

REPORT OF THE CGMS/WMO FORUM ON DATA TRANSMISSIONS FROM METEOROLOGICAL SATELLITES

(Submitted by WMO)

Summary and purpose of document

In examining the frequency plans of CGMS member organizations potential problems of frequency interference were detected in the frequency bands 7750 – 7850 GHz and 1698 – 1710 MHz. It was noted that those potential conflicts are discovered at a very late stage in the implementation process of new systems, and measures to avoid problems are reduced due to schedule and budget impact.

CGMS-33 stressed that for future use of the frequency band 7750–7850 MHz, early coordination would be essential and SFCG Resolution 19-7R2 needs to be strictly applied. It was noted that technical discussions could not be limited to the annual meetings of CGMS and a forum to discuss plans for future systems at the earliest possible date would be necessary. CGMS-33 issued Action 33.13:

“WMO to provide a forum for discussion on data transmission from meteorological satellites, with a goal of resolving radio frequency conflicts, well in advance of notification to ITU, and adopting approaches to avoid them.”

The meeting of the CGMS/WMO Forum on Data Transmissions from Meteorological Satellites took place on 30 August 2006 at the WMO Headquarters in Geneva. The Forum issued eight recommendations to improve future frequency planning and to avoid conflicts and recommended to seek the advice of the Space Frequency Co-ordination Group (SFCG) on frequency sharing issues.

ACTION PROPOSED

CGMS members to take note and to endorse the recommendations of the Forum

**CGMS/WMO Forum on Data Transmissions
from Meteorological Satellites
Geneva, 30 August 2006**

The meeting took place on Wednesday, 30 August 2006 at WMO Headquarters in Geneva. The list of participants is attached as an Annex to this report.

1. INTRODUCTION AND BACKGROUND

The World Radio Conference of the ITU has allocated the frequency band 7750–7850 MHz to the Meteorological Satellite Service with a footnote to restrict the use of this band to transmissions from NGSO satellite in the Meteorological Satellite Service to avoid interference with geostationary Meteorological Satellites. Original plans for the usage of the new frequency band were to assign it for data dump transmissions from polar orbiting meteorological satellites to major reception stations. The allocation, nevertheless, is not restricted to this service type but the Space Frequency Coordination Group (SFCG) has adopted Resolution 19-7R2, prioritising data dump transmissions to Main CDA Earth Stations over broadcasting type applications to User Stations.

Frequency plans for future polar-orbiting meteorological satellite systems indicate that there is potential for harmful interference of one system into another. The first problems were reported to and discussed at CGMS-32. There are two main scenarios for interference

- interference from direct data transmissions into main data dump stations;
- interference between two direct data transmissions into user stations.

Several activities took place between operating organisations with potentially conflicting frequency plans. Studies were produced and proposals for avoidance or minimizing of interference were agreed.

CGMS-33 discovered new potential conflicts and issued action items to the involved operating agencies.

It was noted that those potential conflicts are discovered at a very late stage in the implementation process of new systems, and measures to avoid problems are reduced due to schedule and budget impact.

CGMS-33 stressed that for future use of the frequency band 7750–7850 MHz early coordination would be essential and SFCG Resolution 19-7R2 needs to be strictly applied. It was noted that technical discussions could not be limited to the annual meetings of CGMS and a forum to discuss plans for future systems at the earliest possible date would be necessary. CGMS-33 issued Action 33.13:

“WMO to provide a forum for discussion on data transmission from meteorological satellites, with a goal of resolving radio frequency conflicts, well in advance of notification to ITU, and adopting approaches to avoid them.”

Another area of potential interference due to overlapping frequency bands are in the direct broadcasts of meteorological satellites in the band 1698–1710 MHz. This is more difficult to avoid but minimisation of impact can be reached by proper planning.

Interactions with relevant frequency coordination bodies (e.g., WMO/CBS Steering Group on Radio Frequencies Coordination, SFCG, ITU).

There are several coordination groups available to ensure the coordinated and protected use of the spectrum among MetSat operators prior to ITU-R satellite notification:

(1) Coordination Group for Meteorological Satellites (CGMS):

CGMS provides a forum for an early coordination of future MetSat systems among operators in all aspects of mission planning, e.g., orbits and data formats, in view of mutual cooperation and data/product exchange.

