CGMS-XXXII JMA-WP-05
Prepared by JMA
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Preparatory Activities for WRC-07

The preliminary draft agenda for the next WRC were approved in WRC-03 held in Geneva, Switzerland from June to July 2003. There are some items that deeply MetSat related issues in the agenda.

This working paper reports the JMA's preparatory activities for WRC-07 focussing on some items relevant to the MetSat in the WRC-07 Agenda

Preparatory Activities for WRC-07

1 Introduction

The 2003 World Radiocommunication Conference (WRC-03) that decided the radio frequency allocation on a worldwide basis was held in Geneva, Switzerland from 09 June to 04 July 2003. The results of WRC-03 were reported at CGMS-XXXI Meeting in 2003. With regard to the Sharing studies for between Meteorological Satellite Service (MetSat) and Mobile Satellite Service (MSS) in 1.6GHz band that is one of the WRC-03 Agenda 1.31, the primary allocation to MSS (Earth-to-space) in the 1670-1675 MHz band was approved with a provision that the protection of existing earth station in MetSat from MSS in the above band shall be ensured. The allocation of 1683-1690 MHz that had been operated by MetSat as for GVAR and S-VISSR receiving station was not changed.

It is believed that the sharing issue between MetSat and MSS that had been discussed since WARC-92 was settled. From the viewpoint of the protection of the frequency bands for meteorological activities, the current frequency allocations for MetSat were not changed. Regarding sharing studies between Meteorological Aids Service (MetAids) and MSS in the 1.6GHz band, it was decided that the frequency band for MetAids would be transferred to another frequency band in the future. The timing has not been determined yet.

JMA believes that WMO and CGMS's persevering appeal to ITU-R and the Authorities in various countries resulted in the securing of radio frequency bands for MetSat and EESS since WARC-92.

21 and 8 items were approved at WRC-03 for the WRC-07 Agenda and the WRC-10 preliminary draft agenda, respectively. This working paper provides information concerning ITU-R activities and policies of the Authorities in Japan and reports the JMA's preparatory activities toward WRC-07, focusing on MetSat related agenda items.

2 WRC-07 Agenda relevant to MetSat

JMA pays attention to some items in WRC-07 Agenda approved in WRC-03 as follows.

2.1 Agenda Item 1.2

Studies for the allocation and regulatory issues related to the Earth Exploration Satellite Service (EESS) (passive), space research (passive) service and the meteorological satellite service

"*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 **[COM7/8] (WRC-03)** and **[COM5/3] (WRC-03)***"

This agenda is for the Earth Exploration Satellite Service (passive) in the band 10.6-10.68 GHz and 36-37 GHz and the MetSat (space-to-Earth) in the 18.1-18.3 GHz band.

Especially, JMA pays attention to study and frequency allocation activities relevant to the 18.1-18.3 GHz band within ITU-R.

2.2 Agenda Item 1.4

Studies for the allocation to the Earth Exploration Satellite Service (EESS) (passive) in the 420-470 MHz band

"*to consider provision of up to 6 MHz of frequency spectrum to the Earth exploration-satellite service (active) in the frequency band 420-470 MHz, in accordance with Resolution 727* ***(Rev.WRC-2000)*** "

JMA pays attention to the upgrading for IMT-2000 because the frequency bands for the IMT-2000 are planned to include that for MetSat.

2.3 Agenda Item 1.7

Studies for the result of ITU-R studies regarding sharing between the MSS and the MS in the band 1688.4-1675 MHz

"*to consider the results of ITU-R studies regarding sharing between the mobile-satellite service and the space research service (passive) in the band 1 668-1 668.4 MHz, and between the mobile-satellite service and the mobile service in the band 1 668.4-1 675 MHz in accordance with Resolution* ***[COM5/12] (WRC-03)***"

JMA pays attention to the study activities in ITU-R, since the 1670-1675 MHz band is also the sharing band between MetSat (space-to-Earth) and MSS (Earth-to-space).

3 Preparatory activities for WRC-07

The allocation of 18.1-18.3 GHz band to MetSat and the relevant regulations are particularly emphasized in the Agenda item 1.2 of WRC-07. EUMETSAT proposed to ITU-R that the 200 MHz bandwidth of 18.1-18.3 GHz allocated to MetSat should be expanded to 300 MHz in the 18.0-18.4 GHz. The study for this issue has already started in SG4, SG7 and SG8 of ITU-R. For information, parts of the distribution from EUMETSAT and the liaison statement between WP7B and WP4A of ITU-R are attached as ANNEX 1 and ANNEX 2, respectively.

JMA has no plan to use the above frequency band for MTSAT-1R and MTSAT-2. The frequency plan for the next generation meteorological satellite will be started from this year in Japan. However, JMA believes that the expansion of the frequency band mentioned above would be very useful for MetSat in the world.

