

EXPANSION OF THE FREQUENCY ALLOCATION TO THE METEOROLOGICAL SATELLITE SERVICE AROUND 18.2 GHZ

Next generation geostationary meteorological satellites require bandwidth of 300 MHz for the downlink of sensor data to main ground stations. The analysis of options has shown that the best suitable band would be around 18.2 GHz. An expansion of the FN allocation from present 200 to 300 MHz is required. WRC 2003 has decided on an agenda item for WRC 2007 to deal with this. Technical studies are required to support the WRC 2007 agenda item.

EXPANSION OF THE FOOTNOTE ALLOCATION TO THE METEOROLOGICAL SATELLITE SERVICE AROUND 18.2 GHZ

1 INTRODUCTION

A first series of forecasts of data rates produced by next generation Geostationary Meteorological Satellites (GEO MetSat) has shown that a bandwidth exceeding 200 MHz will be required for downlinks in order to transmit sensor data to major ground stations of MetSat systems.

The bandwidth requirements are primarily determined by the use of high-resolution images and sounding units. The repetition rate of measurements from next generation satellites will be between 5 and 15 minutes, compared to 30 minutes for the 1st generation and 15 minutes for the current generation. The number of spectral channels and the spatial resolution will also be significantly increased.

On-board processing may be applied to reduce the overall data rate. Coding is likely to be applied in order to improve the radio link quality and to reduce the power levels on-board the satellites.

The number of major reception stations is expected to be very low. Two or three ground stations should be sufficient per satellite system.

The implementation of the first spacecraft of the next generation is foreseen for the timeframe 2012 – 2020. To allow timely implementation of the system it will be necessary to decide on the radio frequency plan for the satellites by the year 2007 at the latest.

2 SELECTION OF DOWNLINK FREQUENCY BANDS

2.1 Present Allocations in the ITU Radio regulations

In accordance with the ITU Radio Regulations the following frequency bands can be used for data downlinks from Geostationary Meteorological Satellites:

1670 – 1710 MHz
7450 – 7550 MHz
18.1 – 18.3 GHz
25.5 – 27 GHz

2.1.1 1670 – 1710 MHz

This band is allocated to the Meteorological Satellite Service as a primary service in all ITU regions. Parts of the band are also allocated to the Meteorological Aids Service (1670 – 1700 MHz), and to the Fixed and Mobile Services.

Both, geostationary and polar orbiting meteorological satellites presently use this band. Within CGMS it was agreed that the use of the band is separated as follows:

1670 – 1690 MHz - Downlink of sensor data from geostationary satellites. This includes image data, housekeeping telemetry as well as downlink of the data collection mission. It has to be noted that GOES satellites use this band also for broadcasts to user stations.

1690 – 1698 MHz - Broadcast from geostationary satellites to user stations. This includes WEFAX, High Resolution Image Transmission, MDD as well as LRIT and HRIT transmissions.

1698 – 1710 MHz – All downlinks (with the exception of APT) from polar orbiting meteorological satellites. This includes raw data transmissions (data dumps) as well as HRPT, AHRPT, C-HRPT etc.

It could be assumed that after completion of current generation services a bandwidth of maximum 23 MHz (i.e. 1675 – 1698 MHz) would remain available to support next generation services.

2.1.2 7450 – 7550 MHz

This band is allocated to the Meteorological Satellite Service as a primary service in all ITU regions. The use of the band is limited by Footnote 5.461A to geostationary satellites. The band is shared with Fixed, Fixed-Satellite and Mobile Services.

The band is presently not used by meteorological satellites. A bandwidth of 100 MHz would therefore be available for P-MSG transmissions.

2.1.3 18.1 – 18.3 MHz

The frequency band 18.1 – 18.4 GHz is allocated to the Fixed, Fixed-Satellite and Mobile Services on a primary basis in all Regions of the ITU. Footnote 5.519 provides an additional primary allocation to the Meteorological Satellite Service in the band 18.1 – 18.3 GHz. Any use of this allocation is limited to geostationary satellites.

The Fixed Satellites service presently uses the band for data downlinks and some feeder uplinks. No meteorological applications exist at the present time.

WRC 2003 decided to adopt an agenda item for WRC2007 (agenda item 1.2) to consider the expansion of the FN allocation around 18.2 GHz to provide at least 300 MHz of bandwidth to the Meteorological Satellite Service. Compatibility studies with other services effected will be required to support this agenda item.

2.1.4 25.5 – 27 GHz

This band is allocated on a primary basis to the Earth Exploration Satellite Service (EESS) (Space to Earth), to the Fixed, Inter-Satellite and Mobile Services. Meteorological Satellites are allowed to operate within allocations to the EESS.

