

An aerial photograph of a mountain range. The top of the image shows a range of mountains with significant snow cover under a clear blue sky. Below the mountains, a valley opens up, showing a town or village with buildings and roads. The foreground consists of rolling green hills and fields, with a river or stream visible in the lower part of the frame.

Report of the 43rd Meeting of the
Coordinated Group for Meteorological Satellites

Parallel Working Group Sessions: WGI Report

PARALLEL WORKING GROUP SESSIONS

WG I REPORT

I/0 Introduction

During the plenary session of CGMS-42, Dr. Lars Peter Riishojgaard, Mr Marlin O. Perkins (NOAA) and Mr. Joaquin Gonzalez (EUMETSAT) were appointed as Co-Chairs) and Rapporteur of Working Group I, respectively. Due to the fact that Mr. Perkins could not attend CGMS 43, WGI followed the advice of the Secretariat and appointed Mrs. Vanessa Griffin (NOAA) as co-chair of WGI.

WG I included representatives of the satellite operators from CMA, CNSA, EUMETSAT, ISRO, JMA, KARI, KMA, NOAA, ROSCOSMOS, ROSHYDROMET (absent this time) and WMO (see Annex III for full list of participants).

WGI reviewed and adopted the draft agenda proposed by the CGMS Secretariat.

I/1 Review of actions from the Previous Meeting

Actions from previous meetings were discussed at the beginning of the working group meeting, and their status is summarized below.

Actions and Recommendations from previous CGMS WGI meetings:

WGI status of actions on the occasion of CGMS-42							
Actionee	Action	#	Description	Action feedback/closing document	Deadline	Status	HLPP ref
CGMS members	WGI/3.1	A42.17	CGMS members to nominate representatives in the Task Team to work on RARS related aspects (before 1st IS meeting (WGI.IS-2.1 mid October 2013))	<p>To be discussed between EUM and NOAA during the CGMSSEC#2 on 12 Feb 2014.</p> <p>CGMS-42: WGI/5: The list of representatives for the RARS Task Team (as agreed in CGMS-41) is incomplete:</p> <p>CMA: LIU Jian liujian@cma.gov.cn EUM: anders.soerensen@eumetsat.int, joaquin.gonzalez@eumetsat.int JMA: Hidehiko Murata, satellite@ml.kishou.go.jp NASA: jack.kaye@nasa.gov NOAA: Vanessa.Griffin@noaa.gov CGMS-42-ROSH-WP-01: Sergey Uspensky (uspenskys@planet.iitp.ru) CGMS-42-WMO-WP-19</p> <p>13 May 2015: NOAA nominates AK Sharma, Awdhesh.sharma@noaa.gov, Mitch Goldberg, mitch.goldberg@noaa.gov, Liam Gumley, Liam.Gumley@ssec.wisc.edu</p>	(31 Aug 2013), New deadline 15 Jun 2014	CLOSED	HLPP# 1.4.5
CGMS members	WGI/2	A42.01	CGMS members to provide feedback to WMO (David Thomas, Dthomas@wmo.int) on the preliminary WMO position on frequency protection for WRC-2015.	Discussed in plenary, draft letter endorsed by CGMS-42. (CGMSSEC sent the letter to WMO following CGMS-42).	30 Jun 2014	CLOSED	HLPP# 1.3.3

WGI status of actions on the occasion of CGMS-42							
Actionee	Action	#	Description	Action feedback/closing document	Deadline	Status	HLPP ref
EUM	WGI/2	A42.02	CGMS Liaison officer to SFCG to report to CGMS WGI on the discussions and disposition of SFCG on all topics of interest to the different CGMS members. For achieving that a dedicated CGMS Secretariat WGI working paper will be prepared by EUMETSAT Frequency Manager (in the role of liaison officer from CGMS to SFCG) and will be released to the participants of WGI before end of Q1 of the corresponding year. Based on the contents, CGMS members will decide the level of information they will include in their specific reports to CGMS for the corresponding WGI meeting.	CGMS-43-EUM-WP-03	30 Mar 2015	CLOSED	HLPP# 1.3
CGMS members	WGI/3.2.1	A42.03	CGMS members to regularly report to WGI their plans on the user preparation for their future systems (in areas aspects relevant to the WGI).	NOAA will address this verbally in WGI	CGMS-43	CLOSED	HLPP# 1.4.2
CGMS members	WGI/3.2.1	A42.04	CGMS members to gather responses from manufacturers of receiving stations about experiences and lessons learnt for both LEO and GEO systems. Due date: September 2014 and provided answers to be assessed in dedicated Inter-Sessional meeting in November 2014	Discussed at WGI webex #1 (20 Jan 2015) NOAA response pending, per further discussions in WGI. Discussed at CGMS-43 and closed as a consequence.	15 Sep 2014, 15 Nov 2014	CLOSED	HLPP# 1.4.3

WGI status of actions on the occasion of CGMS-42							
Actionee	Action	#	Description	Action feedback/closing document	Deadline	Status	HLPP ref
CGMS members	WGI/3.2.1	A42.05	CGMS members to nominate focal points to support, via inter-sessional meetings, the analysis of the LRIT/HRIT Global Specification for its usefulness for next generation GEO satellite data dissemination, and propose an update taking into account the availability of new file format standards and dissemination means. Initial coordination to be done by EUMETSAT (as book captain of the document).	EUM: Simon.elliott@eumetsat.int CGMS-43 EUM-WP-05 JMA: Akiyoshi Andou, satellite@ml.kishou.go.jp CGMS-43-JMA-WP-08 (Section 2) NOAA: Paul.seymour@noaa.gov ROSH: Mr. Yuri Chetyrin, leading programmer, SRC "PLANETA", Far Eastern Center E-mail: niokr@dvrpcod.ru Action agreed to be closed by WGI at CGMS-43. A new action will be opened to use the identified team to work on the future updates of the HRIT Global spec	30 Jun 2014	CLOSED	HLPP# 2.
EUM	WGI/4	A42.06	EUMETSAT to provide template to report DCP system characteristics by the different DCP operators of CGMS	Circulated by EUMETSAT Jan/Feb 2015	30 Jun 2014	CLOSED	HLPP# 1.2
CGMS members	WGI/4	A42.07	CGMS DCP operators to provide DCP system characteristics (in the template form provided by EUMETSAT in action WGI/4 A42.06) in support of the preparation activities for the Satcom Forum in 2015.	CGMS-43 EUM-WP-06 NOAA has provided input to EUMETSAT. Closed following WGI discussions at CGMS-43.	30 Sep 2014	CLOSED	HLPP# 1.2.1
WGI and WGIV	Plen E.1.3 (wrt WGI and WGIV)	Plen A42.07	Following the revised scope of WGI and WGIV, the WGs to update the Terms of Reference of both WGs for endorsement by CGMS	Note: This is a plenary action that needs to be treated in WGs I and IV. Not started yet (status Jan 2015).EUM/KPR book captain. CGMS-43 EUM-WP-02 (WGIV paper) NOAA will provide feedback in WGI and WGIV Closed following WGI discussions - for plenary to approve.	CGMS-43	CLOSED	-

WGI status of recommendations on the occasion of CGMS-42								
Actionee	Action	#	Description	Action feedback/closing document	Deadline	Status	HLPP ref	
CGMS space agencies	WGI/2	R42.01	CGMS satellite operators are invited to communicate and take into account the WMO position on frequency protection when addressing WRC-2015 preparation at the national level.	Communication with national representatives implemented, on regular basis, at the level of the different CGMS members (e.g. NOAA, EUMETSAT,..)	(CGMS-43)	CLOSED	HLPP# 1.3.3	
CGMS members	WGI/2	R42.02	CGMS WGI, understanding the complexity of the issues to be covered in the area of frequency management and coordination (including interference assessments) for the existing and future space systems under the responsibility of the different CGMS members, and also recognising the efforts, already in place by most of the CGMS members, to concentrate these discussion in the frame of SFCG, recommends CGMS members to continue bringing all frequency management and coordination issues under the expert forum of SFCG and actions the liaison officer (from CGMS to SFCG) to report to CGMS WGI all aspects of SFCG discussions considered of relevance to CGMS.	EUM/CGMSSEC: markus.dreis@eumetsat.int acts as liaison officer	(CGMS-43)	CLOSED	HLPP# 1.3	