JMA started to appeal to the Authorities in Japan that Japan should support the proposal from EUMETSAT regarding expand of bandwidth for MetSat in the 18 GHz band at WRC-07. As the Japanese Authorities is watching the status of studies in ITU-R and other countries' responses, they keep a neutral position on this matter at the present time.

4 Future Activities

JMA will keep watching the frequency allocation related activities of ITU-R/SGs and relevant bodies in Japan and appeal to the national Authorities for the securing of necessary frequency bands for the meteorological activities including MetSat and EESS described in Agenda Item 1.2 and 1.4 of WRC-07.

5 Conclusion

In order to carry on the smooth operation of meteorological satellites and exploration satellites for the future, JMA believes that it is very important to discuss frequency issues at every opportunity, and that the necessary information should be exchanged among CGMS members.

JMA will provide CGMS members with the status of related activities of the Asia Pacific Telecommunity (APT) and relevant bodies in Japan whenever something to inform comes up.

ANNEX 1

EUMETSAT

PROPOSED MODIFICATIONS TO RECOMMENDATIONS ITU-R SA.1159, SA.1160 AND SA.1161 TO TAKE INTO ACCOUNT NEXT GENERATION METEOROLOGICAL SATELLITE SYSTEMS

Next generation geostationary meteorological satellite systems are expected to have bandwidth requirements up to 300 MHz. This is primarily due to transmission of data from high-resolution sensors. Frequencies around 18 GHz appear to be suitable for transmission of these high data rate considering in particular that a primary allocation to the geostationary meteorological satellite (space-to-Earth) service exists already in the Radio Regulations in the band 18.1-18.3 GHz based No.**5.519**. WRC-03 recognized that the bandwidth of the existing allocation is insufficient to support the required data rates and that sharing between geostationary meteorological satellites and the fixed, fixed-satellite and mobile services is likely to be feasible in the band 18-18.4 GHz, considering in particular that the number of earth stations deployed to support these meteorological satellites will be typically less than five per Region.

WRC-03 resolved to invite ITU-R to conduct 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. In order to conduct the required compatibility studies, it is necessary to include system characteristics, interference and sharing criteria in the appropriate set of ITU-R Recommendations.

Typical system designs for the next generation meteorological satellites focus on a geostationary satellite transmitting data into a relatively large direct data readout earth station. A carrier frequency around 18.2 GHz has been assumed. The system is expected to have bandwidth requirements up to 300 MHz. Therefore, 300 MHz of spectrum shall finally be identified within the entire band 18.0 – 18.4 GHz under consideration. Two options for an extension of footnote No.**5.519** are currently under consideration, either from 18.3 – 18.4 GHz or from 18.0 – 18.1 GHz. For the time being, both options will be considered and further decisions will be taken upon the availability of the results of compatibility studies.

The high data rates are primarily due to transmission of data from high-resolution sensors. For the link budgets it is assumed that the entire available bandwidth of 300 MHz will be used. The most likely modulation techniques for such high data rates are QPSK or 8PSK. In order to have some error detection capability and to operate at lower signal-to-noise ratios, it is also likely that some form of channel coding will be used. As a starting point, rate ½ convolutional coding has been assumed. Other likely candidates are turbo coding or concatenated coding. For all channel coding techniques suitable for very high data rates, the required Es/No will not vary be more than a few dBs so that the assumed rate ½ convolutional code appears to be a good choice in the middle.

Regarding on-board RF subsystems, Travelling Wave Tube Amplifiers (TWTA) is commonly available up to several hundred Watts. Pointable antenna systems with diameters up to about

1.5 meters provide sufficient gain for high data rate transmissions. Economical and practical reasons (satellite mass, deployment mechanism, signal blockage, etc.) may lead to antenna diameters between 0.3 and 1.2 meters. For this assessment, a 50 to 100 W amplifier and a 0.5 to 1.0 m parabolic antenna have been assumed.
The 18 GHz band will be primarily used for meteorological direct data readout systems. This corresponds to very few main earth stations being deployed in locations with elevation angles above 5 degrees. Most European climatic zones of interest will have rain attenuation rates of less than 13 dB for elevation angles above 5 degrees and a link availability in excess of 99.9%. All the above assumptions result finally in a typical earth station antenna diameter of around 8 meters. For comparison, a case with an antenna diameter of 6 m has been included.
Table 1 shows link budget examples for several typical cases where the elevation angle for direct readout stations is above 5 degrees. The data in the first column are currently the ones with the highest likelihood for practical implementation.

