CGMS-XXXIV
WMO WP-11
Prepared by WMO
Agenda item: I/1

REPORT OF THE MEETING OF THE SPACE FREQUENCY COORDINATION GROUP (SFCG-26)

(Submitted by WMO)

Summary and purpose of document

The 26th annual meeting of the Space Frequency Coordination Group took place at the invitation of DLR in Bonn (Germany) from 19–27 September 2006.

Mr Robert Wolf represented the WMO and CGMS in this meeting.

This document includes an extract of the report of SFCG-26 including all topics related to radio frequency use by Meteorological Satellites.

ACTION PROPOSED

CGMS Members to take note of the report and comment, as appropriate

Appendices:

I. Report of the Working Group 3 (EESS and MetSat);
II. Extracts of SFCG Resolution Res 23-1R3 (SFCG Objectives for World Radiocommunication Conferences). Note that the marker +++++ has been introduced at positions where those parts not relevant to Meteorological Satellite Services were deleted;
III. SFCG Resolution Res 19 -7 R3 (Use of the frequency band 7750 – 7850 MHz)
IV. Action Item on Update/Revision of Passive Band Requirements

REPORT OF THE METING OF THE SPACE FREQUENCY COORDINATION GROUP (SFCG-26)

1. The 26th annual meeting of the Space Frequency Coordination Group took place at the invitation of DLR in Bonn (Germany) from 19 – 27 September 2006.

2. The meeting was attended by 42 delegates from the following agencies:

ASI (Italy), CNES (France), CSA (Canada), CSIRO (Australia), DLR (Germany), ESA, EUMETSAT, INSA (Spain), JAXA (Japan), NASA (USA), NOAA (USA), RFSA (Russia), WMO.

Mr Robert Wolf represented the WMO and CGMS in this meeting.

4. This document provides an extract of the meeting results relevant for Meteorological Satellite Service (MetSat) and the Earth Exploration Satellite service (EESS passive).

5. Attached are:

- Report of the Working Group 3 (EESS and MetSat)
- Extracts of SFCG Resolution Res 23-1R3 (SFCG Objectives for World Radiocommunication Conferences). Note that the marker +++++ has been introduced at positions where those parts not relevant to Meteorological Satellite Services were deleted.
- SFCG Resolution Res 19 -7 R3 (Use of the frequency band 7750 – 7850 MHz)
- Action Item on Update/Revision of Passive Band Requirements

6. Cooperation between SFCG and CGMS on the use of radio frequencies are addressed in a separate CGMS document.

Report of SFCG-SWG-3: Remote Sensing and MetSat (Presented by M. Dreis, J. Zuzek)

The work of SWG-3 involved the following main topics:

- Active sensors,
- Passive sensors,
- Meteorological satellite issues,
- Other sensor issues,
- Review of actions from SFCG-25,
- Review of SFCG Recommendations and Resolutions.

8.3.1 Active Sensors

8.3.1.1 Active Sensing in the Lunar Region

There was one input document pertaining to active remote sensing in the Lunar region. Document SF26-11/D was introduced by NASA. This document provides a description of the technical and operational characteristics of a dual-band active spaceborne sensor proposed to operate in the Lunar region in the space research service (active) with 15–150 meter resolution at frequencies near 2.38 GHz and 8 GHz. This active spaceborne sensor is the Lunar Reconnaissance Orbiter (LRO) synthetic aperture radar (SAR). The technical characteristics, mission objectives, orbital parameters, design parameters, and antenna characteristics are given for the LRO SAR.

There was some discussion regarding whether or not there was a need to have an SFCG Recommendation on active sensing frequencies in the Lunar region or, alternatively, whether the existing Recommendation 24-1 could be revised to include Lunar active sensing in addition to active sensing for the Mars region. The group decided that such changes could be considered at a future date when more details are available on active sensing in the Lunar region.

8.3.1.2 Active Sensing in the 100-150 MHz Frequency Range

There was one input document submitted on this topic. Document SF26-12/D was introduced by NASA. This document presents the rationale for the frequency band selection and the technical and operational characteristics of a proposed active spaceborne sensor that would operate in the Earth exploration-satellite service (active) in the 100-150 MHz frequency range. The document also provides an interference assessment for a 1 MHz bandwidth sensor that would operate within this range. The active spaceborne sensor proposed for operation in the range of 100-150 MHz is the synthetic aperture radar (SAR) known as the Microwave Observatory of Subsurface and Subcanopy (MOSS). It is a dual frequency SAR for which the second frequency is about 436 MHz which is in the EESS (active) secondary allocation in the band 432-438 MHz. The document states that there is a need to estimate the vertical flow in the soil column linking surface hydrologic processes with that in the subsurface. For this reason, two frequencies are needed. The 436 MHz frequency would be used to measure moisture near the surface and a frequency within the 100-150 MHz range would be used to penetrate the surface and measure the soil moisture deeper into the soil below the surface.

The group discussed the merits of adding a future WRC agenda item for such an allocation and decided that it was premature to add such an item for the 2010 Conference. However, it was decided to add an item to the “wish list” for a future Conference in Annex 2 of the SFCG Objectives document and such an item was drafted and given to SWG-1 for inclusion in the Annex.

8.3.1.3 Active Sensor Characteristics

There was one document submitted on this topic. Document SF26-55/I was introduced by DLR. This document presents information on a mobile ground-based broadband microwave radar using bands between 1 GHz and 18 GHz. This radar has the useful feature that an almost arbitrary bandwidth can be selected. The document also provides information on an airborne SAR system that is in use which also can operate in several frequency bands up to X band. The main applications of these radars are to take experimental measurements in different SAR/ISAR modes to gain experience in the development of new radar technologies that can be used in future spaceborne radar sensors.

8.3.2 Passive Sensors

8.3.2.1 Passive Sensor Characteristics (General)

T here were three documents submitted that pertained to this topic: SF26-21/D (NASA), SF26-46/D (NOAA), and SF25-55/I (DLR).

