INTERNATIONAL TELECOMMUNICATION UNION

RADIOCOMMUNICATION STUDY GROUPS

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Working Party 7C

LIAISON STATEMENT TO WORKING PARTIES 7E AND 8D

Sharing between the MetAids and MetSat services and the mobile-satellite service in the band 1 670-1 700 MHz

(WRC-03 agenda item 1.31)

Working Party 7C considered the liaison statement from Working Party 8D regarding sharing between the mobile-satellite service (MSS) and the meteorological aids and meteorological satellite service in the bands 1 670-1 675 MHz and 1 683-1 690 MHz. Working Party 7C thanks Working Party 8D for the opportunity to provide the necessary information on these important meteorological systems.

In response the requested information in the liaison statement, Working Party 7C provides the following responses:

1) *The estimated number and locations of ground stations receiving GVAR/S-VISSR transmissions.*

There are about 20 main earth stations deployed in all three ITU Regions that are registered with the ITU. In addition to those main stations, there are more than 400 user stations that have been registered with the WMO to date. Forty-seven of them are in 14 countries in Region 1, 248 of the stations in 12 countries are in Region 2, and 118 stations in 19 countries are in Region 3. However, it is believed that the actual number of stations is far above 1 000 as many operators are not aware of the WMO database initiative or simply do not register since there is no formal requirement to do so. The WMO survey continues and we will keep WP 8D informed of the progress.

2) *Updates to Recommendations ITU-R SA.1158-2 and SA.1264 to include the band 1 670-1 675 MHz.*

Working Party 7C developed a preliminary draft revised Recommendation ITU-R SA.1158 (attached, Doc. 7C/TEMP/19), and a preliminary draft revised Recommendation ITU-R SA.1264 (attached, Doc. 7C/TEMP/18) to include sharing between MetSat and MSS, and MetAids and MSS, respectively, in the band 1 670-1 675 MHz. In summary, there are only a few MetSat earth stations that will require protection in the band 1 670-1 675 MHz. A review of the worldwide MetAids use of the band 1 670-1 675 MHz indicates that systems are primarily operated above 1 675 MHz except for a few countries that will require this part of the band into the foreseeable future. Therefore, MSS use of 1 670-1 675 MHz will have little impact on worldwide MetAid operations provided operations in the few countries requiring the additional spectrum are protected.

3) *An estimate (prepared in conjunction with the WMO) of the extent of current and future use of the 1 670-1 675 MHz band by meteorological aids, the feasibility of their relocation to higher frequencies in the band, and your estimate of the time that would be required to accomplish this.*

Working Party 7C received a contribution from the WMO, ***Assessment of Frequency Requirements for Meteorological Services in the 1 670-1 675 MHz and 1 683-1 690 MHz Bands***, at its May 2001 meeting. Working Party 7C concluded that this submission is adequate to answer the request of Working Party 8D (Doc. 8D/184).

In summary, the document states that there is a large and increasing number of GVAR and S-VISSR user stations. Sharing studies indicate that sharing between the MSS and MetSat in the band 1 683-1 690 MHz would be extremely difficult in most parts of the world. MetAids are planned to be concentrated in the sub-band 1 675-1 683 MHz. However a few National Meteorological Services would continue to need the sub-band 1 670-1 675 MHz. Therefore, it is concluded in the WMO submission that future meteorological services will require the entire portion of the band 1 675-1 690 MHz, not providing any commonly available spectrum for sharing with the MSS. Sharing possibilities exist in the sub-band 1 670-1 675 MHz, provided that exclusion zones are ensured around a small number of main MetSat Earth stations, and the few national MetAids operations using the sub-band 1 670-1 675 MHz are protected.

4) *Data missing from Appendix S7 of the Radio Regulations, to permit calculation of the clearance required to be maintained around MetSat CDA receivers by METs in the MSS.*

Regarding the missing data in Appendix S7, this probably applies to the missing G_r in Table 9A. Main stations will not operate at very low elevation angles but data user stations may operate down to an elevation angle of 3 degrees, for which a gain value towards the horizon of 19 dBi would be applicable.

5) *Analysis/Study to determine the feasibility of MSS (Earth-to-space) sharing with GVAR/S-VISSR systems through the use of separation distances, and determine the appropriate distances. Update Recommendation ITU-R SA.1158-2 with this information.*

Working Party 7C received several study contributions on this agenda item[*]. The basic conclusions of all these contributions are that sharing, even though theoretically possible in some very limited situations, would be subject to such practical constraints and limitations for the MSS that it should rather be considered unsuitable. As pointed out above, there are most likely more than 1 000 user stations operated mostly in Regions 2 and 3. The available study results show that the required coordination distances are often in excess of several hundred kilometres and would cause an enormous coordination burden for the MSS, in particular in coastal areas. In addition, the actual required separation distances of up to few hundred kilometres would cause large service areas not to be available to the MSS. The sharing situation is further complicated in ITU Region 2 where mobile and transportable GVAR stations are operated. In that case, sharing is simply not feasible since the mobile

[*] These contributions have also been submitted to WP 8D (Docs. 8D/83, 8D/85, 8D/78).

and transportable stations cannot be protected. Resolution 227 recognizes that use of the data user stations is on the increase and given the implications of S5.377, this would result in an unpredictable risk for any MSS operator to lose service areas in addition to those already unavailable today.

In addition to in-band interference in the band 1 683-1 690 MHz, the problem of adjacent band interference to thousands of meteorological earth stations operating in the band 1 690-1 698 MHz requires either a guard band below 1 690 MHz or a stringent limitation of out-of-band emissions in the Radio Regulations. An e.i.r.p. density limitation of at least -50 dBW/4 kHz would be required in the band 1 690-1 698 MHz.

6) *Provide WP 8D text, that might be suitable for the CPM Report, regarding sharing between MSS (Earth-to-space) with MetAids and MetSats in the bands 1 670-1675 MHz and 1 683-1 690 MHz, which will be considered by WP 8D.*

Working Party 7C provides CPM text on agenda item 1.31, as it relates to the meteorological services, for use by Working Party 8D (Doc. 7C/TEMP/20). The text reflects the conclusions discussed in Items 1 through 5 of this liaison statement.

Working Party 7C hopes the information provided is helpful for furthering the work of Working Party 8D and would appreciate being kept informed of the progress within Working Party 8D on this subject[**]. In order to facilitate the exchange of information, Working Party 7C offers the following liaison rapporteur on this important agenda item for WRC-03.

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Attachments: Docs. 7C/TEMP/18, 7C/TEMP/19 and 7C/TEMP/20

[**] Please note that WP 7E is the responsible WP in SG 7 for the development of CPM text. Any relevant response should therefore be conveyed also to WP 7E, to be considered at its meeting in October 2001.

ATTACHMENT 1

Source: Doc. 7C/TEMP/18

PRELIMINARY DRAFT REVISION OF RECOMMENDATION ITU-R SA.1264

Possible frequency sharing between the meteorological aids service and the mobile-satellite service (Earth-to-space) in the 1 ~~675~~668.4-1 700 MHz band*

(Question ITU-R 204/7)

(1997)

The ITU Radiocommunication Assembly,

considering

a) that the World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum (Malaga-Torremolinos, 1992) (WARC-92) allocated the 1 675-1 710 MHz band on a primary basis in Region 2 to the mobile-satellite service (MSS) (Earth-to-space) and maintained the primary status of the meteorological-aids (MetAids) service in the band 1 668.4-1 700 MHz;

b) that MSS networks may include geostationary or non-geostationary satellites;

c) that there exist hundreds of MetAids receiving stations and that, moreover, additional similar stations are foreseen in the future in the 1 668.4-1 700 MHz range (see Recommendation ITU-R SA.1165);

d) that the MetAids ground stations can be fixed, mobile or transportable;

e) that several MSS earth station transmitters could potentially operate near a MetAids receiving station;

f) that some MetAids operators plan to increase the spectrum usage and revise the frequency assignment plans for new generations of MetAids systems;

g) that radiosondes operating in the 1 ~~675~~668.4-1 700 MHz band radiate about the same e.i.r.p. density levels toward space as typical hand-held mobile earth stations, and co-channel interference from one or more radiosondes located in the receiving beam of typical MSS satellites may result in unacceptably low ratios of carrier-to-interfering signal power;

h) that hand-held mobile earth stations in the proximity of a MetAids receiver will cause unacceptable levels of interference into the MetAids receiver;

j) that in countries where MetAids stations are present in large numbers, mobile, and/or unregistered, establishment of exclusion zones around MetAids receivers is not practical;

k) that many administrations operate radio direction finding MetAids networks in the 1 ~~675~~668.4-1 700 MHz band in support of synoptic measurements and for fulfilment of other

* This Recommendation should be brought to the attention of the World Meteorological Organization (WMO) and Radiocommunication Working Party 8D.

