra-sonic sensors. Those ultra-sonic sensors will become obsolete because there is no feature of the sound sensors left which is not covered by all other components of the sensor platforms, for example, for assisted parking where the relatively inexpensive ultra-sonic sensors are widely used today.

Sensor	Object Detection	All-weather/ time/ conditions working
Camera		
Light Radar (LIDAR)		
76-77 GHz Radar		
77-81 GHz Radar		

Figure 2: General performance overview of sensor platform components

More than 22 million radar sensors were placed on the market in 2016 in China alone and the country has determined six regional test areas for automatic driving. Many other countries have similar activities. These testing projects will help to identify changes to the overall regulatory environment, which will be required to support autonomous driving. Some countries such as Germany have already changed their regulatory framework in support of automated driving. The perception that the law is not keeping up with technological advances may ultimately not be true, though it is very challenging as the law typically develops after the technology.

There is greater activity in the development of international market-based standards for the size of sensors, their implementation in cars, testing and conformance to technical requirements. However, national regulations still vary considerably in relation to the details, making, re-testing and re-qualification for individual countries necessary.

There are different types of radar sensors. Some are more forward looking with longer operating ranges of between 100 to 200 metres and with smaller antenna opening angles. Others show a shorter operating range with a bigger opening angle for use around the car. The sensors themselves are connected to the Advanced Driver Assistance System (ADAS) box, as it is most

commonly named today. The sensors use synthetic aperture radar (SAR) technology. SAR processing requires significant computing resources to produce the near real-time images needed. Centralised processing of raw sensor data offers several advantages in performance but requires high speed data busses and powerful processors in the car, which present some cost issues. Other designs with regard to centralised versus distributed processing may exist. Radar sensor antennas continue to be a challenge and are an area where there is considerable scope for improvement.

One of the oldest car radar solutions is the 76-77 GHz long range radar which was first implemented for cruise control applications in trucks. Over time, this has become a mandatory application for trucks. Such radars are also used on-board passenger cars, as well as for other applications such as at fixed road surveillance radars, railway level crossing installations, or as anti-collision applications in wing-tips of commercial airplanes or on-board helicopters ([ECC Decision \(16\)01](#)). Within the ECC, studies were recently completed for 76-77 GHz fixed radars versus automotive radars ([ECC Report 262](#)) in support of continued and improved spectrum coexistence of fixed and automotive radar applications in the future.

2-phase plan 24/79 GHz

The early introduction of shorter range anti-collision radars in cars has been based on 24/26 GHz technology ([ECC Decision \(04\)10](#)). This regulation was the basis for the worldwide first market introduction of short range radars in a car premium model in 2005 for which the regulatory approach in Europe is time-limited, and the long-term solutions will be based on 79 GHz ([ECC Decision \(04\)03](#)). 79 GHz sensors have now begun to reach the market. While the regulatory approach set out in [ECC Decision \(04\)10](#) (24/26 GHz short range radars) is time-limited (see figure 3 below), there are some possibilities for narrower bandwidth automotive radars at 24 GHz which provide less resolution accuracy. The regulation for this is set out in [ERC Recommendation 70-03 Annex 5](#).

Following the radar equation, the high bandwidth of 4 GHz and fundamental frequency at 79 GHz will ensure highly reliable radar sensor performance with higher angular and velocity resolution (providing better capability of distinguishing between objects with a range and azimuth resolution of about 3.5 cm). In addition three-dimensional radar is seen as a “must have” in the future as elevation discrimination will also be necessary. The 79 GHz radar sensor implementation in a car has been a challenging aspect over many years. Short range radars have particular importance for the time-critical safety functions, for example pre-crash.