In response to Action Item 25/5 document SF26-21/D, introduced by NASA, provided a historical perspective on the passive frequency band requirements and justification carried out by NASA in preparation for WARC-79. The document contains a summary of a variety of NASA Reports published in 1976 providing an overview on the performance and operational requirements for each measurement type, the measurements taken as well as the applications that may benefit from data for passive bands between 1.4 and 370 GHz. It was noted that the interference thresholds determined in 1976 already relied on the ITU-R Recommendation SA.1029 with the sensor sensitivity levels required and envisaged at that time.

In this context it was noted that one important element when reviewing the passive band requirements in the framework of Action Item 25/5 is the justification of the required sensitivity for a particular band as well as sensitivities for a group of channels in different frequencies band that depend on each other. For the determination of sensitivity requirements different factors have to be taken into consideration in a practical manner such as user requirements, technological possibilities as well as research and development needs.

NASA announced that they plan to review the information in document SF26-21/D with the intention to provide an overview on the development of the requirements for the different passive bands from 1976 until today.

With this information as contained in document SF26-21/D and the intention to provide an overview on the development of the requirements over time, it was considered appropriate to develop an SFCG-Report to capture the material on passive band requirements.

Document SF26-46/D NOAA presented the results of the “Passive Sensing Workshops” held in June 2006 to address the ongoing review and proposed revision of the list of passive sensing bands listed in ITU-R SA.515. This workshop was the second of this kind wherein response to Action Item 25/5 the current passive bands, their importance, relation to each other and the need for combination of channels/bands where evaluated. This evaluation was performed on the basis of evaluation criteria (see document SF26-46/D) which were determined at the first passive sensing workshop in 2004.

After the focus on bands for water vapor and sea surface temperature measurements at the first workshop, this second workshop concentrated on bands to be used for temperature profiling and rain rate measurements.

Although good progress was made, it was concluded that a third workshop would be necessary to complete this task. NOAA announced that they would be willing to plan and host a third workshop to be held in April 2007. In this context it was considered necessary to attract more

contributions and participation in order to be able to finalize the work. A call for papers was considered to be right measure to achieve this goal.

DLR presented information document SF26-55/I providing an overview on their ground-based passive sensor activities and their possible interest in future satellite passive sensing.

Action Item 25/5 is to be closed. However, in order to finalize the work on reviewing the list of passive sensing bands listed in ITU-R SA.515 and to start the development of an SFCG-Report on passive band requirements, it was decided that a new SFCG action item would be initiated. The result of this work can be found in Action Item 26-4.

Resolution 21-2R2 needs to be updated once additional information is developed under the above new action item, but no changes were proposed at this meeting.

8.3.2.2 Passive Sensors above 275 GHz

There were 2 input documents received on this topic: Document SF26-17/D (NASA) and SF26-40/D (EUMETSAT).

NASA introduced document SF26-17/D elaborating in response to Action Item 25/5 on the impact on delaying the allocation of EESS (passive) spectrum above 275 GHz beyond WRC-2010/11. It is concluded that the extensive use of this spectral region by the passive services along with the lack of use of the same by the various active services indicates that the general consideration of frequency allocations between 275 and 3000 GHz at WRC-2010/11 would be premature and that as an alternative, reviewing and revising RR No 5.565 would be desirable.

This is in line with the position expressed in SFCG RES_23-1R2 under Agenda Item 7.2.

However, such an agenda item would require the EESS (passive) users to better define their needs between 275 and 3000 GHz so that adequate evidence exists for the revision of the existing footnote. The new Action Item 26-3-1 will aid in this process through the continued work of the space agencies in better defining their passive sensing needs in this area of the spectrum.

Also in response to Action Item 25/5 EUMETSAT introduced SF26-40/D providing information on sensors using bands above 275 GHz that are under discussion to be implemented on the future programme for the EUMETSAT Polar System (EPS) follow-on system (Post-EPS) to be taken into account when reviewing the EESS passive band requirements for bands above 275 GHz.

8.3.2.3 Sharing in the 6-7 GHz Band (Action Item 25/6)

There were three documents submitted for consideration on this topic: Document SF26-18/D (NASA), SF26-29/D (JAXA), and document SF26-45/D (NOAA).

Document SF26-18/D was introduced by NASA. This document addresses portions of Action Item 25/6 on passive sensing interference issues in the 6-7 GHz range. The document presents information on radio frequency interference (RFI) as seen by the AMSR-E sensor flying on NASA's AQUA satellite launched in 2002 and provides details on how the RFI data was extracted from measurement data taken in 2002. The data presented indicates that there is significant RFI over the continental United States (although not over Canada or Mexico) in the 6-7 GHz passive sensing channel caused by the active services using this range. The data also indicates that the RFI occurs mainly near urban areas with some RFI detected along major highways and the RFI does not appear to be polarized. It is well known that the EESS (passive) does not have any allocation status in this range. However, the 6-7 GHz band is used by a great many passive sensors primarily to measure sea surface temperature.

Document SF26-29/D was introduced by JAXA. This document presents a great deal of data on RFI in the 6-7 GHz band as experienced by the AMSR-E sensor. Data was shown for land masses on a global basis and RFI was present over all populated land areas. This data was largely in agreement with the RFI data presented in the NASA document (SF26-18/D). In addition, this document presented RFI data on a global basis over ocean areas. This RFI appears as rather long vertical stripes of high brightness temperatures over the open ocean. The RFI seems to move over successive passes of the remote sensing satellite and it was noted by JAXA that the RFI over the oceans did not seem to be present in just the last several years and it is getting worse. Several participants speculated as to the possible source of the RFI since it clearly could not be from terrestrial microwave links as they are not present in the open ocean. JAXA replied that it was thought to perhaps be caused by specular reflections from satellite downlinks, but others noted that there are no satellite downlinks in the 6-7 GHz band or even in a nearby band. It was noted by the group that this apparent RFI data required further study to try and understand if it was somehow naturally occurring or manmade interference.

Document SF26-45/D was introduced by NOAA. This document investigates alternatives for sea surface temperature (SST) measurements using the 6-7 GHz band by itself and in combination with other bands that may be less contaminated. The document summarizes the results of the April 2005 Passive Sensing Workshop with regard to bands for SST and gives an overview of some possible mitigation techniques for passive sensors experiencing contaminated data measurements due to interference. It was concluded that additional work is needed to study RFI mitigation techniques that could be applied to future spaceborne passive sensors.

