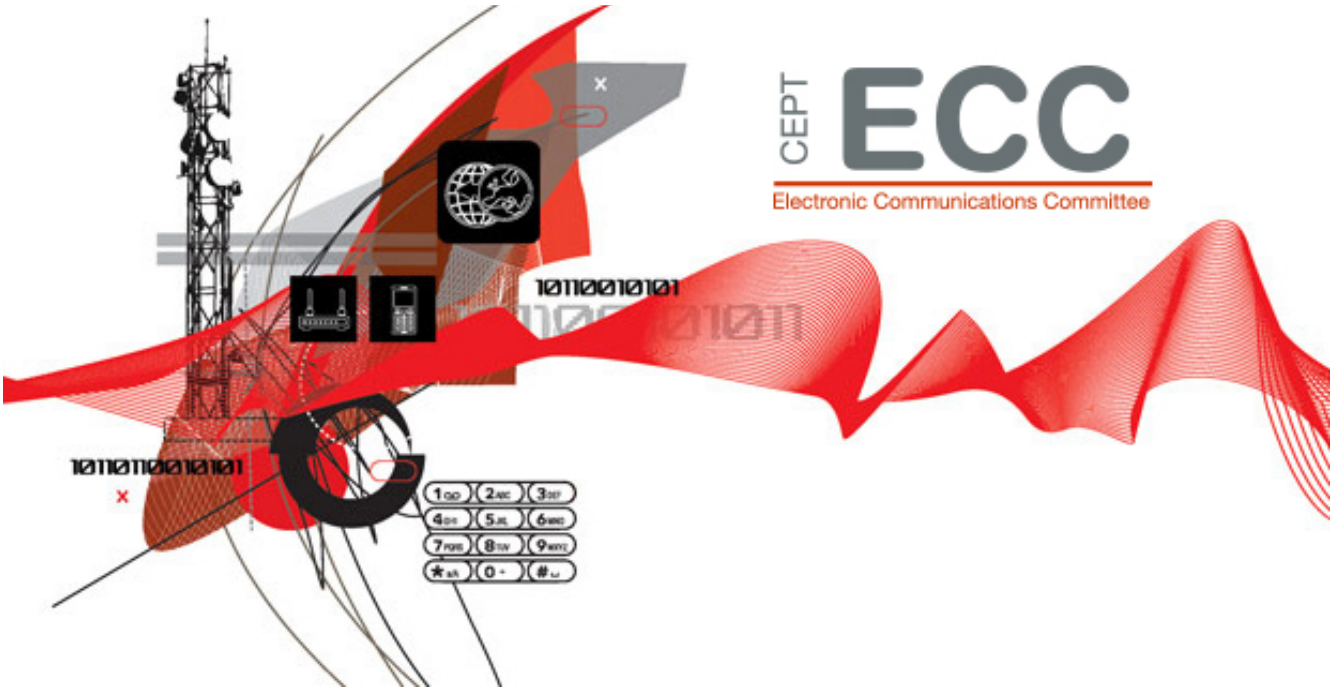

ECC Newsletter August 2023

CEPT workshop unveils path to 6G advancements: a global endeavour towards extreme connectivity

A recent CEPT 6G workshop covered diverse topics, from aerospace and manufacturing to spectrum management and cybersecurity. It brought together industry experts and researchers to discuss the potential of 6G technology, writes Peter Faris and Jaime Afonso, ECO Spectrum Experts

The European Conference of Postal and Telecommunications Administrations (CEPT) workshop on 6G, which took place in Copenhagen on 29 and 30 June, unfolded an exciting vision for the future of mobile communications.

Organised by the ECO, the event brought together industry experts to discuss the evolution in mobile communication and the highly anticipated advancements of 6G. With its promise of extreme connectivity and immersive experiences, 6G has the potential to revolutionise the global mobile ecosystem.

Figure 1: The workshop was attended by around 120 participants in Copenhagen and more following online

Harmonisation was a key theme emphasised during the workshop. If 6G is to be successfully introduced from around 2030 onwards, it will require global and regional alignment in terms of spectrum, standards and timing.

Availability of suitable spectrum is a critical factor for the success of next-generation wireless systems. At the event, speakers identified various spectrum ranges from lower/mid bands (up to 15 GHz) to sub-THz bands as possible candidates for 6G. They also identified different authorisation schemes, not just limited to traditional, licensed and licence-exempt models but also more novel approaches including local or light licensing. Identification of spectrum will need to consider the diverse needs of different applications. Holographic communications and immersive XR were noted as possible applications requiring additional spectrum.