The mission of CGMS is:

- to provide a forum for the exchange of technical information on geostationary and polar orbiting meteorological satellite systems, such as reporting on current meteorological satellite status and future plans, telecommunication matters, operations, inter-calibration of sensors, processing algorithms, products and their validation, data transmission formats and future data transmission standards.
- to harmonise to the extent possible meteorological satellite mission parameters such as orbits, sensors, data formats and down-link frequencies.
- to encourage complementarily, compatibility and possible mutual back-up in the event of system failure through cooperative mission planning, compatible meteorological data products and services and the coordination of space and data related activities.
- In the process of its annual meetings CGMS has adopted the following permanent actions which are relevant to frequency coordination:
 - All CGMS Members to inform the Secretariat of any change in the status or plans of their satellites to allow the updating of the CGMS Tables of Satellites.
 - The Secretariat to review the tables of current and planned polar and geostationary satellites and to distribute this updated information, via the WWW Operational Newsletter, via Electronic Bulletin Board, or other means as appropriate.
 - CGMS satellite operators to update table 7 for polar-orbiting satellite equator crossing times on an annual basis.
 - CGMS Members to update the table on polar-orbiting satellite equator crossing times as well as the table on coverage from geostationary satellites.

(2) Space Frequency Coordination Group (SFCG):

The SFCG is a coordination group of space agencies and was created to perform:

- Early coordination of frequency use for planned satellite systems;
- Agreements of principles on how to use the available spectrum for MetSat, Earth Exploration Satellite and Space operation Service (SFCG Resolution 19-7R2 for X-Band);
- Mission Statement: SFCG is the pre-eminent radio-frequency collegiate of Space Agencies and related national and international organizations through which global space systems spectrum resources are judiciously husbanded for the benefit of humanity;
- Objective: The SFCG was established in order to provide a less formal and more flexible environment, as compared to the official organs of the ITU for the solution of frequency management problems encountered by member space agencies;
- Charter: SFCG provides a forum for multilateral discussion and coordination of spectrum matters of mutual interest concerning space radio-communication services,

such as Space Research, Space operations, Earth exploration satellite and the Meteorological satellite service;

- To complement the RR satellite notification procedure of the ITU-R, an inter-agency frequency coordination procedure was established in the framework of SFCG (RES A12-1R2);
- This inter-agency frequency coordination motivates SFCG members, 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 SFCG members with the aim to minimize the potential radio spectrum interference to existing and planned satellite systems;
- SFCG member agencies involved in such a coordination process can utilize the SFCG satellite database and provide update information on existing and planned satellite systems.

(3) WMO Steering Group on Radio Frequency Coordination (WMO SG-RFC):

- Coordination between WMO Members for the use of frequency bands allocated to the entire range of meteorological activities in the framework of the World Weather Watch (WWW) and their sharing among themselves as well as with other radio communication services.
- The Group includes in its terms of reference to:
 - Facilitate the coordination between WMO Members for the use of frequency bands allocated to meteorological activities with respect to:
 - Coordination of frequency use/assignments between countries;
 - Coordination of frequency use/assignments between various radio communication services (e.g., meteorological aids and DCPs) sharing the same band.

2. PRESENTATION OF THE UPDATED FREQUENCY PLANS (ALL SATELLITE OPERATORS)

NOAA presented document 2 with the up-to-date frequency plans for NPOESS and POESS satellites.

EUMETSAT presented document 3 containing frequency plans for EPS.

CMA presented document 6 including frequency plans for the FY-3 satellites.

KMA and JMA presented their frequency plans but these are only related to geostationary satellite system COMS and MTSAT, respectively.

The representatives of operating agencies have agreed to check consistency with specifications listed in table 7 of the annual CGMS report.

3. DISCUSSION

CGMS has discovered during recent meetings two areas of potential conflicts:

- Potential Interference from NPOESS into MetOp:
 - NPOESS HRD interference into MetOp GDS in X-Band;
 - NPOESS LRD interference into MetOp HRPT in L-Band.

- Potential Interference from FY-3 into MetOp:
 - FY-3 MPT interference into MetOp GDS in X-Band;
 - FY-3 CHRPT interference into MetOp HRPT in L-Band.

3.1 Interference Analysis NPOESS / MetOp

The main factors for the interference potential of NPOESS HRD into MetOP GDS in X-band are:

- Overlapping frequency spectrum of originally 36 MHz, respectively 13.5 MHz after shift of centre frequency and bandwidth reduction;
- NPOESS HRD = broadcasting type application with continuous direct readout transmissions in a band that is prioritised for stored data dumps to CDA-Stations like for the MetOp GDS (SFCG Resolution 19-7R2).

Sharing studies were performed by NOAA and EUMETSAT.

- At the time the studies were performed both systems were planned to operate on the mid-morning orbit. Due to a decision in NOAA to reduce the number of satellites from 6 to 4, this orbit (09:30) was removed from the NPOESS system;
- Results with the original design of NPOESS showed significant data loss during up to 0.23 % of the time in which the Svalbard CDA Earth station has a link to the MetOp satellite!

NOAA agreed to several system modifications by moving of the NPOESS HRD centre frequency from 7812 to 7834 MHz and reducing the NPOESS HRD necessary bandwidth from 36 to 32 MHz and new studies using parameters of the modified system showed that the data loss is reduced to 0.028 % (= 16min) of the time in which the Svalbard CDA Earth station has a link to the MetOp satellite.