Based on these input documents and recognizing that further work was needed on RFI mitigation techniques, the group decided that Action Item 25/6 could be closed and no follow-on action item was needed.

8.3.2.4 Passive Sensor Reference Antenna Pattern (Action Item 25/7)

There were two input documents that were submitted for consideration on this topic: document SF26-19/D (NASA) and document SF26-30/D (JAXA).

Document SF26-19/D was introduced by NASA. This document presents information on passive sensor antenna patterns at various frequencies for several planned and/or operational sensors. Additionally, a type of reference pattern for passive sensors was given in CCIR Report 850 and this information is also provided for comparison purposes in this document. The document presents data for a variety of sensor antenna patterns from 1.4 GHz all the way up to 2.5 THz. It was stressed that the reference pattern in the CCIR Report 850 stated that 90% of the received power should be in the main beam of the passive sensor antenna, 7% should be in the first sidelobe region, 2% in the second sidelobe region and 1% in the backlobe of the antenna. For the 1.4 GHz and for 50.3 GHz, the measured antenna patterns spanned -180 to +180 degrees which would indicate that the reference ITU-R antenna pattern could be extended to between 1 and 60 GHz as a minimum. It was also noted that measured antenna patterns were usually asymmetrical and their shape was dependent on the angle of the two-dimensional cut through the three-dimensional pattern. NASA stated its intention to further develop the information given I the document and to provide a contribution to the February WP 7C meeting.

Document SF26-30/D was introduced by JAXA. This document provides measured antenna patterns for the main beam region in the frequency range 6 to 89 GHz and comparisons with the ITU-R WP 7C reference antenna pattern with roll-off factors of 1.49, 1.8 and 2.0 are made. It was stressed that any reference antenna pattern should not underestimate the interference to passive sensors in compatibility and sharing studies. In this document, the pattern for these three roll-off factors is compared with measurement data for various sensors. The document concludes that a roll-off factor of 1.49 for the reference antenna pattern best matches the measured antenna data since the reference pattern is always higher than the measured data. For roll-off factors of 1.8 and 2.0, the reference pattern is sometimes lower in gain than the provided measurement data.

The group discussed this conclusion and it was noted that while underestimating the interference into the passive sensor in a study may be undesirable, grossly overestimating the interference would also be undesirable. It was also noted that the goal of a reference antenna pattern was not to precisely match measured antenna pattern data. JAXA also intends to make a similar contribution to the next WP 7C meeting to try and further the work on a passive sensor antenna reference antenna pattern.

Based on these submissions, it was decided that Action Item 25/7 could be closed and no further work within the SFCG on this topic was needed.

8.3.2.5 Disaster Management

There were four documents referred to SWG-3 relevant to the topic of disaster management: Document SF26-21/D (NASA), SF26-42/I (ESA), SF26-48/D (NASA) and SF26-55/I (DLR).

Documents SF26-21/D and SF26-55/I were considered under the topic of passive sensor characteristics and are summarized elsewhere. Document SF26-42/I on the results of the last CEOS meeting was presented in Plenary. Document SF26-48/D containing the report of the ITU-D SG2 Q.22/2 Rapporteur was presented in the IWG-DM meeting as well as in Plenary. It was presented yet again in SWG-3. It had been previously agreed that a drafting group would be formed to further consider the Work Plan and other items with respect to Resolution A25-1. This work was undertaken by the drafting group outside of SWG-3.

8.3.3 Meteorological Satellite Issues

8.3.3.1 Coordination between SFCG and CGMS (Coordination Group for Meteorological Satellites)

WMO presented the outcome on a CGMS/WMO forum meeting for members of CGMS which discussed measures to improve the coordination of planned MetSat systems (SF26-51/I) in order to avoid conflicting frequency plans and potential interference as in the case of the future planned use of the 7750 – 7850 MHz band by NPOESS, FY-3 and MetOp.

As an outcome of this meeting this forum formulated recommendations that are aimed to achieve early coordination among CGMS members. Some of the recommendations identify SFCG as the expert group that could support particularly in the evaluation of the sharing studies.
SFCG supports the recommendations agreed at the CGMS/WMO forum on measures that are intended to improve the coordination among Metsat operators in order to avoid such a situation in future.

In a Liaison Statement SFCG proposes that CGMS makes use of the coordination procedure as described in SFCG Res A12-1R2 which motivates, already at the very early stages of a mission design, even before starting the ITU-R notification procedure, to coordinate the planned frequency use with concerned parties.

Furthermore, SFCG proposes to improve coordination between CGMS and SFCG by nominating a responsible person to represent SFCG at CGMS and vice versa on a yearly basis. SFCG recommends that for maximum effectiveness and fastest response in urgent situations the coordinator role would be filled by WMO.

8.3.4.1 Use of the 7750-7850 MHz Band by Non-GSO Meteorological Satellites

8.3.4.2.1 Revision of RES 19-7R2

NOAA introduced document SF26-44/D proposing changes to SFCG RES 19-7R2 in order to reflect the experience that have been gained in the interference analysis and coordination of NPOESS, FY-3 and MetOp between NOAA, CMA and EUMETSAT to enable the coexistence of

systems using different modes of transmission (direct readout or stored mission data downlinks) without changing the aim of this resolution to ensure interference-free reception of vital meteorological and environmental data.

The revised Resolution is contained in RES 19-7R3.

8.3.4.2.2 Spectrum Requirement for Future Non-GSO Meteorological Satellites Systems in the 7750-7850 MHz Band

EUMETSAT introduced document SF26-41/D providing information on the next generation EUMETSAT polar-orbiting meteorological satellite systems (Post-EPS) and estimated spectrum requirements for the raw instrument data downlink to main stations resulting form the preliminary consideration of potential missions for this system.

According to this first estimations the spectrum requirements would exceed the current bandwidth of 100 MHz currently allocated to MetSat in the band 7750–7850 MHz. Therefore, consideration of an extension of this allocation at a future WRC is proposed.

This issues is added to the list of items for future WRCs in Annex 2 of RES_23-1R2, to be further refined as more mature information on the estimated spectrum requirements for future polar orbiting MetSat systems becomes available.