Research and standardisation were also discussed at the workshop, featuring presentations from industry leaders such as Ericsson, Qualcomm and Nokia. These experts shed light on the roadmap towards 6G and the pivotal role of 5G Advanced in laying the foundation for 6G advancements.

Usage scenarios identified under this framework were introduced as essential elements for the seamless growth from 5G to 6G, including new elements of ubiquitous connectivity, integrated artificial intelligence (AI) and communication, as well as integrated sensing and communication.

Extensions to the familiar 5G "pillars" were also proposed where "immersive communication" would replace enhanced mobile broadband, "massive communication" would replace massive machine- type communication (mMTC), and ultra-reliable low-latency communication (URLLC) would become "hyper" reliable (HRLLC).

The 3rd Generation Partnership Project (3GPP) release roadmap, as well as European Telecommunications Standards Institute (ETSI) and International Telecommunication Union Radiocommunication (ITU-R) initiatives were discussed in this context. Particular attention was given to the recent completion of the draft ITU-R framework for 6G, known as "IMT-2030" in ITU terminology.

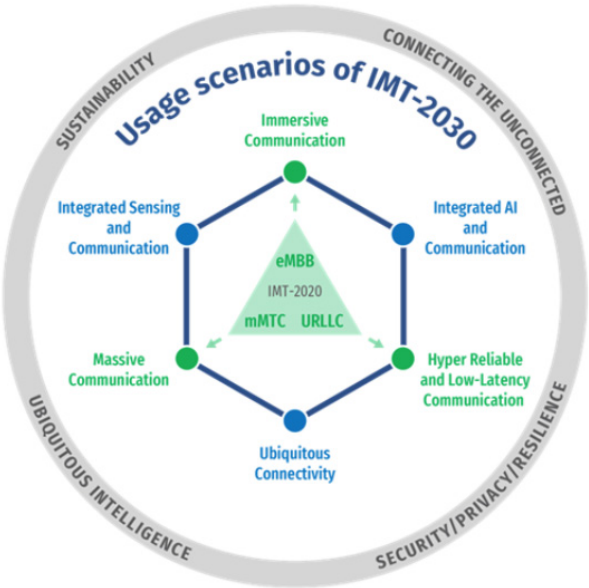

Figure 2: 6G usage scenarios from ITU-R framework for IMT-2030. Source: ITU-R internal document, 06/2023

The timeline for 6G specifications was outlined, with expectations that specifications will be available by 2028. 3GPP Release 19, planned for completion in 2025, is seen as a crucial milestone in enhancing 5G Advanced with cutting-edge capabilities, including energy efficiency, AI/machine learning, XR, sensing, and ambient Internet of Things. This progress will pave the way for the development and deployment of 6G technologies.

Advanced technological developments such as Giga MIMO, which combines the best of wide-band millimetre wave and wide area below 7 GHz, can play a role in facilitating these use cases.

AI is a hot topic at moment and its increasing role was noted by several speakers, both as an enabling technology for 6G as well as a use case, driving the need for additional bandwidth.

The role of non-terrestrial networks (NTN) to enable the goal of ubiquitous connectivity was explored by speakers in particular from Global Satellite Operators Association and the 6G-SKY project. The NTN vision is to develop a multi-layered "network of networks" which would encompass satellite constellations in various orbits as well as high altitude platform systems, aeroplanes and drones to complement coverage from ground-based networks.