WGI status of recommendations on the occasion of CGMS-42							
Actionee	Action	#	Description	Action feedback/closing document	Deadline	Status	HLPP ref
CGMS space agencies (with LEO space-craft)	WGI/5	R42.03	All agencies operating polar orbiting satellites to provide, whenever relevant for operational meteorology, a package based on the core software from the global processing for use in local and regional product processing, in particular level-1 processing	CMA has stated that they will do this, NOAA has IPOPP from NASA and CSPP (Nesdis) both available online. EUM has AAPP. For future systems is TBD ROSH Apr 2015: Processing package for MTVZA-GY/Meteor-M N2 instrument data is being developing. Release date TBD	(CGMS-43)	CLOSED	HLPP# 1.4.4
CGMS members	WGI/5	R42.04	Each agency providing product processing packages to implement a user support function supporting the software release process, the software installation and anomaly resolution	User support is online for NOAA [URL?] JPSS software: http://cimss.ssec.wisc.edu/cspp/ . GOES and GOES-R software: http://cimss.ssec.wisc.edu/csppgeo/software.html . Additional support at www.ospo.noaa.gov TBD for EUMETSAT (USC?) and CMA?	(CGMS-43)	CLOSED	HLPP# 1.4.4
CGMS members	WGI/5	R42.05	CGMS to consider further actions to evaluate and document commonalities and best practices in organisation and architecture of Regional Services.	See WGI IS-01 meeting, Dec '14. To cover global specification and RARS. (Global specs Rational for Polarisation aspects for Direct Broadcast (e.g. FY-3C) Standardisation of User Terminals (HRPT), for example in terms of G/T. HRIT/LRIT Global specs for the instruments on board GOES-R and MTG. RARS: Status of progress of Regional RARS implementation (or plans for it) Definition of regions. Models for securing HRPT (L/X Band) "infrastructure" in a region Ideas for data gathering within regions and for inter-regions data transfer	(CGMS-43)	CLOSED	HLPP# 1.4.5

WGI status of recommendations on the occasion of CGMS-42							
Actionee	Action	#	Description	Action feedback/closing document	Deadline	Status	HLPP ref
CGMS members	WGI/5	R42.06	Agencies to provide a complete and comprehensive Space to Ground Interface Control Document for each satellite family, defining the radio frequency encoding and data layout of the direct broadcast downlink	NOAA: http://noaasis.noaa.gov/NOAASIS/pubs/HRD-LRD_Transition.pdf EUM: Metop on EUMETSAT web page [URL?]	(CGMS-43)	CLOSED	HLPP# 1.4.2
CGMS members	WGI/5	R42.07	CGMS to promote standardisation of the data interface between the direct broadcast reception station and the product processing software		(CGMS-43)	CLOSED	HLPP# 1.4.5
CGMS members	WGI/5	R42.08	CGMS to promote standardisation of the pass scheduling interface between the Regional Service and the direct broadcast reception station.		(CGMS-43)	CLOSED	HLPP# 1.4.5
CGMS space agencies (with LEO space-craft)	WGI/5	R42.09	All agencies operating polar orbiting satellites to provide product processing auxiliary data via the Internet	Refer to CCSDS 902.1 (http://public.ccsds.org/sites/cwe/rids/Lists/CCSDS%209021R1/CCSDSAgency.aspx)	(CGMS-43)	CLOSED	HLPP# 1.4.5
CGMS members	WGI/5	R42.10	CGMS to consider further actions on standardising the interregional interfaces for exchange of products, pass scheduling, monitoring and other information.	Closed following CGMS-43 discussions	(CGMS-43)	CLOSED	HLPP# 1.4.5

WGI status of recommendations on the occasion of CGMS-42							
Actionee	Action	#	Description	Action feedback/closing document	Deadline	Status	HLPP ref
CGMS space agencies	WGI/5	R42.11	CGMS Satellite operators to support the definition and implementation of community agreed operational procedures for LEO satellite data direct read-out, acquisition, and relay in the context of the DRARS Implementation Group.		(CGMS-43)	CLOSED	HLPP# 1.4.5

Note that recommendations are closed at the relevant plenary session irrespective of whether they have been fulfilled or not. New (and sometimes the same) recommendations are then raised as necessary.

I/2 Revised Terms of Reference of WGI

EUMETSAT-WP-02 provided, in response to CGMS-42 action 42.07 (raised at plenary), revised draft Terms of Reference for WGI (as follows):

1.1 Scope of WGI

CGMS WGI will provide a regular forum for CGMS agencies to address topics of interest in areas related to global coordination of satellite systems and telecommunication. The working group will address these issues for existing operational systems and also for future ones and will aim at supporting CGMS in preparing for the future generation of meteorological satellite systems and to contribute on the consolidation and updates of interoperability and standardisation that the evolution of technology imposes.

1.2 Objectives

WGI will have the following objectives:

- 1) Provide a technical forum for CGMS agencies to address global issues and technical aspects of their satellite systems;
- 2) Address areas of mutual interest and advice agencies on topics related to frequency coordination and management;
- 3) Act as CGMS point of contact, at expert level, between CGMS and other groups and organisations in areas of frequency management (e.g. SFCG, ITU and preparation status and topics for WRCs);
- 4) Address technical and operational aspects of direct broadcast services (present and future) of mutual or global interest for the CGMS agencies;
- 5) Promote standards and interoperability and operational procedures to the CGMS agencies for the benefit of the user community of their direct broadcast services and the associated regional retransmission services;
- 6) Address technical and operational aspects of the Data Collection Systems at international level;
- 7) Promote standards and interoperability and operational procedures to the CGMS agencies for the benefit of the user community of the DCS Regional (and international) systems;
- 8) Optimisation/harmonisation and update of CGMS global specifications.
- 9) Address topics from the CGMS High Level Priority Plan within the scope of WGI.

LIST OF CGMS AGENCIES REPRESENTATIVES IN WORKING GROUP I				
Organisation (CGMS members)	First name	Last name	Role	Email
CMA	Luo	Dongfeng		luodf@cma.gov.cn
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EUMETSAT	Joaquin	Gonzalez Picazo	Rapporteur	joaquin.gonzalez@eumetsat.int
IMD	n/a*			
IOC/UNESCO	n/a*			
ISRO	n/a*			
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*CGMS members to confirm their key point of contact for WGI activities.

The document identifies the scope and objectives of the working group and identifies the list of representatives (to be appointed by the different CGMS agencies). During the presentation of the working paper it was suggested that the proposed Terms of Reference (ToR), once approved by CGMS, would be included on the CGMS web page dedicated to WGI, and that the list of (permanent) representatives to the Group would be maintained by CGMS Secretariat, based on the updates to be provided by the respective agencies.

WGI reacted positively to the proposed ToR and thanked the CGMS Secretariat for the draft proposal. The draft was endorsed with a minor modification of objective 3), as follows:

- 3) Act as CGMS point of contact, at expert level, between CGMS and other groups and organisations in areas of frequency management (e.g. SFCG, ITU, ITU regional groups, and preparation status and topics for WRCs);

I/3 Frequency management matters: SFCG, ITU and WRC activities

EUMETSAT-WP-03 on frequency management topics provides a report from the CGMS/SFCG Liaison Officer on the discussions and dispositions of SFCG from its 34th meeting (3 – 11 June 2014) on all frequency management issues of mutual interest and concern, in order to support CGMS members in their decision on what level of information they will include in their specific reports to CGMS for the corresponding WGI meeting.

SFCG at its 34th meeting noted the issues reported by CGMS in SF34-62/I and took the information into account in its considerations on related subjects. Furthermore, SFCG agreed to the CGMS

approach for mutual reporting and entitled the CGMS Liaison Officer to report back to CGMS-43 on issues discussed at SFCG-34 that could be of interest to CGMS, namely:

- The updated SFCG Recommendation 11-1R4 on the use MetSat in the band 1670 – 1710 MHz,
- The updated SFCG Resolution 19-7R4 on the use MetSat in the band 7750 – 7900 MHz,
- SFCG objectives for WRC-15 agenda items of mutual interest.

In particular, SFCG noted with appreciation that the position and objectives of CGMS and SFCG members on WRC-15 issues of mutual interest are in-line and supports the letter from CGMS to WMO highlighting the importance of the various types of instruments using the band 5350 - 5470 MHz and the need to preserve this very important spectrum against potential interference from RLAN.

MetSat use at 1695 – 1710 MHz

At SFCG-34, NOAA provided an updated status (June 2014) of the situation in the United States regarding the repurposing of the band 1695 – 1710 MHz.

Legislation in the United States has authorized an auction intended for spectrum sharing in the band 1695 – 1710 MHz between U.S. Federal stations in the Meteorological Satellite Service (S-E) with mobile users for broadband wireless communications. According to this, the auctioning of the band 1695 – 1710 MHz was scheduled for November 2014 with expected implementation of all necessary mitigation measures, i.e. coordination zones, coordination portal, monitoring capability, GOES-R frequency shift down by 3.5 MHz and relocation of radiosondes within 3 years from the time when winner is certified.