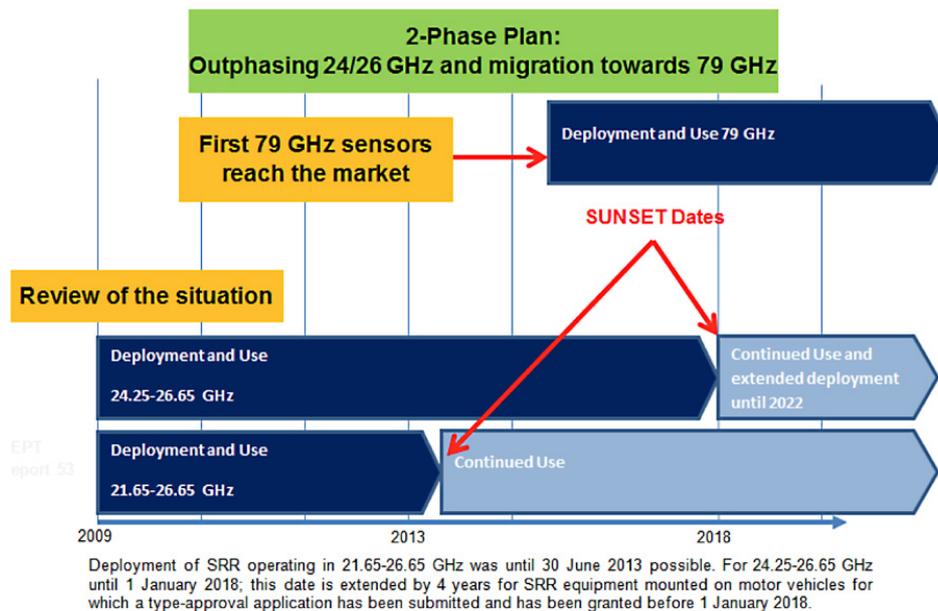


Figure 3: European 2-Phase Plan 24/ 79 GHz

Along with a greater capability for distinguishing between objects, the main advantages of the 77 GHz to 81 GHz frequency range (79 GHz band) are that radar devices can be much smaller, a single technology can be used for all applications, and the risk of mutual interference is lower.

The European spectrum regulation for 79 GHz is in place, and in July 2017, the FCC in the USA expanded the 76-77 GHz band to include the entire 76-81 GHz band for car radars. However, full global implementation is still pending. This aspect is one of the focal points for the automotive industry right now to achieve a truly global implementation. The process of implementation has started in many countries outside Europe, especially after the successful outcome under Agenda item 1.18 at the World Radio Conference in 2015, but sometimes it is subject to national tests and procedures as mandated by the respective national laws before implementation can take place. This introduces some uncertainty about how long national implementation may take in some important jurisdictions outside of Europe.

Future changes

Industry also indicated an interest in a combined regulation for 76-77 GHz and 77-81 GHz, and this may lead to some new spectrum activities in the future. New frequency ranges for sensors above 100 GHz in the automotive field are not discussed at this moment but could of course become a subject as technology continues to evolve.

Another change observed in relation to automotive radar is that the technology is evolving from FMCW ‘chirp’ to OFDM-based solutions. There are concerns amongst the providers that this may raise new intra-automotive radar sensor interference issues due to possible increased noise generation in the sensor’s receiver. It seems clear that solutions for this must be found in the standardisation arena (e.g. standardisation of the waveforms). This does not exclude that the subject in relation to fully automated cars may come to regulators in the future, if the market alone cannot solve this.

Cooperative automotive communications

Cooperate automotive communications such as ITS (Intelligent Transport Systems) can be used to increase the performance of car sensor platforms, either by means of direct vehicle-to-vehicle communications or by communication between the vehicle and the traffic infrastructure, including cellular technologies. Applications can include alert features such as for accidents or icy roads ahead, traffic congestion alerts or vulnerable road user detection.

The ECC regulatory framework is set out in:

Frequency range	Usage	Regulation
5 905 MHz to 5 925 MHz	Planned for future ITS applications	ECC Decision (08)01
5 875 MHz to 5 905 MHz	ITS traffic safety applications	ECC Decision (08)01
5 855 MHz to 5 875 MHz	ITS non-safety applications	ECC Recommendation(08)01

[ECC Decision \(08\)01](#) and [ECC Recommendation \(08\)01](#) were amended in 2015. The two harmonisation deliverables were made neutral in order to include all traffic modes and not to be specific to road traffic alone.

Ongoing investigations towards a further amendment of ECC Decision (08)01 may see the inclusion of the spectrum up to 5925 MHz for ITS, namely including the spectrum which until now was identified for future ITS usage. The ongoing discussions also take into account Urban Rail Systems (driverless metro systems) for which a request from ETSI was received.

It is expected that the ECC will soon receive a mandate from the European Commission to investigate the extension of the 5.9 GHz ITS regulation in the corresponding EC Decision [2008/671/EC](#). No application under the umbrella of the ITS regulation should be excluded, and it can be foreseen that the amended EC Decision, as well as ECC Decision, will be technology neutral.

The spectrum access principle for ITS in 5855-5925 MHz is based on shared use of the spectrum. This includes all technologies which are in line with the technical minimum requirements for spectrum access, and includes 3GPP V2V technologies - although all existing compatibility studies in ECC were based on IEEE 802.11/11p/ ETSI G5.

Some stakeholders raised concerns that competing technologies in 5875-5925 MHz could impact on interoperability and utility of this band but no immediate need to take any regulatory action is seen so far in Europe. Apart from that it is important for the regulation to be technology neutral and to enable efficient use of spectrum. Considering which technology is most suitable for traffic safety-related ITS is not a spectrum policy matter.