requirements, including unscheduled radiosonde flights that preclude the possibility of time sharing with the MSS;

l) that several countries are operating GVAR and S-VISSR MetSat earth stations in the sub-band 1 683-1 690 MHz, where co-channel operation with the MetAids service is not feasible;

lm) that synoptic data collected by these MetAids stations benefit all member administrations of the WMO World Weather Watch;

mn) that currently available radiosondes which operate in the 1 668.4-1 700 MHz MetAids allocation have large frequency tolerances, of the order of ±4 MHz, and new generations of radiosondes having smaller frequency tolerances would probably be significantly more costly and unaffordable in the near-term (5 years or more, see Recommendation ITU-R SA.1165),

recognizing

1 that WARC-92 decided that, in the band 1 675-1 710 MHz, stations in the MSS shall not cause harmful interference to, nor constrain the development of, the meteorological satellite and MetAids services and the use of this band shall be subject to the provisions of Resolution No. 46 (WARC-92) (Radio Regulations No. 735A (SS.377));

2 that radiosondes are consumable equipment and therefore their cost is of critical importance. Hence significant increase of their cost may have an adverse impact on meteorological operations;

3 that implementation of MetAids systems with improved radiocommunication characteristics would require additional cost and appropriate time-frames for transition,;

4 that use of the band 1 668.4-1 700 MHz for MetAids operations varies worldwide and is dependent on regional MetSat operations, meteorological requirements, and national spectrum plans,

noting

a) that some many administrations will be unable toare not operate operating MetAids systems in the band 1 668.4-1 675 MHz as a result of frequency sharing constraints with respect to new aeronautical mobile (ground-to-air) systems being deployedother services allocated in the 1 670668.4-1 675 MHz band and the inability to accommodate radiosondes in the remaining 1 668.4-1 670 MHz band due to the allocations toincluding the radioastronomy service in the band 1 668.4-1 670 MHz;

b) that some most administrations avoid MetAids frequency sharing problems with meteorological-satellite earth station receivers by operating radiosondes at frequencies below 1 685683 MHz;

c) that MSS networks cannot share frequencies with meteorological-satellite earth station receivers in the 1 690-1 698 MHz band (see Recommendation ITU-R SA.1158);

d) that enhancements to equipment to improve spectrum efficiency are technically feasible, but may take years to implement and the budgetary resources to perform such enhancements may not be readily available worldwide,;

e) some administrations plan to continue to use the sub-band 1 670-1 683 MHz for national MetAids operations for the foreseeable future, *recommends*

1 that manufacturers of MetAids equipment be urged to further develop equipment with improved radiocommunication characteristic (i.e. occupied bandwidth and frequency tolerance of radiosondes, and selectivity of MetAids receivers) at minimum incremental cost in order to reduce the bandwidth requirements of MetAids equipment;

2 that MetAids system operators and/or other appropriate organizations, in particular WMO, be urged to take appropriate steps to implement their systems with improved radiocommunication characteristics taking into account *recognizing* **2** and **3**. Such implementation should take into consideration their operating requirements and the need to facilitate potential sharing with other services (e.g. MSS);

3 that, in connection with the long-term efficiency enhancements of *recommends* **1** and **2**, efficient spectrum management techniques should be implemented for MetAids systems to minimize the spectrum needed for MetAids systems in the 1 675668.4-1 690 MHz band, such that a segment of that band may become universally available for accommodation of MSS (Earth-to-space) networks without impacting worldwide operation of MetAids systems;

4 that, it is essential, for the concentration of MetAids operations in a sub-band, that improved protection of MetAids operations should be promptly planned and implemented in that sub-band;

5 that the sub-band 1 675-1 683 MHz be maintained for use by MetAids so that interference to MetSat user stations between 1 683-1 700 MHz can be avoided;

~~**5** that studies should be pursued further with a view to identifying the sub-band where MetAids operations should be concentrated.~~

6 that MetAids operations be concentrated within the sub-band 1 675-1 683 MHz taking into account *recognizing* **2** and **3**;

7 that sharing possibilities between the mobile-satellite service and MetAids exist in the sub-band 1 668.4-1 675 MHz, taking into account national requirements indicated in *noting* e).

ATTACHMENT 2

Source: Doc. 7C/TEMP/19

PRELIMINARY DRAFT REVISION OF RECOMMENDATION ITU-R SA.1158-2

Possible sharing of part of the 1 67005-1 710 MHz band between the meteorological-satellite service (space-to-Earth) and the mobile-satellite service (Earth-to-space)

(Question ITU-R 204/7)

(1995-1997-1999)

The ITU Radiocommunication Assembly,

considering

a) that the World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum (Malaga-Torremolinos, 1992) (WARC-92) has allocated the 1 675-1 710 MHz band on a primary basis in Region 2 to the mobile-satellite service (MSS) (Earth-to-space) and maintained the primary status of the meteorological-satellite (MetSat) service (space-to-Earth);

b) that each of these two services may be provided by geostationary-satellite systems and non-geostationary satellite systems;

c) that for more than 20 years the international group of MetSat service operators have agreed to separate the band 1 67550-1 710 MHz into three four sub-bands which are being used and are expected to continue to be used as follows:

1 67550-1 69083 MHz: main earth stations at fixed locations for reception of raw image data, data collection data and spacecraft telemetry from geostationary meteorological satellites;

1 683-1 690 MHz: main earth stations at fixed locations for reception of raw image data, data collection and spacecraft telemetry from geostationary meteorological satellites; user stations for direct readout from geostationary meteorological satellites (GVAR and S-VISSR) (see Note 1);

1 690-1 698 MHz: user stations for direct readout services from geostationary meteorological satellites. (Some MetSat service operators currently use frequencies below 1 690 MHz to provide direct readout services from geostationary meteorological satellites.);

1 698-1 710 MHz: user stations for direct readout services and prerecorded image data at main earth stations from non-geostationary meteorological satellites;

d) that the 1 67550-1 690 MHz band is and will continue to be used primarily but not exclusively by a limited number of main meteorological earth stations (command and data acquisition (CDA)) and the 1 683-1 690 MHz part of the band is and will continue to be used also by direct readout primary data users stations (PDUS GVAR and S-VISSR));

e) that there exist thousands of MetSat earth stations in the 1 690-1 710 MHz band, many of them using small antennas;

f) that for different functions provided by the MetSat service, meteorological earth stations in the 1 690-1 710 MHz band and in the 1 683-1 690 MHz band can be fixed, mobile or transportable;

g) that Recommendation ITU-R SA.1027 provides sharing criteria for current MetSat systems using satellites in low-Earth orbit (LEO);

h) that Recommendation ITU-R SA.1161 provides sharing criteria for current MetSat systems using satellites in geostationary orbit (GSO);

j) that MSS earth station transmitters are expected to be deployed near or within a MetSat service area;

k) that some operators of meteorological satellites plan to increase the channel bandwidths and revise the frequency assignment plans for new generations of meteorological satellites, which would make interleaving of meteorological and mobile-satellite channels impracticable;

l) that geostationary MetSat space stations, which initially serve a certain area, may be relocated from time to time in order to provide coverage of another area;

m) that Annexes 1, 2, 3, 4 and 45 provide a view pertaining to the technical sharing aspects of the MetSat and MSS services operating in the 1 67550-1 710 MHz band;

n) that mobile-satellite techniques are either available or may be able to be developed to automatically and dynamically avoid transmissions from earth stations in the vicinity of receiving MetSat earth stations and that such techniques are described in Annex 3,

recognizing

1 that No. S5.377 of the Radio Regulations (RR) states that, in the band 1 675-1 710 MHz, stations in the MSS shall not cause harmful interference to, nor constrain the development of, the MetSat and meteorological aids services, and that the use of this band shall be subject to coordination under RR No. S9.11A;

2 that studies (see Annex 1) have indicated that potential interference to meteorological earth stations from co-frequency MSS earth stations would be acceptable when the meteorological earth stations are protected by exclusion zones with radii of up to several hundred kilometres 55 km for LEO MSS and 70 km for GSO MSS and appropriate technical measures are employed to avoid transmissions by mobile earth stations within these exclusion zones;

3 that the control of the mobile earth stations will could be achieved with a location determination system forming part of the mobile satellite network; this location determination may require a narrow-band signalling channel transmitted from the mobile earth station to the mobile satellite.;

4 that studies (see Annex 5) indicate that interference from MSS earth station emissions in the band 1 670-1 675 MHz to meteorological earth stations would be acceptable with limited restrictions on MSS operations, *further recognizing*

5 that studies conclude that the complex challenge of MSS sharing in the band 1 683-1 690 MHz with the increasing number of GVAR and S-VISSR stations (see Note 1), especially mobile and future stations, would be extremely difficult;

~~**4** that the great number of meteorological earth stations operating in the 1 690-1 698 MHz band and its dense occupation by meteorological data channels, would render operation in this band of mobile earth stations impracticable;~~

~~5~~6 that sharing in the band 1 690~~8~~-1 710 MHz ~~based on geographical separation~~ would not be feasible in view of the large number of MetSat earth stations, ~~and~~ their generally unknown locations and the increasing use of the service,

recommends

1 that mobile earth stations possibly operating in part of the 1 67~~5~~0-1 690 MHz band shall not transmit, except on a narrow-band signalling channel, inside the exclusion zones around main meteorological earth stations ~~(CDA and PDUS)~~, taking into consideration the radii identified in *recognizing* 2, increased by the precision (km) of the position determination system referred to in *recognizing* 3 (see Note ~~1~~2); ~~additional study is required to determine the criteria for coordination between MSS and GVAR/S-VISSR (geostationary operational environment/stretched visual and infrared spin scan radiometer) (see Note 2) stations in this band;~~

