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Satellite-based Internet of Things systems get a 21st century refresh

Operators who look for spectrum are facing opportunities and challenges in the existing ECC regulatory framework, writes Peter Faris and Jaime Afonso

The demand for spectrum for satellite-based Internet of Things (IoT) systems is on the rise. Recent technological developments have meant that smaller, cheaper satellites can now be deployed. As a result, there has been an increase in demand for spectrum from new players who want to deploy systems for a range of applications in sectors such as transport, energy and agriculture.

ECC Report 305, published in February 2020, provides further details on typical-use cases. Such applications tend to have low data-rate and low duty cycle requirements, for example, to transmit several kilobytes of data every few hours. This can be facilitated by a small constellation of satellites in low Earth orbit – a few hundred kilometres above the planet. They operate in narrow bandwidths in mobile-satellite service allocations available below 1 GHz.

Figure 1: Simplified schematic of typical satellite IoT applications

The increase in demand for spectrum for these types of satellite IoT systems has led to renewed interest in the ECC regulatory framework for Satellite Personal Communications Systems, or S-PCS.

Going back to the start

In the 1990s there was a surge in the use of mobile satellite service systems. The ITU and its member administrations recognised that such growth could be long-term, and that new, competing systems would emerge, so they made additional allocations of spectrum available. At the 1992 World Administrative Radio Conference and subsequent World Radiocommunication Conferences, it was decided that additional allocations of spectrum would be provided for mobile satellite service systems on a worldwide basis, and that they would be provided in frequency ranges below 3 GHz (see, for example, the outcome of the 1997 Conference).

CEPT undertook several initiatives to harmonise authorisation conditions and procedures. At that stage, it was considered that a coordinated approach was needed, given the vital importance for Europe's telecommunications and space industries.

The background and definition of the term S-PCS were described in detail in a 1995 CEPT ECTRA Report. The term "Little LEO", for example, was originally developed to distinguish mobile satellite service systems which operate below 1 GHz from "Big LEO" systems which operate above 1 GHz.

S-PCS operating below 1 GHz covers services such as low-bit-rate data communications, messaging, position determination and other non-voice applications for individual users, providing global coverage. These satellite systems are identified as "S-PCS below 1GHz" (S-PCS < 1 GHz), operating in the harmonised frequency bands 137-138 MHz (space-to-Earth) and 148-150.05 MHz (Earth-to-space), as well as 400.15-401 MHz (space-to-Earth) and 399.9-400.05 MHz (Earth-to-space).

In 1999, CEPT developed and published three CEPT Decisions for these bands:

- ERC Decision (99)06 on the harmonised introduction of satellite personal communication systems operating in the bands below 1 GHz (S-PCS< 1GHz);
- ERC Decision (99)05 on Free Circulation, Use and Exemption from Individual Licensing of Mobile Earth Stations (S-PCS < 1GHz)
- ECTRA Decision (99)02 on Harmonisation of authorisation conditions in the field of Satellite Personal Communications Services (S-PCS) in Europe, operating in the bands below 1 GHz (S-PCS < 1 GHz)

The harmonised conditions within this framework aim to ensure "maximum spectrum efficiency, maximum protection for terrestrial services as provided by the Radio Regulations and maximum competition" as set out in ERC Decision (99)06. This ERC Decision provides a procedure for the harmonised introduction of S-PCS within CEPT countries, including principles and criteria for the identification of spectrum to be used by the mobile earth stations, as well as technical and operational constraints for each system to be introduced.

ERC Report 087 was developed in 2000 to address sharing between S-PCS < 1 GHz and existing terrestrial services in the relevant bands allocated to mobile satellite systems below 1 GHz. The studies identified mitigation techniques to be employed by individual systems to improve the compatibility between mobile earth stations and other radio services. Based on this, operational constraints were specified for the candidate mobile satellite systems in accordance with the requirements of ERC Decision (99)06.

Accordingly, five systems were included in the original framework within the year 2000, of which only one – Orbcomm – remains in operation. The ECC Decisions then remained untouched for several years until recently.

The opportunities and the challenges

The opportunities provided by this framework, in particular the possibility for exemption from individual licensing across CEPT, have proven to be of interest to new operators planning to deploy satellite IoT systems in these bands. As a result, the ECC has received

requests from five new operators since late 2018 – Hiber, Argos Kineis, Swarm, Myriota and Fleet Space. These requests have been presented and discussed within Project Team FM 44 (PT FM44).