This means that the technical solution for sharing between different technologies (3GPP V2V, IEEE 802.11/11p/ETSI G5, and also Urban Rail Systems) must be standardised. There is also a need to define, to some extent, how the cellular and automotive industries evolve to support connected cars.

Another band: 63-64 GHz

[ECC Decision \(09\)01](#), which was amended in 2016, should also be mentioned here in the context of sensor platforms. The 63-64 GHz band provides possibilities to exchange a large amount of raw sensor data at a short distance, which is essential for life-threatening situations, as well as time-extending aspects like closer distance driving with cooperative adaptive cruise control (C-ACC) and truck platooning. These may require both the 5.9 GHz and 63-64 GHz bands to achieve a reasonable level of performance with sufficient system redundancy. In the 1990s, C-ITS research showed that the 63 GHz band has benefits for cooperative applications, but due to the lack of feasible semiconductor technologies, systems have not been implemented for specific use in this band. In this respect, there are thoughts that ITS in this frequency range could benefit from the WiGig (Wireless Gigabit) ecosystem and align with the WiGig channelisation. Another idea would be to use the 76-81 GHz for cooperative applications and not only for sensors, in order to use part of the radio components (including antenna) which are used for sensors. Research projects at a European level are encouraging stakeholders to further elaborate the solutions for cooperative applications in this frequency range.

Thomas Weber, Spectrum Expert, European Communications Office

Making the migration to IP-based Networks

"Mr. Watson, come here, I want you."

The Public Switched Telephony Network (PSTN) has come a long way since those immortal words were spoken by Alexander Graham Bell to his assistant Thomas A Watson during a test of a telephone call in a Boston laboratory in 1876. Today, the PSTN remains the most widely used network in the world for the provision of legacy telecommunications services.

The world continues to evolve however, and voice communications is now just one of a suite of services that can be delivered across global electronic communications networks. Consumer demand for voice services, particularly fixed line voice services, has continued to decline in recent years. Moreover, the consumption of voice and SMS services provided vertically by the traditional telecommunications operators continues to decline as consumers increasingly adopt a variety of new and innovative communications services such as WhatsApp, Viber and Facebook Messenger, which offer voice, video and messaging capability.

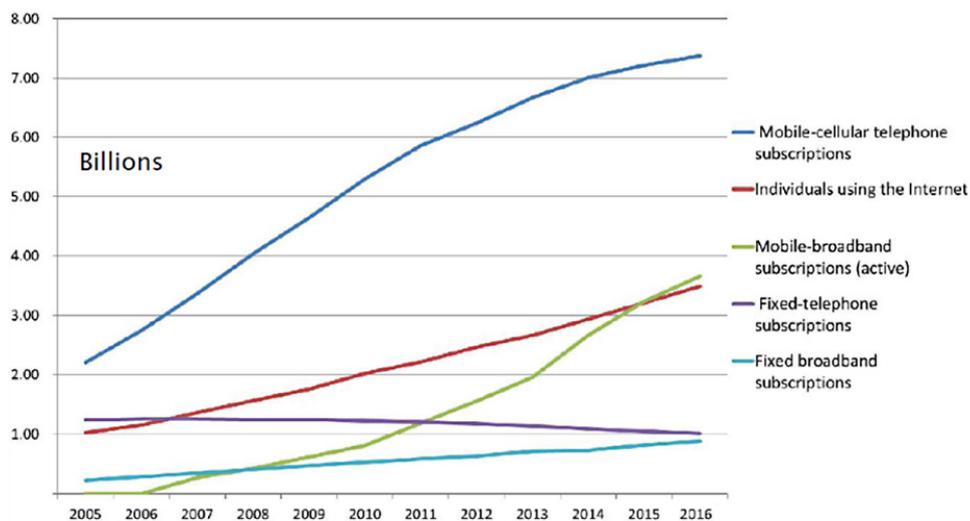


Figure 1: Global ICT Subscriptions (Source: Neotelis)

The shift to IP: Demand for additional services, higher speeds and better quality

During the 1990s when internet access first came to the mass market, the PSTN became the gateway to the World Wide Web. Web services were basic and bandwidth speeds limited. As investors and industry stakeholders began to recognise the demand for faster networks to support an evolving and increasingly bandwidth-hungry suite of services, capital flowed into the telecommunications industry and the main players began to position themselves for the business opportunity. This need for greater capacity and support for multiple services resulted in ambitious plans for a shift towards all-IP networks. Circuit-switched networks (PSTN/ISDN) began to be migrated to a new architecture called Next Generation Networks (NGN) based on an all-IP

platform (namely IP multimedia sub-system (IMS) with soft switches). The migration to NGN is a process in which whole or parts of the existing networks are replaced or upgraded to the corresponding NGN components. In turn, it provides additional services on a network capable of higher speeds and greater quality of service while attempting to maintain legacy services provided by the original network.