~~NOTE 1 – The WMO is invited to inform the ITU, at regular intervals, of the geographical position of main meteorological earth stations.~~

~~NOTE 2 – GOES stands for geostationary operational environmental satellite; GVAR stands for GOES variable; VISSR stands for visual and infrared spin scan radiometer; S/VISSR stands for stretched VISSR;~~

2 that mobile-satellite systems be equipped with demonstrated location determination capability, permitting the determination of the position of the mobile earth stations, in order to assure compliance with *recommends* 1;

3 that the narrow-band signalling channel, which may be required worldwide by certain location determination systems, be assigned in agreement with the meteorological operators concerned;

4 that, in the 1 683-1 690 MHz band, sharing is considered extremely difficult, in particular in Regions 2 and 3, in view of the present deployment of hundreds of fixed and mobile meteorological earth stations and future developments which pose enormous coordination burdens and operational restrictions on MSS systems taking into account *recognizing* 2;

5~~4~~ that the 1 690-1 710~~1 698~~ MHz band not be used by mobile earth stations in view of the very large and increasing number of meteorological earth stations;

~~**5** that the 1 698-1 710 MHz band not be used by mobile earth stations in view of the very limited and complex sharing potential as well as the expected increase of meteorological systems and their protection stipulation in RR No. S5.377.~~

6 that the MSS could share the band 1 670-1 675 MHz with the MetSat service based on minor restrictions to ensure no worldwide impact on MetSat operations in the band 1 670-1 710 MHz.

NOTE 1 - GOES stands for geostationary operational environmental satellite; GVAR stands for GOES variable; VISSR stands for visual and infrared spin scan radiometer; S/VISSR stands for stretched VISSR;

NOTE 2 - The WMO is invited to inform the ITU, at regular intervals, of the geographical position of main meteorological earth stations.

SUP current Annex 1

ADD new Annex 1

ANNEX 1

Sharing analysis between the meteorological-satellite service and the mobile-satellite service in the band 1 683-1 690 MHz

1 Introduction

WRC-2000 received proposals for a primary allocation of the band 1 683-1 690 MHz to the mobile-satellite service in Regions 1 and 3. These proposals were not adopted for a number of reasons, amongst them the lack of information regarding GVAR (GOES Variable) and S-VISSR (Stretched Visible and Infrared Spin Scanning Radiometer) meteorological earth stations and the impact of modifications to Appendix S7 adopted at WRC-2000.

The band 1 683-1 690 MHz is mainly used by three different types of meteorological earth stations. While there are only a limited number of main MetSat earth stations deployed in all three ITU Regions, there are a large number of meteorological earth stations operated in Regions 2 and 3 and some in Region 1. The locations of many of these stations are unknown and some of them are even mobile and can therefore not be coordinated. During WRC-2000, it was also acknowledged that there is an increase in use of these stations in Regions 2 and 3 and that potential MSS operation should not constrain current and future development of the MetSat service as specified in S5.377.

It has been established in earlier studies that sharing is theoretically feasible if an appropriate separation distance is kept pursuant to coordination under S9.11A. However, sharing is not practical where a large number of meteorological earth stations are deployed as the required exclusion zones would take up large parts of the mobile-satellite service area.

WRC-2000 has adopted new coordination parameters for meteorological earth stations in a modification to Appendix S7 which require also a review of the assumptions made in earlier studies, in particular Recommendation ITU-R SA.1158. Whereas these earlier studies considered primarily required separation distances based on propagation by diffraction, the new coordination parameters make it now necessary to also take into account propagation by tropospheric scatter and layer ducting effects.

In addition to in-band interference, the problem of adjacent band interference to meteorological earth stations operating in the band 1 690-1 698 MHz needs to be addressed as well. More than 5 000 user stations are operating worldwide in the band 1 690-1 698 MHz receiving meteorological data from geostationary satellites. It is evident that a mobile earth station transmitting in the vicinity of a meteorological user station will cause harmful adjacent band interference in view of practically unavoidable out-of-band emissions. A guardband or some other suitable means to protect these meteorological stations will therefore be necessary.

2 Meteorological earth station characteristics

Regarding types of meteorological earth stations, main stations with antenna diameters up to 15 m as well as primary data user stations such as GVAR (GOES Variable) and S-VISSR (Stretched Visible and Infrared Spin Scanning Radiometer) are operating in this band. Table 1 lists the key technical characteristics used for this study.

Sharing and interference criteria for space-to-Earth data transmission systems in the Earth exploration-satellite and meteorological-satellite services using satellites in low-Earth orbit have been established in various ITU-R recommendations. In addition to Appendix S7, Recommendation SA.1160 can be used as reference as it applies to data dissemination and direct readout systems in the meteorological-satellite service using satellites in geostationary orbit.

Table 1 lists the corresponding parts of this recommendation applicable to GVAR and S-VISSR stations. For the main stations, relevant data from Table 9 of Annex 7 of Appendix S7 have been used. The acceptable interference values are given for reference bandwidths between 660 kHz and 2.11 MHz but have been scaled to 4 kHz which is used as the reference bandwidth for coordination in compliance with Appendix S7.

TABLE 1

Typical MetSat station characteristics

MetSat earth station	**GVAR**	**S-VISSR**	**MAIN**
Channel centre frequency [MHz]	1 685.7	1 687.1 1 687.5	several channels in the whole band 1 675-1 690
Bandwidth [kHz]	4 200	6 000	30 to 6 000
Antenna diameter [m]	4-5	2.4-5.4	9-15
G/T [dB/K]	15	8.5-15	25
Min. elevation [deg.]	3	3	5
Interference criteria in 4 kHz	–175.3	–175.3	–178
Percentage of time for interference	0.025	0.025	0.0055

The required separation distances are to a significant extent a function of the elevation angle. This angle ranges between 3° and 90° for stations receiving data from geostationary satellites. Main stations will not operate at elevation angles of less than 5°. The number of meteorological earth stations as currently registered with the WMO exceeds 300 for the user stations and 15 for the main stations in the 1 683-1 690 MHz band.

3 Mobile-satellite system characteristics

3.1 Earth terminal characteristics for GSO MSS systems

Recommendation M.1184 provides information on mobile-satellite system characteristics to be used in sharing studies with other primary services in the range 1-3 GHz. Table 2 shows an extract of typical transmission characteristics for low gain terminals communicating with a geostationary MSS satellite. Due to the large distances involved, a relatively high power density is required to transmit a signal to the geostationary orbit.

For the same type of service, the required e.i.r.p. is typically 10 to 20 dB higher compared to transmissions to a low-Earth orbiter. As the interference to the MetSat stations is primarily determined by the amount of energy radiated towards the horizon, some degree of antenna discrimination will occur. Unless the MSS terminal actually operates at low elevation angles, the overall effect will be very similar to the systems using omnidirectional antennas. It has therefore been assumed that the mobile terminals operate in a way which result in approximately 0 dBi gain towards the horizon. Any specified maximum antenna gain was therefore subtracted from the given maximum e.i.r.p. in order to obtain an estimate for the e.i.r.p. in the direction of the horizon.

TABLE 2

Typical characteristics of GSO MSS terminals extracted from M.1184

MSS earth station type	**System C of Table 1a**	**System D of Table 1a**	**Inmarsat MMSS**	**Inmarsat LMSS**	**Can. Reg. Table 3**
E.i.r.p. per channel (dBW)	12.5	10.9	27	25	15
Max. antenna gain (dBi)	0	0	14	12	2.5
E.i.r.p. towards horizon (dBW)	12.5	10.9	13	13	12.5
Channel data rate (kb/s)			2.4	2.4	1.2
Modulation scheme			OQPSK	OQPSK	BPSK
Main lobe bandwidth or modulation bandwidth (kHz)	4.7	4.7	2.4	2.4	2.4
Assumed e.i.r.p. density towards horizon (dBW/4 kHz)	11.8	10.2	13	13	12.5

3.2 Earth terminal characteristics for LEO MSS systems

Information has been published on a number of MSS LEO systems in a more or less advanced planning stage with widely varying system characteristics. Recommendation M.1184 lists eight systems of which five have been selected as representative examples. Their characteristics are shown in Table 3. Some assumptions had to be made on antenna gains towards the horizon. In the absence of relevant information, it was assumed that a nearly omnidirectional antenna typical for handheld mobile units would be used with little or no discrimination towards the horizon.

