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Guidance for the development of band plans with contiguous bandwidths for mobile broadband applications for use in spectrum planning

M Series

Mobile, radiodetermination, amateur and related satellite services

ITU International Telecommunication Union

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

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Note*: This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.*

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REPORT ITU-R M.2264

Guidance for the development of band plans with contiguous bandwidths for mobile broadband applications for use in spectrum planning

(2012)

1 Introduction

This Report provides guidance on the development of frequency arrangements for systems operating in large contiguous bandwidths in the mobile service, with a view to assisting administrations on spectrum planning issues.

2 Relevant ITU-R Recommendations

Recommendation ITU-R M.1036 – Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations (RR);

Recommendation ITU-R M.1808 – Technical and operational characteristics of conventional and trunked land mobile systems operating in the mobile service allocations below 869 MHz to be used in sharing studies;

Recommendation ITU-R M.1823 – Technical and operational characteristics of digital cellular land mobile systems for use in sharing studies;

Recommendation ITU-R M.2015 – Frequency arrangements for public protection and disaster relief radiocommunication systems in UHF bands in accordance with Resolution 646 (Rev.WRC-12);

Recommendation ITU-R F.1399 – Vocabulary of terms for wireless access.

3 Spectrum planning for mobile broadband applications

There are certain methods/approaches that are conducive to planning the efficient use of spectrum for broadband applications. Fundamentally, consideration should be given to developing a harmonized band plan for such applications when large contiguous portions of the radio-frequency spectrum (sufficient for multiple blocks for broadband wireless access) are available for broadband applications in the land mobile service, such as those outlined in this Report, would increase the efficient use of spectrum.

Factors to consider in spectrum planning for mobile broadband applications include:

- harmonized spectrum and harmonized frequency arrangements for broadband mobile systems in the mobile service are desirable;
- harmonized frequency arrangements in the bands allocated to the mobile service could reduce the overall cost of broadband systems by providing economies of scale and expanded equipment availability, facilitating deployment and enhancing cross-border coordination;
- when developing frequency arrangements for mobile systems, possible technological constraints (e.g. cost efficiency, size and complexity of terminals, high speed/low power digital signal processing, and the need for compact batteries) need to be taken into account;
- guardbands between different systems should be minimized to make more efficient use of the spectrum;

- current and future advances in communication technologies (e.g. multimode/multiband terminals, enhanced filter technology, adaptive antennas, advanced signal processing techniques, techniques associated with cognitive radio systems, variable duplex technology and wireless connectivity peripherals, etc.) may facilitate more efficient use and increase overall utilization of radio spectrum, including the use of larger contiguous bandwidths;
- Recommendation ITU-R F.1399 – Vocabulary of terms for wireless access, defines the term "frequency block" as "A contiguous portion of spectrum within a sub-band or frequency band, typically assigned to a single operator".

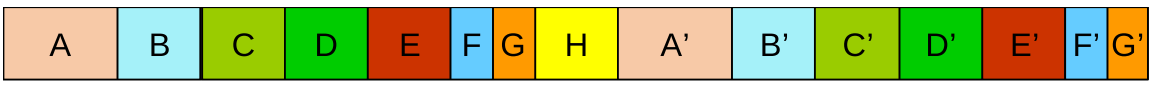
A harmonized plan could be developed for the contiguous band and then smaller blocks or sub-bands could be tailored and designated to different individual uses such as commercial operators, public safety agencies, utilities, business or industrial companies, etc. For example, the illustration in Fig. 1, shows a sample band plan with paired arrangements (A-A', B-B', etc.) for various uses that have the same duplex separation. There is a sample centre gap (H) that can be used for other purposes including some applications utilizing unpaired arrangements. If necessary, guardbands can be provided at the frequency boundaries of blocks that need frequency separation. The sub-bands could be assigned as follows, for example:

A-A' = commercial operator or application #1,
B-B' = commercial operator or application #2,
…,
E-E' = public safety agency or application #1,
F-F' = public safety agency or application #2,
G-G' = Utility company or application #1,
etc.

While the blocks in each pair A and A', B and B', etc. are of equal size and with a constant duplex frequency separation, they do not necessarily have to be operated as paired blocks. Radiocommunication applications utilizing unpaired spectrum (such as those using TDD technology or one-way communication such as mobile broadcasting) can also be implemented in individual blocks taking into account interference avoiding measures such as guardbands, geographic separation, link direction and/or time synchronization that preserve compatibility with services in adjacent paired blocks.

FIGURE 1

Sample band plan for various uses in a band of sufficiently large bandwidth



This approach is most suitable for large contiguous amounts of spectrum that are being developed to make available multiple blocks, each containing one or more channels to support broadband applications. While only parts of the larger band may be available in the initial development, it is essential to plan ahead and to develop a consistent band plan that can be implemented over time.

Some qualities of an efficient band plan for broadband applications in the mobile service are as follows:

– large contiguous symmetrical blocks that could support multiple approaches such as FDD and TDD;
– sufficient transmit and receive spacing, consistent with the available state-of-the-art filter and duplexer technology;
– consistent base and mobile transmit direction.

This harmonized approach could:

– enable higher spectrum utilization, reduced interference, improved economies of scale and deployment of the similar type of equipment across various mobile applications;
– support interoperability and roaming;
– enhance the possibility of specific user groups (e.g. public safety agencies) obtaining additional capacity (traffic overflow) by using adjacent blocks when needed (possibly invoking higher priority traffic) with the same terminal equipment;
– support implementing paired or unpaired spectrum usage;
– support technology evolution to larger bandwidths. As technology evolves, the application in each block could be re-deployed or changed as needed to use newer technologies, with minimal or no impact to the adjacent blocks.

Other planning considerations

In the context of such a harmonized band plan if FDD technology is implemented in paired adjacent blocks, using a consistent duplex direction (both using either the typical conventional or a reversed duplex direction) could minimize any need for guardbands between blocks.

The operating parameters such as transmitter powers, adjacent channel emissions and receiver susceptibility implemented within adjacent blocks of the band plan should be chosen to facilitate coexistence with minimum interference. High power transmissions should not be located in the same band as other lower power ones as they may overpower the receivers of equipment operating in adjacent channels. For example, receivers have difficulty coexisting in bands in close proximity to bands used by powerful radio location transmitters. Therefore, the band plan should accommodate services in adjacent bands, so that high and low power signals are not adjacent.

The duplex frequency separation should be determined based on careful considerations of the possibility of intermodulation products. Band plans should be chosen such that harmonics of device transmitter signals do not appear in the receive channels of other bands. The size of the block in the centre (referred to as block H in the example in Fig. 1) should be determined based on both the amount of unpaired spectrum needed, as well as the minimum centre gap required between the paired blocks. The centre duplex gap needs to be chosen based on the frequency band so it is not too narrow in relation to the band frequency. If the gap is too narrow, the duplex filter will require very steep roll-off and such filters have additional pass-band loss and thus are less efficient and reduce the battery life of mobile devices.

In addition to its use for TDD, the centre gap may also be used paired with an external band provided certain technical conditions are met. Although the centre gap could also be used for some other uses, these should be defined so that they do not interfere with receivers using the centre gap as part of the duplex gap filtering. For example, applications under the satellite and fixed (P-P) services, and applications for low power unlicensed use have been implemented successfully in duplex gaps in many operating systems. Another possible use for the centre gap could be for the reception of radio waves of cosmic origin.

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