For the protection of the most important sites at which MetSat Earth stations of federal users are located in the US, 27 coordination zones were identified with typical coordination zone sizes of 40 km for POES, respectively 10 km for GOES reception. Earth stations of non-federal users located outside of these zones will not be protected. In order to ensure that broadband mobile users will respect those coordination zones the mobile base stations will authorize the user terminals to operate in the band 1695 – 1710 MHz.

Furthermore, the status of the situation with regard to the company LightSquared requesting to combine 5 MHz of spectrum between 1670 - 1675 MHz, which they already occupy, with the adjacent 1675 - 1680 MHz band was reported. Studies to determine if LightSquared could operate without harmful interference to GOES and GOES-R operations in the band 1675 - 1695 MHz band are completed, but were still under review and therefore not publically available at the time of the SFCG-34 meeting. The studies with regard to radiosondes conclude that moving of their use from the band 1675 – 1680 MHz to 400.15 – 406 MHz is feasible.

In view of this situation in the United States for sharing of the band 1695 – 1710 MHz and changes in the use of the 1670-1710 band for various Meteorological Satellite Services, such as expanded data

dissemination by GOES and the use of the emergency weather information distribution systems, illustrates the need to review Recommendation SFCG 11-1R3 which was last reviewed in 2005.

The updated **Recommendation SFCG 11-1R4** takes into account the evolutions since this last revision in 2005 of the MetSat services in the different sub-bands in the range 1670 – 1710 MHz. The most significant change to this recommendation is the addition of “recommends 4” which elaborates on the situation and conditions when a MetSat operator intends to extend the use of non-geostationary MetSat systems below 1698 MHz. Recommend 4 stipulates *“that when extending the operation of future non-geostationary satellites from 1698 – 1710 MHz into 1695 – 1710 MHz, protection of the reception of transmissions from geostationary meteorological satellite systems operating below 1698 MHz should be facilitated through inter-operator coordination, as appropriate.”*

MetSat use at 7750 – 7900 MHz

In order to ensure the continued efficient use of the recently enlarged band from 7750 – 7850 MHz to 7750 – 7900 MHz at WRC-12, it was considered necessary to review SFCG Resolution 19-7R3 with the view to assist in the most optimum use of this meteorological satellite service band 7750 – 7900 MHz, providing a guideline to the MetSat operators, which are currently in the phase of planning and developing next generation polar-orbiting systems using this band.

The updated **SFCG Resolution 19-7R4** now takes into account the extension of the MetSat allocation from 7750 – 7850 MHz to 7750 – 7900 MHz, but does not contain any significant changes to this Resolution on the way and conditions as to how MetSat systems shall utilize this spectrum.

SFCG objectives for WRC-15 (Resolution SFCG 32-1R2)

SFCG defines its objective in the framework of an SFCG Resolution which is updated at every SFCG meeting until WRC-15. In the following sections only those SFCG objectives for WRC-15 agenda items are highlighted and discussed that are of mutual interest to SFCG and CGMS.

WRC-15 Agenda Item 1.1

This agenda item deals with consideration of additional spectrum allocations to the mobile service and identification of additional frequency bands for International Mobile Telecommunications (IMT) and to facilitate the development of terrestrial mobile broadband applications, likely to concentrate on bands below 6 GHz.

The frequency bands of mutual concern are:

- the 1695 – 1710 MHz band used for meteorological satellite applications;
- the bands 2025 – 2110 MHz and 2200 – 2290 MHz used for earth exploration satellite and space operation (TM/TC and ranging) services;
- the band 3400 - 4200 MHz used for Galileo Data Distribution Network and the dissemination of meteorological data by systems like EUMETCast, CMACast and GEONETCast;

- the active remote sensing band 5350-5470 MHz used for SARs, scatterometers and altimeters.

1695 – 1710 MHz

The 1695 – 1710 MHz band is used by all meteorological-satellite systems with Earth stations operated by almost all National Meteorological and Hydrological Services (NMHS) and many other users. This band is essential for providing operational and time-critical meteorological information to the users around the world. For this reason SFCG is opposed to an allocation/identification of the frequency band 1695 – 1710 MHz for terrestrial mobile broadband applications including IMT except if such allocation/identification ensures the protection of MetSat Earth station operations in that band.

So far there are no indications from any of the six ITU regional groups or individual countries to propose this band for the introduction of mobile broadband, except potentially the US (to be confirmed).

2025 – 2110 MHz and 2200 – 2290 MHz

Although these bands no longer seem to play a major role in the global identification of additional spectrum for broadband mobile systems (thanks to the negative results of the sharing studies in the framework of the responsible fora within the ITU-R WRC-15 preparatory process namely JTG 4-5-6-7), there are still some proponents for these bands (or parts of) in the mobile industry and by some individual countries.

SFCG objects to any IMT identification in these bands under agenda item 1.1 and opposes any revisiting of the conditions set in RR No. 5.391 pertaining to the bands 2025 – 2110 MHz and 2200 – 2290 MHz used for space research, earth exploration-satellite and space operation services.

3400 - 4200 MHz

This frequency range is one of the prime targets of the mobile industry to cover their broadband spectrum requirements. Some parties even go as far as to propose the entire C-Band (3400 – 4200 MHz) for a mobile broadband identification. However, there is also very strong opposition by all commercial satellite operators and a number of countries around the world against identifying further spectrum in this frequency range.

Note: Already at WRC-12 the band 3400-3600 MHz was allocated to the mobile service and identified for International Mobile Telecommunications (IMT) in a number of countries by footnotes RR No. 5.430A, 5.431A, 5.432A, 5.432B and 5.433A to the Radio Regulations. Thus, an identification of the entire C-Band for mobile broadband systems is very unlikely, given the strong opposition from various sides. However, given the strong pressure on administrations, a possible scenario could be that parts of the band 3400 – 4200 MHz (to a maximum 3400 – 3800 MHz) would be globally (or at least regionally) identified for mobile broadband systems implementation. Thus, the remaining spectrum available for FSS systems could continue to be used for the dissemination of meteorological data.

5350 – 5470 MHz

Under this agenda item also the extension of the current RLAN (WiFi) spectrum (5150 - 5350 MHz and 5470 - 5725 MHz) by also allocating the gap in between (5350 - 5470 MHz) for RLANs is under discussion.

Such additional allocation of the band 5350 - 5470 MHz would affect most severely SARs such as CSAR on Sentinel-1 or RadarSat. Less sensitive to RLAN interference, but also affected in the long term by such an RLAN introduction in the band 5350 – 5470 MHz, could be scatterometers and altimeters. Thus, SFCG opposes an allocation to the Mobile Service in this band for use by terrestrial mobile broadband applications.

All studies performed in ITU-R JTG 4-5-6-7 agreed that, with the current RLAN parameters, compatibility cannot be achieved, even if the RLAN systems are limited to indoor use only. Thus, additional mitigation techniques to the ones identified so far would be required to achieve compatibility. The same situation applies to the compatibility with terrestrial and aeronautical radars operating in the band 5350 – 5470 MHz. So far the RLAN industry has failed to identify such mitigation techniques which could ensure compatibility. As a result the ITU regional groups CITEL (Americas) and CEPT (Europe) will not propose the implementation of RLANs in the band 5350 – 5470 MHz at WRC-15, but this issue will continue to be studied and could result in an agenda item for WRC-19.

WRC-15 Agenda Item 1.6

This agenda item deals under 1.6.1 with consideration of possible additional primary allocations to the fixed-satellite service (Earth-to-space and space-to-Earth) of 250 MHz in the range between 10 GHz and 17 GHz in Region 1.

Agenda item 1.6.2 deals with consideration of possible additional primary allocations to the fixed-satellite service (Earth-to-space) of 250 MHz in Region 2 and 300 MHz in Region 3 within the range 13-17 GHz.

One of the targeted frequency bands for a possible allocation of FSS (Earth-to-space) is 13.25 – 13.75 GHz, which raises particular concerns with regard to the allocation of this band to EESS (active). This band is used for active remote sensing (altimeters and scatterometers) by missions such as Cryosat, Jason-2, -3, Jason-CS (Sentinel-6), Sentinel-3, and HY-2.

Thus, SFCG supports the protection of existing space science service allocations. No additional allocation of spectrum to support FSS (Earth-to-space and space-to-Earth) should be made in space science service bands unless acceptable sharing conditions are agreed. There is particular concern with the possible allocation of FSS (Earth-to-space) in the 13.25-13.75 GHz band allocated to EESS (active). This band is used for active remote sensing (altimeters and scatterometers) by missions such as Cryosat, Jason-2, -3, Jason-CS, Sentinel-3, and HY-2. ITU-R studies concluded that sharing between EESS (active) and FSS (Earth-to-space) is not feasible. Therefore, SFCG supports no new allocation to FSS (Earth-to-space) in the band 13.25-13.75 GHz.