TABLE 3

Typical characteristics of non-GSO MSS terminals extracted from M.1184

MSS earth station type	**System A of Table 4a**	**System E of Table 4a**	**System F of Table 4a**	**System G of Table 4a**	**System H of Table 4a**
E.i.r.p. per channel (dBW)	6	3	7	6.1	8
Max. antenna gain (dBi)	0	0	0	1	2
E.i.r.p. towards horizon (dBW)	6	3	7	5.1	6
Modulation scheme	QPSK	QPSK	QPSK	QPSK	QPSK
Modulation bandwidth (kHz)	31.5	1900	25	500	2050
assumed e.i.r.p. density towards horizon (dBW/4 kHz)	−3.0	−1.6	7.0	5.1	1.1

4 Interference assessment from MSS earth terminals to MetSat earth stations operating in the band 1 683-1 690 MHz

A transmitting terrestrial MSS terminal may cause interference to a receiving MetSat earth station if transmission is effected in its vicinity. A separation distance is consequently required between the MSS earth station and any of the MetSat stations in order to reduce the received interfering signal below the protection criterion. In addition to the free space loss, the signal will be attenuated due to atmospheric effects, path obstacles and diffraction due to the Earth's curvature and terrain variations. However, besides direct paths and propagation by diffraction, there exist additional propagation mechanisms which can cause significant interference to meteorological earth stations. Figure 1 gives an overview of the geometrical constellation and the associated propagation mechanisms.

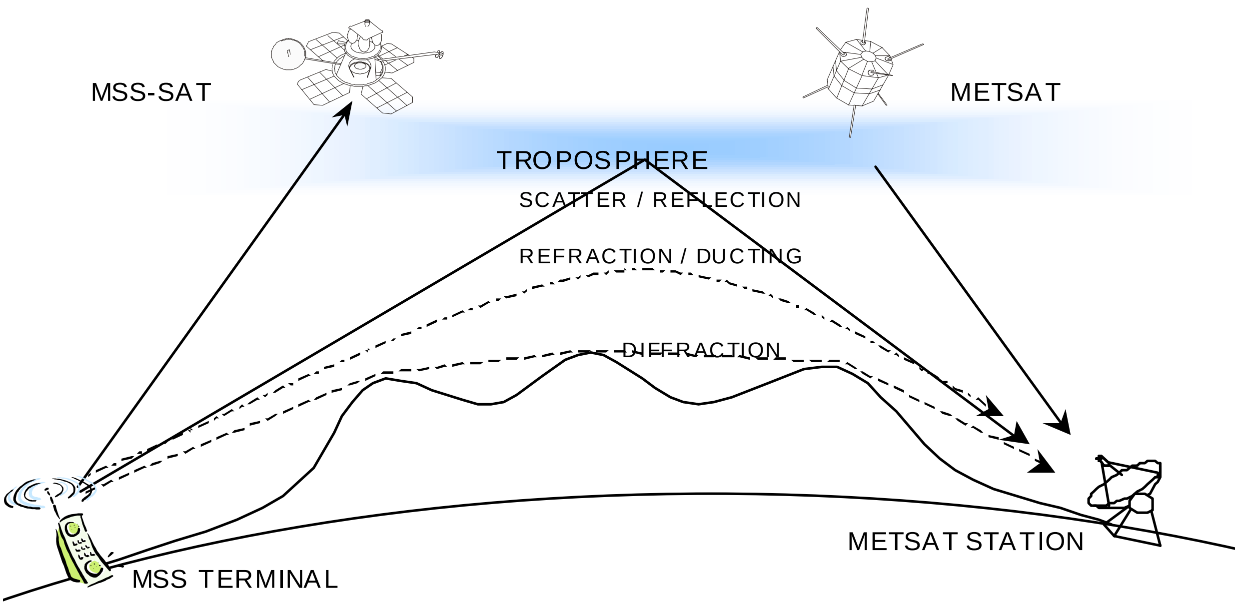

FIGURE 1

Geometrical constellations and propagation mechanisms

Propagation by diffraction determines often the dominating signal component if the permissible interference probability is moderate to high. However, for rather small percentages of time, during which interference is permissible, other propagation mechanisms, such as tropospheric scatter or layer ducting, are likely to result in stronger interfering signal components than the diffraction path. It is therefore necessary to investigate several propagation modes of potential significance.

For the MSS terminal, an antenna centre point at a height of 2 m has been assumed. For the meteorological main stations, an average antenna height of 12 metres above ground has been assumed and 5 metres above ground for primary data user stations, such as GVAR and /S-VISSR stations.

4.1 Determination of coordination distances according to Appendix S7

Appendix S7 was significantly modified and amended at WRC-2000. Meteorological earth stations were included in the corresponding tables of Annex 7, so that formal system parameters are now available for the determination of the coordination area around an earth station. The key parameters for coordination are given in Table 1 in the column for the main stations.