8.3.4 Other Sensor Issues

8.3.4.1 Registration and Notification of Active and Passive Sensors

There was one document submitted on this topic. Document SF26-23/I from NASA provides information related to WRC-03 Agenda Item 1.12 as it pertains to the possible changes to Appendix 4 of the Radio Regulations to better enable the registration and notification of both active and passive sensor systems within the ITU-R. It is noted that Appendix 4 of the Radio Regulations provides the data elements required for the advance publication, coordination and notification of an administration's systems. However, parameters suitable for describing spaceborne active and passive sensors are not presently included. The document offers an example of one possible means to rectify this deficiency. The group briefly discussed this document and it supported the concept given in the document as well as the possible example of a solution. This information was forwarded to SWG-1 for possible inclusion in the SFCG WRC-07 Objectives document.

8.3.4.2 Ultra Wide-Band Vehicular Radars

CISRO introduced information paper SF26-50/I informing SFCG that on 27 July 2006 the Australian Communications and Media Authority (ACMA) announced the variation of a class license titled "Radiocommunications (Low Interference Potential Devices) Class License 2000" which authorizes the operation of ultra-wideband short-range vehicle radar in the 22-26.5 GHz band.

Although CSIRO, NASA, ESA, JAXA, WMO and Bureau of Meteorology (Australia) provided inputs to the public consultation process in Australia the permission of an introduction of SRR into the 24 GHz-Band could not be avoided. The licensing of vehicular radars in Australia has been authorised by the ACMA under the general provisions that apply in Europe (European standard ETSI 302-288-1). However, the contributions from the scientific community helped CISRO to influence the process to the extend possible.

After a lively discussion on the topic it was concluded that the decision taken by ACMA and the continuing lobbying of SARA underlines the still existing political pressure and market forces of the automotive industry. In view of potential revision of regulations as contained in the regulatory framework in Europe (something similar is also intended by ACMA at a given date) requires outmost attention of the scientific community.

SPACE FREQUENCY
COORDINATION GROUP

Resolution 23-1R3 (Extract)

SFCG OBJECTIVES FOR WORLD RADIOCOMMUNICATION CONFERENCES

The SFCG,

CONSIDERING

a) that its member agencies are vitally interested in achieving changes to the ITU Radio Regulations (RR) in order to enhance future space science system operations, and to improve Disaster Prediction, Disaster Detection and Disaster Mitigation space systems;

b) that changes to the RR can only be accomplished at World Radiocommunication Conferences (WRCs);

c) that on the agendas of all of these WRCs, items of interest to SFCG member agencies may be included;

d) that it is essential for SFCG member agencies to coordinate their conference preparations and to provide the necessary rationale for their requirements in order to achieve the desired results at WRCs;

NOTING

that consideration of the frequency allocations required to implement space systems to be used in Disaster Prediction, Disaster Detection, Disaster Mitigation and Environmental Monitoring is critical for Public Safety and Property Protection,

RESOLVES

1. that consideration of SFCG WRC Objectives for the next and subsequent competent conferences identified in Annex 1 is vital for member agencies;

2. that, in preparation for WRCs, Annex 1 shall be up-dated in the light of conference agendas and evolving Objectives;

3. that Annex 2 shall list items of interest to SFCG members for consideration at a future conference, but not yet sufficiently mature for inclusion in Annex 1.

4. that member agencies will urge their administrations to make proposals to competent WRCs which satisfy these Objectives.

ANNEX 1 TO SFCG RESOLUTION 23-R3

SFCG WRC-07 OBJECTIVES

Introduction

These are the objectives of SFCG members relative to the space science services on the agenda of the 2007 World Radio Communication Conference (WRC-07). The contents may be used by SFCG members to inform their Administrations, and to facilitate conference preparation and WRC consideration.

The presentation is organized to align with Agenda for the WRC-07 as presented in Resolution **802 (WRC-03)**. Not all of the items in that agenda are of interest to the SFCG and therefore only those specific agenda items, relating to SFCG issues, are discussed herein.

SFCG promotes the use of space-based passive sensors to provide vital ecological and environmental data that is unobtainable by any other means. Such passive sensors depend for their successful operation on frequency bands that are defined by the physical laws of the atmosphere.

SFCG also promotes spectrum efficiency and recognizes the need for and the value of sharing frequency bands between more than one radio service, in cases where mutually agreed sharing and protection criteria have been established based on the results of ITU-R studies.

Agenda Item 1.2 "to consider allocations and regulatory issues related to the Earth exploration-satellite (passive) service, space research (passive) service and the meteorological satellite service in accordance with Resolutions **746 (WRC-03)** and **742 (WRC-03)**"

Resolution 746 (WRC-03) ***resolves 1*** calls for sharing analyses between geostationary meteorological satellites operating in the space-to-Earth direction and the fixed, fixed-satellite and mobile services in the band 18-18.4 GHz to define appropriate sharing criteria with a view to extending the current 18.1-18.3 GHz geostationary meteorological satellites allocation in the space-to-Earth direction to 300 MHz of contiguous spectrum. This will satisfy the requirement for the transmission of data from high resolution sensors on the next generation geostationary meteorological satellites, which will be launched in the time-frame 2015-2020.

SFCG Objective

SFCG supports this expansion of the current 18 GHz allocation for transmission of high rate data from geostationary meteorological satellites. SFCG members are encouraged to take an active role in the development of proposals and positions within their respective Administrations' preparatory processes for the CPM and WRC-07. Either sub-band within 18.0-18.4 GHz would be acceptable but it would be preferred to have a global allocation.

Status

Working Party 7B has documented a description of the instruments and measurements that are foreseen for the third generation MetSat systems and conducted a series of sharing studies. Working Party 4A actively participated in the sharing studies to define the impacts of the geostationary meteorological satellites frequency band extension. Working Party 7B updated the sharing studies based on suggestions from Working Party 4A and used that to develop CPM text. Two sub-bands have been considered for extension of the current allocation in the band 18.1-18.3 GHz, i.e. 18.0-18.1 GHz and 18.3-18.4 GHz. Agreement among the interested parties has been achieved that sharing would be feasible in both sub-bands under certain conditions. The draft CPM text is available in Annex 1 to Document 7B/151 at: http://www.itu.int/md/R03-WP7B-C-0151/en.