Sharing studies between EESS (active) and FSS (space-to-Earth) performed so far are showing compatibility between both services.

As the need for additional primary allocations of 250 MHz to the GSO FSS in frequency bands between 10 and 17 GHz is recognized and supported and the corresponding ITU-R studies show compatibility with the EESS (active), there might be a need to accept an allocation to the FSS (space-to-Earth) the band 13.4 – 13.65 GHz subject to the implementation of relevant mitigation techniques (e.g. PFD mask, limitation of transmit antenna size, etc.).

WRC-15 Agenda Item 1.9.2

This Agenda Item deals with the possibility of allocating the bands 7375 - 7750 MHz and 8025 - 8400 MHz to the maritime-mobile satellite service (MMSS) and additional regulatory measures, depending on the results of appropriate studies.

The potentially-affected space science service bands under this agenda item are 7450 - 7550 MHz MetSat (space-to-Earth, GSO) and 8025 - 8400 MHz EESS (space-to-Earth). Thus, according to the SFCG position, no new allocations to the MMSS should be made in these frequency bands unless acceptable sharing criteria with the science services are developed.

Of particular concern is the potential interference to EESS (space-to-Earth) operations in the band 8025 - 8400 MHz at high latitudes from ships operating in closer proximity. Large exclusion zones may be needed to avoid interference to EESS earth stations. Many EESS earth stations are located near coastal areas (e.g., Svalbard, McMurdo, Maspalomas, Lannion, Wallops) and could be seriously affected by emissions from vessels navigating in the area.

All compatibility analyses on the two different sharing aspects (MMSS vs. EESS and MMSS vs. the space research service (SRS)) came to similar conclusions regarding the sharing difficulties with EESS and the required separation distances to protect the SRS Earth stations.

Furthermore, the issue of the large number of exclusion zones and the regulatory mechanisms for implementing and keeping up-to-date the necessary exclusions zones makes such an allocation to the MMSS impracticable.

Consequently, CEPT, as the initial proponent of this agenda item, does not support an allocation to the MMSS in the band 8025 - 8400 MHz.

WRC-15 Agenda Item 1.10

This agenda item deals with the consideration of spectrum requirements and possible additional spectrum allocations for the mobile-satellite service (MSS) in the Earth-to-space and space-to-Earth directions, including the satellite component for broadband applications, within the frequency range from 22 GHz to 26 GHz.

The main frequency bands commonly at risk for SFCG and CGMS member agencies could be:

- The EESS (passive) band 23.6 - 24 GHz (purely passive, but to be protected against unwanted emissions taking into account interference apportionment and the levels contained in ITU-R Resolution 750 (rev. WRC-12));
- The first 500 MHz of the EESS/SRS space-to-Earth band 25.5 – 27.0 GHz.

The frequency band 25.5 – 27 GHz is allocated to the EESS (space-to-Earth) and is used for data links for EESS payloads. Relevant sharing criteria for this service are given in Recommendation ITU-R SA.1027. Studies have been performed with SRS receiving Earth stations tracking non-GSO SRS satellites. These studies, using protection criteria given in Recommendation ITU-R SA.609 show no compatibility between MSS downlink and SRS. Since the sharing criteria in Recommendation ITU-R SA.1027 are globally more stringent than the protection criteria in Recommendation ITU-R SA.609, it is expected that similar conclusions would apply to the EESS (space to-Earth). With regard to MSS uplinks, it has been shown that separation distances larger than 330 km would be required for SRS. These distances would even be larger when considering EESS. So far, the frequency bands targeted by the proponents of such new allocations to the MSS are still not clear, if there are any at all. Thus, the developments in preparation for this WRC-15 agenda item needs to be further carefully monitored.

WRC-15 Agenda Item 1.11

This agenda item deals with the consideration for a new primary allocation for the Earth exploration-satellite service (Earth-to-space) in the 7-8 GHz range. Initially proposed by ESA through CEPT this agenda item calls for the identification of a suitable frequency band for an EESS (Earth-to-space) allocation in the 7-8 GHz range for telecommand operations to complement telemetry operations of EESS (space-to-Earth) in the 8025 - 8400 MHz band.

Although there are currently no MetSat systems envisaged that would make use of such a new allocation in the near future, such spectrum would enlarge the potential evolutions of future MetSat systems and deployment scenarios. Supported by the necessary spectrum requirement studies and positive conclusions of the necessary compatibility assessments with the other already allocated services, SFCG supports a primary allocation to EESS (Earth-to-space) in the band 7190 - 7250 MHz as provided for in Method A of the Draft CPM Report. This would satisfy the EESS spectrum requirements identified.

WRC-15 Agenda Item 9.1.1

This agenda item deals with Resolution 205 (REV.WRC 12) - Protection of the systems operating in the mobile-satellite service in the band 406 - 406.1 MHz. Cospas-Sarsat space segment providers have developed protection criteria for the Cospas-Sarsat search and rescue instruments and local user terminals in the 406.0 - 406.1 MHz band in order to protect them against broadband out-of-band emissions and against narrow-band spurious emissions. These protection criteria have been recognized at the ITU-R level through ITU-R M.1478-1. However, they do not provide protection against emissions in adjacent bands which could hinder the Cospas-Sarsat system's ability to detect and/or relay signal from beacons. Several noise measurements have been conducted using all the

three space components. The measurements of the 406 - 406.1 MHz band must be carefully examined, as Cospas-Sarsat has a general concern on the reception and processing of weak distress signals, in certain areas, caused by an increase of noise in the Europe and Asia.

Current analysis of observations show that over certain years, this noise (measured in the 406 - 406.1 MHz band) has increased by 15 to 20 dB above the interference level in some areas. Measurements performed at 406 MHz have shown that the noise level is especially high over Europe and also confirms the concern in part of Asia. This noise issue in UHF band addresses the frequency range between 390 MHz and 420 MHz might be caused by the operation of terrestrial systems deployed in many countries. Thus, Cospas-Sarsat with the support of its space segment providers will need to develop the relevant protection criteria for submission to the relevant ITU-R groups and translation into an ITU-R recommendation.

In order to ensure adequate protection of MSS systems in the frequency band 406 - 406.1 MHz, the revision of Resolution 205 is also required introducing further mitigation measures. Those would also include design and implementation of improved filters at the LEOSAR, GEOSAR and MEOSAR systems space receivers, which are already planned for future generation of satellites.

SFCG supports a revision of Resolution 205 (Rev WRC-12) containing appropriate mitigation measures, such as establishment of a guard band above 406.1 MHz concerning new frequency assignments to mobile networks.

CEPT and CITELE will propose to WRC-15 a significant step forward to improve the protection of the band 406 - 406.1 MHz by means of implementation of guard bands from 405.9 MHz to 406 MHz and from 406.1 to 406.2 MHz applicable to new frequency assignments in the mobile and fixed services.

WRC-15 Agenda Item 9.1.5

This agenda item deals with the consideration of technical and regulatory actions in order to support existing and future operation of fixed satellite service (FSS) earth stations within the band 3400 - 4200 MHz, as an aid to the safe operation of aircraft and reliable distribution of meteorological information in some countries in Region 1 (Resolution 154 (WRC-12)).

This agenda item which was initially targeted particularly to countries in Africa now receives special attention due its discussion on the question whether or not the use of the FSS for aviation applications are safety related or not and thus, could significantly impact on the discussions of the same band under Agenda Item 1.1 where the band 3400 – 3800 MHz is one of the prime targets of the mobile industry to introduce broadband mobile on a global basis.

The importance of the band for distribution of meteorological information is undisputed in the context of this agenda item and will be appropriately reflected in the modifications to Resolution 154. Studies on this issue indicate that Resolution 154 (WRC-12) could be modified, calling for relevant administrations in Region 1 to use special care in the coordination, assignment, and management of frequencies taking into consideration the potential impact on FSS earth stations used for satellite communications related to safe operation of aircraft and reliable distribution of meteorological information in the frequency band 3400-4200 MHz. In parallel to the modification of

Resolution 154 (WRC-12), consideration may be given to modifying RR No. 5.430A to include a reference to the modified Resolution.

