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OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM ON SATELLITE UTILIZATION AND PRODUCTS

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EVOLUTION OF DIRECT BROADCAST*(Submitted by the Secretariat)*

Summary and Purpose of Document

The present document reports on the ongoing evolution of Direct Broadcast (DB) services.

On one hand, the frequency allocation to Meteorological Satellite Services in L-Band (around 1.7 GHz) is now threatened in the United States and possibly worldwide since the US plan to allocate the upper part of this band (1.695-1.710 GHz) to broadband mobile communication services. This would affect DB services from current LEO satellite generations, which are planned to continue through the next decade.

On the other hand, it is anticipated that DB services from the future generation of LEO systems will be mainly, if not exclusively, in X-Band (7.750-7.850/7.900 GHz), in order to accommodate considerably higher data rates than current satellite systems. Several LEO systems are already using X-Band: Aqua, Terra, NPP, and FY-3 (for the MPT service). This evolution raises several issues:

- Current lack of CGMS standard protocol applicable to X-Band;
- Higher sensitivity than L-Band to weather conditions;
- Higher class of hardware needed for receiving stations;
- Higher class of user hardware and software for handling high data rates.

This was discussed at the IGDDS meeting in 2010 and reported to CGMS. CGMS-39 took actions to develop a standard and to organize the use of X-Band frequencies for LEO Direct Broadcast. It was furthermore agreed at CGMS that WMO would perform a survey in the global user community in order to assess the need for maintaining a low data rate DB service in L-Band for future systems, in addition to the planned high-rate services in X-Band.

ACTION PROPOSED

The sixth session is invited to take note of the issues related to the evolution of Direct Broadcast and provide guidance and recommendations as appropriate, in particular as concerns:

- The survey on the need for low data rate L-Band service;
 - Information to be communicated to the user community;
 - Feedback to be communicated to satellite operators.
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EVOLUTION OF DIRECT BROADCAST

1. Introduction

The adoption of global dissemination standards for Direct Broadcast (DB) services is one of the important achievements of the global meteorological satellite community in the past decades through the Coordination Group for Meteorological Satellites (CGMS). The CGMS has defined the HRIT/LRIT and AHRPT/LRPT dissemination standards for geostationary and polar-orbiting satellite systems respectively, based on recommendations of the Consultative Committee on Space Data Systems (CCSDS).

Table 1: List of CGMS Dissemination Standards

Name	Scope	Applicable Frequency	Possible Data Rate
LRPT	LEO satellites low rate	137 MHz	72 kbps
		or Mission specific	Mission specific
AHRPT	LEO satellites high rate	Mission specific	Mission specific
LRIT	GEO satellites low rate	Mission specific	10 - 256 kbps
HRIT	GEO satellites high rate	Mission specific	256 kbps-10 Mbps

“Direct Broadcast” designates here data transmission from the meteorological satellite to users in real time, without any on-board storage. This definition mainly applies to LEO satellites; in the case of geostationary satellites, the expression Direct Broadcast is often used for services that are not “Directly” broadcasting in the true sense, since the data is generally pre-processed (geo-located and calibrated) on the ground and uplinked to the spacecraft for onward dissemination. Furthermore, some derived products or other information may be included into the dissemination stream, e.g., in the case of the LRIT dissemination. In such cases “Re-broadcast” would be a more appropriate designation.

DB services have been mainly implemented in the 1675-1710 MHz band, which is allocated in the L-Band, by the International Telecommunications Union (ITU), to Meteorological Satellite Services on a co-primary, non-exclusive basis. This frequency allocation is however challenged by the expansion of broadband mobile telecommunication services.

In parallel, as technology evolves, a growing number of dissemination services for new generation satellite systems are likely to use X-Band and to depart from the current standards. The X-Band is already used by some R&D satellites (NASA/Aqua and Terra), for NPP and for the FY-3/Medium-Resolution Picture Transmission (MPT) service. The use of X-Band enables higher data rates up to 140 Mbps. These systems are using the 7750-7850 MHz frequency band, which is also allocated to the Meteorological Satellite Service. This band is expected to be extended up to 7900 MHz in 2012.

