

CURRENT FREQUENCY ISSUES RELATED TO METEOROLOGICAL SATELLITES

(Submitted by WMO)

Summary and purpose of document

This document provides an update on current frequency issues related to meteorological satellites, including passive bands :

- WRC-07 agenda items,
 - Ultra Wide Band (UWB) issues,
 - Initialisation of the work for bands above 275 GHz
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ACTION PROPOSED

This document is for information and comments from CGMS.

1. Introduction

Radio-frequencies represent scarce and key resources for the meteorological community to either collect the observation data upon which its predictions are based or processed and disseminate weather information and warnings to the public.

A number of issues are currently discussed in international forum presenting either interest or high potential of risk for the meteorological community, in particular for meteorological satellites operations.

The following issues are developed in the current documents:

- WRC-07 agenda items,
- Ultra Wide Band (UWB) issues,
- Initialiation of the work for bands above 275 GHz

Finally, it should be noted that WMO is planning a Workshop on radio-frequencies currently scheduled 20-21 March 2006. CGMS representation and/or presentation on meteorological satellites current and future frequency use would be welcomed.

2. WRC-07 preparation

Among WRC-07 agenda items, 3 items concern frequency bands or issues of prime interest for Meteorological satellites:

- agenda item 1.2: Extension of the 18 GHz METSAT allocation and protection of the 10.7 and 36 GHz EESS (passive) bands;
- agenda item 1.17: Protection of the 1.4 GHz EESS (passive) band;
- agenda item 1.2: Unwanted emissions in EESS (passive) bands.

In addition, several agenda items do not directly concern Meteorological interests but, due to their wide open scope in terms of frequency ranges under study, might have an impact on frequency bands used for meteorological purposes.

- agenda item 1.5: Possible additional allocations for aeronautical telecommand and high bit-rate aeronautical telemetry between 3 and 30 GHz;
- agenda item 1.8: High Altitude Platform Stations (HAPS) in the 28 and 31 GHz band;
- agenda item 1.18: Pfd limits for Highly Elliptical Orbit (HEO) satellites in the frequency band 17.7-19.7 GHz.

WRC-07 is scheduled end 2007 and the Conference Preparatory Meeting (CPM) early 2007. The year 2006 will be crucial for finalizing the different positions and WMO representation to the relevant meetings will be of prime importance to support meteorological views. A WMO position paper is currently under preparation and will be finalized by end March 2006.

2.1 Agenda item 1.2 (CPG/PT2)

a) Issue 1 : Resolution 742 (WRC-03) on frequency band 36-37 GHz

As part of global passive measurements, the band 36-37 GHz is vital for the study of global water circulation since this band is able to monitor the rain, the snow, the ocean ice and the water vapour for ocean and land surfaces. Observations in the band for sensing the melting of snow near the surface are of very high interest. A number of passive sensors and radio altimeters are already using or are planned to use this frequency band in the near future (e.g.,

CMIS, MIMR, AMSR, AMSR-E, AMR, SMMR, SSM/I, SSMI/S, TMI, MEGHA-TROPIQUE and MWRS) for such measurements. These measurements are fully operational (regular use of the data, continuity of service, several usable data products) and are used on a world-wide basis. The retrieved data are used and exchanged between the meteorological organisations in all regions. The retrieved parameters are actually derived from a set of measurements performed at five frequencies which are interrelated (6, 10, 18, 24 and 36.5 GHz).

This band is shared between Earth Exploration Satellite Service (EESS) (passive) and Fixed and Mobile Services. Studies are still on-going to identify the maximum e.i.r.p for fixed and mobile links that could provide a means to ensure the protection of passive sensors in the 36-37 GHz .

b) Issue 2 : Resolution 746 (WRC-03) on METSAT allocation at 18 GHz

This issue is the follow-up of a European proposal to WRC-03 and aims at covering next generation geostationary meteorological satellites requirement that are to be launched in the time frame 2015-2020 and that would require bandwidth exceeding 200 MHz (18.1-18.3 GHz) as currently given in Radio Regulations footnote **5.519**.

An extension of 100 MHz additional bandwidth is required, mainly determined by the use of IR and UV sounding units and high-resolution imagers with an higher repetition rate of measurements and the number of spectral channels. The geographic resolution will also be significantly increased compared to the current generation of geostationary meteorological satellites.

It seems that there is a general consensus to support such 100 MHz extension but the question is whether the extended band should be 18-18.1 GHz or 18.3-18.4 GHz. These is also a preference to consider a global worldwide allocation. The US are currently favoring the lower band but there might be political problems due to the existing allocation of Broadcasting Satellite Service (BSS) in the band 18-18.1 GHz.

c) Issue 3 : Resolution 746 (WRC-03) on frequency band 10.6-10.68 GHz

As part of global passive measurements, the band 10.6-10.7 GHz is of primary interest to measure rain, snow, sea state and ocean wind for ocean and land surfaces. A number of sensors are already using or are planned to use this frequency band in the near future (e.g. CMIS, MIMR, AMSR, AMSR-E and TMI) for such measurements. These measurements are fully operational (regular use of the data, continuity of service, several usable data products) and are used on a world-wide basis. The retrieved data are used and exchanged between the meteorological organizations in all regions and are actually derived from a set of measurements performed at five frequencies which are interrelated (6, 10, 18, 24 and 36.5 GHz).