WRC-15 Agenda Item 9.1.8

WRC-12 decided to put on the WRC-19 preliminary agenda the issue of nanosatellites and picosatellites. In preparation for that, WRC-15 agenda item 9.1.8 deals with regulatory aspects for nanosatellites and picosatellites under Resolution 757 (WRC-12), which invites ITU-R “to examine the procedures for notifying space networks and consider possible modifications to enable the deployment and operation of nanosatellites and picosatellites, taking into account the short development time, short mission time and unique orbital characteristics” and instructs the Director of the Radiocommunication Bureau “to report to WRC 15 on the results of these studies”. Many universities, space agencies and companies show a fast growing interest in the development and exploitation of nanosatellites and picosatellites. The increasing miniaturisation of electronics has enabled these satellites to offer a means to perform a variety of missions in space, from educational, research and experimentation to Earth observation and telecommunication missions.

The following difficulties in application of the Radio Regulations on nanosatellites and picosatellites have been identified and require careful consideration:

- The typically short development time of nanosatellites and picosatellites is not in line with the usual timeline of the regulatory coordination and notification process.
- Late knowledge of detailed orbital parameters as a result of the opportunistic launch arrangements. Furthermore, since many of these satellites are not equipped with a propulsion system their orbit will decay over mission time;
- Limited experience with the applicable regulatory procedures by some of the administrations involved as well as some of the developers of nanosatellites and picosatellites, leading to:
 - Inadequate ITU filing data provided in turn leads to unnecessary administrative burden to the ITU-R Radiocommunication Bureau (BR) and administrations involved,
 - Nanosatellites and picosatellites which are not always operating in the appropriate frequency band or radiocommunication service,
 - Late initiation of the ITU filing due to late knowledge of the orbital parameters;
- Issues related to the growth in numbers of small satellites launched and under development;
- Nanosatellite and picosatellite spectrum requirements are expanding along with their evolving applications;
- The large growth in numbers of nanosatellites and picosatellites puts pressure on the available allocations and associated ITU filings create additional administrative burden on the BR as well as on administration.

SFCG favours the study of this issue, since it recognizes that a growing number of nanosatellite and picosatellite are under development in the world. At present many of these satellites operate in frequency bands allocated to the amateur-satellite service. Now there is an increasing demand for these satellites to operate in other satellite services and frequency bands. Many of these satellites

are launched for scientific, experimental or educational purposes, sometimes in the form of constellations and there is a growing interest for commercial non-scientific applications. SFCG supports that the frequency bands used should align with the applications being supported. An investigation on how this growing number of satellites can be supported is needed. Given the complexity in obtaining a common definition of which types of satellites should be classified under the category nanosatellites and picosatellites and because these definitions tend to relate to elements that are not relevant from a frequency management perspective (size, mass, cost), SFCG supports further consideration of modifications to the RR, if needed, to facilitate the development of nanosatellites and picosatellites, taking into account the comparatively short development time and the potential lack of advance knowledge of certain operational parameters.

Any changes to the ITU-R Radio Regulations in relation to this agenda item should be carefully developed to ensure protection of all satellite missions. SFCG is of the opinion that any satellite, including nanosatellites and picosatellites, will have to be registered with the ITU and must adhere to the ITU-R Radio Regulations.

WRC-15 Agenda Item 10

Agenda Item 10 of WRC-15 calls for proposals for possible agenda items for WRC-19.

CNES, DLR and EUMETSAT, supported by France and Germany, proposed to CEPT an agenda item for WRC-19 for upgrading the secondary allocations to the MetSat (space-to-Earth) and the EESS (space-to-Earth) in the band 460 – 470 MHz to primary in order to secure future use of the band for ARGOS-4 and ICARUS. The objective of such an agenda item for WRC-19 is to improve the regulatory status of the MetSat (space-to-Earth) and the EESS (space-to-Earth) services in the frequency band 460 - 470 MHz while putting relevant constraints on these services in order to protect the existing primary (mobile, fixed) services. This proposal is in the CEPT “shopping list” for WRC-19 agenda items for further consideration.

SFCG also supports a proposal for such an agenda item. Also a similar proposal is expected from the US. The proposals for WRC-19 agenda items are currently under definition within the different regional groups and gathered in shopping lists.

One proposal for a new agenda item seems to be common across many of these regional groups, namely the identification of frequency spectrum for mobile broadband above 6 GHz which would concern a number of frequency bands used by EESS and MetSat systems. Furthermore, it is possible that the issue of RLANs in the band 5350 – 5470 MHz will be subject for an agenda item for WRC-19.

WGI thanked EUMETSAT for the detailed report provided on the frequency related topics of interested to CGMS.

CGMS WGI also wanted to re-iterate to SFCG the appreciation of CGMS on the support provided in protecting and preserving the frequency bands assigned or related to the activities of CGMS.

During CGMS meetings WGI was reported (via WGII) that IROWG has identified a potential of interference by ground based transmitters to RO receivers using the new L5 GPS signal. However, no clear information was made available to WGI during its CGMS 43 meeting to allow an informed discussion. In view of the possible implications for the RO receivers, EUMETSAT was tasked by the WGI to contact IROWG chair(s) seeking clarification on the identified potential of interference.

CGMS-43 action - WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
EUM	WG/I	A43.01	EUMETSAT to contact IROWG Chair to confirm needs for dedicated frequency protection for GNSS (Clarified between EUMETSAT and IROWG during CGMS-43 and closed as a consequence).	CLOSED	OPEN	HLPP # 1.3

CMA-WP-04 describes that the China Meteorological Administration (CMA) is planning to deploy a scatterometer — WindRadar on FY-3E meteorological satellite, and to deploy a precipitation measuring radar on Fengyun Rain Measurement (FY-RM) satellite. These two radars each have a channel operating in 13.25-13.75 GHz, which is an important band for the earth remote sensing of space-borne active sensors. In Annex_1 of CMA-WP-04, CMA presents the result of a compatibility study between fixed-satellite service (FSS) and PMR2, which concludes that the ITU-R's possible new primary allocations to the fixed-satellite service (FSS) within frequency range 13.25-13.75 GHz, which has been allocated to the EESS (active) on a primary basis, would cause harmful interference in PMR2, and PMR2 would also create harmful interference to FSS earth stations.

WGI thanked CMA for the detailed report and concurred with the conclusions of CMA as provided in WP-04 and recalled that there is a specific agenda topic for WRC-15 that covers this issue. It is to be stressed that the proposed new allocations to the FSS (Earth-to-space) in the 13.25-13.75 GHz band allocated to EESS (active) are not supported by SFCG agencies (and CGMS members). Regarding the sharing studies between EESS (active) and FSS (space-to-Earth) performed so far (which will be complemented by inputs from CNES to the forthcoming ITU-R WP 4A meeting in June 2015), they are showing compatibility between both services. As the need for additional primary allocations of 250 MHz to the GSO FSS in frequency bands between 10 and 17 GHz is recognized and supported and the corresponding ITU-R studies show compatibility with the EESS (active), there might be a need to accept an allocation to the FSS (space-to-Earth) the band 13.4 – 13.65 GHz subject to the implementation of relevant mitigation techniques (e.g. PFD mask, limitation of transmit antenna size, etc.) and include regulatory conditions to ensure the protection of the sensors operating under the EESS (active) allocation.

Consequently, WGI agrees that this topic is of relevance and importance to all CGMS agencies and therefore, CGMS satellite operators are invited to communicate and take into account these views when addressing WRC-2015 preparations at their respective national levels.

NOAA-WP-06 reported that GOES-R will be the first in the series of the next generation of U.S. geostationary environmental satellites. NOAA would like to coordinate GOES-R frequencies with the CGMS MetSat operators for use at 75 W and 137 W. As required by International Telecommunication Union (ITU) regulations, the GOESR network was published on 14 October 2014 as GOES-EAST-4 (75 W) and GOESWEST-4 (137 W), found in the ITU's International Frequency Information Circular (IFIC) 2780, under special section numbers CR/C/3606 and CR/C/3607, respectively.

The ITU Radiocommunication Bureau requested a decision from administrations, found to be possibly affected by the GOES-R filing, no later than 14 February 2015. The U.S. received comments from a number of MetSat operator administrations and is currently corresponding with these administrations with a view to reaching an agreement on the coordination request.

The ITU identified 25 countries for coordination under RR9.7. To date the USA has not received a decision from 15 administrations and will be sending messages to each of the countries in early May to request their decision. The USA have received agreements from Australia and Malaysia. The remaining countries have provided their objections and we are beginning the process of trying to reach agreements.

