

**COORDINATION OF DATA FORMATS AND FREQUENCY PLANNING  
FOR POLAR-ORBITING SATELLITES**

*(Submitted by WMO)*

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**Summary and purpose of document**

To inform CGMS Members on the status of activity related to coordination of data formats and frequency planning for polar orbiting satellites.

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**ACTION PROPOSED**

CGMS satellite operators are urged to consider the recommendations contained in the CGMS Task Force Report and to continue an active dialogue to provide a consistent plan for equator crossing times and frequencies and to keep WMO informed through mechanisms similar to that used to inform WMO Members of the LRIT/LRPT transition dates and duration. As part of such a dialogue, it is suggested that Table 1 be updated on an annual basis at each meeting of CGMS.

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## DISCUSSION

### Background

1. At CGMS-XXVIII, the commonality of future direct readout services of CGMS Members was discussed. CGMS-XXVIII recalled the principles that have guided CGMS in coordinating direct readout services. Firstly, it recalled that CGMS satellite operators for both past and present systems had provided two types of direct broadcast services, low and high resolution. It also recalled that the low and high resolution services had vastly improved during the more than thirty years of service and were now referred to as low and high rate services.

2. With regard to data formats within the low and high rate services, CGMS Members had developed and agreed upon the concept of global and mission-specific specifications. The global specifications would be followed by all CGMS Members while mission-specific specifications would be provided by each CGMS Member for an individual satellite mission. The global specifications provided sufficient structure to allow any ground receiving station to receive data while the mission-specific specification would allow ground receiving stations to process data unique to a specific satellite. In this fashion, WMO Members need purchase only one type of receiving station for LRIT, LRPT, AHRPT or HRIT data.

3. Each of the four services would be provided in the 137–138 MHz (for LRPT) or 1675–1710 MHz (for LRIT, AHRPT or HRIT data) bands. CGMS-XXVIII also noted that these requirements were contained within the Manual and Guide for WMO's Global Observing System. The use of the concept for coordinated use of data formats and frequency had allowed WMO National Meteorological and Hydrological Services to operate over 1,300 ground receiving stations world wide and over 11,000 ground receiving stations used by WMO Members in general.

4. CGMS XXVIII also recalled the proposal by WMO that direct broadcast service on board meteorological satellites be complemented and supplemented by alternative telecommunications services with the ultimate goal for a smooth and orderly transition to the full use of alternative telecommunications service for broadcast service starting with the future generation of satellites. It noted that planning for NPOESS was in the preliminary stages with regard to a frequency plan and data formats. CGMS-XXVIII noted that another issue which was relevant and should be considered, in the light of the proposed plans for polar-orbiting satellites by at least four CGMS Members, was the need to coordinate equator-crossing times. Thus, CGMS-XXVIII suggested that all CGMS satellite operators consider activities that would follow the agreed concept for data formats and coordinated frequency plans. In order to further the dialogue in this important area, CGMS-XXVIII suggested that a small task force meet before the next CGMS to discuss the possibilities to coordinate the data formats and frequency plans for all satellites especially those in polar-orbit including their equator crossing times. WMO offered to host such a task force meeting and CGMS-XXVIII Action Item 28.18 was agreed upon as follows:

**ACTION 28.18            WMO to host a task force meeting to discuss coordination of data formats and frequency planning for all polar-orbiting satellites including their equator crossing times, by early 2001.**

### CGMS Task Force Meeting

5. The CGMS Task Force Meeting to discuss coordination of data formats and frequency planning for all polar-orbiting satellites including their equator crossing times was held at the World Meteorological Organization (WMO) Headquarters in Geneva, Switzerland on 24 January 2001. At the meeting, presentations were made by EUMETSAT, WMO, NOAA and China.

### **STANDARD CGMS LRPT/AHRPT FORMATS**

6. The Task Force reviewed the CGMS approved concept of global specifications for LRPT/AHRPT formats that had been agreed to by all CGMS Members and mission specific specifications that were specific to an individual mission.

7. The Task Force noted that both EUMETSAT and NOAA confirmed that their new satellite systems (Metop and NPOESS, respectively) would conform to the CGMS Global Specifications for LRPT and AHRPT. China indicated that it would confirm by 28 February 2001 if the CHRPT format onboard the new FY-3 satellites would also conform to the AHRPT Global Specifications, Issue 1.0 October 1998. Subsequently, China confirmed that the new FY-3 satellites would also conform to the AHRPT Global Specifications, Issue 1.0 October 1998.

**Action item: China to confirm that the CHRPT format will conform to the AHRPT Global Specification, Issue 1.0 October 1998, before 28 February 2001.**

### **STANDARD CGMS FREQUENCY PLAN**

8. The Task Force reviewed the current status of radio frequency allocations in the 400 MHz and 7.8 GHz bands. There were several potential problems identified where usage of the 400.15 - 400.1 MHz band and 7750 – 7850 MHz band were proposed for direct broadcast, including conflicts with the Meteorological Aids, Mobile Satellite and Fixed Services as defined by ITU. Control of X-band transmissions would need to be implemented by the satellite operators to avoid interference between the various systems, especially in the reception area of CDA stations. Although unable to identify a solution, the Task Force agreed that each CGMS satellite operator should continue to seek ways to improve the prospects of appropriate frequency allocations.