These new developments raise several issues which are discussed below.

2. Current and Planned Direct Broadcast Services

For current dissemination services, the details contained in the tables below are actual characteristics. For future systems, they are only tentative, based on information shared in CGMS.

Table 2: Direct Broadcast Services for Geostationary satellites (as of December 2011)

Satellite	Service	Frequency	Data rate
Meteosat-8	LRIT	1691.0 MHz	128 kbps
Meteosat-9,10,11	LRIT	1691.0 MHz	128 kbps
	HRIT	1695.15 MHz	1.0 Mbps
GOES-11	WEFAX	1691.0 MHz	
	GVAR	1685.7 MHz	2.1 Mbps
GOES-12,13,14,15	WEFAX/LRIT	1691.0 MHz	128 kbps
	GVAR	1685.7 MHz	2.1 Mbps
	EMWIN	1692.7 MHz	9.6 kbps
	DCS/DPCR	1694.5 MHz	100/300/1200 bps
MTSAT-1R, 2	LRIT	1691.0 MHz	75 kbps
	HRIT	1687.1 MHz	3.5 Mbps
GOMS-N2, N3	LRIT	1691.0 MHz	64-128 kbps
	HRIT	1691.0 MHz	0.665-1 Mbps
FY-2E,F,G,H	LRIT	1691.0 MHz	150 kbps
	S-VISSR	1687.5 MHz	660 kbps
INSAT 3D	LRIT		
	HRIT		
COMS-1	LRIT	1692.14 MHz	256 kbps
	HRIT	1695.4 MHz	3 Mbps
GOES-R,S,T	GRB	1686.6 MHz	31 Mbps
	HRIT/EMWIN	1694.1 MHz	400 kbps
	DCS/DCPR	1679.9 MHz	300/1200 bps
FY-4	TBD	TBD	TBD
	TBD	TBD	TBD
MTG	TBD	TBD	TBD

Table 3: Direct Broadcast Services for Sun-Synchronous Satellites (as of December 2011)

Satellite	Service	Frequency	Data rate
NOAA-18, 19	HRPT	1698 or 1707 MHz	665.4 kbps
	APT	137.5 or 137.62 MHz	1.7 kHz
MetOp-A,B,C	AHRPT	1701.3 MHz (1707 MHz backup)	3.5 Mbps
	LRPT	137.1 MHz (137.9125 MHz)	72 kbps
Meteor-M-1,2	HRPT	1700 MHz	665 kbps
	LRPT	137.9 or 137.1 MHz	72 kbps
FY 1,D	HRPT	1700.4 MHz	1.33 Mbps
FY 3	AHRPT	1704.5 MHz	4.2 Mbps
	MPT	7775 MHz	18.7 Mbps
NPP	HRD	7812 MHz	15 Mbps
JPSS-1	HRD	7812 or 7830 MHz	20 Mbps
	LRD (TBC)	1706 MHz (TBC)	3.88 Mbps
JPSS-2	HRD	7812 or 7830 MHz	20 Mbps
	LRD	1706 MHz	3.88 Mbps
EPS 2G	HRD	7.8 GHz	40-90 Mbps
Terra	DB	8212.5 MHz	13 Mbps
Aqua	DB	8160 MHz	15 Mbps
DMSP	RTD	2.2 GHz (encrypted)	1 Mbps

As can be seen from the tables above, most geostationary services are using the lower part of the L-Band allocation (1675-1695 MHz) while LEO services are using either the upper part of the L-Band (1695-1710 MHz), or VHF (137 MHz) for APT/LRPT, or X-Band (7750-7850 MHz) for recent and future services.