The requests from new operators have raised a number of challenges in terms of how to use and interpret a framework developed and unchanged for the past 20 years, taking into account both advances in technology as well changes in policy and procedures within the ECC.

According to ERC Decision (99)06, new candidate systems can be added to the list of systems to be considered for introduction in CEPT countries when all necessary inter-service and intra-service compatibility studies have been successfully completed and agreed. Any required operational constraints based on the results of studies would also be added to the Decision.

Such studies have been underway within Project Team SE 40 since 2019 and results have been included in draft ECC Report 322.

The intra-service issues have proven to be one of the most challenging aspect in the studies, particularly as the number of new systems introduces a level of complexity that can slow down the overall review of the Decision. In other words, each combination of new candidate systems within the same band, as well as the existing Orbcomm system (in the case of the lower band), needs to be considered.

It should be noted that the intra-service compatibility studies are not intended to replace the ITU coordination process. Coordination principles under Article 9 of the Radio Regulations such as satellite network priority are excluded from consideration in these studies.

It is also worth noting that the requirement for such detailed intra-service studies is unique to this specific framework; other ECC Decisions on harmonisation of satellite bands do not contain similar requirements.

Simplifying and speeding up the process

These issues have been discussed in ECC and various sub-groups since 2019. Recognising the challenges, ECC agreed that a wider review of the framework would be beneficial in order to simplify the process for candidate operators, as well as the ECC groups addressing these issues.

However, as such a review would itself take some time, it was decided that this should not be at the expense of the operators who had already submitted requests for inclusion under the framework and were awaiting the outcome of studies. It was also agreed that individual

updates of ERC Decision (99)06 could be published once the necessary studies were completed and agreed for each candidate system, without needing to await results for other operators who applied later in the process.

Consequently, three revisions of the Decision have been published since November 2020 – most recently in March 2021 – providing results for the Hiber, Argos Kineis and Swarm systems respectively. The corresponding studies have been included in draft ECC Report 322, which is intended for final publication once conclusions have been agreed for all new candidate systems.

Taking the next steps

Sharing studies remain ongoing, in particular to address two candidate systems, Myriota and Fleet Space. It is expected these studies could be completed by the end of the year.

Discussions have been initiated in PT FM44 on the wider review, which aims to merge the three existing Decisions into one. It will also aim to simplify and "future-proof" the overall process for any future candidate systems while ensuring sufficient protection for existing operators and for systems operating in adjacent bands. A draft work item is planned to be agreed by the end of the year, which will define in detail the scope and timeline for this activity.

Updated regulatory framework for Radio LAN is now ready in Europe

Ongoing work by the Electronic Communications Committee sees regulations renewed for Radio Local Area Networks at 5 and 6 GHz, writes Doriana Guiducci

It may be a well over 18 months since many of us had reason to visit an airport, but if you flew in recent weeks and months, there is a chance that you used a Wireless Access System (WAS) there. A WAS is a broadband radio system, which can be deployed either inside or outside buildings, usually in geographically limited areas – it is often used in places such as airports.

More specifically, at the airport you would have used broadband Radio Local Area Networks (RLANs), a subset of WAS. They are the major type of equipment deployed today and are predominantly used inside buildings.

Even if you haven't had the opportunity to travel in recent months, you may have seen RLANs in action at your local coffee shop, at a hotel or a shopping centre. They typically include public and private applications also offered in homes, schools, hospitals, railway stations, and so on.

These types of applications are usually intended for connections between traditional business products such as PCs, laptops, servers, printers and other networking equipment, as well as digital consumer electronic equipment in the wireless home network environment.

Since 2003, when the World Radiocommunication Conference (WRC) first allocated on a primary basis the 5150–5350 MHz and 5470–5725 MHz bands to the mobile service (except aeronautical mobile service), CEPT committed to harmonising the use of frequencies for RLANs in the 5 GHz range.

In 2004, it adopted the ECC Decision (04)08, which defines the harmonised use of the 5 GHz frequency bands for the implementation of WAS/RLAN equipment operating exempt from individual licensing. The Decision has been periodically revised and updated to support the rapid take-up of WAS/RLAN applications on a large scale deployment.