Apart from the 10.68-10.7 GHz band that is covered by the RR footnote **5.340** under which all emissions are prohibited, the band 10.6-10.68 GHz is also shared between Earth Exploration Satellite Service (EESS) (passive) and Fixed and Mobile Services. It has to be stressed that current deployments of FS links in certain administrations already create significant levels of availability degradation of passive measurements in this band. Additional constraints on the 10.6-10.68 GHz passive band would hence not be acceptable. Studies are still on-going to identify the maximum e.i.r.p for fixed and mobile links or other regulatory solutions that could provide a means to ensure the protection of passive sensors in the 36-37 GHz .

2.2 Agenda item 1.17 (CPG/PT2) : Protection of the 1.4 GHz EESS (passive) band

Under agenda item 1.16 (WRC-03) and acknowledging the non-completion of technical compatibility studies, last WRC-03 made a conditional secondary allocation to FSS for MSS feeder links nearby 1.4 GHz. Agenda item 1.17 (WRC-07) is the follow-up of this issue and request to finalize these technical studies in a view to determine whether these MSS feeder link are compatible with existing services and in particular passive service in the 1400-1427 MHz band.

For EESS, this band is a vital resource for measuring salinity and other aspects of the Earth and its atmosphere and, to that respect, is one of the passive bands quoted in footnote **5.340** that prohibits all emissions, emphasizing its particular importance for the scientific community. A number of sensors are planned to use this frequency band in the near future (SMOS, HYDROS, AQUARIUS) for such measurements.

Based on a 10% apportionment of the EESS protection criteria, current technical studies have determined power limits for the uplink and downlink that could ensure compatibility between the MSS feeder links and EESS in the 1400-1427 MHz.

It should also be noted that there is a certain buying out from both the company supporting such use and the US administration. On this basis, certain administrations, including European countries, are currently supporting a deletion of this FSS/MSS allocation.

2.3 Agenda item 1.20 (CPG/PT2) : Unwanted emissions in EESS (passive bands)

The issue of the protection of the Earth exploration-satellite service (passive) from unwanted emissions of active services has been on the agenda for the 3 last WRCs for which a number of administrations were supporting regulatory measures for the protection of passive services, and in particular the inclusion in the Radio Regulations of limits on the unwanted emissions of active services.

After difficult discussions up to the last few days of the WRC-03, no agreement to take such action was reached and a compromise solution was to continue the studies according to Resolution 738 and re-visit the issue at WRC-07.

It can be noted that such an inclusion of limits in the RR was taken by WRC-03 to protect to protect the EESS (passive) in the bands 31.3-31.5 GHz with regards to HAPS, as given in RR footnote **5.543A**.

The frequency bands under consideration are given in Resolution 738 (WRC-03), namely the 1400-1427 MHz, 23.6-24 GHz, 31.3-31.5 GHz and 50.2-50.4 GHz, are all key bands for the scientific and meteorological communities and quoted in footnote 5.340 that prohibits all emissions.

Studies are still on-going in a specific ITU-R Task Group (TG 1/9) and agreement on adequate out-of-band levels to protect EESS passive sensors is likely to occur, at the main exception of the protection of the 1400-1427 MHz band from Fixed Service that might be of great concern.

In addition, it is more than likely that most of the discussions would certainly lie on the regulatory field that would oppose, such as at the last WRC-03, proponents of strong regulatory measures in the Radio Regulations (majority of administrations) and other administrations (mainly US) favouring coordination process between operators. It however appears that this latter solution would be almost impossible to manage and control and would hence put at risk safe operations of passive sensors.

2.4 Other Agenda items

Agenda item 1.5 (CPG/PT3) : Aeronautical telecommand and telemetry

This agenda item cover the range from 3 to 30 GHz in which a number of frequency bands are used for meteorological purposes. In addition, large amount of spectrum up to several hundred MHz are currently expected either for telecommand or for telemetry.

In particular, the band 22.5-23.6 GHz has recently been proposed as a potential long-term candidate band for the US. This band is adjacent to the 23.6-24 GHz passive band for which compatibility difficulties regarding out-of-band emissions with aeronautical services would certainly be similar to those currently studied under agenda item 1.20. If the band 22.5-23.6 GHz were to be actually proposed, it would probably generate confusion with all the work already in progress under agenda item 1.20.

No studies to date have been performed and it is expected that it will be initiated at the forthcoming ITU-R WP 7C (November 05).