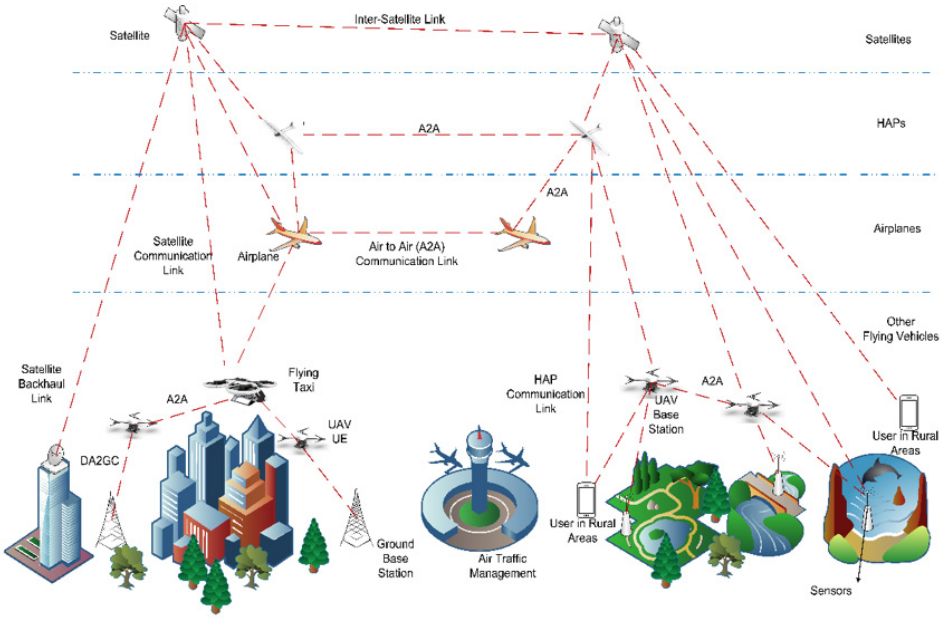

Figure 3: Overview of NTN connectivity scenarios. Source: 6G-SKY

Spectrum policy is a crucial aspect for the successful deployment of 6G. In this respect, the draft Radio Spectrum Policy Group opinion on 6G development was emphasised. This opinion considers among other things, the ongoing 5G implementation of primary and pioneer bands, the role and need for licence-exempt or light-licensed spectrum for offloading some of the 6G traffic, NTN to support 6G development, and to continue current initiatives on 5G.

During the workshop there was discussion on the respective spectrum needs of 6G and WiFi, with clear consensus that both will continue to grow and require access to spectrum. It was, however, less clear how the respective spectrum needs could best be met, how authorisation regimes may need to evolve, and how the networks themselves may be configured in future, not least to address indoor and outdoor demand. One speaker proposed that "indoor WiFi and outdoor 6G will bridge the digital divide together".

The progress of 5G deployment was also reviewed during the workshop. The European Telecommunications Network Operators' Association provided statistics on the population coverage of 5G in Europe compared to other regions and highlighted the importance of supportive policies for 5G deployment. Spectrum availability, harmonisation, and allocation were highlighted to ensure the success of 6G implementation.

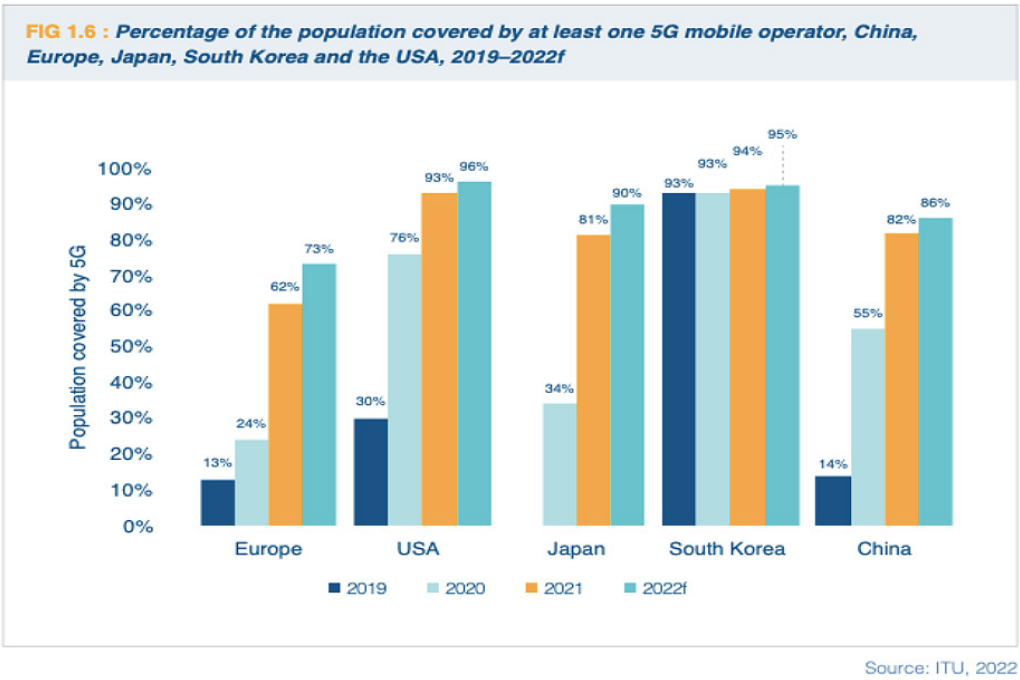

Figure 4: Percentage of population covered by 5G in Europe vs other regions. Source: ITU 2022, presented by ETNO

The suitability of different licensing approaches to meet the needs of 6G was also addressed in the workshop. The potential of spectrum sharing was noted, particularly in the context of new technologies. For example, antenna arrays can enable and improve sharing opportunities.