9. The Task Force also reviewed the development of the low-resolution and high-resolution services. It recalled that low-resolution services were also meant to be inexpensive and affordable by those WMO Members unable to afford the high-resolution receiving systems. The Task Force also observed that with the technological advances expected for the new satellite systems it would not be possible to provide appropriate data utility and products in the present low-resolution format and dissemination frequency. Additionally, the cost for such low-resolution receivers produced in small numbers could become more expensive than a higher-resolution receiver that would be produced in larger numbers.

### **COMMONALITY OF USER STATIONS**

10. The Task Force thus suggested that the CGMS satellite operators investigate the possibility to establish a global data dissemination service. The global service would be based on the already approved CGMS global specification for AHRPT. The global service should be provided by all satellite operators with near-polar-orbiting satellites. The global service should have a common frequency in the 1698-1710 MHz band and common bandwidth (3.5 MHz). Finally, the global service should have comparable content. It was recognized that the data content from an individual satellite would be mission specific. Thus, the Task Force suggested that the AHRPT data content for Metop be considered as a benchmark and that all other near-polar-orbiting satellites seek to provide a comparable data content. WMO would be asked to provide input as to which data and products would be appropriate to maintain comparable data content.

**Recommendation: CGMS satellite operators investigate the possibility to establish a global data dissemination service with common frequency, common bandwidth CGMS global specifications for AHRPT and comparable data content.**

**Recommendation: WMO to provide input as to which data and products would be appropriate to maintain comparable data content.**

11. The Task Force also noted the intent by CGMS satellite operators to develop prototype user stations and that they would make the design available to all manufacturers in order to reduce the cost of user stations, thus providing for commonality of user stations.

12. The Task Force agreed that an LRPT service with a data rate of 72 kbs could not be expected to serve user requirements in the long-term. In light of the discussion at CGMS-XXVIII by WMO concerning the future of direct broadcast, the Task Force confirmed the potential for alternative dissemination means. Thus, the Task Force suggested that the CGMS satellite operators investigate alternative dissemination means, including those that would take advantage of internet-like systems using push-pull ftp or commercial point to multi-point services.

**Recommendation: CGMS satellite operators investigate alternative dissemination means.**

**EQUATOR CROSSING TIMES FOR SATELLITES IN POLAR-ORBIT**

13. The Task Force reviewed Table 1 which highlighted the need to have a coherent plan for equator crossing-time for polar-orbiting satellites. Before discussing the individual plans for each CGMS satellite operator, the Task Force discussed equator crossing-time scenarios. It noted that the near-polar-orbiting satellites had been shared by one or two satellite operators (NESDIS and the Russian Federation) in the past but in the future there would be four operators with satellite systems in near-polar-orbit (EUMETSAT, China, NESDIS and the Russian Federation). When discussing an idealized equator crossing-time scenario, the Task Force identified several important factors to consider together:

- For 3 satellite systems, the idealized spacing between satellites should be 4 hours,
- For 4 satellite systems, the idealized spacing between satellites should be 3 hours,
- Meteorologically, the satellite should be evenly distributed in terms of equator crossing-time
- The AM orbit would provide an advantage for less cloud imagery and therefore more cloud-free sounding retrievals,
- Evenly distributed equator crossing-times provide for reduced probabilities of interference (although interference at high latitudes was unavoidable),
- Station keeping capabilities for individual satellites should be part of the system design,
- Maintain satellite phasing (in terms of the Right Ascension of the apogee ) is important,
- The instrument payload should be considered for a particular equator crossing time,
- The noon equator crossing time was not attractive for technical and meteorological reasons.

14. The Task Force was of the opinion that the best scenario for equator crossing-time was one that had: better spacing between satellites; provided for fewer conflicts over identical main ground stations (CDAs); and avoided redundant instruments on different satellites with similar overpass times.

15. Thus, the Task Force suggested that CGMS further consider a four time-slot scenario. Since there were impending time constraints for some CGMS Members, the Task Force agreed to suggest that CGMS Senior Officials consider the recommendation as a matter of urgency. The Task Force further requested WMO to provide advice on the need for sounding instruments in the 0530 and 1730 orbits.