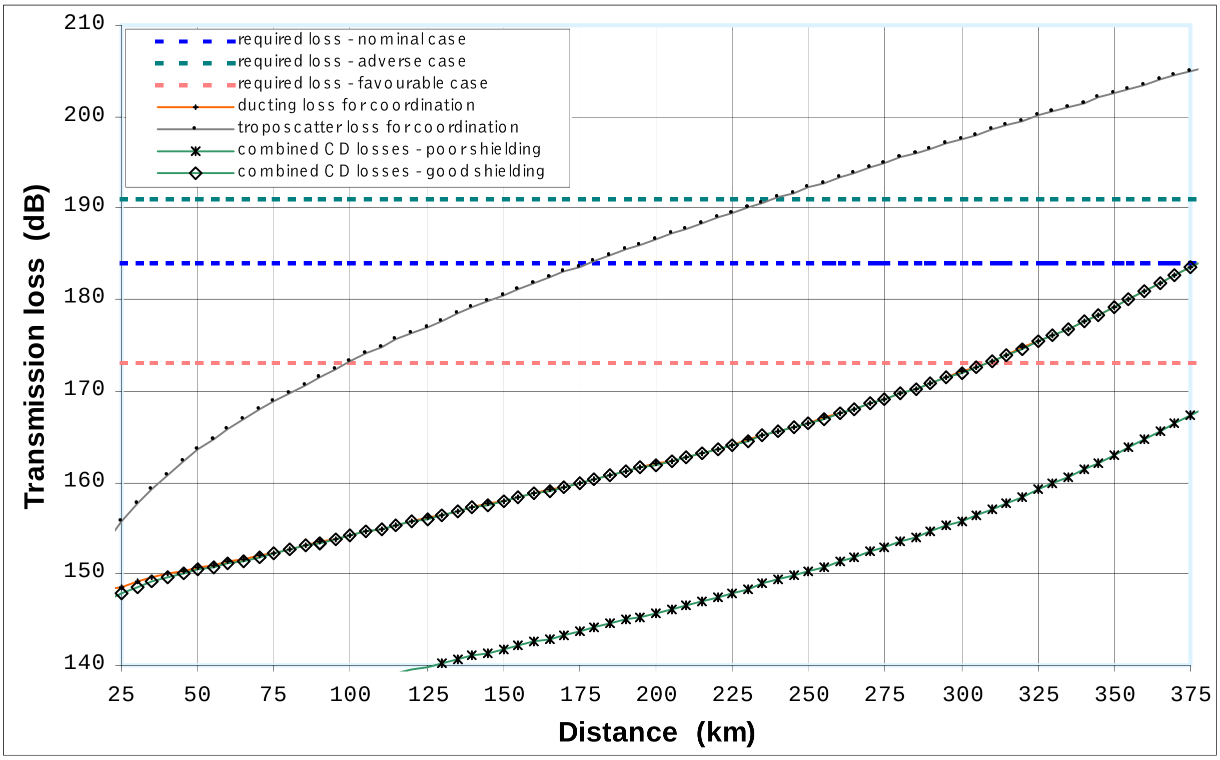

FIGURE 2

Coordination distances for meteorological main stations

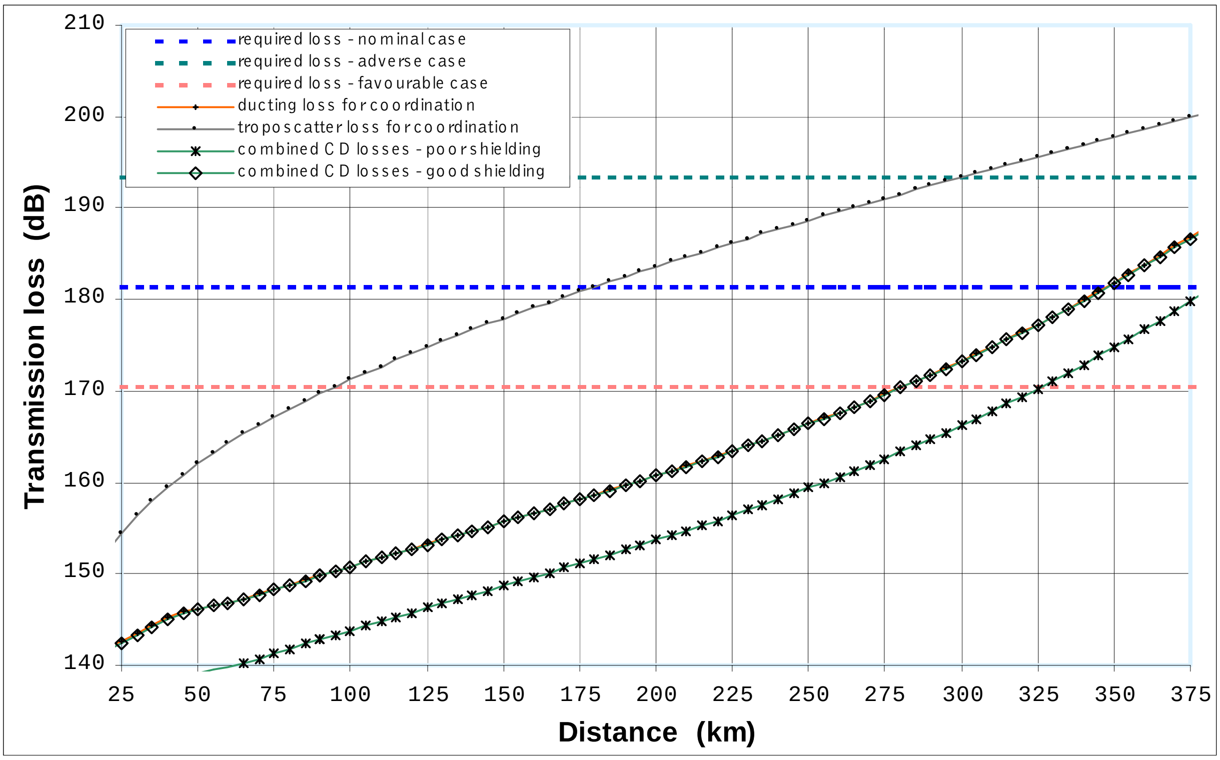

FIGURE 3

Coordination distances for primary data user stations

Figure 2 shows the results for a case with little site shielding and another one with good site shielding for main stations. In addition, for the case of good site shielding, the 2 individual components for the ducting and the troposcatter mechanism are shown. It can be seen that in this case the ducting component is much larger than the troposcatter component. Figure 3 shows the same for primary data user stations.

MSS e.i.r.p. densities towards the horizon have been assumed with 0, 6 and 13 dBW/4 kHz, representing a low power non-GSO case (referred to as favourable), a high power non-GSO and simultaneously low power GSO case (nominal) and a high power GSO case (adverse).

The antenna gain of the meteorological main station was assumed with 0 dBi for adverse and nominal conditions, and –5 dBi under favourable conditions. For the primary data user stations, the adverse gain was set to 5 dBi because of significant deployment of these stations also at low elevation angles.

The latitude of the earth station was assumed with 45 degrees for the main stations and 60 degrees for the user stations. The water vapour content used was 7.5g/m^3, and the fraction of path over water was zero. The nearest coast line in the direction of reception was assumed with 100 km. It shall be noted that stations near large bodies of water and oceans will require significantly larger coordination distances. This remains to be investigated.

The heights of the nearest obstacles were assumed with 50 metres each at a distance of 10 km in the case of poor shielding, and 100 metres for user stations and 200 metres for main stations.

respectively, for the case of good shielding. Main stations are typically deployed in shielded areas whereas user stations are often just near the Met-Office and sometimes deployed on the roof of the building.

4.2 Determination of actually required separation distances

The coordination distance determines the distance below which a closer investigation of the actually required separation has to take place. The separation distance is consequently the boundary distance below which in all likelihood harmful interference will be caused to the receiving MetSat station unless additional blockage of the signal path, for example by buildings or hills, takes place. In addition to the free space loss, the signal will be attenuated due to atmospheric effects, path obstacles and diffraction due to the Earth's curvature and terrain variations. The main additional contribution comes from diffraction losses. For frequencies below a few GHz, the vegetation loss may be neglected. Atmospheric attenuation can be calculated from Recommendation ITU-R P.676 but is also insignificant around 1.7 GHz.

The required separation distances can be calculated based on Recommendation ITU-R P.452. This Recommendation addresses long term effects such as propagation by diffraction (Recommendation ITU-R P.526) or tropo-scattering as well as short-term propagation effects such as reflection, refraction, ducting and hydrometeor scattering.

A mathematical model based on Recommendation P.452-9 has been used to derive an estimation for the required separation distances. The matter is very complex and only a few cases could be investigated. Main parameters were antenna centre point altitudes and shielding by hills or mountains.

Like for the coordination distance calculations, a case with little site shielding and another one for good site shielding was considered for both meteorological main and user stations. For little site shielding, the dominating effect of signal refraction and tropospheric scatter can be clearly seen.

Detailed results for the various components as well as the impact of site shielding are shown in Figures 4 and 5 for basically the same assumptions made for the calculation of the coordination distances. In addition, the terrain roughness for layer reflaction/refraction has been assumed with 200 metres, the gain of the interfering transmitter antenna towards the troposphere with 3 dBi and the gain of the meteorological stations towards the troposphere with 15 dBi.

