Upgrading mobile service allocation in 3600-3800 MHz

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World Radio Conference 2023 Agenda Item 1.3 calls for studies to examine the feasibility of allocating 3600 – 3800 MHz band to the mobile service (except aeronautical mobile) on a primary basis in Region 1 (i.e. Europe, Middle East and Africa). The band is already allocated to the mobile service in Region 1 but on a secondary basis, i.e. not allowed to cause interference to, or claim interference protection from, primary services. Services with primary allocation in this band in Region 1 are the fixed and fixed satellite services. This brief paper outlines some of the key issues raised by the possible upgrading of the mobile service status to primary, discusses potential approaches to minimise the impact on incumbent fixed and fixed satellite networks and presents Plum capabilities that may be relevant to affected stakeholders.

Key Issues

Upgrading the secondary Mobile Service (MS) allocation to a primary allocation status will have implications for incumbent primary service networks that are already operating in the 3600-3800 MHz band. These include systems operating under the Fixed Service (FS) and Fixed Satellite Service (FSS); providing primary status for the Mobile Service may imply that FS/FSS systems could no longer establish new sites and/or expand their capacity by increasing their bandwidth.

ITU-R Resolution 246, which is associated with Agenda Item 1.3, states that any new allocation should not impose constraints on the existing systems of primary services. The same resolution also notes that 'for African countries, especially those in tropical areas, the operations of FSS systems are more reliable for use in C-band frequencies (3 400-4 200 MHz), rather than in higher frequency bands' such as Ku (12/14 GHz) and Ka (20/30 GHz) bands.

The feasibility of a primary Mobile Service allocation will, therefore, be partly dependent on how extensively FS/FSS systems are deployed in a region or country.

In general, FS links are typically used for high capacity point-to-point links with relatively low densities. FSS links in this band operate in the space-to-Earth direction, i.e. Earth stations receive satellite transmissions. Commonly, C-band Earth stations have large antennas and serve as 'gateways' carrying trunk or network traffic and as 'telemetry, tracking, and command' (TT&C) stations used for housekeeping communication between spacecraft and the ground. There may also be VSATs which are more densely-distributed small two-way satellite systems for private and government applications.

Potential interference between IMT base stations and FS/FSS receivers will be the key factor to consider as

- power transmitted from a base station is higher than power of a mobile terminal;
- interference paths originating from base station transmitters into FS/FSS receivers are not temporary as transmitters and receivers are fixed; and
- interference paths are likely to be less obstructed due to relatively higher antenna heights of base station transmitters compared to mobile terminal heights.

To minimise the impact of interference, establishing coordination areas around FS/FSS receivers may have to be considered. Alternatively, or in addition, guard bands may have to be introduced to take advantage of discrimination provided by the base station transmitter and FS/FSS receiver selectivity masks.

Plum has undertaken several studies intended to clarify options for spectrum sharing in C-band and these have included desktop modelling, laboratory measurements and realistic field trials to illustrate the potential for geographical sharing between mobile services and satellite receivers[1].

Further Plum trials, for a European broadband operator, examined the implications of the degree of additional protection that might be afforded to Earth station receivers by the belt of trees around the site where they operate. This study measured the additional isolation due to vegetation in different seasons to assess the possibility of spectrum sharing between the Earth station and potential broadband transmitter sites in a nearby city. Data from this work has also been used to update the relevant ITU-R Recommendation (P.833, 'Attenuation in Vegetation')

[1] https://plumconsulting.co.uk/compatibility-lte-services-vsat-receivers/

Figure 1: Earth station receivers surrounded by the belt of trees

Another consideration is cross border interference. ITU Radio Regulations, associated with the use of parts of the 3400-4200 MHz band by the Mobile Service in different ITU regions, include clauses relating to cross-border interference. For example, before an IMT base station is brought into use the responsible administration is required to ensure that a specified power flux density limit at the border with neighbouring administrations is complied with.

The implications of interference into the incumbent services operating in the bands *adjacent* to 3600-3800 MHz will also need to be considered. The ITU Radio Regulations frequency allocation table shows that the primary services operating in the adjacent bands are also FS/FSS systems. Depending on the interference scenario examined, the use of additional filters at FS/FSS receivers and/or limiting IMT base station out-of-band emissions may have to be facilitated to minimise the impact of adjacent band interference.

Current situation in Europe

In Europe, the 3600-3800 MHz band has already been harmonised for mobile services as part of the European Commission Decision (2008/411/EC) covering the band 3400-3800 MHz published in 2008[2].

In 2014, the decision was amended by the Commission Implementing Decision (2014/276/EU)[3] to take account of the CEPT work on the technical conditions of spectrum harmonisation presented in CEPT Report 49 which includes the results of studies on the least restrictive technical conditions (e.g. block edge mask), frequency arrangements and principles for co-existence and coordination between wireless broadband and existing spectrum uses[4].

