Challenges of World Radio Conference studies: 10 GHz spectrum

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The outcome of the World Radio Conference 2019 (WRC-19) has now been disseminated, changes to regulations and technical licence conditions are being implemented and spectrum awarded. Attention is now turning to the agenda items identified for the next World Radio Conference scheduled for 2023 (WRC-23) for which preparatory work will be starting within ITU-R as well as regional and national bodies to address the necessary studies needed to inform future spectrum decisions. Simple minimum coupling (worst case) sharing studies are usually the first step in assessing any changes to frequency allocations. Then, depending on the outcome, these may be followed by detailed discussions and analysis involving other considerations such as density and geographic location of incumbents, coordination requirements and remedies for incumbents.

This Insight highlights the challenges faced when considering one of the agenda items, as an example, that will be addressed over the forthcoming study period, namely the potential for 10 – 10.5 GHz to be identified as an IMT band.

Identification of the band

Agenda item 1.2 for WRC-23 identifies a number of potential IMT frequency bands including 10.0 to 10.5 GHz. According to the ITU Region 1 allocations, shown in Figure 1, the band is already allocated to mobile services on a primary basis in the frequencies 10.0 to 10.45 and 10.5 to 10.55 GHz. However, this allocation does not guarantee co-existence with other primary services which are Earth Exploration Satellite Service (EESS) (active), Fixed Service and Radiolocation Service.

The allocations in other ITU Regions (2 and 3) differ and in Region 2 there is no mobile allocation in the 10.0 to 10.5 GHz range.

It should be noted that some services (shown in lower case in Figure 1) are secondary which means they shall not cause interference to stations of primary services or shall not claim protection from harmful interference of a primary service. However, it does not mean that their use should be disregarded in any co-existence studies – but the need for 500 MHz of spectrum may merit consideration.

It is also worth noting that a footnote in the Radio Regulations states that systems operating in EESS shall not cause interference to or claim protection from Radiolocation systems operating in this band even though both services are primary.

In the following sections we consider the issues that need to be considered in CEPT countries to develop their position on allowing the introduction of IMT at 10 GHz.

Considerations in CEPT (European) countries

Allocations and applications of major use or interest to CEPT countries are provided in the European Common Allocation (ECA) table[1]. If we consider the current potential use of the 10.0 to 10.5 GHz band and adjacent bands in CEPT countries then there is a wide range of applications, civil and military, that maybe deployed as shown in Figure 2.

Figure 1: ITU Region 1 allocations in 9.9 to 10.55 GHz

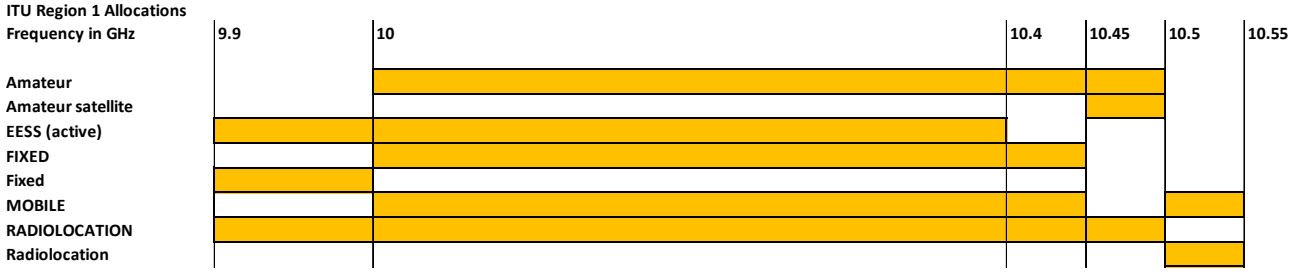


Figure 2: Applications in 9.9 to 10.55 GHz from the European table of frequency allocations and applications in Europe (ECA)

In practice each country does not allocate or use the frequencies for all the applications shown and therefore there are differing uses and priorities on an individual country basis.

It can be seen in Figure 3[2] how the actual applications can vary by country, based on three examples, which has practical implications on determining the potential to share the 10 GHz band with IMT.

A major user of the band is the military which already shares the 9.9 to 10.5 GHz band with a number of civil applications. This is feasible because of the intermittent use of military applications or the limited geographic deployment of defence systems. Whether it would also be feasible to share with IMT networks on a national basis will be an important consideration or perhaps the frequency band will be suitable for local IMT licensing to support vertical industries. The use of an automated frequency co-ordination system may facilitate sharing.