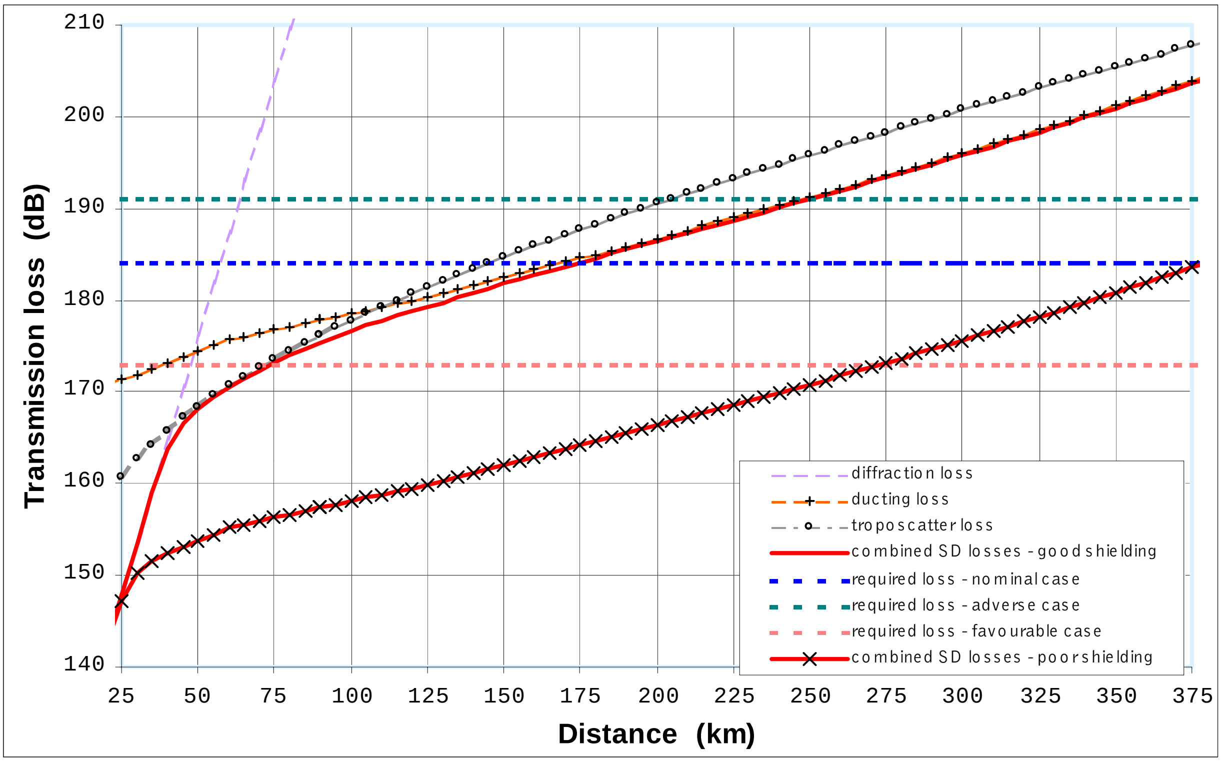

FIGURE 4

Separation distances for meteorological main stations

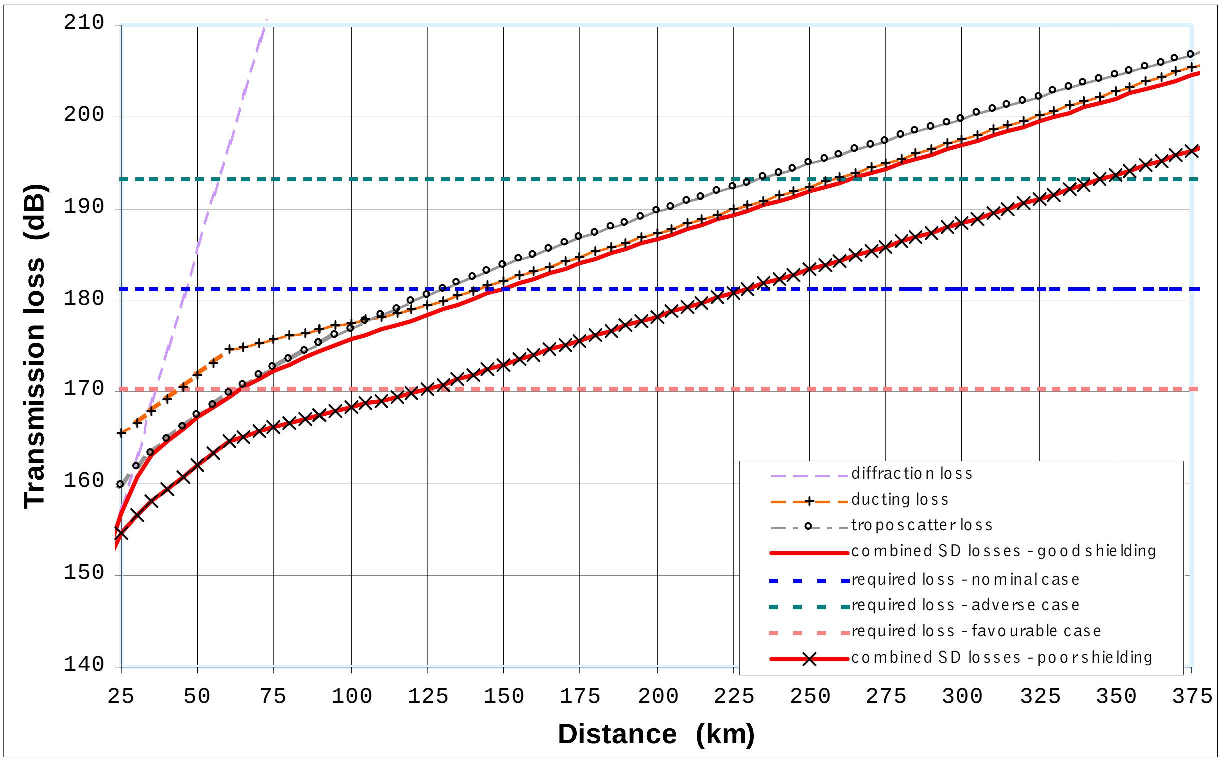

FIGURE 5

Separation distances for primary data user stations

4.3 Adjacent band interference assessment from MSS earth terminals to MetSat earth stations operating in the band 1 690-1 698 MHz

In addition to in-band interference, the problem of adjacent band interference to meteorological earth stations operating in the band 1 690-1 698 MHz needs to be addressed as well. More than 5 000 user stations are operating worldwide in the band 1 690-1 698 MHz receiving meteorological data from geostationary satellites. These stations are not registered with the ITU and coordination is therefore neither practical nor possible.

It is evident that a mobile earth station transmitting in the vicinity of a meteorological user station will cause harmful adjacent band interference in view of practically unavoidable out-of-band emissions. A guardband will therefore be necessary because it is obvious that the modulated signal spectrum does not drop to zero outside the main channel but follows a certain mask determined by the modulation and pulse shaping method, as well as possible additional filtering. The ITU-R (Task Group 1/5) has established out-of-band emission specifications for MSS terminals which show a 35 dB attenuation outside the required bandwidth.

Meteorological data user stations operating in the band 1 690-1 698 MHz have a protection requirement of -160.4 dBW/4 kHz which may be exceeded by 0.025% of time. Assuming the same range of mobile terminal characteristics as for the other cases, shielding by a house or other obstacle with a height of approximately 15 metres, and on top a 35 dB out-of-band signal reduction, results already in separation distances up to 7 km for the high power terminals. This is illustrated in Figure 6. The 35 dB attenuation is therefore not sufficient. An attenuation on the order of 60 dB would be required for the high power terminals. For this reason, either a guardband would be needed or a hard limitation of the e.i.r.p. spectral density towards the horizon. Such a hard limit would be on the order of –50 dBW/4 kHz. This can already be achieved by the non-GSO MSS systems B, D, E and H described in Recommendation M.1184 assuming a 35 dB out-of-band attenuation but not by the high power terminals. For a line-of-sight link, an MSS terminal with an out-of-band e.i.r.p. density of –50 dBW/4 kHz would have to keep a distance of around 4.7 km. This can be estimated by means of:

$$d \approx 0.014 \cdot 10^{a/20}$$

where d is the distance in metres and a is the difference between the required protection of -160.4 dBW/4 kHz and the MSS actual out-of-band e.i.r.p. density towards the horizon (e.g. -50 dBW/4 kHz).

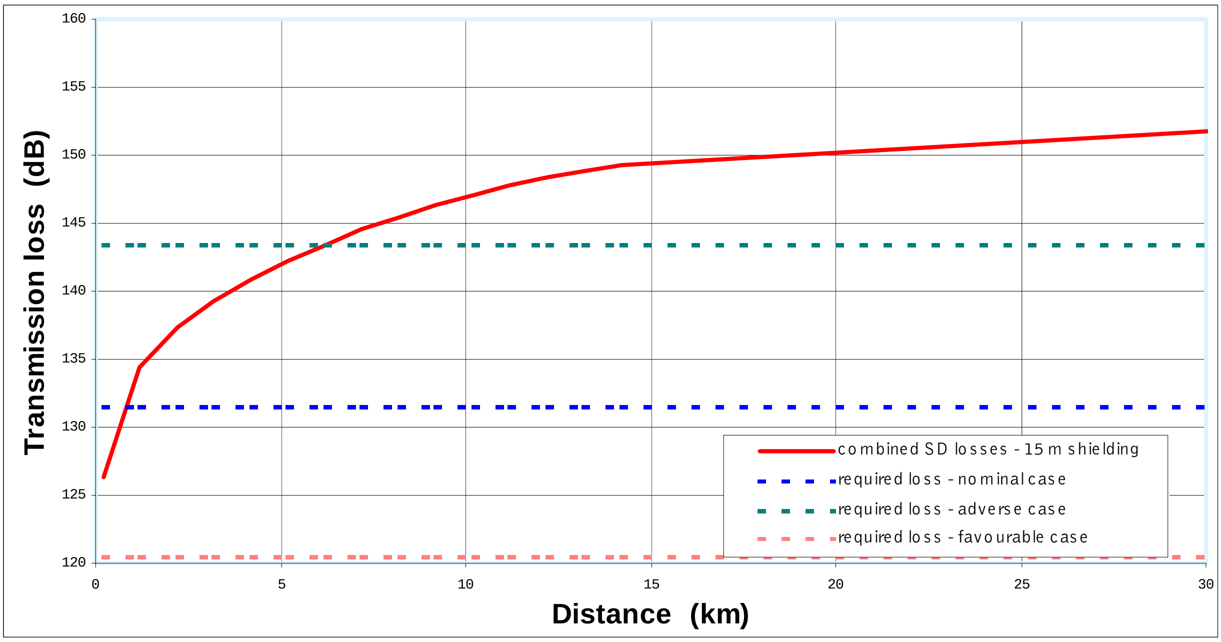

FIGURE 6

Separation distances for primary data user stations

5 Conclusions

Sharing, even though theoretically feasible, would in practice be very difficult in areas where meteorological main or data user stations such as GVAR and S-VISSR are deployed. The required separation distances up to a few hundred kilometres already for the most favourable climatic zone A2 would cause large service areas not being available to the MSS, rendering the typical feature of this service as not available. There are currently more than 15 main stations operated in all three Regions and more than 400 data user stations registered with the WMO which are operated mostly in Regions 2 and 3, but some of them also in Region 1. The actual number is expected to be far above one thousand as users do not have a requirement to formally register their stations.

In addition to in-band interference in the band 1 683-1 690 MHz, the problem of adjacent band interference to thousands of meteorological earth stations operating in the band 1 690-1 698 MHz requires either a guardband below 1 690 MHz or a stringent limitation of out-of-band emissions in the Radio Regulations. An e.i.r.p. density limitation of at least –50 dBW/4 kHz would be required in the band 1 690-1 698 MHz.

A summary of the obtained coordination and separation distances derived in this study is contained in Table 4. It shall be noted that this study has not considered propagation effects near large bodies of water or oceans which will result in significantly higher distances.

TABLE 4

Required separation distances for various propagation mechanisms entirely contained within climatic zone A2

Station type	**Typical coordination distances**	**Typical separation distances**	**Units**
main stations – good shielding (typical case)	310-375	75-250	km
main stations – poor shielding (rare case)	375	275-375	km
primary data user stations – good shielding (rare case)	280-375	60-265	km
primary data user stations – poor shielding (typical case)	325-375	125-350	km

MOD Annex 2

ANNEX 2

Information on worldwide MetSat systems

MetSat system	Function	Frequency (MHz)	RF bandwidth (MHz)	e.i.r.p. (dBW)
GMS (GSO)	Sensor	1 681.600	20.000	27.0
	S-VISSR	1 687.100	6.000	25.0
	WEFAX1	1 691.000	0.260	17.0
	WEFAX2	1 691.000	0.032	7.0
	Ranging 1	1 684.000	1.000	17.0
	Ranging 2	1 688.200	1.000	–4.5
	Ranging 3	1 690.200	1.000	–4.5
	DCP report	1 694.500	0.400	4.0
	Telemetry	1 694.000	0.400	10.0
FY-2	Sensor (~~S-~~VISSR)	1 681.6	20	27
	S-VISSR	1 687.5	2	25.5
	WEFAX	1 691.0	0.26	21
	Ranging 1	1 690.5	1	18
	Ranging 2	1 686.5	1	3
	Ranging 3	1 684.5	1	3
	DCP report	1 709.5	1	9
	Telemetry	1 702.5	0.4	15
GOES (GSO)	Sensor W/B	1 676.000	5.000	19.0
	Sensor raw image	1 681.600	25.000	27.9
	Sensor multi	1 681.478	0.500	19.0
	Sensor mode AAA	1 685.700	5.000	19.0
	Ranging 1	1 684.000	1.000	27.9
	Ranging 2	1 688.200	1.000	27.9
	Ranging 3	1 690.200	1.000	27.9
	Direct readout	1 687.100	3.500	27.9
	WEFAX	1 691.000	0.026	27.9
	Telemetry	1 694.000	0.020	19.0
	DCP report 1	1 694.450	0.400	19.0
	DCP report 2	1 694.500	0.400	21.1
	DCP report 3	1 694.800	0.400	19.0