PREVIOUS COORDINATION EFFORTS VERSUS GOES-R FILINGS

NOAA successfully coordinated several GOES satellite networks beginning in the 1970s with GOES-EAST and GOES-WEST, continuing with GOES-EAST-1 and GOES-WEST-1 (GOES I-M), GOES-EAST-2 and GOES-WEST-2 (GOES N-P). The frequencies filed for GOES-R under GOES-EAST-4 and GOES-WEST-4 continue the use of the same frequency bands coordinated for prior GOES satellite networks with additional frequencies in X-band, viz., 7216.6 MHz (uplink) and 8220 MHz (downlink).

401-403 MHz

The band 401-403 MHz is allocated, inter alia, to the meteorological-satellite service (Earth-to-space) and traditionally has been used for uplinks from data collection platforms (DCPs) to both polar-orbiting and geostationary MetSats. The greatly expanded use of this band made it necessary to partition the 2 MHz into segments that would lead to continued harmonious use by the many MetSat networks in orbit as well as those planned. NOAA's GOES-R series follows this agreement as captured in the ITU Radiocommunication Recommendation ITU-R SA.2045, entitled "Basic general partitioning and sharing conditions for the band 401-403 MHz for future long-term coordinated use of data collection systems on geostationary and non-geostationary METSAT and EESS systems". Specifically, for the GOES-R series, GOES-R will comply with recommendation 2, viz., "that the band 401.7-402.435 MHz remains available only for DCS on geostationary MetSat systems" by employing up to 933 channels using 750 Hz steps (a potential maximum total use of 0.699750 MHz of the 0.7 MHz found in 401.7 – 402.4 MHz). In following this ITU-R recommendation NOAA feels that successful coordination of its use of 401.7-402.4 and the specific frequencies at 401.7 MHz, 401.85 MHz, 402 MHz, and 402.4 MHz can be readily achieved with the other CGMS MetSat operators.

460-470 MHz

The band 460-470 MHz is allocated on a secondary basis, for the meteorological satellite (space-to-Earth), *inter alia*. In the past this band has seen limited use by NOAA's GOES satellites, but its use is expected to expand for the GOES-R series with the 468.775 MHz and 468.825 MHz downlinks employed to interrogate data collection platforms within the footprints of the GOES-R 75 W and 137 W longitudinal positions. In order to prevent interference with the primary terrestrial services allocated in this band, the GOES-R downlinks will employ a spread spectrum technique that limits the power flux density (pfd) at the Earth's surface to a level less than $-152 \text{ dBW/m}^2/4 \text{ kHz}$. This low pfd and the geographic location of DCPs interrogated by these GOES-R downlinks should avoid any conflict with DCPs responding to commands from other CGMS MetSat operators. Based on these operating constraints NOAA feels that coordination should be possible with the CGMS members using this band.

1675-1695 MHz

This band is allocated on a primary basis for Meteorological satellite (space-to-Earth) and Meteorological aids.

Within this band, there are four services being continued or replacements of those from the current operational GOES satellites, viz. Data Collection Program Report (DCPR) (1679.9 MHz and 1680.2 MHz), GOES ReBroadcast (GRB) (1686.6 MHz), CDA telemetry (1693 MHz) and High Rate Information Transmission/Emergency Managers Weather Information Network (HRIT/EMWIN) (1694.1 MHz). The DCPR is being moved from 1694.5 MHz and 1694.8 MHz to 1679.9 MHz and 1680.2 MHz, but will continue to use the same amount of spectrum, viz. 400 kHz at each frequency.

The GRB replaces the existing GOES Variable (GVAR) service, requiring a larger bandwidth to accommodate the much increased data rates. The GVAR currently operates at 1685.7 MHz requiring 4.22 MHz bandwidth, while GRB will need either 9.7 or 10.9 MHz to transmit the processed data and will operate at 1686.6 MHz. GOES-R telemetry will be transmitted at 1693 MHz instead of the current 1694 MHz with increased spectrum needs of 80 kHz from the existing 16 kHz.

The original Low Rate Information Transmission (LRIT) and weather facsimile (WEFAX) downlink at 1691 MHz (586 kHz) will be combined with the EMWIN currently operating at 1692.7 MHz (27 kHz) in a single downlink known as HRIT/EMWIN, where the HRIT replaces LRIT. The new combined service will transmit at 1694.1 MHz, requiring 1.21 MHz of bandwidth. The existing sensor data downlink at 1676 MHz will be moved to X-band (8220 MHz) to accommodate the greatly expanded data rates from the advanced sensors on-board the GOES-R spacecraft.

All of these replacements or changes will continue transmission to ground stations in the United States, either to Wallops Island, Virginia or to the backup site at Fairmont, West Virginia as well to those locations within the telecommunication footprints of the two GOES-R satellite positions at 75 W and 135 W that have the proper receiving equipment – similar to the current GOES operational scenario. Overall, the L-band needs for the GOES-R series will be more contiguous (i.e. smaller breaks between frequencies) than those of the existing operational GOES satellites in the range from

1679.7 MHz to 1694.605 MHz. Due to the very similar expected operations of NOAA's GOES-R satellites to those currently in orbit, as well as the existing interference-free service now provided by NOAA's GOES satellites in L-band, no interference is expected to the CGMS members who operate geostationary MetSats using frequencies in the range cited above. Based on these operation conditions, NOAA asks for coordination of all the GOES-R L-band downlinks.

7190-7235 MHz and 8025-8400 MHz

Due to the much higher data rates from new and advanced sensors on-board the GOES-R satellites, the geostationary MetSat L-band allocation in 1675-1695 MHz is insufficient to accommodate the necessary 120 MHz of spectrum for the raw sensor downlink. Additionally, the processed data uplink must be moved to meet the 9.7 MHz or 10.9 MHz continuous data stream sent to the GOES-R satellite. These two new frequencies, the first for a NOAA GOES satellite, have not been coordinated previously with CGMS members. The uplink at 7216.6 MHz is allocated within the United States, via footnote, to NOAA GOES earth stations operating in the meteorological-satellite service (Earth-to-space) and will only transmit to GOES-R satellites at their authorized longitudinal positions. The 120 MHz downlink centred at 8220 MHz operates under the Earth exploration-satellite (space-to-Earth) primary allocation in 8025-8400 MHz. This signal will be transmitted for reception at only the two GOES-R ground stations.

Due to the narrowly focused use of these X-band frequencies planned by GOES-R satellites, NOAA seeks the coordination agreement from the CGMS members for use of this spectrum.

ACTIONS AND/OR RECOMMENDATIONS FOR CONSIDERATION

NOAA requests that CGMS examine GOES-R frequency bands and provide appropriate comments and actions for coordination. NOAA requests MetSat operators in the CGMS meeting, consider approval of this coordination for GOES-R. The launch of GOES-R is expected in March 2016 and coordination agreement is urgently required for 75 W and 137 W.

WGI noted the detailed report provided by NOAA on the status of coordination of GOES-R and did not identify any reservation by the different CGMS members attending WGI to the GOES-R frequency plan submitted by NOAA for international coordination. WGI wanted also to recall that ITU procedures for international coordination of frequencies and systems cannot be waived by CGMS agencies. WGI also reminded that SFCG is the natural forum to address coordination topics between space agencies prior, or in parallel, to submission for coordination within ITU. Consequently WGI confirmed the support to NOAA in the coordination process and expect that the use of the existing working practices within SFCG will help in expediting the overall coordination process.

WGI also re-iterated the need of CGMS members to closely and regularly liaise with their national frequency management/regulation authorities on the importance of the frequency bands assigned/associated to MetSats and EESS and the need to protect/preserve them. These regular activities shall ensure that adequate awareness is raised, and maintained, with the national authorities that will convey the national positions to the WRC, and reminded all CGMS members of

the fact that none of the CGMS members is a member of ITU with voting rights (by definition of the membership in ITU –which is done at national signatory level).

EUM-WP-04 is provided in response to HLPP 2014-2018, item 1.3.2. The assessment shows the situation in the EESS band 8025 – 8400 MHz, from the regulatory, usage and frequency coordination and sharing perspective and highlights the mechanisms implemented within SFCG to foster an efficient use of the spectrum as well as to facilitate coordination between space agencies. In addition, a similar assessment is performed for the MetSat band 7750 – 7900 MHz.

8025 – 8400 MHz

Frequency allocation in the ITU-R Radio Regulations (RR)

The band 8025 – 8400 MHz is among other primary services allocated to the Earth Exploration-Satellite service (space-to-Earth) on a primary basis. This EESS service includes the use by MetSat which is defined as an Earth exploration-satellite service for meteorological purposes (RR Article 1.52).