The needs for local and vertical users were presented, covering a diverse range of industries including aerospace, manufacturing and entertainment. Verticals and local licensing regimes have been discussed for some time and are now emerging as a reality, enabling innovation and new business models across a diverse range of sectors. The role of private networks was also discussed, for applications including autonomous quarrying vehicles and enterprise networks.

Beyond the spectrum domain, other topics including energy efficiency, cybersecurity and numbering were noted as important issues to be considered by CEPT administrations. On the latter, it was noted that it is extremely difficult to predict the demand for 6G number ranges and changes in assignment eligibility criteria. However, the use of numbers will continue to evolve and play a greater role behind the scenes in authentication, verification and call routing.

In conclusion, the workshop laid the groundwork for the anticipated 6G era, with global stakeholders collaborating to shape the future of extreme connectivity and immersive experiences. As research and development continue to progress, Europe and the world awaits the transformative potential that 6G may bring to the mobile landscape and beyond.

Presentations and photos from the workshop are available here.

Fixed service in flux: enhancing spectrum efficiency and capacity for future networks

Jaime Afonso, ECO Spectrum Expert, unveils the dynamic world of telecommunications and delves into the technological advancements of fixed service networks

Fixed service (FS) plays a pivotal role in modern telecommunications infrastructure: It facilitates seamless communication between fixed points and serves diverse user needs. Telecom operators rely on FS for various applications, including mobile network infrastructure, fixed or mobile network backhaul links, and connecting remote premises. These high-capacity links might offer a viable alternative to fibre optic cables in terms of ease and deployment cost.

Technological advancements in FS

The evolution of modulation schemes has been a driving force behind the increased capacity and efficiency in FS applications. As demand for higher data rates grows, higher-order modulation schemes such as 128 QAM and 1024 QAM are becoming widely adopted.

These advanced modulation techniques enable the transmission of more data in a given bandwidth, significantly increasing the capacity of FS links. Moreover, the Adaptive Coding Modulation (ACM) technique is another critical technology that optimises the use of radio resources. By dynamically adjusting modulation and coding schemes based on the prevailing radio propagation conditions, ACM ensures that the link operates at the highest possible data rate while maintaining a reliable and stable connection. This adaptability is particularly crucial in outdoor wireless links, where propagation conditions can vary rapidly.

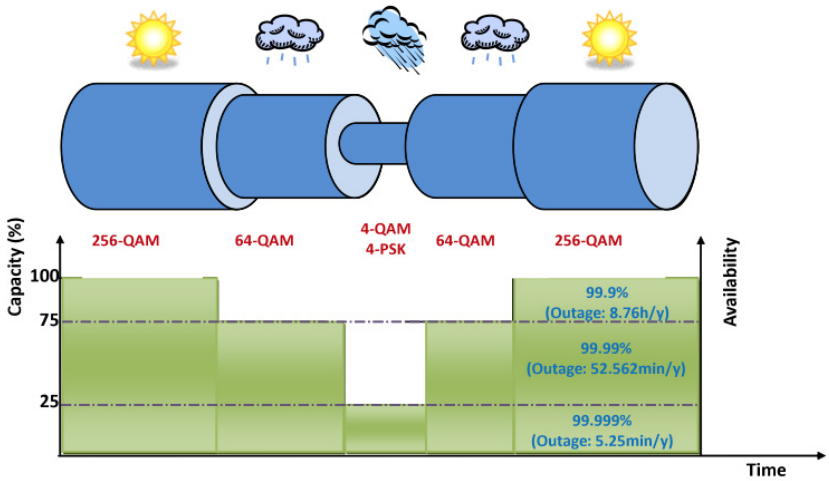

Figure 1 - Adaptive Coding Modulation technique example

As data traffic continues to surge, efficient spectrum use is crucial for meeting the increasing demand for capacity. Bands and Carrier Aggregation (BCA) is a transformative technology that enables the aggregation of multiple carriers from different frequency bands, leading to higher capacity connections and enhanced spectrum efficiency.