But is NGN not old news?

Yes and no. Since the exuberance of the late 1990s and the early signs of convergence between information and communications technologies (ICT), some seismic events have had a significant impact on investment in telecommunications networks. When the “dot.com” bubble burst in 2001 there was a flight of capital from the ICT industry. This, coupled with a collective hangover from buying very expensive 3G spectrum licenses, left the biggest telcos with a lot of debt on their balance sheets. This in turn had an impact on the world’s largest network equipment vendors resulting in a prolonged period of downsizing and consolidation in the industry. Nevertheless, while there were some major investments in migrating to NGN core networks in Europe, investment in next generation access (NGA) networks lagged behind despite efforts from regulators to increase infrastructure competition by stimulating investments. In 2006 and 2007 a couple of major technological breakthroughs, amongst other factors, rekindled the capital markets’ interest in telecommunications. They were: DOCSIS 3.0 and the introduction of smartphones.

DOCSIS 3.0 enabled cable operators to provide communications services on their networks, making it possible for them to provide a compelling triple play bundle of TV, broadband and fixed line voice. In fact, cable operators had a big advantage over incumbent fixed line operators as they were entitled to have access to incumbent networks, based on ex-ante regulation, to provide services in areas not served by their own networks. DOCSIS 3.0 represented such a disruptive threat to the traditional telco business that incumbent operators were required to act rapidly in order to remain competitive. This resulted in moves to invest heavily in access networks.

The introduction of another disruptive technology, smartphones, changed the way consumers engaged with communications services, which now required an almost constant online connection. The capacity needed for Wi-Fi hotspots and for mobile backhaul added to the business case for NGN and NGA investment to support this ever increasing demand.

The global financial crisis 2008-2009

"In stormy times, some people build shelters; others build windmills." (Chinese proverb)

Despite the business opportunities that were emerging, the industry was not immune to the global financial crisis of 2008-2009. Operator revenues were affected as consumers curbed spending and investment in capital projects slowed. However, the silver lining for the industry was that many governments around the world recognised the importance of the knowledge society for generating new forms of employment, and sought to implement, as part of their national programmes for government, “smart economy” strategies. Central to these plans was the need for investment in

fast and reliable communications networks. Today, at least in the CEPT area, we are seeing the fruits of those plans in terms of investment in IP-based network infrastructure, with many countries having already migrated to all-IP or being well advanced in their migration projects.

ECC Report 265

In 2014, the ECC's Working Group Numbering and Networks, through its Project Team on Technical Regulatory Issues (PT TRIS) started a project to look at the status of migration projects in the CEPT area. This was due to the fact that evidence of increased activity was noted in some countries. It culminated, on 31 May 2017, with the adoption of [ECC Report 265](#) entitled "Migration from PSTN/ISDN to IP-based networks and regulatory aspects".

The report is essentially based on an exchange of experiences in the regulation of migration toward IP-based networks and services between different CEPT countries - through their respective national administrations. The report also provides a status update on the migration process in some countries, and identifies various technical challenges. The report does not aim to mandate specific regulatory measures but may be used to inform future policies with the objective of providing a better understanding about the technical and regulatory drivers for migration. It may also provide some guidance on how this evolution will pave the way for the provision of multiple services on faster and more reliable IP platforms.

Drivers for migration: The operator perspective

This article has already addressed the changes in how consumers engage with communications services, and how that engagement is driving the need for faster and more reliable networks to support data consumption. Cisco estimates a compound annual growth rate in data (exabytes per month) of 24% per annum for the period until 2021.

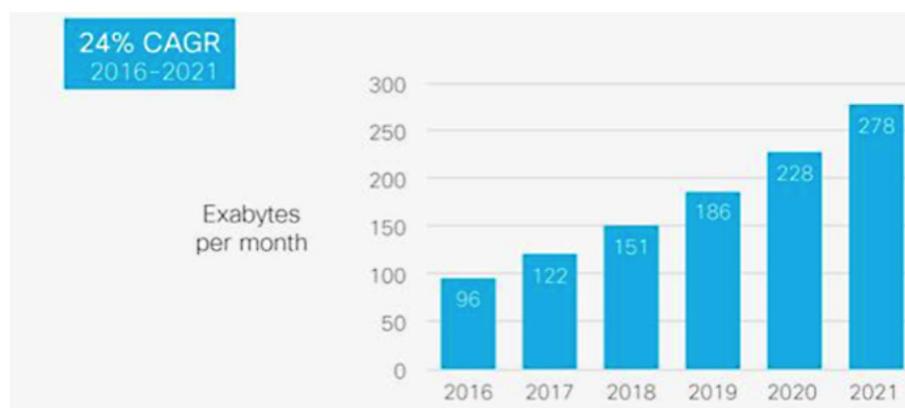


Figure 2: Global IP Traffic Forecast 2016-2021 (Source: Cisco)