Impact of some applications on potential coexistence with IMT

With a diverse range of current users of the band, there are many potential impacts that must be considered when looking at reallocation.

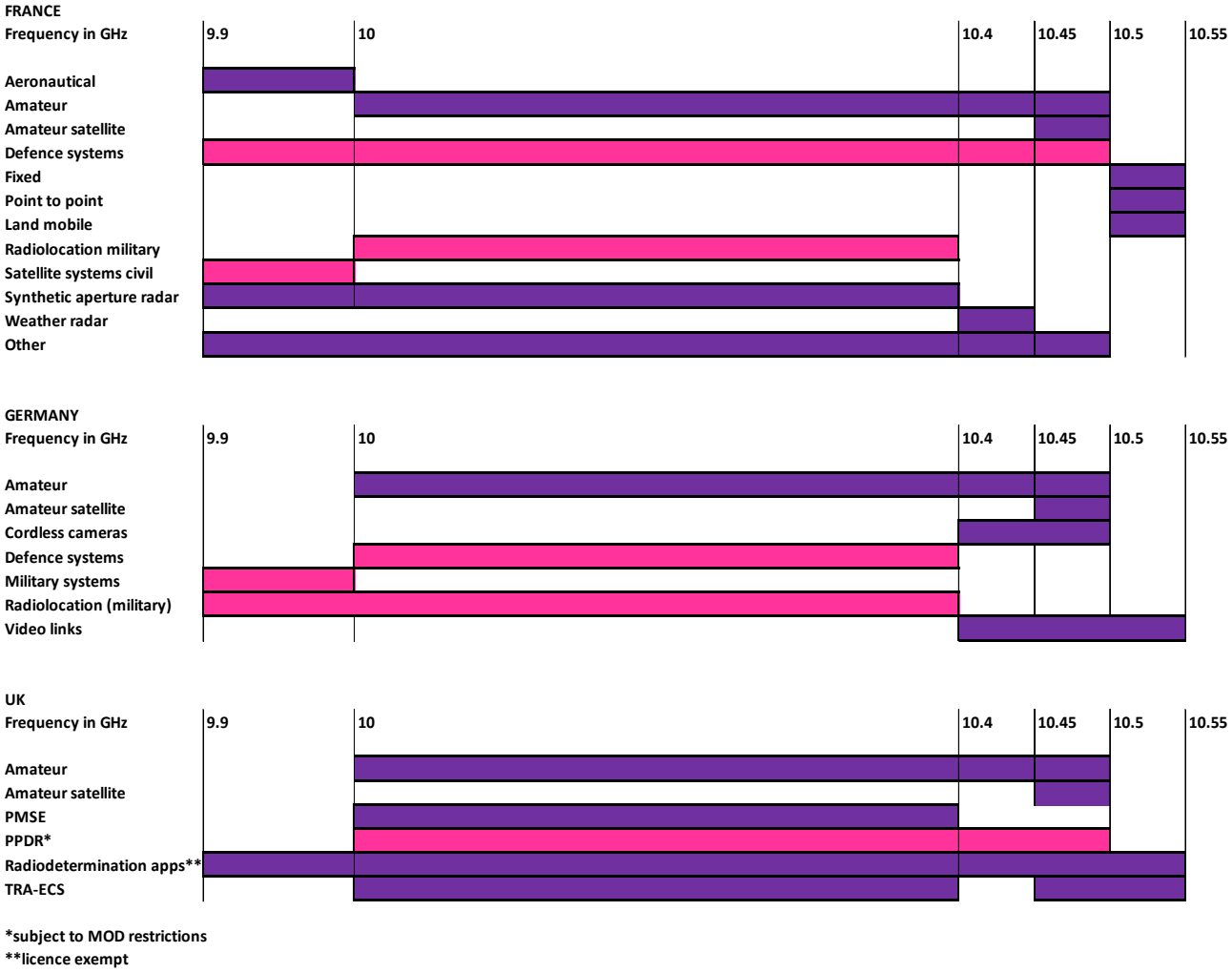
X-band radars operate in the 8 to 12 GHz frequency range and are used for a wide range of civil and military applications as they can provide very good precision (high precision imagery) over sufficient ranges and can use small cheap antennas making them suitable for deployment on small pleasure boats as well as large vessels and aircraft. Mobile radars may be used for weather monitoring, detecting and tracking land vehicles and aircraft in coastal and border areas, air traffic control, maritime vessel control and perimeter and airborne surveillance. It is expected that demand for X-band radars will continue to grow with the forecasted global demand for surveillance and targeting growing from $4.58 billion in 2016 to $5.61 billion by 2021[3]. The potential for coexistence will need to consider the likely geographic locations and density of deployment of X band radars operating in the 10.0 to 10.5 GHz band and also adjacent bands as well as potential future demand.