BCA not only enables efficient use of available spectrum but also reduces congestion, providing operators with more flexible capacity expansion options. This technology is vital for supporting the rapid growth of 5G networks, which demand higher data rates and enhanced network performance.

All this comes together with other technologies such as the incorporation of cross-polarisation interference cancellation (XPIC) and multiple-input multiple-output (MIMO) technologies and the use of automatic transmit power control, or ATPC as it is known in the industry.

Spectrum: The key to expanding capacity

FS applications operate across various frequency bands, each catering to specific technical requirements and use cases.

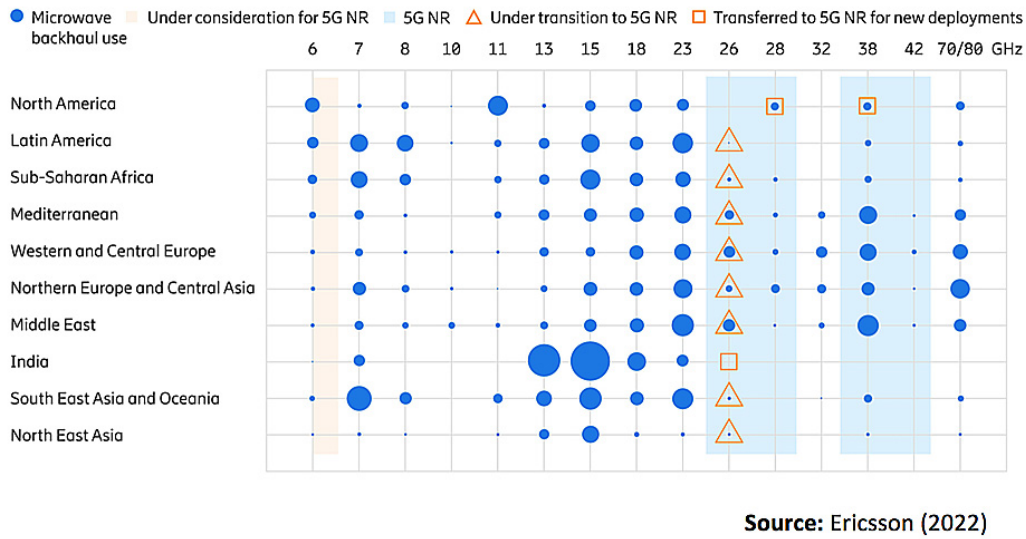

Figure 2 – Overview on FS spectrum use including 5G backhaul

Frequencies below 10 GHz are typically used for long-haul trunk/backbone networks and rural coverage, where the propagation characteristics are favourable for wide coverage and longer links. In contrast, higher frequency bands like the E-band (70/80 GHz) are widely used for short-haul, high- capacity connections in urban and densely populated areas. The E-band's ability to provide multi- Gbps capacity in a single radio makes it a preferred choice for supporting 5G backhaul and other high-data-rate applications.

The efficient allocation and management of spectrum resources play a critical role in optimising FS networks' performance. Telecommunication regulatory bodies, such as the European Conference of Postal and Telecommunications Administrations (CEPT), play a crucial role in spectrum harmonisation and fostering collaboration among member countries.

The recently published update of ECC Report 173, developed by CEPT and SE19, a spectrum engineering group, focuses on the spectrum requirements and development of the FS in Europe from 1997 to 2021. It aims to provide a comprehensive overview and serve as a reference for administrations, manufacturers, and telecom operators. The methodology involves data from previous version of ECC Report 173 and a 2021 questionnaire, which gathered responses from 32 CEPT countries.