Notwithstanding the demand for data, there are other factors influencing operators' migration strategies as detailed in ECC Report 265. These include:

- A limited and reducing supply of spare parts for legacy network elements;
- A reduction or cessation of vendor support for legacy network equipment and software;
- A dearth of expertise and experience in maintaining legacy networks caused by the retirement of engineers with the requisite skills and experience to support legacy systems;
- Fewer customers for legacy services resulting in lower revenues, higher unit costs per service and higher maintenance costs per customer;
- NGN equipment that is both cheaper to purchase and to operate on a common platform for multiple IP-based service offerings.

Furthermore, the real estate cost of housing modern network equipment is much lower as the nodes have a smaller footprint. Therefore, operators with large amounts of prime real estate have an opportunity to fully realise the value of this extra space by migrating to all-IP.

The report also evaluates the various options for migrating customers where different access network technologies are used. These include:

- Full migration – where the access network technology has been fully migrated (e.g. fibre-to-the-home (FTTH));
- Emulation of legacy services using technology such as multi-service access nodes (MSAN);
- Migration to the core-IP network using broadband ports.

Regulatory obligations

While the operator's core concerns are to reduce costs, increase revenue and remain competitive, they must also take account of their regulatory obligations in their respective migration strategies. Such obligations include: maintaining access to emergency services; supporting number portability, and ensuring an enhanced customer experience through the provision of superior products, better customer service and shorter time-to-market with higher speed and less latency.

One key finding of the ECC Report 265 was the need for operators to raise awareness of migration projects with their customers and to provide advance notice and regular updates throughout the process in order to minimise the risk of any potential disruption.

Dealing with disruption

Against the backdrop of disruptive competition from over-the-top (OTT) players (such as Google, Facebook and Netflix), migration poses some significant challenges. Ultimately OTT players will benefit the most from increased network investment and faster speeds. Since 2011, the user base for the four largest social media apps is now approaching 3 billion users globally while the user base for the four largest messaging apps (which all support voice and messaging) approaches 3.5 billion users globally.

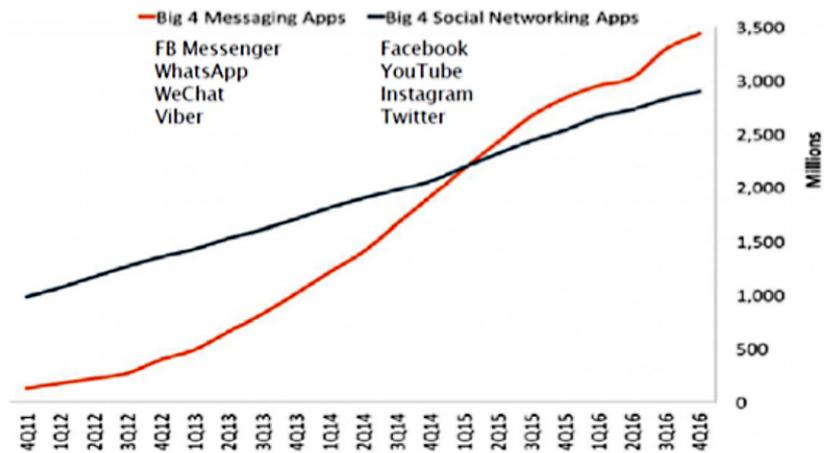


Figure 3: Monthly active users of top 4 social media and messaging apps (Source: Neotelis and BusinessInsider.com)

As existing operator revenues are eroded by OTT competition they will need to adapt and be innovative in order to fully monetise their investments. Regulators will also need to have the flexibility to adapt to this new competitive landscape where attention will need to be given to net neutrality, data security and privacy, as well as to the existing regulatory objectives of competition and consumer protection.

From a technical regulatory perspective, equivalents to the existing suite of wholesale network inputs will need to be provided for, and IP interconnection will become an area of increasing interest for regulators in the short term. The diversity of types of IP interconnection, of signalling protocols and codecs will require a harmonised approach and broad consultation among key stakeholders.

In conclusion, regulators must strive to strike a balance between fostering competition and consumer choice while stimulating network investment in the coming years. Equally, market players will need to strike a balance between earning a reasonable rate of return on their network investments while meeting emerging customer demand for services that require faster and more reliable networks.