Resolution 746 (WRC-03) ***resolves 2*** calls for sharing analyses between the EESS (passive) and the SRS (passive) and the fixed and mobile services in the band 10.6-10.68 GHz to determine appropriate sharing criteria. The EESS (passive) operating in the band 10.6-10.68 GHz may experience harmful interference from the emissions of systems of active services. The band 10.6-10.68 GHz is primarily used for the measurement of rain, snow, sea state, ocean wind and soil moisture.

SFCG Objective

SFCG supports the protection of this EESS (passive) allocation that is critically required to provide continued availability of satellite-based data used in the development of disaster, prediction, weather and climate models on a global scale, from interference from the active service systems operating in the 10.6-10.68 GHz band. Revisions to RR No. **5.482** that specify operational limits on the technical characteristics of the terrestrial active services sharing the band (FS and MS) are needed. SFCG prefers that the values of the existing No. **5.482** be modified using single-entry emission limits identified in Method B1 in the draft CPM Report, with impacts on both the active and passive services in the band. SFCG members are encouraged to take an active role in the development of proposals and positions within their respective Administrations' preparatory processes for the CPM and WRC-07.

Status

Sharing studies using dynamic models have been completed. Draft CPM text can be found in ITU-R Document 7C/259 Annex 4 at: http://www.itu.int/md/R03-WP7C-C-0259/en. Some of the methods include mitigating factors that might be undertaken by the EESS (passive) service and possible limits on some technical characteristics of the FS and MS systems in this band taking into account inputs from Working Parties 8A and 9D. Working Party 7C has produced a Preliminary Draft New Recommendation ITU-R RS.[10 GHz MITIGATE] on technical and operational constraints on EESS (passive) systems to facilitate sharing with the FS in this band. WP 9D is developing a Recommendation regarding technical and operational constraints on the FS to facilitate sharing in the 10.6-10.68 GHz band with the EESS (passive). Studies have identified elevation angle, transmitter power and e.i.r.p limitations for both Point-to-Point (P-P) and Point-to-Multipoint (P-MP) FS systems in the band to facilitate sharing. Additionally, WP 9D has suggested automatic power control as an interference mitigation technique. Recent measurements performed in the 10.6-10.68 GHz band show that over a few countries (for example Australia, Japan and Italy), passive sensors are currently interfered at such a high level that corresponding data have to be discarded. Passive sensors are not normally able to discriminate between these natural radiations and man-made radiations, except when interference levels are at several orders of magnitude compared to the sensitivity threshold. These interference levels, that were not existing a few years ago, are symptomatic of a problem and justifying the need to review current power limits in RR No. **5.482**.

Resolution 742 (WRC-03) calls for sharing studies between the passive services and the fixed and mobile services in the band 36-37 GHz in order to define appropriate sharing criteria. EESS (passive) systems may experience harmful interference if a high density of fixed or mobile service stations is deployed in the band 36-37 GHz. The band 36-37 GHz is primarily used for the measurement of rain, snow, ocean ice, oil spills and clouds.

SFCG Objective

SFCG supports the protection of this EESS (passive) allocation that is critically required to provide continued availability of satellite-based data used in the development of disaster, prediction, weather and climate models on a global scale, from interference from the active service systems operating in the 36-37 GHz band. Studies have shown that limitations on the technical characteristics of the terrestrial active services sharing the band are needed. SFCG prefers that the limits identified in Method C1, in the draft CPM Report, which will impact both the active and

passive services in the band, be included in Article **5** of the Radio Regulations. SFCG members are encouraged to take an active role in the development of proposals and positions within their respective Administrations' preparatory processes for the CPM and WRC-07.

Status

Sharing studies using dynamic models have been completed. Draft CPM text is available in ITU-R Document 7C/259 Annex 4 at: http://www.itu.int/md/R03-WP7C-C-0259/en. Some of these methods include mitigating factors that might be undertaken by the EESS (passive) service and possible limits on some technical characteristics of the FS and MS systems in this band. Working Party 7C has produced a Preliminary Draft New Recommendation ITU-R RS.[36 GHz MITIGATE] on technical and operational constraints on EESS (passive) and SRS (passive) systems to facilitate sharing with the FS in this band. WP 9D is developing a Recommendation regarding technical and operational constraints on the FS to facilitate sharing in the 36-37 GHz band with the EESS (passive). Studies have identified elevation angle, transmitter power and e.i.r.p limitations for both Point-to-Point (P-P) and Point-to-Multipoint (P-MP) FS systems in the band to facilitate sharing. Additionally, WP 9D has suggested automatic power control as an interference mitigation technique.

The studies indicated that compatibility between future FS operations and the passive sensors currently operating in this band could be achieved if the FS EIRP/power and deployment densities are moderate.

+++++

Agenda Item 1.4 "to consider frequency-related matters for the future development of IMT-2000 and systems beyond IMT-2000 taking into account of the results of ITU-R studies in accordance with Resolution **228 (Rev.WRC-03)**".

Any allocation to the IMT-2000 systems in bands already allocated to the meteorological aids, meteorological-satellite, Earth exploration-satellite, and space research services could pose a threat to those services.

SFCG Objective

The SFCG objective is to protect space science services allocations that may be considered for allocation to IMT-2000 and future systems, and support suppression of Resolution **228 (Rev. WRC-03)**. The 410-430 MHz and 2700-2900 MHz bands have been identified as candidate bands for IMT-2000 and systems beyond IMT-2000. SFCG members view the identification of these two bands for IMT-2000 and systems beyond IMT-2000 with concern, realising the possibility of interference to manned space systems and meteorological radars and are encouraged to take an active role in the development of proposals and positions within their respective Administrations' preparatory processes for the CPM and WRC-07.

Status

Working Party 8F has developed draft text for the CPM Report (see ITU-R Document 8F/[*add a proper reference*] including a large list of candidate bands). The 410-430 MHz and 2700-2900 MHz bands have been identified as two of these candidate bands for IMT-2000 and systems beyond IMT-2000.