With a diverse range of current users of the 10 GHz band, there are many potential impacts that must be considered when looking at reallocation.

Another consideration will be the development of new radars; next generation radars are expected to be available by 2027 and will be low cost, lightweight and use, for example, active phased arrays. The life cycle for radars, in particular those used by the military, can be significant and costly as they have to be integrated with for example command and control systems, missiles and anti-aircraft guns. These market considerations will also have implications for potential coexistence with IMT in addition to any technical sharing analysis for current and future radars.

Fixed Service applications are also primary users. These applications have either been licensed, or planned to be licensed, on an individual or block basis[4] in a number of countries[5]. In terms of sharing with potential future IMT deployments, it is important to consider how much margin fixed links have to accommodate any additional interference from other services. It is also important to design representative IMT deployment scenarios to be able to quantify the interference

Figure 3: Applications in example countries



into fixed links. In cases where no sufficient margin exists, other mitigation mechanisms may have to be considered (for example, geographic separation or guard bands).

EESS also has a primary allocation in the band. These have active systems – that is, they transmit and receive radio signals. The implications of interference from a population of IMT transmitters located within or nearby the measurement areas need to be analysed to assess the impact of interference into EESS receivers. Important parameters for the analysis are EESS receiver interference sensitivity and IMT population densities and emission characteristics.

Programme making and special events (PMSE), such as video links, also use the band but often this is on a secondary basis.

Next steps

In preparation for the meetings in CEPT and ITU addressing the WRC agenda items individual administrations and interest groups such as the European Defence Agency (EDA) and GSM Association (GSMA) will take a high-level view on the potential for new and incumbent services to share the identified frequency bands (in this example 10.0 to 10.5 GHz).

This may involve undertaking initial sharing analysis (co-channel and adjacent band). It will be necessary to identify and agree on the representative technical parameters of the services involved and the appropriate ITU-R propagation models. For example, the use of minimum coupling loss analysis provides an insight on the coexistence potential and where the outcome is favourable sharing is likely to be possible. But where the numbers from the analysis are significantly untenable that may

indicate the introduction of a new service, IMT in this specific example, may not be feasible even when considering actual deployments and interference mitigation techniques.

Where the outcome of the initial worst-case analysis is marginal further detailed studies involving deterministic and/or statistical interference scenarios may be undertaken such as described in the Plum insight "What's yours could be mine (shared)"[6].

The outcome of the sharing studies could indicate the need to restrict incumbent or new use, modify or replace equipment or even migrate from the band. The sharing analysis results will guide administrations taking a view on the practicality of introducing the new IMT allocation in the 10.0 to 10.5 GHz band and lead to the development of positions on the agenda item prior to WRC-23.

Final word

We are on the first stage of the next round of preparations for a World Radio Conference. The agenda item on the 10.0 to 10.5 GHz is just one of many that will be addressed over the forthcoming months. Other agenda items likely to be of interest and challenging include the review of the UHF band (470 – 960 MHz) in Region 1 and allocation of 6 GHz bands for IMT on a world-wide basis. Stakeholders will be establishing their positions on contentious issues based on the outcome of sharing studies and discussions will be held in technical study groups to accommodate interests of different communities using the radio spectrum.

About Plum

We are a leading independent consulting firm, focused on the telecommunications, media, technology, and adjacent sectors. We apply rigorous analysis to address challenges and opportunities across regulatory, radio spectrum, economic, commercial, and technology domains.

We have built an extensive knowledge on issues related to radio spectrum sharing over the years through numerous studies undertaken for regulators, operators and manufacturers. We are capable of designing sharing scenarios, developing appropriate analysis methods, implementing sharing analysis, preparing reports and drafting contributions for national and international meetings and representing our clients' interests in these meetings.

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[1] Source: https://www.efis.dk/sitecontent.jsp?sitecontent=ecatable
[2] Source: http://www.efis.dk/
[3] Source: Markets and Market at www.marketsand markets.com/
[4] Block licensing means that a single user is licensed to use a block of spectrum which they can manage themselves provided they meet the necessary technical conditions
[5] ECO Report 004 provides an overview of the countries implementing CEPT/ERC/REC(12)05 which provides the harmonised channel plan for digital terrestrial fixed services operating in the 10 to 10.68 GHz band.
[6] https://plumconsulting.co.uk/plum-insight-whats-yours-could-be-mine-shared/