It will be interesting!

ECC Report 265 is available at the ECO Documentation Database - <http://www.ecodocdb.dk/>

Freddie McBride, Expert in Numbering & Networks, European Communications Office

Opportunities for spectrum for PMSE applications

If you plan to attend a sporting or cultural event this Autumn, spare a moment to imagine what is going on behind the scenes. Key to the success of that event are programme making and special event (PMSE) applications. They support broadcasting, information, sports and culture events, and include everything from radio microphones and audio applications (such as talkbacks and ear monitors), cordless cameras and relevant video links.

In recent years, available spectrum for PMSE applications has been reduced. This is due to the fact that some parts of the spectrum, previously used by these applications, have been targeted for other uses, in particular with the designation of new frequency bands for mobile broadband. Thus, in accordance with its [2015-2020 strategic plan](#), the ECC has been working on identifying suitable spectrum for PMSE to compensate for this reduction.

Spectrum demand for PMSE is generally time and location specific. On this basis, and taking also into account the divergent national frequency plans across CEPT countries, spectrum for PMSE is identified on a 'tuning range' basis. The term 'tuning range' for PMSE means a range of frequencies over which radio equipment is envisaged to be capable of operating. Within this tuning range, the use in any one country of radio equipment will be limited to the range of frequencies identified nationally (if any) within that country for PMSE. It will be operated in accordance with the related national regulatory conditions and requirements.

Progress in technology has meant that equipment can now tune over a wider piece of spectrum. This allows the identification of large tuning ranges, and provides administrations with the flexibility to identify, within any given range, the spectrum available for PMSE, depending on demand and national conditions.

In order to facilitate the development of standardised PMSE equipment, ERC Recommendation 25-10 was set up in 1995. Its main target is to identify harmonised tuning ranges for these types of applications. Since then, it has been amended a couple of times to reflect the changes in the spectrum use and to include new opportunities for spectrum for PMSE. The [latest version](#), developed within [Project Team FM 51](#) and published in October 2016, represents a significant step towards harmonisation, whilst maintaining some flexibility for CEPT administrations to account for national circumstances. It is reflected through the consolidation of the frequency ranges available for PMSE across CEPT and the rationalisation, as far as possible, of the terminology and usage conditions.

Identifying new spectrum opportunities for radio microphones

An overview of the frequency ranges currently available in CEPT for audio PMSE applications is provided in Table 1.

Table 1: Frequency ranges included in ERC Recommendation 25-10 for use by audio PMSE applications

Type of link	Frequencies/Tuning ranges
Radio microphones and in-ear monitors	29.7-47.0 MHz (mainly for non-professional PMSE use)
	174-216 MHz (shared use)
	470-694 MHz (shared use, core band for professional use)
	694-790 MHz (availability reduced for countries implementing MFCN in the 700 MHz band)
	823-832 MHz (harmonised for audio PMSE in EU countries)
	863-865 MHz (mainly for non-professional PMSE use)
	1350-1400 MHz (new range identified)
	1518-1525 MHz (new range identified)
	1785-1805 MHz (harmonised for audio PMSE in EU countries)
Audio links, talkback and production communications	174-216 MHz (shared use)
	470-694 MHz (shared use)
	694-790 MHz (availability reduced for countries implementing MFCN in the 700 MHz band)

The recent review of ERC Recommendation 25-10 provided the opportunity to include two new frequency ranges for audio PMSE with associated technical conditions. This was the result of studies assessing the compatibility between audio PMSE systems and the incumbent use of these ranges:

- 1350 - 1400 MHz: Identified for radio microphones with a maximum equivalent isotropically radiated power (e.i.r.p.) of 20 mW, noting that a maximum e.i.r.p. of 50 mW may be allowed in the case of body-worn radio microphones or for equipment with Spectrum Scanning Procedure (SSP) implemented.
- 1518 – 1525 MHz: Identified for radio microphones for indoor use with a maximum e.i.r.p. of 50 mW.

These new spectrum opportunities, together with technological developments which potentially lead to a more efficient use of the spectrum, should help to respond to a lot of the demand for audio PMSE.

The availability of the band 694-790 MHz for PMSE has been reduced due to its identification for mobile/ fixed communication networks (MFCN). In order to compensate for this reduced availability, the ECC is looking at further possibilities. This would help in addressing peak demands, such as large events or locations with a potential high density of transmitters (for example, production studios, theatres, etc). As a result, and following a national initiative from the United Kingdom, ECC recently started investigating the possible use in Europe of low-power audio PMSE in the band 960-1164 MHz. This task won't be easy: the band is already used extensively by a range of aeronautical systems for civil aviation and military purposes.