A further Commission Implementing Decision (2019/235)[5] was published in January 2019 to update the technical conditions of the decision in line with CEPT Report 67 where, in support of the introduction of next generation (5G) terrestrial wireless systems, harmonised conditions for both non-active antenna systems (non-AAS) and active antenna systems (AAS) used in broadband networks under synchronised, semi-synchronized and unsynchronised operations are provided. The other important issue addressed in the Commission Implementing Decision (2019/235) is the defragmentation of the frequency band to facilitate the roll-out of 5G networks with sufficiently large contiguous blocks of spectrum (e.g. 80-100 MHz) in line with the policy objective of gigabit connectivity[6].

In response to the harmonisation efforts outlined above, the UK regulator Ofcom recently published a statement detailing plans for the award of 120 MHz spectrum in the 3600-3800 MHz band. The statement notes that the 3600-3800 MHz band is the primary band for 5G services in Europe and Ofcom is therefore aiming to clear the band of its current fixed links and satellite systems[7]. A different approach has been adopted in Germany where the upper part (3700 – 3800 MHz) has been reserved for local assignments[8].

Current situation in the Middle East and Africa

A recent document[9] published by the Global Mobile Suppliers Association (GSA) outlines national positions regarding the use of C-band by 5G networks. The document indicates that the band 3600-3800 MHz has already been assigned for 5G use in Kuwait, Qatar, Saudi Arabia and UAE. The lower part of the band (i.e. 3600-3700 MHz) has been assigned in Bahrain. Many of the remaining countries have plans for assigning the band for 5G services.

How can Plum help?

Plum consultants have gained many years of experience on issues related to radio spectrum sharing through numerous studies undertaken for regulators, operators and manufacturers. Summary of our capabilities is provided below.

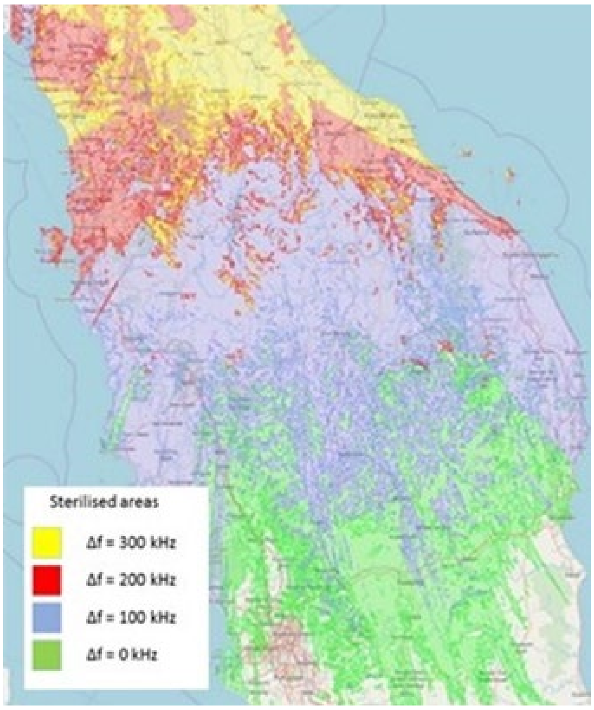
- Access to radio spectrum: Much of our work aims to optimise the use of radio spectrum by deriving appropriate technical conditions including limits on in-band and out-of-band transmission power levels, acceptable interference levels, guard bands, geographic separations and filtering

[2] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32008D0411
[3] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32014D0276
[4] https://www.ecodocdb.dk/document/49
[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019D0235
[6] https://www.ecodocdb.dk/document/3357
[7] https://www.ofcom.org.uk/__data/assets/pdf_file/0020/192413/statement-award-700mhz-3.6-3.8ghz-spectrum.pdf
[8] https://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/Areas/Telecommunications/Companies/TelecomRegulation/FrequencyManagement/ElectronicCommunicationsServices/FrequencyAward2018/20200128_SpectrumDiagram_pdf.pdf;jsessionid=A1B827642987D2668E228577CC627B46?__blob=publicationFile&v=1
[9] https://gsacom.com/

requirements which can be adopted when defining spectrum authorisation / licensing technical conditions. We also represent our clients at the technical committees of the ITU, regional organisations such as CEPT and standards bodies such as ETSI.

- Coverage and interference analysis: We can undertake a comprehensive coverage and interference analysis service using our in-house modelling tools. We develop system deployment and interference scenarios and analyse them using techniques ranging from simple minimum coupling loss analysis to complex simulations aiming to derive maps of coverage and interference contours using terrain and clutter databases. Our modelling capabilities incorporate a wide range of standard radio propagation models (e.g. ITU Rec. 452), as well as algorithms developed in-house for specific ad-hoc requirements.