More recently, there has been increasing momentum all over the world to open additional spectrum for WAS/RLANs in the 6 GHz band. The argument to do so is that it will respond to the ever-increasing demand for higher connection speeds and data traffic volumes, which

could be more easily met by means of the wider channel bandwidth being available.

Several countries have adopted, or are in the process of adopting, regulation to allow WAS/RLANs in different portions of the 6 GHz band. In CEPT, the ECC Decision (20)01 on the harmonised use of the frequency band 5945-6425 MHz for WAS/RLANs was issued in November 2020.

Figure: Countries enabling RLAN at 6GHz (source WiFi-Alliance)

The update of the regulatory framework at 5 GHz

In July this year, the ECC completed the latest revision of ECC Decision (04)08 on the harmonised use of the 5 GHz frequency bands for the implementation of WAS including RLANs. They are summarised in the figure below. This update follows the WRC-19 decision that existing global conditions in the 5150-5250 MHz band would be relaxed to allow indoor usage in trains and cars, as well as outdoor usage with certain limitations. It was also agreed at WRC-19 that the 5725-5850 MHz band would be extended for use in certain countries outside Europe.

In addition, the updated harmonised conditions in the 5 GHz band take into account the explanatory paper that ECC had already developed to clarify which frequency bands were possible for 5 GHz RLAN usage in vehicles.

Figure: Provisions in ECC Decision (04)08 for the use of WAS/RLANs in the 5 GHz range

Based on the same harmonisation measures, in July ECC also published CEPT Report 79 to provide a response to the European Commission Mandate to CEPT to amend Commission Decision 2005/513/EC.

In order to enable RLAN use on a national basis in the band 5725-5850 MHz, while ensuring the protection of road tolling systems, smart tachograph and radars, ECC is now finalising a new ECC Report. This will provide national administrations with guidance on suitable limitations for appropriate technical conditions, mitigation techniques and regulatory measures.

In ECC Report 277, ECC already addressed the use of short range device applications in cars in the 5725-5875 MHz band. This Report also studied the coexistence between WAS/RLAN systems operated in cars under short range device regulation and intelligent transport systems, as well as road tolling systems.

The careful assessment by ECC in the work highlighted above, has allowed all these systems to operate in the band 5725-5875 MHz at the same or adjacent frequencies.

The new regulatory framework for the 6 GHz band

In November 2020, ECC adopted a new ECC Decision (20)01 for the harmonised use of the frequency band 5945-6425 MHz. This opens 480 MHz of spectrum for the unlicensed use of WAS/RLANs.

ECC also developed two CEPT Reports – CEPT Report 73 and CEPT Report 75 – in response to the European Commission mandate to CEPT to study feasibility and to identify harmonised technical conditions in the 5925-6425 MHz band for the provision of wireless broadband services.

These Reports assess compatibility and coexistence scenarios and study harmonised technical parameters for WAS/RLANs operating, on the basis of a general authorisation, ensuring coexistence with appropriate mitigation techniques and/or operational compatibility or coexistence conditions.

Further to the work of the ECC and the resulting CEPT Reports, in June the European Commission adopted the Commission Implementing Decision on the harmonised use of radio spectrum in the 5945-6425 MHz frequency band for the implementation of WAS including RLANs. The Decision sets the condition for low power indoor WAS/RLAN devices, which can operate indoors with a maximum power of 200 mW, and also for the very low power portable devices which may operate both indoors and outdoors with a maximum power of 25 mW.

ECC started its spectrum engineering studies in 2017 for the definition of the new regulatory framework for WAS/RLAN in the 6 GHz band. Since then, the ECC Report 302 on sharing and compatibility studies for WAS/RLAN in the frequency band 5925-6425 MHz has been published, as well as the ECC Report 316 on sharing studies assessing short-term interference from WAS/RLAN into fixed service in the band.

Currently, ECC is continuing its work to further study out-of-band emissions from very low power WAS/RLAN devices operating in the band 5945–6425 MHz. The purpose of this work is to protect a set of urban rail systems that operate in certain cities in Europe, in the band 5915-5935 MHz. This study should investigate interference scenarios from very low power WAS/RLAN 6 GHz devices to communication-based train control systems. It will address the different types of communication-based train control networks that are currently operated, as well as possible future systems. This work will also provide elements to respond, by June 2024, to the recent EC Mandate to CEPT to review the limit of out-of-band emissions below 5935 MHz applicable to very low power WAS/RLAN devices.