Allocation to services		
Region 1	Region 2	Region 3
8 025-8 175	EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A	
8 175-8 215	EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A	
8 215-8 400	EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A	

5.462A In Regions 1 and 3 (except for Japan), in the band 8 025-8 400 MHz, the Earth exploration-satellite service using geostationary satellites shall not produce a power flux-density in excess of the following provisional values for angles of arrival (θ), without the consent of the affected administration:

–135 dB(W/m ²) in a 1 MHz band	for	$0 \leq \theta < 5^\circ$
–135 + 0.5 ($\theta - 5$) dB(W/m ²) in a 1 MHz band	for	$5^\circ \leq \theta < 25^\circ$
–125 dB(W/m ²) in a 1MHz band	for	$25^\circ \leq \theta \leq 90^\circ$
		(WRC-12)

Frequency usage in the band 8025 – 8400 MHz

As the band is very heavily used by a large number of EESS missions, the SFCG has maintained a database dedicated solely for this frequency band 8025 – 8400 MHz for a number of years.

With this database an overview of the current and future planned usage is provided allowing space agencies to plan their frequency use in this band on the basis of this background information and thus introduce their system into this band in the optimal way in terms of selected frequencies and characteristics to avoid, to the maximum extent, mutual interference with the other systems in the database.

Extract from the SFCG X-Band Database for the band 8025 – 8400 MHz

The SFCG maintains a database populated with satellite systems using, or planning to use, the frequency band 8025 – 8400 MHz.

As a complement to the general SFCG database in which only missions of SFCG member agencies are contained, this dedicated database provides a quick overview of the satellite system population in this band including missions of non-SFCG members as well as missions of SFCG members not included yet in the general database. It contains a number of technical parameters which can be used for frequency selections, pre-coordination purposes and interference simulations.

The SFCG X-Band database constitutes an attempt, on a best efforts basis, to provide an overview on all earth exploration satellites operating in the band 8025 - 8400 MHz. It neither claims to be complete nor precise in every respect. Use of this database is free and open to everybody having a vested interest in this area. Data shall not be used for commercial purposes.

Currently the SFCG X-Band database contains more than 110 satellite systems with one or more satellites in a constellation or series of satellites. 70 of which are already deemed to be in operation.

Only two systems currently under development are planning to use this frequency band for GSO systems, namely GOES-R and FY-4.

Figure 1 below provides an overview of the bandwidth distribution of the 70 satellite systems deemed to be already in use, noting that the number of frequency assignments is around 100 (not counting the systems for which no clear bandwidth information is available). For simplification of the overview the assignments consisting of more than one channel have been combined and counted in the column of the overall bandwidth (e.g. 2 x 140 MHz is included in column 251- 300 MHz).

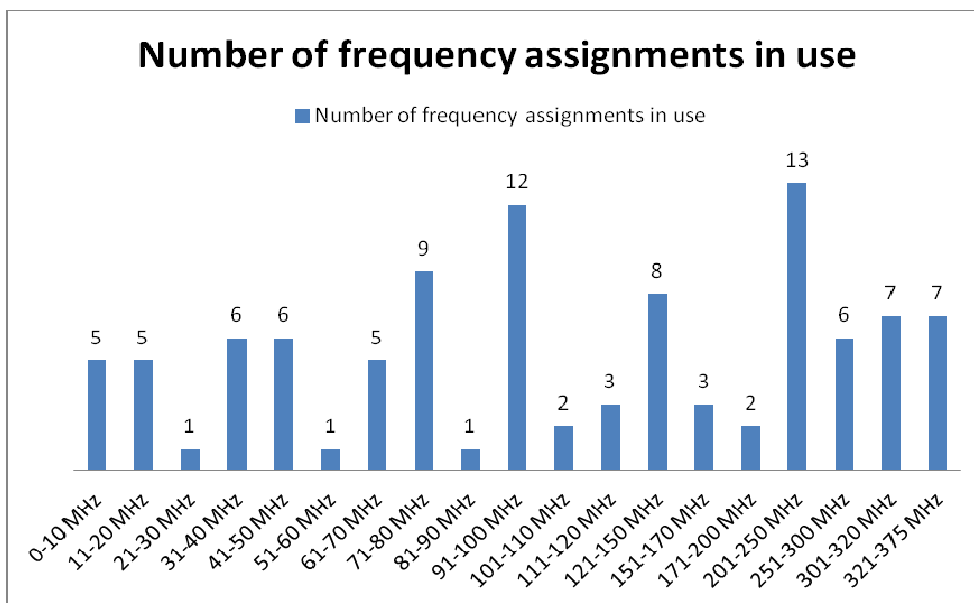


Figure 1 Bandwidth distribution of operational satellite systems using the band 8025 – 8400 MHz
 (Source: SFCG X-Band database, Status: March 2015)

In Figure 2 below also the bandwidth distribution of the around 45 satellite systems under development is added, showing that the trend for frequency assignments with larger bandwidth is continuing.

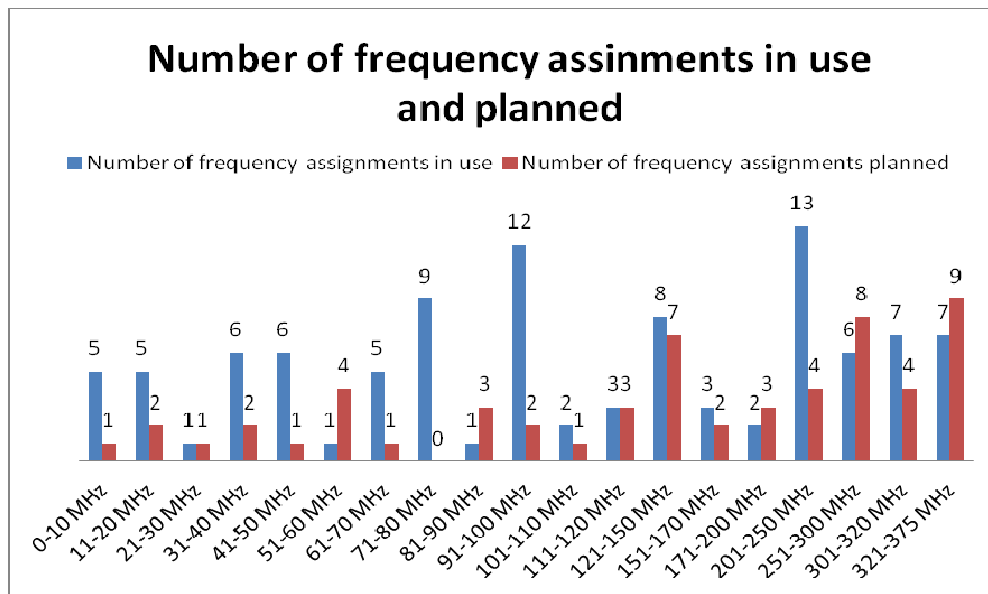


Figure 2 Bandwidth distribution of operational and planned satellite systems using the band 8025 – 8400 MHz
 (Source: SFCG X-Band database, Status: March 2015)

Frequency coordination and sharing in the band 8025 – 8400 MHz

Since the band is so densely used there is no means of avoiding frequency overlap with a number of other missions (see Figure 1 above). Depending on the bandwidth required there might be the possibility to avoid one or the other mission with high potential of mutual interference by means of frequency separation, but in most cases a frequency overlap will be unavoidable as the overall width of the band is only 375 MHz and the bandwidth requirements of the individual missions is ever increasing. Considering the very dense usage situation there is no possibility for introducing the concept of a frequency plan to group missions to minimise the interference potential and at the same time to maximize the usage potential of this spectrum resource. In order to mitigate the interference potential with other frequency overlapping missions other measures have been implemented. For this, the SFCG developed Recommendation SFCG 14-3R9 (Attachment 1) containing a number of mitigation measures that should be implemented to minimize the interference potential and, with this, improve the efficient use and counter congestion of this spectrum resource, such as:

- transmissions only when in view of the Earth stations;
- phasing of the orbital parameters for sun-synchronous satellites;
- low sidelobe, high gain satellite antennas;
- in case of low gain antennas use of isoflux instead of omnidirectional antennas;
- avoid broadcast mode operations, but if then in the lower part of the band;
- future missions to re-use characteristics of existing systems for homogeneity;
- power flux-density less than $-123\text{dB(W/m}^2\text{ MHz)}$;
- use of variable coding and modulation (VCM) techniques where practicable;
- polarisation discrimination, geographical separation of earth stations and large Earth station antennas with low sidelobes (Recommendation ITU-R S.465);
- prevent unwanted emissions exceeding the ITU-R deep space interference criterion (Rec. ITU R SA.1157) in the band 8400 – 8450 MHz;
- use of the band 25.5 – 27 GHz when possible;
- use of on-board power-controllable RF power amplifiers, where practicable.