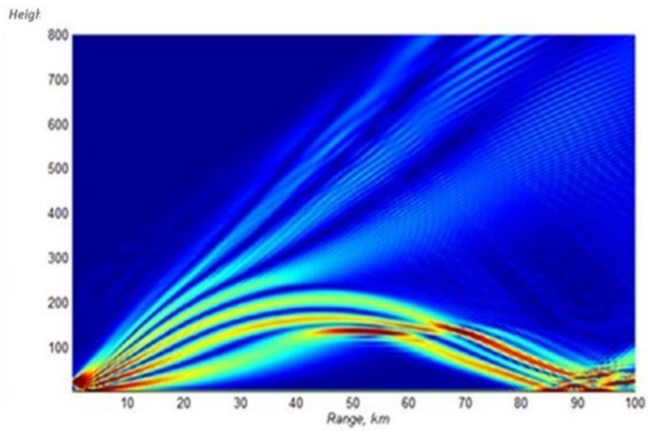
Figure 2: An example interference coverage map



- System planning: Our experience includes designing radio links in order to achieve a particular performance objective based on equipment and propagation behaviour taking account of intra- and inter-system interference, trading-off different system parameters (including emission levels, antenna characteristics, performance objectives, coverage requirements and network architectures) and collating, verifying and processing the technical data that has to be submitted both at a national and international level for the purposes of coordination and spectrum licensing.

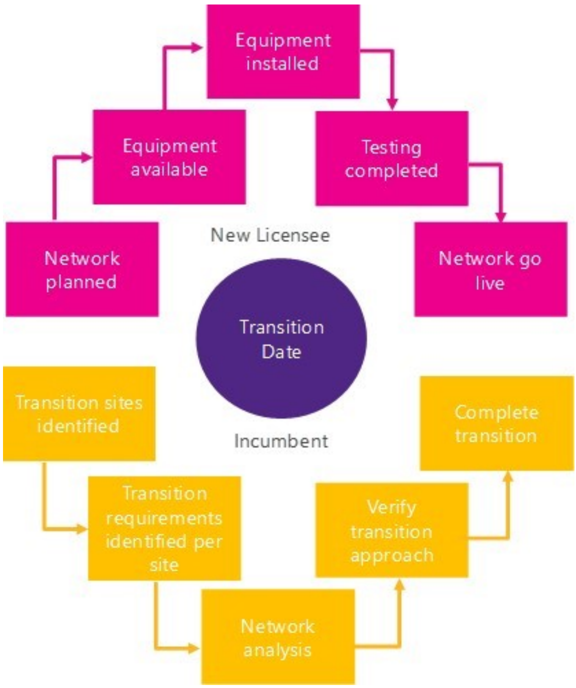
- Radio propagation: A significant activity within Plum has been the development of new propagation models, and the gathering of experimental data to support this work. Plum staff are active members of ITU-R Study Group 3, and were closely involved in the development of propagation models including the 'wide-range' model of Recommendation P.2001 and Recommendations P.452 for interference prediction and P.1546, widely used for planning and international co-ordination.

Figure 3: Modelling of tropospheric ducting using a parabolic equation model implemented in the open source SciLab environment



- Spectrum transitioning: It may be necessary to put in place. firm dates for cessation of all incumbent services after a spectrum award; or a process to ensure new licensees can access their frequencies and roll-out their new networks and services as planned. Plum's experience in transition plan development activities include stakeholder discussions to understand and explore the issues related to the transition process; identification of regions and frequencies requiring transition activities through technical impact analysis; suggestions for a way forward to deal with any conflicts; and proposals for compliance monitoring against the transition milestone activities.

Figure 4: Spectrum transition plan elements



- Experimental work and field testing: We undertake field trials and measurement campaigns with a well-equipped survey vehicle and a variety of measuring receivers, test transmitters, channel sounders and spectrum analysers interfaced to computer and GPS systems.

Figure 5: Plum measurement campaign example

These facilities may be used to gather data as the basis for developing models for various frequency bands and radio spectrum sharing environments, or for operational system planning and interference investigation. We also undertake laboratory testing often to provide additional information on equipment technical parameters to facilitate spectrum sharing analysis. We have designed and built a range of experimental equipment including millimetric-wave channel sounders and bistatic radar systems.

About Plum

Plum is an acclaimed independent consulting firm with a global focus. Plum specialises in the telecommunications, media and technology space and adjacent sectors.

Plum offers consulting services for its clients across multiple areas including business and technology strategy, legal and transactions support, economics and policy development, commercial solutions, regulation, technology and architecture, and specialist technical areas.

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