MetSat system	Function	Frequency (MHz)	RF bandwidth (MHz)	e.i.r.p. (dBW)
METEOSAT (GSO)	DCP reports	1 675.281	0.435	12.5
	Telemetry	1 675.929	0.030	5.0
	Sensor	1 686.833	5.300	10.7
	Ranging 1	1 691.000	0.660	21.3
	Ranging 2	1 694.500	0.660	21.3
	Fax high resolution 1	1 691.000	0.660	21.3
	Fax high resolution 2	1 694.500	0.660	21.3
	WEFAX1	1 691.000	0.026	21.3
	WEFAX2	1 694.500	0.026	21.3
	MDD	1 695.770	0.720	9.0
	HRIT	1 695.150	1.960	18.4
	LRIT	1 691.000	0.660	16.6
GOMS (GSO)	Sensor	1 685.000	5.000	23.0
	WEFAX1	1 671.48 1 690.8	0.018	18.8
	WEFAX2	1 674.48 1 691.4	0.018	18.8
	Fax high resolution 1	1 672.48 1 691.0	0.0024	12.3
	Fax high resolution 2	1 673.48 1 691.2	0.0024	12.3
	DCP 1	1 697.0	2.000 (300 × 3 kHz)	9.7
	DCP 2	1 688.5	1.000 (100 × 10 kHz)	12.0
Typical LEO MetSat	Worst case	–	3.000	9.0

NOC Annexes 3 and 4

ADD Annex 5

ANNEX 5

Interference from MSS uplinks in the band 1 670-1 675 MHz to MetSat downlinks above 1 675 MHz

This annex is a sharing study that applies to MSS uplinks in the band 1 670-1 675 MHz and to MetSat downlinks above 1 675 MHz. The expectation is that if MSS uplinks were to be restricted to the band 1 670-1 675 MHz, there would be minimal interference to MetSat downlinks in the rest of the 1 670-1 710 MHz band. This annex does not consider interference to MetAids in this band.

1 Assumptions

a) There is a uniform spatial distribution of emitters (density equal to ρ emitters per km^2) outside a circle of radius *d* centred at the MetSat station. *d* is therefore the minimum separation distance.

b) There is a uniform distribution of emitter carrier frequencies across the band 1 670-1 675 MHz.

c) The propagation loss (in dB) between a MetSat station and an emitter at distance *r* (in km) from the station is derived from Recommendation P.526, namely

$$115 + 10\log r + 1.11r$$

d) Each emitter has an e.i.r.p. of *E* watts toward the horizon. Annex 1 assumed that the emitter antenna gain toward the horizon is around 0 dBi. However, it is recognized that some emitters may occasionally be pointing toward the horizon during set-up, and that a few of these may therefore point at the MetSat station. To account for this possibility, we will assume that the average gain toward the horizon is 10 dBi rather than 0 dBi.

2 Cumulative interference from all emitters

The average interference power received from a thin circular ring of emitters of radius *r* and thickness *dr* centred at the station is

$$dI = \frac{2\pi \rho r G E K dr}{L_1 L_2 L(r)}$$

L_1 is the polarization loss and L_2 is a factor that accounts for signal blockage. These two losses are taken to be 3 dB and 2 dB respectively. Therefore L_1L_2 = 3.16. *G* is the MetSat station antenna gain toward the horizon (averaged over all azimuths around the station). *L(r)* is the propagation loss given above (but not expressed in dB):

$$L(r) = 3.16 \times 10^{11} r e^{0.256r}$$

K is a factor (to be determined) that accounts for the emitter carrier offsets from the centre of the MetSat receiver passband. Integration over the total area occupied by the emitters yields.

$$I = \frac{2\pi\rho GEK}{L_1 L_2}\int_d^{\infty}\frac{r\,dr}{L(r)} = 2.46\times10^{-11}\rho GEKe^{-0.256d}$$

3 Emitter carrier offsets, and evaluation of K

If *S(f)* is the power spectrum from an MSS emitter, normalized so that its integral over all frequencies is unity, and if *H(f)* is the MetSat station receiver transfer function, then

$$K = \int_{-\infty}^{\infty} S(f)\left|H(f)\right|^2 df$$

Assume that the spectrum and transfer function can be approximated by Gaussian functions having -20 dB bandwidths of B_1 and B_2 respectively, so the integral can be evaluated analytically. Then

$$K = \sqrt{\frac{1}{1+(B_1/B_2)^2}}\,e^{-18.4F^2/(B_1^2+B_2^2)}$$

where F is the difference between the carrier frequency of one of the emitters and the centre of the MetSat receiver passband. Let F_0 be the value of *F* when the emitter carrier is at the centre of the band occupied by the emitters. Then under assumption 2 for multiple carriers, *F* is uniformly distributed from $F_0 - B/2$ to $F_0 + B/2$, where *B* is the band occupied by the emitters (5 MHz in our case). Averaging *K* over this distribution in *F* gives

$$K_{ave} = \frac{B_2}{2B}\sqrt{\frac{\pi}{18.4}}\left\{erf\left[\left(F_0+\frac{B}{2}\right)\sqrt{\frac{18.4}{B_1^2+B_2^2}}\right] - erf\left[\left(F_0-\frac{B}{2}\right)\sqrt{\frac{18.4}{B_1^2+B_2^2}}\right]\right\}$$

where

$$erf(u) = \frac{2}{\sqrt{\pi}}\int_0^u e^{-x^2}dx$$

K_{ave} rapidly drops to zero, as it should, as the offset F_0 increases.

4 Example

Let us estimate the minimum separation distance from a MetSat CDA station receiving sensor data at 1 676 MHz. For this case, F_0 = 3.5 MHz and B_2 = 5.2 MHz. Since B_1 is only a few kHz, it can be neglected compared to B_2 when evaluating the error functions in the equation for K_{ave}. We get

$$K_{ave} \approx 0.052\frac{B_2}{B}$$

Substituting this value of *K* into the expression for *I*, and rearranging, gives

$$\frac{I}{B_2} = 1.28\times10^{-12}G\frac{E\rho}{B}e^{-0.256d}$$

To use this formula, set I/B_2 equal to the long-term sharing criterion that has been established in Recommendation ITU-R SA.1161 for this wideband downlink, which is –150.7 dBW per 2.6 MHz. This is equivalent to $I/B_2 = 3.27\times10^{-16}$ W/MHz. For a given average CDA antenna gain toward the horizon, the formula then shows how the minimum separation distance *d* depends on the emitter e.i.r.p. density $E\rho/B$ toward the horizon. To get an idea what to expect, assume that the average gain of the CDA antenna toward the horizon is 0 dBi. It is recognized that emitters near the main beam of the CDA antenna will see a gain greater than 0 dBi. But most emitters will not be near the main beam, so they will see a gain less than this. Therefore a 0 dBi average gain seems reasonable for this calculation. Also assume a spatial density of 1 emitter per km^2 and an average emitter e.i.r.p. toward the horizon of 100 watts per kHz. This e.i.r.p. results from an assumed transmitter power density of 10 dBW per kHz, which may be considered typical for GSO MSS transmitters, and from an average antenna gain of 10 dBi toward the horizon in accordance with assumption 4. Then the minimum required separation distance from a CDA station is about 71 km. From this example it appears to be fairly easy to select MSS parameters for the band 1 670-1 675 MHz that do not cause problems for MetSat downlinks above 1 675 MHz.

5 Conclusion

It has been shown that wideband MetSat downlinks to CDA stations whose carrier frequencies are only 1 MHz above the upper edge of the band 1 670-1 675 MHz are protected from MSS uplinks in that band, if reasonable restrictions are placed on MSS parameters. Restrictions rapidly disappear with distance of the MetSat carrier from that band. Therefore it can be concluded that any MSS system implemented in the band 1 670-1 675 MHz, and complying with suitable separation distance restrictions and e.i.r.p. density restrictions, can co-exist with MetSat downlinks above 1 675 MHz.

ATTACHMENT 3

Source: Doc. 7C/TEMP/20

PROPOSED CPM TEXT
AGENDA ITEM 1.31 (RESOLUTION 227): ADDITIONAL MSS

Allocations in the 1-3 GHz range

The following text is proposed regarding sharing between MSS and MetAids, and MSS and MetSat in the bands 1 683-1 690 MHz and 1 670-1 675 MHz.