+++++

Agenda Item 1.8 "to consider the results of ITU-R studies on technical sharing and regulatory provisions for the application of high altitude platform stations operating in the bands 27.5-28.35 GHz and 31-31.3 GHz in response to Resolution **145 (WRC-03)**, and for high altitude platform

stations operating in the bands 47.2-47.5 GHz and 47.9-48.2 GHz in response to Resolution **122 (Rev.WRC-03)**"

Resolution 145 (WRC-2003) calls for technical sharing criteria or high altitude platform stations (HAPS) system design conditions to ensure that HAPS applications in the fixed service operate successfully on a non-harmful interference, non-protected basis in the bands 27.5-28.35 GHz and 31-31.3 GHz. The 31.3-31.8 GHz band is allocated to the radio astronomy, Earth exploration-satellite (passive) and space research (passive) services. WRC-03 amended No. **5.543A** to specify signal levels that would protect satellite passive services and radio astronomy stations in the band 31.3-31.8 GHz.

SFCG Objective

SFCG supports the need for protection of the 31.3-31.8 allocation to the radio astronomy, Earth exploration-satellite (passive) and space research (passive) services. The maximum levels of unwanted emissions by HAPS in the passive band contained in RR No. **5.543A** must continue to apply. SFCG members are encouraged to take an active role in the development of proposals and positions within their respective Administrations' preparatory processes for the CPM and WRC-07.

Status

Draft CPM Report text has been prepared, see Document 4-9S/134, Annex 3 at: http://www.itu.int/md/R03-WP4.9S-C-0134/en. Studies focused on issues related to HAPS sharing with broadband wireless access and fixed-satellite service systems, and no consideration was given to revisiting the EESS (passive) sharing criteria.

Agenda item 1.20 "to consider the results of studies, and proposals for regulatory measures regarding the protection of the Earth exploration-satellite service (passive) from unwanted emissions of active services in accordance with Resolution **738 (WRC-03)**"

Resolution **738 (WRC-03)** calls for studies on the compatibility analyses between EESS (passive) and the corresponding active services in certain bands listed below with a view to updating Recommendation ITU-R SM.1633 or developing additional Recommendations.

EESS (passive) band	Active service band	Active service
1 400-1 427 MHz	1 350-1 400 MHz	Fixed service (FS) Mobile service (MS) Radiolocation service
1 400-1 427 MHz	1 427-1 429 MHz	FS, MS (except aeronautical mobile service) and space research service* (Earth-to-space)
1 400-1 427 MHz	1 429-1 452 MHz	FS and MS
23.6-24 GHz	22.55-23.55 GHz	Inter-satellite service
31.3-31.5 GHz	30-31 GHz	FSS (Earth-to-space)
50.2-50.4 GHz [1]	50.4-51.4 GHz[1]	FSS (Earth-to-space)[1]
50.2-50.4 GHz[1]	47.2-50.2 GHz (Regions 2 and 3) 49.44-50.2 GHz[1] (Region 1)	FSS[1]

[1]Studies in this band must take into account No. **5.340.1** of the Radio Regulations.

* An apparent anomaly is present in the text of Resolution **738 (WRC-03)** with respect to the active services in the band 1 427-1 429 MHz. According to the Table in the Resolution, the fixed, mobile

(except aeronautical mobile) and space research (Earth-to-space) services are to be considered in this band. In fact, the band 1 427-1 429 MHz is allocated to the fixed, mobile (except aeronautical mobile) and space operation (Earth-to-space) services.

Resolves 2 of Resolution **738 (WRC-03)** invites the ITU-R to further study the impact of implementing the values provided in *considering f)* and *g)* for unwanted emissions of fixed-service systems operating in Regions 2 and 3, taking into account that the impact on fixed-service systems in Region 1 has already been investigated.

SFCG Objective

SFCG supports the protection of these EESS (passive) allocations that are critically required to provide continued availability of satellite-based data used in disaster prediction and in the development of global weather and climate models. Appropriate mandatory power limits for unwanted emissions developed on a band-by-band basis as identified by Method A in the draft CPM Report, would be most effective if included in the Radio Regulations. SFCG members are encouraged to take an active role in the development of proposals and positions within their respective Administrations' preparatory processes for the CPM and WRC-07 with the aim of developing appropriate measures to ensure the protection of the Earth exploration satellite service (passive) from unwanted emissions.

Status

Task Group 1/9 has completed compatibility studies The analysis methodology used in studies was also reviewed, with emphasis on the emission and radiation model, the sensitivity analysis and frequency dependent rejection as well as documenting and quantifying approximations used in the studies. The draft CPM text is available in Document 1-9/189, Annex 1 at: http://www.itu.int/md/R03-TG1.9-C-0189/en.

+++++

Agenda Item 7.2 "to recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, taking into account Resolution **803 (WRC-03)**"

SFCG Objectives with respect to the draft Agenda for WRC 20[10]

SFCG members are encouraged to take an active role in the development of proposals and positions within their respective Administrations' preparatory processes with a view to include the following items in the agenda of WRC-10:

- **WRC-2010 Agenda Item 2.2**
  WRC-2010 preliminary draft Agenda item 2.2 "to consider frequency allocations between 275 GHz and 3 000 GHz taking into account the result of ITU-R studies in accordance with Resolution **950 (WRC-03)**".

  The SFCG supports replacement of this Agenda item with one that reviews and revises RR No. **5.565** to update the uses of the spectrum from 275 to 3 000 GHz by the Earth exploration-satellite (passive), radio astronomy, and space research (passive) services. Moreover, the lack of use by the various active services indicates that the consideration of frequency allocations between 275 GHz and 3 000 GHz taking into account the result of ITU-R studies in accordance with Resolution **950 (WRC-03)** is premature.

  The revision of Resolution **950 (WRC-03)** is needed and the consequent replacement of the existing WRC-2010 Agenda Item 2.2.

  ++++++

Annex 2 to SFCG Resolution 23-1R3

Items of interest to SFCG members for consideration at future conferences.