Looking at additional frequencies for cordless cameras and video links

As illustrated in table 2 below, spectrum below 3 GHz is the prime range for the use of cordless cameras and other wireless video applications. This is due to the advantageous radio wave propagation conditions, relatively low signal attenuation and the amount of equipment available.

The use of higher frequencies (e.g. above 10 GHz) is currently limited.

Table 2: Frequency ranges included in ERC Recommendation 25-10 for use by video PMSE applications

Frequencies/Tuning Ranges		Type of link, information
2010-2500 MHz (note 1)	2010-2025 MHz (new)	Cordless cameras, portable and mobile video links. Harmonised within EU countries.
	2025-2110 MHz	Cordless cameras, portable and mobile video links
	2200-2300 MHz	Cordless cameras, portable and mobile video links
	2300-2400 MHz	Cordless cameras, portable and mobile video links
	2400-2500MHz	Cordless cameras, portable and mobile video links
2700-2900 MHz (new)		Cordless cameras, portable and mobile video links. Not available for mobile air to ground video links
7.0-8.5 GHz (new)		Cordless cameras, portable and mobile video links, temporary point-to-point video links.
10.0-10.68 GHz		Cordless cameras, portable video links, temporary point-to-point video links
21.2-24.5 GHz (note 2)		Cordless cameras, temporary point-to-point video link
47.2-50.2 GHz		Cordless cameras
<small>Note 1: Within the tuning range 2010-2500 MHz, the frequency band 2110-2200 MHz is not available for PMSE. Note 2: The band 23.6-24 GHz is not available for PMSE.</small>		

Due to the reduction in the availability of some frequency bands previously used for video PMSE (such as the 2500-2690 MHz band for example), ECC has been looking at new frequency bands for these applications. It has identified two opportunities below 3 GHz:

- **2010 - 2025 MHz:** This band, previously assigned to mobile operators (as part of the ‘2GHz unpaired bands’), has remained unused by mobile networks. It has the advantage of being adjacent to the 2025 - 2110 MHz range, which is already used for video PMSE. The identification of this band under similar conditions will extend the available tuning range and will benefit from existing technology.
- **2700 - 2900 MHz:** This band is used mainly for air traffic control and meteorological radars. There have been extensive studies on the potential impact from video PMSE systems into existing systems in this and adjacent bands. As a result of the studies, ECC identified some opportunities for video PMSE use in 2700 - 2900 MHz. The conditions for the use of the band, subject to a proper coordination, are summarised in [CEPT Report 61](#), which was developed in response to a Mandate from the European Commission on the subject. Additional activities are ongoing within [Project Team FM 51](#) on the development of guidelines for the deployment of cordless cameras and relevant video links in the band.

In addition, the identification of tuning ranges in higher frequencies has been studied. As a result, the tuning range 7 - 8.5 GHz has been added to the possible frequency ranges for cordless cameras and relevant video links. It reflects the fact that some portions of this range had already been assigned on a national basis for video PMSE applications, and that sharing opportunities exist with the main uses of this range (e.g. fixed links, satellite services).

Extending the amount of information on the national conditions for PMSE use

The operation of PMSE equipment in many CEPT member states requires appropriate authorisation of the frequencies to be used by that PMSE equipment. Availability of specific frequency ranges for PMSE, conditions of use of these ranges and the national authorisation scheme, may differ greatly between the various CEPT member administrations. In addition, it is important to note that a number of PMSE uses, in particular those of news gathering, happen at unpredictable times and locations, and necessitate a very rapid response time.

Consequently, it is in the interest of administrations and of the PMSE users and manufacturers to have access to updated information for PMSE use. As a result, ECC agreed to include within the ECO Frequency Information System ([EFIS](#)) a specific module related to PMSE use. Specifically, this [tool](#) provides, for each of the frequency ranges contained in ERC Recommendation 25-10, detailed information on its availability for PMSE in most of the 48 CEPT countries and, when available, the associated technical and regulatory conditions.