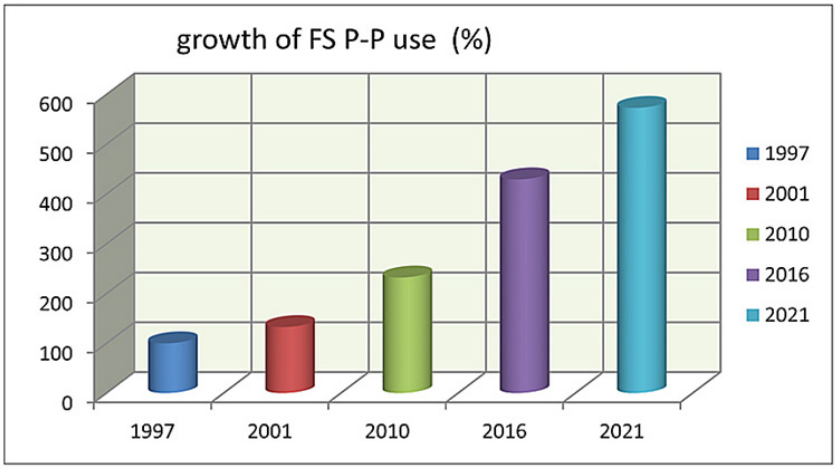

Figure 3 – Growth of FS use (reference: 1997)

The reported use of frequency bands between 1997 and 2021 for point-to-point links is shown below.

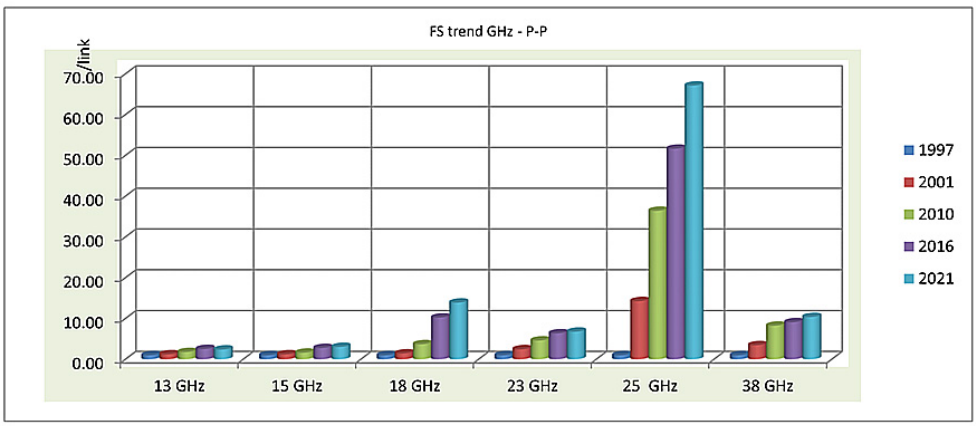

Figure 4 – FS spectrum use per frequency bands below 38 GHz (reference: 1997)

Frequency bands operating with wider bandwidth channels have revolutionised FS applications. The E-band has emerged as a game-changing solution, offering extremely wide channels that enable multi-Gbps capacity in a single radio as illustrated in the picture below. This has proven especially valuable for meeting the ever-increasing demands of 5G networks, where high-capacity backhaul is essential.

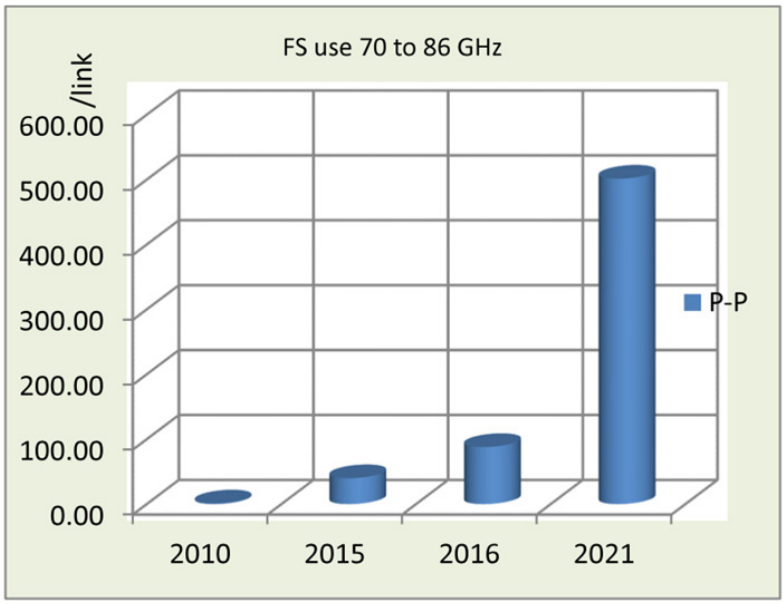

Figure 5 –FS spectrum use in the 70/80 GHz frequency bands (reference: 2010)

Looking beyond the E-band, the W-band (92-114.25 GHz) and D-band (130-174.8 GHz) present exciting prospects for future FS links. Therefore, reflecting this trend, a harmonised channel and block arrangements for the D-Band and the W-Band were developed in CEPT, as contained in ECC Recommendations (18)01 and (18)02, respectively.