Improve allocations for active sensors
Review RR footnotes Nos. **5.469A**, **5.476A**, **5.498A**, **5.501B** and **5.513A**, which affect active sensor operations in the following bands:

8550 – 8650 MHz
9500 – 9800 MHz
13.25 – 13.75 GHz
17.2 – 17.3 GHz

Improve allocation status at 24 GHz
Upgrade from secondary to primary the allocation to EESS (active) in the band 24.05-24.25 GHz

Possible Allocation for EESS (active) of 1 MHz bandwidth in the range 100 – 150 MHz
Consideration of an additional allocation of 1 MHz bandwidth to the Earth exploration-satellite service (active) within the 100-150 MHz band for the purpose of providing a companion band at a lower frequency to the existing secondary allocation in the 432-438 MHz band which would enable dual-frequency measurements of soil moisture under a substantial vegetation canopy while also reaching a useful depth within the uppermost soil layer.

SFCG-27 should examine the above-mentioned active sensor related issues with a view to determining the relevance of any or each of them to disaster management.

Extension of the MetSat allocation at 7750 – 7850 MHz
Extension of the primary allocation to MetSat at 7750 – 7850 MHz to accommodate increased frequency spectrum requirements for future polar orbiting MetSat systems.

+++++

Support Agenda item relevant Disaster Assistance through Space-based Remote Sensing
Earthquakes, hurricanes, typhoons, tornadoes et al. occur yearly throughout the world with devastating effects. The impact of these disasters in terms of the loss to human life and Gross Domestic Product of the nations affected by these disasters has escalated dramatically in the past 20 years due primarily to the increase of population in coastal areas and the significant GDP growth of developing countries.

Existing technologies cannot prevent the occurrence of natural disasters. However, existing and emerging technologies can be used to improve their prediction, detection and mitigation. The use of space systems (satellites) is required in efforts to better predict, detect and mitigate natural disasters on a global basis. The ability to predict, detect, and monitor the scope of disaster events is heavily reliant on terrestrial and space-based a sensor (active and passive) systems. To ensure that the next (and planned follow-on) passive sensor systems can operate at the efficacy required for disaster assistance, efforts are required in diverse fields such as industry and Academe, government, and relief agencies. In the area of Radio Regulations, it is a matter of some urgency that the radio frequency bands necessary for disaster assistance by sensors must be made more readily available to those sensors, and those bands must be protected from anticipated interference sources (from active emissions). In particular, the following actions should be considered:

- enhance the EESS (passive) allocation at 4.2-4.4 GHz to enable improved monitoring of soil moisture and sea surface temperature, to better understand global water circulation for oceans, global warming, and to improve weather prediction (review footnote RR No. **5.438**);
- enhance the EESS (passive) allocation at 6-7 GHz to enable improved monitoring of soil moisture and sea surface temperature, to better understand global water circulation for oceans, global warming, and to improve disaster and weather prediction (review footnote RR No. **5.458**); and
- possibly expand the bandwidth available to the L band SAR to improve monitoring of deformation of the Earth's surface with little influence from vegetation, and to improve monitoring of soil moisture with higher spatial resolution (review footnote RR Nos. **5.332** and **5.332A**).

ANNEX 3 to Resolution SFCG 23-1R3

**DISASTER PREDICTION, DETECTION AND MITIGATION-
URGENT SPECTRUM REQUIREMENTS**

- ✓ **TSUNAMI STRIKES BANDA ACEH – up to 100,000 dead! (Dec. 2004)**
- ✓ **HURRICANE KATRINA INUNDATES GULF COAST – New Orleans evacuated (Sept. 2005)**
- ✓ **HURRICANE RITA CLOSES OIL REFINERIES IN GULF OF MEXICO (Sept. 2005)**
- ✓ **TYPHOON LONGWANG HITS S.E. ASIA CAUSING HAVOC & DEATHS (Sept. 2005)**
- ✓ **EARTHQUAKE DEVASTATES PAKISTANI KASHMIR – up to 30,000 dead! (Oct. 2005)**
- ✓ **HURRICANE STAN CAUSES DESTRUCTION IN CENTRAL AMERICA (Oct. 2005)**

Shown above are headlines from the world's newspapers reporting on just a few of the natural disasters that have taken their toll, in terms of human lives and property, during a time interval of less than a year.. Many more earthquakes, hurricanes, typhoons, tornadoes etc. have occurred since in addition to the ones highlighted in the above headlines. The impact of these disasters in terms of the loss to human life and to the Gross Domestic Product (GDP) of the nations affected by these disasters has escalated dramatically in the past 20 years due primarily to the increase of population in coastal areas and the significant GDP growth of developing countries.

Natural disasters know no favourites. All nations are affected by them: developed countries and developing countries alike. The only difference lies in the greater resources available to developed countries to recover from these disasters. Developing countries may require many years to recover from a natural disaster event. However, in all countries, the individual people and families who have lost relatives, friends, and all their possessions, are equally affected.

Existing technologies cannot prevent the occurrence of natural disasters. However, existing and emerging technologies can be used to improve their prediction, detection and mitigation.

Of particular importance in the efforts to predict, detect and mitigate natural disasters is the use of space systems (satellites). These systems are required in efforts to better predict, detect and mitigate natural disasters on a global basis. All space systems depend entirely for their operation on the availability of and access to the radio frequency spectrum. In the case of post-disaster communications used to mitigate the after-effects of the event, fixed and mobile satellites have a definite role in providing communications where no other means to communicate survives, and in complementing any surviving terrestrial communications. The ability to predict and detect disaster events is heavily reliant on terrestrial and space-based sensor systems. Space-based sensor systems come in two varieties, active (radar-like) sensors and passive (non-emitting) sensors.

Passive sensors use physics-determined frequency bands to sense fundamental Earth parameters such as sea-surface temperature, atmospheric temperature, wind speed and direction, and water vapour. The next generation of such sensors are expected to be capable of detecting a change in sea-surface temperature of $^{3}/_{100}$ of a Kelvin. Changes of this magnitude in sea-surface temperature can be used to more accurately predict the onset and intensity of a disaster event, such as a typhoon. However, to detect such a small change not only requires the proper regulatory allocation in the necessary physics-determined frequency bands but also a controlled low background noise

against which to detect the change. If even a small amount of radio frequency emissions from active radio services are inserted into this background noise, the result is that the sensitivity of the sensor measurement is reduced and, consequently. the value of that measurement for disaster prediction is diminished.