ANNEX 4: NATIONAL CONDITIONS FOR AUDIO PMSE APPLICATIONS

Export search results to CSV

Implementation status
 - empty -> No info (default value) Y – the whole band is available for PMSE N – the band is not available for PMSE L – limited availability

Frequency Band	ALB	AND	AUT	AZE	BEL	BIH	BLR	BUL	CVA	CYP	CZE	D	DNK	E	EST	F	FIN	G	GEO	GRC	HNG	HOL	HRV	I	IR
A1: 29.7-47.0 MHz	Y	L	L	Y	Y	Y	L	Y	N	Y	L	L	L	L	L	L	L	N	L	Y	L	L	N	N	
A2: 174-216 MHz (Radio microphones)	Y	L	Y	Y	Y	Y	N	Y		Y	Y	Y	N	L	Y	Y	Y	L	L	Y	Y	L	Y	Y	
A3: 470-694 MHz (Radio microphones)	Y	Y	Y	Y	Y	Y	L	Y		Y	Y	Y	L	Y	Y	Y	Y	Y	Y	L	Y	L	Y	Y	
A4: 694-790 MHz (Radio microphones)	Y	L	Y	Y	L	Y	L	L		L	L	L	L	Y	Y	Y	N	Y	Y	L	L	Y	L	L	
A5: 823-832 MHz	Y	Y	Y	Y	Y	Y	Y	Y		Y	L	Y	Y	Y	Y	Y	Y	Y	L	Y	Y	Y	Y	Y	
A6: 863-865 MHz	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	L	Y	Y	Y	Y	Y	
A7: 1350-1400 MHz	Y		Y	Y		N	N			N	Y	N	N	N	N	L	N	N	Y	N	N	L			
A8: 1518-1525 MHz			Y	Y		N	N			N	N	N	N	N	N	N	L	Y	Y	N	N	N			
A9: 1785-1805 MHz	Y	L	Y	Y	L	Y	N	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	L	Y	Y	Y	Y	Y	
B1: 174-216 MHz (Audio links)	Y	L	N	Y	Y	Y	N	N		Y	Y	N	N	L	N	Y	N	L	L	Y	L	L	Y	Y	

National restrictions information is provided below

Implementation status
 * - Individual licence may be required I – restrictions apply (e.g. geographical restrictions)

Frequency Band	Country	Implementation	Remark
A1 29.7-47.0 MHz	AUT	L*	6 dedicated channels up to 120 kHz are available
	AZE	Y*	
	BIH	Y*	On tuning range. Radio microphones and ALD as per ERC/REC 70-03 Annex 10
	BLR	L	Limited to 33.175-40 MHz / 40.025-48.5 MHz
	BUL	Y	ERC/REC 70-03/Annex 10
CZE	L		For PMSE (operation of the wireless microphones and of the aids for hearing impaired, coming under SRD category) may be used 27.5-27.915 MHz band and 36.4 - 38.5 MHz band. https://www.ctu.eu/sites/default/files/obsah/o-ctu/cze_rsusp-26-09.2010-10_en.pdf
	D	L	Basic parameters: frequency ranges: 32.475-34.325 MHz and 36.610-38.125 MHz; channel raster: 50 kHz; max. radiated power: 10 mW e.r.p. Detailed information: Mikrofone">www.bnetza.de/allgemeinzuteilungen->Mikrofone ->Vfg. 53/2015 For legacy equipment individual licensing with more permissive technical parameters may be possible. (detailed information: https://www.ctu.eu/sites/default/files/obsah/o-ctu/cze_rsusp-26-09.2010-10_en.pdf)

Figure 1: Availability of frequency ranges for audio PMSE ([Source](#))

Additionally, some graphical features have been implemented to display the status of any range in all CEPT countries or to gather the status of all bands for each CEPT country.

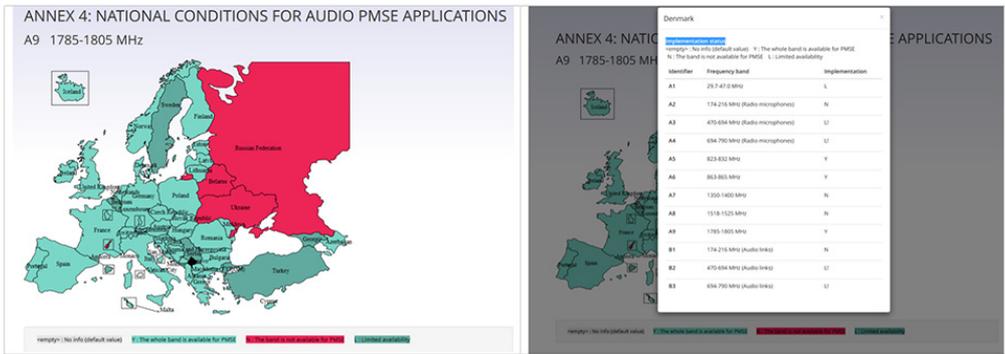


Figure 2: Graphical displays related to PMSE use in EFIS ([Source](#))

This new development should contribute to the improvement in working practices for the use of PMSE in Europe. So too should the additional information made available on a dedicated [page](#) of the ECC website, which includes things such as the contact points for the various CEPT national administrations concerning PMSE related activities.

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