Agenda item 1.8 (CPG/PT3) : HAPS in the 28 and 31 GHz band

WRC-03 incorporated power density limits in RR footnote **5.543A** to protect to protect the EESS (passive) in the bands 31.3-31.5 GHz with regards to HAPS operating in the Fixed Service (FS). These limits adequately protect passive satellite services operating in 31.3-31.8 GHz and are assumed to provide sufficient power for operation of ground-to-HAPS links. It is essential to make sure that this agenda item does not lead to revisiting these power density limits.

Agenda item 1.18 (CPG/PT3) : HEO satellites in the 18 GHz band

This agenda item concerns the determination of power flux density (pfd) limits to be applied to Highly Elliptical Orbit (HEO) satellites in the 17.7-19.7 GHz.

The protection of the 18.6-18.8 GHz EESS (passive) band from Fixed-Satellite Service and Fixed Service are given in RR provisions **5.522A**, **21.5A**, **21.16.1** and **5.522B**, finalised at the WRC-2000 after more than 10 years of discussions !

It is essential to make sure that this agenda item does not lead to revisiting these provisions.

3. UWB issues

Ultra Wide Band (UWB) applications represent a new technology (at least for civil world) that transmit very low power over very large bandwidth, up to several GHz. It represents a new challenge for frequency management since it is not possible to regulate these applications under the current Radio Regulations or national regulations. Apart from very specific devices, these applications are expected to be deployed on a very large scale and hence intended to operate on a licence exempt basis that would not allow any control (in number in particular) while authorised.

On this basis, and concerning meteorological satellites, these UWB devices can present a risk of for both passive sensors and Earth Stations receptions due to the aggregation of interference produced by multiple devices.

International discussions have been held in ITU-R within a specific Task Group (TG 1/8), debate somehow complicated by the fact that the US administration has already issued in 2002, its own regulations and authorised the use of such UWB applications on the basis of EIRP limits.

TG 1/8 has recently finalised its work, recognising the different national or regional regulations (US, Europe or Japan) and summarising up to date compatibility technical studies.

Two different bands are currently considered :

- 1-10.6 GHz band for “generic” UWB devices mainly for telecommunications and location tracking applications,
- 21.6-26.6 GHz for Automotive Short-Range Radars (SRR)

For the first band, it appears that the US regulations is not sufficient to protect most of the radiocommunications services but would be sufficient for meteorological satellites, either for the 1.4 GHz and 10.6 GHz passive bands or reception stations. Europe and Japan are currently in the process of adopting their own regulations and have either confirmed or even tightened the EIRP limits proposed by the US. It hence appears that, currently, the meteorological satellite operations would be safeguarded.

This is certainly not the case for the second band (21.6-26.6 GHz) covering the 23.6-24 GHz passive band. Indeed, this issue has been one of the most sensitive and discussed issue between the powerful automotive lobby and the whole scientific and meteorological community. In this case, the EIRP level regulated in the US has been shown as by far not being sufficient to protect the 24 GHz passive sensors acknowledging the high car density and noting that between 4 and 8 radars are expected per car. On this basis, after tremendous amount of discussions and political pressure, Europe has also allowed in 2004 such use but only on a limited basis, in number (maximum 7% of the cars equipped) and in time (only up to 2013) after which SRR will have to be deployed in the 79 GHz band. It can also be noted that Canada has recently authorise such 24 GHz SRR but with a “notch” in the 23.6-24 GHz band with lower EIRP levels assumed to ensure the protection of passive sensors.

However, at this stage, and recognising the by nature worldwide measurements performed in this band, the US regulation still put at risk the global integrity of the measurements in the 23.6-24 GHz band. This is without saying that the European Regulations will not be jeopardised in the future and make sure that the limitations will be strictly applied. The meteorological community will certainly have to be vigilant with this respect.

It is finally worth noting that the ITU-R TG 1/8 has confirmed the non compatibility between these SRR and EESS (passive) presenting a negative margin higher than 30 dB !

4 Initialization of the work for bands above 275 GHz

The Preliminary agenda for the 2010 World Radiocommunication Conference already includes an agenda item requesting to consider frequency allocations between 275 GHz and 3 000 GHz.

Due to the radiocommunication technology developments, its obviously mainly relates to scientific use of the spectrum and in particular to passive sensing. New technological advancements enable the implementation of passive measurements in the range 275 GHz to 1000 GHz of chemical and physical parameters of high interest for climatological and meteorological purposes.

In order to allow for satisfactory future allocation, there is a need for the scientific and meteorological communities to perform detailed studies to determine the adequate frequency bands above 275 GHz to be used by EESS and the related sensors characteristics as well as performance and protection criteria.

The SFCG has currently initiated a consistent work item (also including bands below 275 GHz) and a scientific work would be needed from the meteorological community to undertake such work aiming at defining which bands would be of interest in the future for meteorological satellites further noting that there are already some sensors performing measurements in these bands or that are being developed to be launched in a near future.

The expertise of CGMS, in cooperation with SG-RFC would certainly ease progressing this issue that would be vital to prepare and safeguard long-term developments for meteorological satellites.