To ensure that the next (and planned follow-on) passive sensor systems can operate at the level of sensitivity indicated, some improvements are required; such as the following:

(1) the active and passive sensor design and development industry needs to be re-established with a broader base of support than is now the case; wherein sensor development is primarily driven by relatively few dedicated individuals;

(2) plans must be adopted and resources allocated for the deployment of a comprehensive network of the appropriate sensor (active and passive) and communication satellites to provide effective continuous monitoring, prediction and early warning of natural disasters, and,

(3) necessary radio frequency bands must be made more readily available to sensors and cleared of interference sources (active emissions) to the maximum extent practicable.

Some of the most critical improvements in the radio frequency spectrum required to enable this comprehensive network, in addition to those already included in the Agenda of WRC-2007 (e.g, Agenda Items 1.2 & 1.20), are:

- enhance EESS (passive) allocation at 4.2-4.4 GHz, to enable improved monitoring of soil moisture and sea surface temperature, to improve the understanding of global water circulation for oceans, global warming, and to improve weather prediction accuracy and range (review RR No. **5.438***);
- enhance EESS (passive) allocation at 6-7 GHz, to enable improved monitoring of soil moisture and sea surface temperature with wider dynamic range than in 4.2-4.4 GHz, to improve the understanding of global water circulation for oceans, global warming, and to improve weather prediction accuracy and range (review RR No. **5.458***);
- possibly expand the bandwidth available to the L band SAR to improve monitoring of deformation of the Earth's surface (removes majority of measurements inaccuracy due to vegetation), and to improve monitoring of soil moisture while resolving desired smaller ground areas.

The SFCG should consider identifying additional bands and footnotes for review.

In order to enable the comprehensive network, it is crucial that these modifications to the Radio Regulations be considered and implemented as soon as possible.

SPACE FREQUENCY
COORDINATION GROUP

RESOLUTION 19-7R3

USE OF THE 7750-7850 MHz BAND BY NON-GSO METEOROLOGICAL SATELLITES

The SFCG,

CONSIDERING

a) that sensors onboard Meteorological Satellites (Metsats) are an increasingly important tool for monitoring the Earth and its environment;

b) that such sensors are becoming more complex with resulting increased data rates;

c) that the ITU Radio Regulations allocate the band 7750-7850 MHz to Metsats in non-geostationary orbits on a primary basis with PFD limits as listed in Table 21-4 of the RR;

d) that Metsat operators are developing plans to use the band to transmit such vital meteorological and environmental data to a number of ground stations, including direct read-out and CDA stations;

e) that spectrum requirements of individual missions may exceed 50 MHz, thus limiting the possibility of segmentation as a means of interference avoidance;

f) that only conscientious frequency management of the 7750-7850 MHz band will satisfy the future requirements of numerous Metsat operators;

RESOLVES

1. that space agencies planning and operating Metsats develop procedures for efficient use of the 7750-7850 MHz band that allow interference-free reception of vital meteorological and environmental data;

2. that in case of interference from Metsats operating direct readout downlinks to Metsats operating data dump downlinks, Metsats operating direct readout downlinks implement operational procedures to reduce this interference to an acceptable level. In the extreme this could include switching-off the direct broadcast transmissions while within the reception area of CDA stations during stored mission data dumps;

3. that space agencies planning Metsats in this band maximize the potential for sharing among Metsat operators by: a) coordinating frequency selection with other Metsat operators early in the system design process; b) employing techniques such as pulse-shaping and higher-order modulation to minimize the occupied bandwidth; and c) selecting a center frequency to maximize the contiguous bandwidth available for other users;

4. that MetSat operators implement interference mitigation techniques to maximize the potential for sharing among Metsats systems using this band.

SFCG-26

SFCG ACTION ITEM No. 26-4

SUBJECT: Update/Revise EESS Passive Band Requirements

SUPPORTING MATERIAL: SF26-21/D, SF26-31/D, SF26-46/D, SF26-55/I, Resolution 21-2R2

SFCG POSITION:

It is essential to continue to update the EESS passive band requirements for the bands listed in Resolution 21-2R2, especially the establishment of requirements from 275-3000 GHz in preparation for the potential revision of RR No. 5.565 during WRC 2010.

ACTIONS TO BE TAKEN:

(1) The "Responsible Person" and "Contributors" will work to plan and convene another "Passive Sensing Workshop" no later than the Spring of 2007 to further the work on establishing and evaluating a descriptive list of passive sensing bands in support of the revision of Table 1 of SFCG Resolution 21-2R2. This will include a "Call for Papers" to be disseminated to potential interested parties in the field of passive remote sensing. The "Call for Papers" needs to be specific enough to allow contributions to the Workshop on any subset of bands or even a single band since such information will be useful in any case. Furthermore, the "Call for Papers" should be shared with the IEEE Geoscience and Remote Sensing Society (GRSS) and its Frequency Allocations in Remote Sensing (FARS) technical committee.

(2) A follow-up correspondence group led by the "Responsible Person" will consider the results of the workshop to revise and update Table 1 of SFCG Resolution 21-2R2 as appropriate. This update should also include EESS passive band requirements between 275 and 3000 GHz.

(3) The correspondence group will develop a draft SFCG Report that includes and describes the passive remote sensing requirements given in Table 1 of SFCG Resolution 21-2R2. This will include a description of the major measurement areas (e.g., water vapour, rain, clouds, etc.) and their associated frequency bands. The Report will also include an evaluation of all of the frequency bands for each measurement area comparing the utility and relative advantages of the frequency bands.

RESPONSIBLE PERSON:	F. Eng	(NOAA)
CONTRIBUTORS:	M. Dreis	(EUMETSAT)
J. Zuzek	(NASA)	
K. Maeda	(JAXA)	
S. Tishchenko	(RFSA)	
J Pla	(CNES)	

DUE DATES: 1. Workshop Plans and Call for Paper: December 2006
2,3. Correspondence Group Results: 3 weeks prior to SFCG-27