TABLE 1

Link budget examples for meteorological satellite systems operating around 18 GHz

Carrier frequency	18.2	18.2	18.2	GHz
Maximum bandwidth	300	300	300	MHz
Minimum elevation angle	5	5	5	deg.
Permitted PFD on surface of earth	-115	-115	-115	dBW/m2/MHz
Satellite RF power	20	50	100	W
Satellite antenna gain (1 m/ 0.5m parabolic)	43.0	43.0	37.0	dBi
Satellite EIRP	56.0	60.0	57.0	dBW
Distance satellite - Earth station	41343	41343	41343	km
Free space propagation loss	210.0	210.0	210.0	dB
Polarization loss	0.3	0.3	0.3	dB
Long term downlink loss	210.3	210.3	210.3	dB
Rain margin for 99.9% availability	13.0	13.0	13.0	dB
Short term downlink loss	223.3	223.3	223.3	dB
Earth station antenna diameter	8.0	6.0	8.0	m
Earth station antenna gain for 50% efficiency	60.7	58.2	60.7	dBi
Short term signal power level at receiver input	-106.6	-105.1	-105.6	dBW
Receiver system temperature	300	300	300	K
PFD on surface of earth	-130.9	-126.9	-129.9	dBW/m2/MHz
Receiver noise power density	-203.8	-203.8	-203.8	dBW/Hz
Signal to noise density ratio (C/No) - long term	110.2	111.7	111.2	dB/Hz
Signal to noise density ratio (C/No) - short term	97.2	98.7	98.2	dB/Hz
Required C/No for QPSK, R=1/2 coded	92.6	92.6	92.6	dB/Hz
System margin - long term	17.6	19.1	18.6	dB
System margin – short term	4.6	6.1	5.6	dB

These data are the basis for the proposed updates to the relevant ITU-R Recommendations. The modifications to Recommendation ITU-R SA.1159 are straightforward. The minimum elevation angles are given by the Radio Regulations, although in practice typical elevation angles are expected to be above 15 degrees for most direct data readout stations. A system availability of 99.9% is commonly required although a trend towards 99.99% is noticeable. Bit error rates around 10^{-7} are standard practice for systems using channel coding.

For Recommendation ITU-R SA.1160, the matter is more complicated. Data from the link budget, in particular the margins and the signal-to-noise ratios have been used in connection with the algorithm of Recommendation ITU-R SA.1022 to determine the permissible interference power densities for long and short term conditions. The required signal-to-noise ratio is based on QPSK modulation with R=1/2 convolutional channel coding and technical losses of 2 dB. For determining the long-term permissible interference, it was assumed that one third of the short-term margin could be used up (q=1/3) and for the short-term permissible interference excess; the entire long-term margin could be used up (q=1). In this context it is suggested to review Recommendation ITU-R SA.1022, as it is not specified how the interference density levels should be derived for short and long term interference. A short-term interference excess probability of 0.1% was considered adequate in line with a system availability of 99.9%.

As the band is shared with several other services, an appropriate apportionment of the interference levels is required. For this purpose, the interference criteria are translated into sharing criteria by means of Recommendation ITU-R SA.1023. Regarding the apportionment of long-term interference between space and terrestrial systems, it can be expected that approximately equal contributions will arise from space and terrestrial services around 18 GHz, perhaps even more from space systems. It is therefore suggested to assume 50% for each of these sources. Regarding the number of short term interferers, 2 NGSO FSS satellites are considered appropriate for space services and 2 FS links coupling at rare occasions via the troposphere or ducting may be reasonable for terrestrial systems. To date, this band is apparently not used by the mobile service and no deployment plans are known.

Based on these data, appendices 1 to 3 contain proposals for modifications to Recommendations ITU-R SA.1159, SA.1160 and SA.1161 in order to provide required information on geostationary MetSat systems.

The rest is omitted.

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ANNEX 2

Working Party 7B

LIAISON STATEMENT TO WORKING PARTY 4A

Sharing analyses between geostationary meteorological satellite systems operating in the space-to-Earth direction and the fixed, fixed-satellite and mobile service systems in the band 18-18.4 GHz

To update our previous liaison statement (Document 4A/9) regarding WRC-07 Agenda item 1.2 and Resolution 746 (WRC-03), Working Party 7B provides Working Party 4A with information related to a possible geostationary meteorological satellite space-to-Earth link in the 18 GHz band. Specifically, the Annex to this liaison statement provides a description of the intended MetSat use of the proposed expanded 18 GHz allocation, example 18 GHz MetSat link budgets, and specific 18 GHz MetSat parameters regarding performance, interference and sharing criteria. Concerning Table 6 in the Annex, Working Party 7 B would like Working Party 4A to consider the appropriateness of assigning the short- and long-term interference budget equally between space and terrestrial (fixed and mobile) services and of the equivalent number of interferers and provide a response to Working Party 7B.
We look forward to the active participation of Working Party 4A in providing information and technical studies that may be required to address this agenda item, which deals in part with the possible expansion of the current 200 MHz geostationary meteorological satellite service (MetSat) space-to-Earth allocation from 18.1-18.3 GHz to a bandwidth of 300 MHz in the band 18-18.4 GHz.

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The rest is omitted.

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