2.8 Agenda item 1.31 – Additional MSS allocations in the 1-3 GHz range

2.8.1 Band 1 683-1 690 MHz

2.8.1.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The ITU-R has conducted several studies regarding the feasibility of sharing between MSS and MetSat, and in particular MSS and GVAR/S-VISSR earth stations. As a result of these studies, Recommendation ITU-R SA.1158 has been updated to include information on sharing between MSS and GVAR/S-VISSR stations. The studies regarding sharing between MSS and GVAR/S-VISSR stations indicate sharing is not feasible due to the large and increasing number of GVAR and S-VISSR earth stations used mainly in Regions 2 and 3, with some also in Region 1. Moreover, there are also transportable and mobile GVAR and S-VISSR stations in Regions 2 and 3. Exclusion zones of several hundred kilometres are required and cannot be established around earth terminals that are mobile or that may be periodically relocated. The ITU-R has also reviewed the studies regarding MetAids use of the band 1 683-1 690 MHz and concluded that the relatively few MetAids systems operated in the band 1 683-1 690 MHz can be concentrated below 1 683 MHz if sufficient time for transition is provided.

2.8.1.2 Analysis of sharing studies

2.8.1.2.1 Study results regarding sharing between MSS and MetAids

Sharing studies indicate that co-channel sharing between MetAids and MSS is not feasible due to unacceptable levels of interference to both systems. Studies also indicate that time-sharing between MetAids and MSS is also not feasible due to the operational nature of both services. The band 1 683-1 690 MHz is also allocated to the MetSat service on a co-primary basis. Studies and operational experience have shown that co-frequency sharing between MetAids and MetSat downlinks is not feasible. MetAids operations are concentrated below 1 683 MHz in many parts of the world (Regions 2 and 3) to avoid interference to GVAR and S-VISSR (also see Section 2.8.1.2.2) MetSat downlinks. The WMO has identified future requirements for narrow-band MetAids operations as 1 675-1 683 MHz. However a number of administrations continue to use wideband systems that should not exceed a requirement of 12 MHz, which is consistent with national spectrum availability in those countries. In reviewing the available study results, an MSS allocation in the band 1 683-1 690 MHz will most affect MetAids operations in ITU Region 1 in those locations where the limited number of MetSat stations does not prevent their use in 1-683-1 690 MHz.

2.8.1.2.2 Study results regarding sharing between MSS and MetSat

Sharing the band 1 683-1 690 MHz, even though theoretically possible in some areas of the world, would be subject to such practical constraints and limitations for the MSS that it should be considered unsuitable. There are currently more than 15 main earth stations operated in all three Regions and more than 400 registered data user stations operated mostly in Regions 2 and 3, but some of them also in Region 1. The number of registered data user stations is increasing and the actual number of existing stations is believed to be in excess of 1 000.

The available study results show that for the most favourable climatic zone, A2, the required coordination distances are often in excess of several hundred kilometres and would cause an enormous coordination burden for the MSS. The problem increases for coastal areas where coordination distances above 1 000 km could be required. In addition to the coordination burden, the actual required separation distances up to a few hundred kilometres would cause large service areas not being available to the MSS; rendering typical features of this service such as global or regional coverage as well as unrestricted mobility, as unavailable. Resolution 227 also recognizes that the use of the data user stations is on the increase and given the implications of S5.377, this would mean an unpredictable risk for any MSS operator to lose service areas in addition to those unavailable today. As an additional system burden, the MSS mobile earth station locations would have to be determined with sufficient accuracy relative to the required separation distances.

In addition to in-band interference in the band 1 683-1 690 MHz, the problem of adjacent band interference to thousands of meteorological earth stations operating in the band 1 690-1 698 MHz requires either a guard band below 1 690 MHz or a stringent limitation of out-of-band emissions in the Radio Regulations. A value of at least –50 dBW/4 kHz would be required in the band 1 690-1 698 MHz.

Assuming the band 1 670-1 675 MHz proves suitable for an allocation to the MSS, finding an additional 2 MHz of spectrum in the range 1 683-1 690 MHz without significant restrictions imposed on the MSS appears difficult. In the range 1 683-1 687 MHz, service areas in many countries, in particular Region 2, will not be available due to GVAR operations. Around 1 687 MHz, several MHz are not available in major parts of Region 3 due to S-VISSR operations. The frequency range just below 1 690 MHz is constrained by the required out-of-band emission specifications in order to protect thousands of meteorological earth stations operating in the band 1 690-1 698 MHz.

2.8.2 Alternative frequency bands in response to Resolution 227 (*resolves to invite ITU-R* 3)

2.8.2.1 Band 1 670-1 675 MHz

2.8.2.1.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Due to the sharing difficulties between the MSS and MetSat service in the band 1 683-1 690 MHz in Regions 2 and 3, the ITU-R studied the band 1 670-1 675 MHz as an alternative band for an MSS allocation as called for in Resolution 227, *resolves to invite ITU-R* **3**. In summary, sharing between the relatively few MetSat main earth stations and MSS uplinks in the band 1 670-1 675 MHz is considered feasible provided the MSS can protect the MetSat earth stations through the use of exclusion zones and position determination. Sharing between the MSS and the MetAids service is also considered feasible if protection is provided to MetAids operations in those countries where there is a continuing requirement to use 1 670-1 675 MHz. Providing protection to MetAids systems operating in the few countries requiring use of 1 670-1 675 MHz will most likely result in the MSS not using the band within that country. Recommendations ITU-R SA.1158 and ITU-R SA.1264 have been updated to address sharing between the MSS and MetSat and MetAids services, respectively.

2.8.2.1.2 Analysis of sharing studies

2.8.2.1.2.1 Study results regarding sharing between MSS and MetAids

Sharing between MetAids and MSS in the band 1 670-1 675 MHz is considered feasible due to the low use of the band for MetAids operations. However, there are a number of countries that operate MetAids systems that will continue to require use of the band 1 670-1 675 MHz. Sharing between the MSS and MetAids within those specific countries is not feasible. The majority of MetAids operations are concentrated in the frequency range 1 675-1 683 MHz with some operations conducted in 1 683 to 1 690 MHz in locations where no MetSat stations are deployed and those few countries that will continue to require 1 670-1 675 MHz. A survey of band usage indicates that MetAids frequency requirements can be satisfied with the spectrum available above 1 675 MHz.

2.8.2.1.2.2 Study results regarding sharing between MSS and MetSat

Sharing is considered feasible in the band 1 670-1 675 MHz if an appropriate separation distance is maintained at all times between the few MetSat main earth stations and MSS earth stations, as determined pursuant to coordination under No. S9.11A. The mobile earth station locations will have to be determined with sufficient accuracy to enforce the required separation distances. Coordination of mobile earth stations in this band would therefore be subject to the ability of MSS systems to respect these separation distances through location determination capabilities.

2.8.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method No. 1

A worldwide MSS allocation would be created, with the application of No. S5.377, in the band 1 670-1 675 MHz. This option has the advantage in that protection of the few MetSat main earth stations will place little constraint on the MSS. However MSS operations would not be possible in the few countries that will continue to use the band 1 670-1 675 MHz for MetAids operations. As a consequence of making a worldwide MSS allocation at 1 670-1 675 MHz, the Conference may consider aligning the Region 2 MSS allocation by suppressing the allocations at 1 675-1 710 MHz since studies show MSS use is not feasible in 1 675-1 683 MHz and 1 690-1 710 MHz, and determined to be extremely difficult in 1 683-1 690 MHz.

Method No. 2

A worldwide MSS allocation would be created, with the application of No. S5.377, in the band 1 683-1 690 MHz. This solution has the disadvantage that in many countries, MSS operations would be prevented by the operation of a large and increasing number of GVAR and S-VISSR earth stations used mainly in Regions 2 and 3, with some also in Region 1; with transportable and mobile GVAR and S-VISSR stations in Regions 2 and 3. As a consequence of making a worldwide MSS allocation at 1 683-1 690 MHz, the Conference may consider aligning the Region 2 MSS allocation by suppressing the allocations at 1 675-1 683 MHz and 1 690-1 710 MHz since studies show MSS use is not feasible.

Method No. 3

The third option is to make no additional allocations within the band 1 670-1 710 MHz to accommodate the MSS. This option would ensure no impact to incumbent users, but would also provide no additional spectrum to the MSS. However, the conference may want to consider the aligning the Region 2 allocations with the allocations in Regions 1 and 3.

2.8.4 Regulatory and procedural considerations

If a worldwide MSS allocation is made in either the 1 670-1 675 MHz band or the 1 683-1 690 MHz band, protection of the incumbent MetSat and MetAids services could be ensured by the application of Footnote No. S5.377 - which would require revision to reflect the actual band limits of the MSS allocation. In addition, a proper footnote supplementing S5.377 would be required for which the following text should be considered:

"Mobile-satellite systems using the [1 670-1 675 MHz] [1 683-1 690 MHz] band shall not cause harmful interference to earth stations of the meteorological-satellite service. To avoid causing harmful interference, mobile earth stations shall not operate, except on a non-interfering signalling channel, within the zones around the meteorological earth stations defined in the coordination process. The mobile-satellite system shall have precise position determination capabilities to ensure compliance with this provision."