The main factors for the potential interference from NPOESS LRD into MetOp HRPT in L-Band are:

- Overlapping frequency spectrum of originally 4.5 MHz, respectively no overlap after shift of centre frequency and bandwidth reduction;
- At the time the studies were performed both systems were planned to operate on the mid-morning orbit. Due to a decision in NOAA to reduce the amount of satellites from 6 to 4 this orbit (09:30) was removed from the NPOESS system;
- Contrary to the situation in X-Band both system are planned to use this band for the same application, namely for direct read out broadcast to user stations.

The results of studies performed by EUMETSAT with the original design of NPOESS showed significant data loss during of up to 3% at the time in which a HRPT user station has a link to the MetOp satellite!

NOAA agreed on moving the NPOESS LRD centre frequency to the METOP HRPT back-up frequency of 1707 MHz and reducing the NPOESS LRD necessary bandwidth from 12 to 6 MHz.

The results of studies performed by NOAA including these modifications to the design of NPOESS indicated that there would be no data loss since the frequency spectrum overlap with operational MetOp HRPT frequency is avoided with the shift of the NPOESS LRD centre frequency and bandwidth reduction.

Only if MetOp were to use its back-up frequency, the amount of data loss would remain at about 3%.

The decision of NOAA to reduce the amount of satellites from 6 to 4 and to give up the 09:30 morning orbit would further reduce the likelihood of interference between the systems but would not totally remove it.

3.2 Interference Analysis FY-3/ MetOp

The main factors for the potential interference from FY-3 MPT into MetOp GDS in X-Band are:

- Overlapping frequency spectrum of 29 MHz;
- FY-3 MPT = broadcasting type application with continuous direct readout transmissions in a band that is prioritised for stored data dumps to CDA-Stations like for the MetOp GDS (SFCG Resolution 19-7R2).

The results of studies performed by EUMETSAT in response to CGMS-33 action item 33.12 showed:

- Data loss during up to 0.0118 % (= 7min) of the time in which the Svalbard CDA Earth station has a link to the MetOp satellite;
- Although both systems operate on a mid-morning orbit, the time shift in the equatorial crossing time between them (FY-3: 10:00 – 10:20(D), MetOp: 09:30(D)) is a significant factor to mitigate the interference potential;
- An operation of FY-3 at the same equatorial crossing time as MetOp would increase the data loss significantly to 0.218 %.

Main factors for the interference potential from FY-3 CHRPT into MetOp HRPT in L-Band are:

- Overlapping frequency spectrum of 2.45 MHz,
- Both system are planned to use this band for the same application, namely for direct read out broadcast to user stations.

The results of studies performed by EUMETSAT showed:

- Data loss during up to 1 % of the time in which a HRPT user station has a link to the MetOp satellite.

4. CONCLUSION AND RECOMMENDATIONS

Although the above-mentioned study results and the agreement on system modifications indicate that potential interference is at an acceptable level it is felt that the sharing discussions were started at a very late stage in time and necessary system modifications were difficult to implement.

To avoid new potential conflicts in future the group agreed on the following recommendations:

- Rec 1:** CGMS members to consult and take into account the table 7 of the annual CGMS report (Polar-orbiting satellite equator crossing times) and relevant ITU documentation before assigning frequency bands for future systems.

- Rec 2:** WMO to consider to maintain table 7 on the CGMS Web-site and to keep it current based upon inputs from CGMS satellite operators.
- Rec 3:** CGMS Members to inform CGMS, SFCG, and SG-RFC on their frequency plans for future systems at a time prior to completion of their system feasibility studies of future systems.
- Rec 4:** All affected CGMS members to make available relevant detailed system parameters to allow the performance of sharing studies.
- Rec 5:** All affected CGMS members to conduct sharing studies with existing users of a target frequency band in case of unavoidable overlaps.
- Rec 6:** All affected CGMS members to conduct sharing studies with known future systems.
- Rec 7:** CGMS to initiate technical discussions by SFCG on the evaluation of the sharing studies. This should be done via the established interface between the two groups. It needs to be recognized that there might be problems which could occur from time delays due to schedules of the annual meetings. This could be solved by creation of a dedicated SFCG and/or CGMS "Inter-sessional Working Group" working mainly by correspondence.
- Rec 8:** Sharing studies should be conducted expeditiously and need to be refined as part of the system feasibility studies and as part of the preliminary system design until an acceptable solution is found. Only after mutual agreement is reached the process of advance notification to the ITU should be initialised.
- Rec 9:** On the basis of SFCG recommendations /proposals CGMS to invite involved operators to develop an agreement to minimize frequency interference and data loss. CGMS should be notified on the relevant agreements.

It was agreed that these recommendations will be forwarded to CGMS and an information document will be addressed to the SFCG meeting to take place in September 2006.

CGMS FREQUENCY COORDINATION
30 August 2006

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