**Recommendation: CGMS further consider a four time-slot scenario.**

**Recommendation: WMO to provide advice on the need for sounding instruments in the 0530 and 1730 orbits.**

**Table 1**

Satellite	Service	Start	EOL	Eq. Cross-time	Freq (MHz)	BW MHz	Data rate (Mb/s)
Metop-1	LRPT	2006	2011	0930	137.9125	.150	.072
Metop-2	LRPT	2010	2015	0930	137.9125	.150	.072
Metop-3	LRPT	2015	2020	0930	137.9125	.150	.072
Metop-1	AHRPT	2006	2011	0930	1701.3	3.5	3.5
Metop-2	AHRPT	2010	2015	0930	1701.3	3.5	3.5
Metop-3	AHRPT	2015	2020	0930	1701.3	3.5	3.5
Metop-1	Stored CDAs	2006	2011	0930	7800	63	70
Metop-2	Stored CDAs	2010	2015	0930	7800	63	70
Metop-3	Stored CDAs	2015	2020	0930	7800	63	70
NPOESS-1	LRD	2009	2014	1330	400.3-400.8	?	.230
NPOESS-2	LRD	2010	2015	0530	400.3-400.8	?	.230
NPOESS-3	LRD	2013	2018	1330	400.3-400.8	?	.230
NPOESS-4	LRD	2016	2021	0530	400.3-400.8	?	.230
NPOESS-1	HRD	2009	2014	1330	7750-7850	50	20
NPOESS-2	HRD	2010	2015	0530	7750-7850	50	20
NPOESS-3	HRD	2013	2018	1330	7750-7850	50	20
NPOESS-4	HRD	2016	2021	0530	7750-7850	50	20
NPOESS-1	SMD	2009	2014	1330	?	?	?
NPOESS-2	SMD	2010	2015	0530	?	?	?
NPOESS-3	SMD	2013	2018	1330	?	?	?
NPOESS-4	SMD	2016	2021	0530	?	?	?
NOAA-15	APT	1998	2001	0730	137		
NOAA-15	HRPT	1998	2001	0730	1698		
NOAA-16	APT	2000	2003	1400	137		
NOAA-16	HRPT	2000	2003	1400	1698		
NOAA-M	APT	2001	2004	1330	137		
NOAA-M	HRPT	2001	2004	1330	1698		
NOAA-N	APT	2004	2007	1330	137		
NOAA-N	HRPT	2004	2007	1330	1698		
NOAA-N'	APT	2008	2011	1330	137		
NOAA-N'	HRPT	2008	2011	1330	1698		
FY-1C	CHRPT	1999	2001	0830	1698-1710	5.4	1.3308
FY-1D	CHRPT	2001	2003	0900	1698-1710	5.4	1.3308
FY-3A	CHRPT	2004	2007	1010	1698-1710	5.4	4.5
FY-3B	CHRPT	2006	2009	1010	1698-1710	5.4	4.5
FY-3C	CHRPT	2008	2011	1010	1698-1710	5.4	4.5
FY-3D	CHRPT	2010	2013	1010	1698-1710	5.4	4.5
FY-3E	CHRPT	2012	2015	1010	1698-1710	5.4	4.5
FY-3A	MPT	2004	2007	1010	7750-7850	23.2	18.5
FY-3B	MPT	2006	2009	1010	7750-7850	23.2	18.5
FY-3C	MPT	2008	2011	1010	7750-7850	23.2	18.5
FY-3D	MPT	2010	2013	1010	7750-7850	23.2	18.5
FY-3E	MPT	2012	2015	1010	7750-7850	23.2	18.5
FY-3A	MDPT	2004	2007	1010	8025-8215 / 8215-8400	140	108
FY-3B	MDPT	2006	2009	1010	8025-8215 / 8215-8400	140	108
FY-3C	MDPT	2008	2011	1010	8025-8215 / 8215-8400	140	108
FY-3D	MDPT	2010	2013	1010	8025-8215 / 8215-8400	140	108
FY-3E	MDPT	2012	2015	1010	8025-8215 / 8215-8400	140	108
Meteor 3M N1*	Raw	2001	2004	1030	466.5	.24	FM, analogue
Meteor 3M N1*	Raw	2001	2004	1030	1700	2	PSK, 665.4 kbs
Meteor 3M N2	LRPT	2003	2007	1030	137.89 / 137.1	.15	QPSK, 72 kbs
Meteor 3M N2	HRPT	2003	2007	1030	1700	2	PSK, 665.4 kbs

## **TASK FORCE MEETING SUMMARY STATEMENT**

The Task Force summarised the meeting results in noting that: (1) agreement had been confirmed on the data format for LRPT and AHRPT; (2) a global data dissemination service should be investigated based on the AHRPT format with common frequency and bandwidth and comparable data content; (3) the LRPT service may be more appropriately accompanied through alternative dissemination means; (4) a four--time-slot scenario for equator crossing times should be considered.

### **Post CGMS Task Force Meeting**

Immediately following the CGMS Task Force Meeting and in response to its decision to inform CGMS of the recommendations from the meeting as a matter of urgency, the Task Force Meeting Report was delivered to all CGMS Senior Officials.

### **WMO activities**

The WMO CBS OPAG IOS Expert Team on Satellite Utilization and Products has plans for a reduced group meeting in December 2001 and a full Expert Team Meeting in 2002. Part of the agenda for the December 2001 meeting includes consideration of the recommendations from the CGMS Task Force Meeting.

### **WMO recommendation**

CGMS satellite operators are urged to consider the recommendations contained in the Task Force Report and to continue an active dialogue to provide a consistent plan for equator crossing times and frequencies and to keep WMO informed through mechanisms similar to that used to inform WMO Members of the LRIT/LRPT transition dates and duration. As part of such a dialogue, it is suggested that Table 1 be updated on an annual basis at each meeting of CGMS.