The band is heavily used by the Fixed and Mobile Service. Footnote 5.536A and 5.536B states that in many countries EESS cannot claim protection from stations of the Fixed and Mobile services, nor constrain future developments of these services, which makes the EESS allocation in essence secondary in these countries.

Given the fact that the present main EESS downlink band around 8 GHz is overcrowded, it has to be expected that the band 25.5 – 27 GHz will be used by most future EESS satellites including non GSO (Geo-Synchronous Orbit) satellites. This will create difficult sharing conditions for geostationary spacecraft downlinks.

2.1.5 Choice of future Frequency Band

The choice of the suitable frequency band has to be based on several inputs, such as

- Availability of sufficient bandwidth
- Availability of spacecraft and ground station technology
- Frequency Co-ordination issues with existing services
- Considerations concerning parallel operations with current generation

Taking into account the above it appears that the band 18.1 – 18.4 GHz (assuming that WRC 2007 will agree on the expansion of the footnote allocation) is the best suitable band. Alternatively, the band 18.0 to 18.3 GHz could also be considered but currently it appears that the sharing situation is easier and more homogeneous in the band 18.1 to 18.4 GHz. Transmitters operating around 18 GHz are state-of-the art and are used in many telecommunication satellites. For the same reason availability of ground station receiver and demodulator modules for this frequency band are commercially available. The bandwidth of 300 MHz appears sufficient for reasonable scenarios.

The band 1670 – 1710 MHz appears not to be a good choice for two reasons: The bandwidth would be limited to 23 MHz only and parallel operations with MSG would only be possible by sufficient space separation. Furthermore it can be expected that bands below 3 GHz will have to be shared more and more with Mobile and Mobile Satellite Services.

The band 7450 – 7550 MHz would be very well suitable but provides only 100 MHz bandwidth. There is no feasible option for expansion of this bandwidth. Concerning

availability of space and groundstation technology, this band would be a very good band for operations.

It could be considered whether the band could be used in addition to a second operation band; for example, imagery data could be downlinked in the band 7450 –7550 MHz; Sounding and other data could be transmitted at 18.1- 18.4 GHz. This would require a second transponder and antenna system but would provide low cost reception equipment for the imager data.

The band 25.5 – 27 GHz provides sufficient bandwidth for all scenarios (1.5 GHz) but will be used by most future EESS satellites including NGSO (Non Geo-Synchronous Orbit) spacecraft. Furthermore, this band is already used by data relay systems for the inter-satellite links from NGSO user spacecraft to geostationary data relay systems. There will be a heavy burden on co-ordination and interference from polar systems, which can only be limited by strict operations co-ordination. This will be difficult if not impossible in reality.

Although technology is presently not fully developed it can be expected that space and groundsegment modules will be available around the implementation dates of next generation geostationary systems.

FN 5.519 provides spectrum between 18.1 – 18.3 GHz for the Meteorological Satellite Service (S/E) limited to the use by geostationary satellites and shall be in accordance with the provision of Art. 21, table 21-4 (this regulates the allowed power flux density at the surface of the Earth).

The extension of the bandwidth in FN 5.519 would harmonize the allocation to the Meteorological Satellite Service with current allocations to other services in the table of frequencies which covers 18.1 to 18.4 GHz.

3 EXPANSION OF FN 5.519

WRC 2003 has adopted an agenda item (WRC07 / 1.2) to consider the expansion of the FN 5.519 with respect to an additional allocation to the Meteorological Satellite Service. This agenda point is tied to relevant compatibility studies and it will now be necessary to prepare technical studies to demonstrate the feasibility of sharing with existing services in the foreseen expansion band.

Radio Services concerned are:

Fixed, Fixed-Satellite, Mobile, and Meteorological Satellite Service.

A first set of studies will have to be prepared by 2004 and will have to be submitted to the relevant ITU Working Parties. The conclusions of the working parties needs to be available by the beginning of 2006 to allow for the inclusion of the study results into relevant sections of the technical report to WRC-07 to be agreed by the Conference Preparatory Meeting in 2006.

4 CONCLUSION

Third generation geostationary meteorological satellite systems require bandwidth of around 300 MHz for the downlink of sensor data to main ground stations. The above analysis of options has shown that the best suitable band would be around 18.2 GHz. An expansion of the FN allocation from the present 200 to 300 MHz appears to be the most attractive approach. WRC 2003 has adopted an agenda item for WRC 2007 to consider such an expansion. Technical studies addressing compatibility issues with all services affected are required to support the WRC 2007 agenda item.