These higher frequency bands promise even greater capacity, making them instrumental in the evolution of 5G New Radio (NR) and the potential deployment of 6G wireless backhaul. However, with the potential for higher data rates and capacity, the challenges of deploying equipment in these higher frequency bands must be addressed. Factors such as atmospheric absorption and equipment costs will need to be considered to fully harness the potential of the W-band and D-band for future networks.

Spectrum management and regulatory challenges

Regulatory frameworks must adapt to the changing landscape of FS networks, facilitating the deployment of advanced technologies and supporting the increasing capacity demands of future networks. Flexible licensing regimes, such as light licensing, licence exemption, and block assignment, are being explored for higher frequency bands to promote spectrum efficiency and accommodate new technologies.

In terms of bands strategy and trends, the responses vary among countries, with different bands considered important by various administrations and industries. Traditional bands below 18 GHz are expected to retain their strategic relevance for backbone and long-distance links, rural coverage, and mobile network backhaul.

The introduction of 5G in previously used FS bands could lead to migration of FS applications to other bands, making them strategically important in the coming years.

The E-band has seen rapid growth and is considered important for high-capacity dense networks for small cell backhaul. Unlicensed or lightly licensed bands are expected to gain significance, and some higher frequency bands (18-32 GHz) necessary for the transition of 24.5-26 GHz for 5G are also strategically important.

FS links cater to diverse geographical contexts, ranging from short links in urban areas to long links in rural regions. Tailored geographical context definitions are being explored to optimise network performance and meet diverse user needs. As technology advances and higher frequencies come into play, link planning methods are adapting to ensure efficient network performance and to address challenges in network expansion.

Drones, rail and 5G technologies: how the 1900 MHz band is evolving

Robin Donoghue, ECO Expert in Spectrum Management, explores the recent developments in the 1900 MHz band. The band, he says, holds a significant promise for digital European cordless 5G technologies, governmental drones and enhanced railway communications

For almost 30 years the frequency band 1880-1900 MHz has been designated for digital European cordless telecommunications (DECT). DECT equipment has traditionally been best known for the cordless domestic handsets connected to the landline network. As far back as 1998, an Electronic Communications Committee decision, ERC/DEC/(98)22, has set out the harmonised technical use of the spectrum and exemption from individual licensing and free circulation of DECT equipment.

However, the DECT standard is evolving with DECT New Radio +, a 5G data transmission protocol, bringing the benefits of 5G technology.

Alongside those DECT developments, there are now other innovations being introduced aimed at using the 1900 MHz spectrum. Two such innovative uses are the governmental use of uncrewed aircraft systems (UAS), more commonly known as drones, and use by the rail industry for railway mobile radio (RMR). The rail use is an enhancement to the RMR 900 MHz core band.

The ECC has carefully studied these innovations to minimise interference to either the DECT systems or to these new radio services. In allowing the new innovations in the 1900 MHz sub-bands, it is essential to ensure there is no undue harm caused to or from the radio serviced immediately adjacent to the DECT 1880-1900 MHz frequency bands.

The ECO Report 03, developed from information uploaded to the ECO Frequency Information System (EFIS) database, reports that the 1805-1880 MHz band is licensed to mobile network operators in almost all CEPT administrations. In addition, the 1900-1920 MHz band is licensed to mobile network operators in approximately half of all CEPT administrations. Therefore, due protection of the commercial mobile networks has had to be ensured.

Developments for the governmental use of drones

In 2018, the Working Group Frequency Management (WG FM) initiated the development of an ECC report on spectrum solutions for UAS. This was initially intended to cover both, "the commercial use of command and control systems in the 1900-1920 MHz band" and

"the governmental use of command and control as well as payload systems by UAS in the 1880-1900 MHz and 1900-1920 MHz bands".

However, as there were insufficient contributions brought on commercial drones, in October 2020 it was decided to focus on governmental uses. Those governmental uses could include the enhancement of public safety by police forces at large public events or use by public authorities in gaining easier and cheaper access to public infrastructure for inspection.