3. Possible use of L-Band by Mobile Broadband Services

In June 2010, the US National Telecommunications and Information Agency (NTIA) and the Federal Communications Commission (FCC) issued a public enquiry regarding the possible reallocation of several frequency bands, including the L-Band, in the framework of a Presidential initiative to develop Mobile Broadband Services. In spite of a formal response by WMO - as well as hundreds of individual responses - calling for the preservation of this band, the NTIA now plans to open the upper-part of the L-Band, i.e. 1695-1710 MHz, to Mobile Broadband Services over the US territory. Provisions would be made in the US to establish "exclusion zones" with the aim to preserve data reception from US satellites (NOAA POES) at a few critical US federal locations.

There would be severe potential consequences for meteorological satellite DB:

- Interference preventing the operational reception of LEO DB services in the US, except for NOAA POES reception at a few selected federal sites;
- Risk of interference at the federal sites as well if the exclusion zones did not ensure sufficient protection;
- Risk of extension of this situation to other parts of the world if the telecommunications industry encourages other countries to take the US initiative as a model.

It is hoped, however, that the band in question will not be attractive enough for the telecommunications industry given that it is limited (15 MHz only) and hampered by several exclusion zones across the US territory.

4. Harmonization of future dissemination services

As shown in Tables 2 and 3 above, some of the future generations of geostationary and polar-orbiting meteorological satellites will use dissemination in X-band for high data rate dissemination services that cannot be accommodated in L-band. The current CGMS standards HRIT and HRPT are unlikely to be applicable in these cases. Therefore, in response to a question from WMO at CGMS-38, CGMS-39 took action to develop a new standard, as indicated below:

Action 39.43: EUMETSAT and NOAA to prepare a new global specification for LEO high rate broadcast services and present it for consideration at the next meeting of CGMS.

Action 39.44: CMA to nominate a Point of Contact to follow the evolution of the new global specification for LEO high rate broadcast services and to comment accordingly at CGMS 40.

5. Assessing the need for Low Data Rate services in L-Band for future systems

At CGMS-39, WMO was informed by EUMETSAT that no low data rate service in L-Band was envisaged for the Second Generation EPS system, which would only have a high data rate service in X-Band. Moreover, NOAA indicated that JPSS-2 would, in principle, have a Low Data Rate service in L-Band, but such a service is currently not budgeted for JPSS-1, and is not designed on NPP, which only operates in X-Band. The WMO Secretariat therefore suggested consulting the user community in order to assess the need for a low data rate service in L-Band, and the following actions were agreed:

Action 39.45: WMO to consult WMO Members on the requirement for a "Low Data Rate" service in L-Band on future generation polar-orbiting systems, and on the expected contents of such a service.

Action 39.46: EUMETSAT to re-assess the European user requirement for a L-band service from its LEO satellites, bearing in mind the ongoing broader consultation process of WMO, and report to CGMS accordingly.

In this forthcoming consultation, the following points should be brought to the attention of Members:

- Current experience of the DB user community in both L-Band and X-Band;
- Dramatic increase of data rates;
- Technological evolution towards affordable X-Band equipment ;
- Low sensitivity of L-Band to rain attenuation;
- Threat to the L-Band frequency allocation;
- On-going development of a CGMS standard for high data rate DB in X-Band;
- Alternative data access mechanisms, such as RARS combined with DVB rebroadcast.

6. Conclusions

ET-SUP-6 is invited to take note of the issues above and make recommendations, as appropriate, in particular as concerns the survey on the need for low data rate L-Band service; information to be communicated to the user community; and feedback to be communicated to satellite operators.

It should be noted that DB is of primary importance for LEO systems, for which there is no affordable alternative to DB for near real time data access. The situation is different with geostationary systems, which are permanently within visibility of a Command and Data Acquisition station and for which a rebroadcast scheme using a DVB-S transponder on a telecommunication satellite is a perfectly suitable and even recommended alternative to DB in the Integrated Global Data Dissemination Strategy (IGDDS).