Figure 1 - UAS used in the coordination of fire fighting

Key to setting the sharing mechanism for 1900 MHz UAS was to ensure due protection both of existing DECT and to ensure the drones could coexist with any 1900 MHz RMR use. It was determined that co-channel operation between governmental drones and RMR in the 1900-1910 MHz band at the same location was not feasible, irrespective of the technology used.

However, where the DECT New Radio + technology was assumed, it was found that UAS could potentially be used in both the 1880 to 1900 MHz and 1910 to 1920 MHz bands. Conditions had to be attached first: Certain technical constraints on power, transmit power control and distance from any RMR infrastructure had to be mandated. Furthermore, the number of drones operated in any location would need to be limited to three. On this basis, the WG FM in June 2023 published a new ECC Report 352.

Work continues on an ECC Recommendation, based on the ECC Report 352. This work was started in early 2023 and is expected to be complete by the summer of 2024. Early proposals include a form of virtual geo-fencing around 1900 MHz RMR infrastructure. If this proposal is adopted, it would see RMR infrastructure managers providing detailed

locations of 1900 MHz rail infrastructure into a secure database, which the governmental drone user would access to correctly observe the necessary distance between the rail infrastructure and the drone.

Developments for enhanced rail communications

In our Newsletter of August 2019, we set out the initiatives that are moving rail safety communication away from the legacy 2G-based system to a modern communication system based on newer technologies such as long-term evolution, 4G, or new radio, 5G. At the end of that article, we noted work had commenced on the 1900-1920 MHz band, following a Mandate to CEPT from the European Commission.

That work resulted in the CEPT Report 076 and ECC Decision (20)02 which designated the unpaired frequency band 1900-1910 MHz for RMR on a non-exclusive basis.

It is expected that the paired frequency bands 874.4-880.0 MHz and 919.4-925.0 MHz, known as the 900 MHz bands, will be the primary bands used for RMR communications. However, there are areas where there may be a need for additional channels to be in use, such as in large rail shunting yards.

Some of these shunting yards are at the border of European countries. Therefore, it has now been necessary to consider the issue of cross-border coordination, to minimise the potential for interference between 1900-1910 MHz RMR networks on either side of a country border.

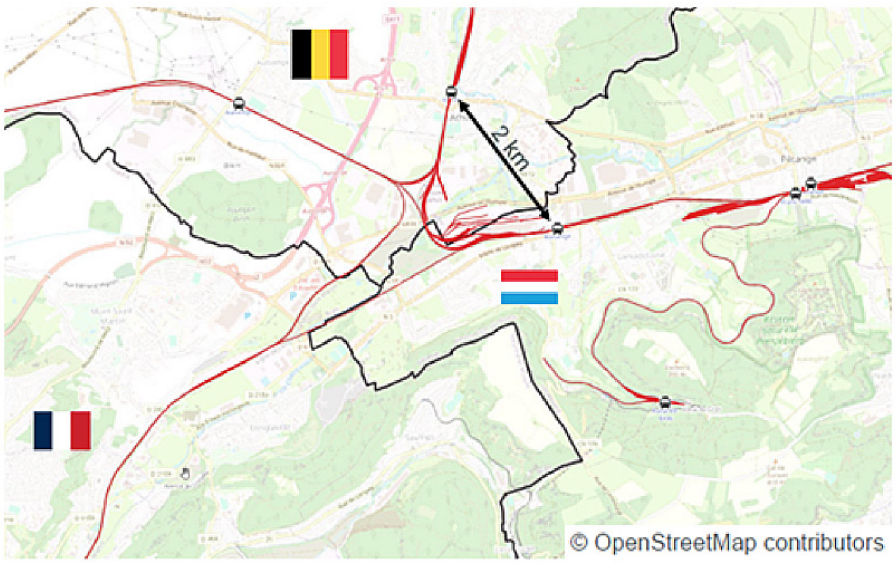

Figure 2 -Rail shunting yard at a three-way border

In the ideal situation, adjacent country RMR networks would be fully synchronised. However, that is not always possible. Therefore, the WG FM, in June 2023, published a new ECC Recommendation (23)01 on cross-border coordination for railway mobile radio in the 1900-1910 MHz TDD frequency band. This was in turn based on the analysis

detailed in the ECC Report 353, also published in June 2023. This new ECC Recommendation can now be used by rail infrastructure managers to set bilateral or multilateral agreements for cross-border coordination between RMR networks. These agreements will be based on a mutually agreed received power level, known as the "coordination trigger field strength".