In addition Recommendation SFCG 21-2R3 (Attachment 2) further provides mechanisms (selection of modulation scheme and spectral emissions masks) for the efficient spectrum utilisation for space science services on space-to-earth links.

Within the framework of these measures as outlined above, future missions planning to use this band are announced through the yearly presentation of information on current and future planned missions of the individual SFCG member agencies and are further coordinated through the application of Resolution SFCG A12-1R3 on the procedures for inter-agency frequency coordination.

7750 – 7900 MHz

Frequency allocation in the ITU-R Radio Regulations (RR)

The band 7750 – 7900 MHz is among other primary services allocated to the Meteorological-Satellite service (space-to-Earth) on a primary basis. The use of this band by MetSat systems is limited to non-geostationary satellite systems (RR Footnote 5.461B).

Allocation to services		
Region 1	Region 2	Region 3
7 750-7 900 MHz FIXED METEOROLOGICAL-SATELLITE (space-to-Earth) 5.461B MOBILE except aeronautical mobile		

5.461B The use of the band 7 750-7 900 MHz by the meteorological-satellite service (space-to-Earth) is limited to non-geostationary satellite systems. (WRC-12)

Frequency usage in the band 7750 – 7900 MHz

Contrary to the band 8025 – 8400 MHz, this band is only used, or planned to be used, by a limited number of space agencies for their MetSat (see Figure 3 below), which is obvious as this band is dedicated specifically to MetSat system and there is only a limited number of space agencies operating such systems.

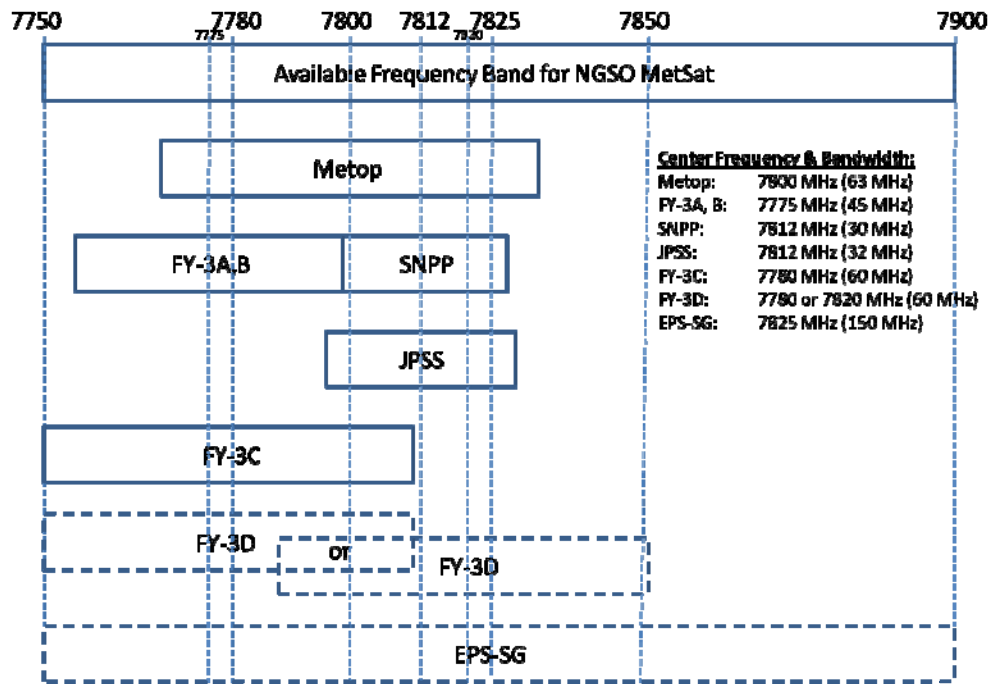


Figure 3 Overview of the current and known planned use of the band 7750 – 7900 MHz

Compatibility among MetSat system in the band 7750 – 7900 MHz

With document SF33-47/D the results of a compatibility assessment between the direct data broadcasts of EPS-SG and FY-3 in the band 7750 - 7900 MHz were provided and presented to the SFCG-33 meeting in 2013. Among the satellites outlined in Figure 1 above, the ones with the highest risk of mutual interference are EPS-SG DDB and the series of FY-3 satellites. The reason is that they fly on similar orbits (EPS-SG: 9:30 LTAN and FY-3A: 10:30 LTAN, FY-3C and FY-3D LTANs are still TBD). For the flying NPP satellite and the planned JPSS, both on afternoon orbits, the risk of interference with EPS-SG or FY-3 is negligible as compared to the case of EPS-SG versus FY-3.

For assessing the compatibility of the data broadcasts of FY-3 and EPS-SG, simulations were conducted assuming:

- FY-3 earth stations in Svalbard and Beijing, with EPS-SG (in the two options for data rates/modulation/bandwidth) transmitting continuously in broadcast mode (DDB), and
- EPS-SG earth stations in Svalbard and Darmstadt, with FY-3 transmitting continuously in broadcast mode (MPT) with different data rates/bandwidth.

Considering the relevant ITU-R protection criteria as contained in ITU-R Recommendation SA.1027, the interference potential between EPS-SG and FY3 satellites both operating in broadcast mode, assuming full spectrum overlap, is very low (0.01% (3 - 6 minutes/year) or even less when considering an actual Eb/No criteria. Such already very small interference potential only exists for high latitude stations such as Svalbard. Large margins are available for victim earth stations of both systems at mid and low latitudes.

A comparison of the results with those of a theoretical FY-3 equator crossing time equal to the one of EPS-SG (9:30) shows that the actual shift of equator crossing times between FY-3 and EPS-SG constitutes a significant factor to mitigate the potential of interference between both systems.

It should be noted that for both systems the data rates, bandwidth requirements and centre frequencies likely to be required in the timeframe > 2020 were not finally determined by the time of conclusion of this assessment in 2013. However, given the fact that there was no significant difference in the overall time of potential interference when varying the data rates/bandwidth of either system, the overall interference potential between EPS-SG and FY-3 in the 7750 – 7900 MHz band can be considered very limited and relatively independent from the finally selected data rates, modulation scheme and bandwidth required.

The compatibility assessment and its results as presented at SFCG-33 were endorsed by CMA and NOAA.

Frequency coordination and sharing in the band 7750 – 7900 MHz

Due to the initially limited bandwidth available (until WRC-12: 7750 – 7850 MHz = 100 MHz) and the different usage concepts (main data dumps vs. direct readout) a separation of the different missions was not possible when starting to utilize this band. Thus, Resolution SFCG 19-7R4 was introduced to set force some principle for using this band and through this to ensure the coexistence of the different missions in this band.

With the next generation of NGSO MetSat systems this band will be more homogeneously used for direct readout services, once Metop will be no longer operational (>2030). However, as the bandwidth requirements for direct readout services also has and will continue to increase significantly, the introduction of a frequency plan to fully avoid frequency overlap will be difficult to implement, even with the recent enlargement of the frequency allocation to MetSat to 150 MHz (7750 – 7900 MHz).

Compatibility assessments as outlined in section 2.2.1 above however show that coordinated phasing of the equator crossing times between the different polar orbiting MetSat systems constitutes the most significant factor to mitigate the potential of interference between the systems and that, with this, the interference potential between the low number of MetSat systems using this band is very small.

Within the framework of these measures as outlined above, future missions planning to use this band are announced through the yearly presentation of information on current and future planned missions of the individual SFCG member agencies and are further coordinated applying Resolution SFCG A12-1R3 on the procedures for inter-agency frequency coordination.

CGMS WGI thanked EUMETSAT for the report and summary provided and concluded that the corresponding aspect of the HLPP (1.3.2) was properly addressed in EUM-WP-04. In addition, CGMS WGI wanted to re-iterate to SFCG the appreciation of CGMS on the support provided, as an expert forum, in coordinating and in protecting and preserving the frequency bands assigned or related to the activities of CGMS. CGMS WGI participants also confirmed the need to perform the necessary coordination and interference assessment studies whenever new systems are planned and to share within SFCG and WGI the results and information gathered for analysis and comment. Noting the importance of maintaining interference free systems, WGI concluded that this point should be maintained in the HLPP and that a specific bullet should be added to cover the interference assessment on regular basis for MetSats X-Band.

WP-CMA-03 provides a description of current and future CMA Fengyun satellite systems as well as a list of radio frequencies used/to be used by these networks. CMA indicated that the provided WP contained an update on the information for FY-2G.

Satellite	Period of Utilization	Position/ LST	Service/ Application	Direction	Service freq. (MHz)	Emission	Bandwidth (kHz)	Polarization	Data Rate (kbps)
Current and future geostationary CMA satellite systems									
FY-2C		123.5E	DCP	E-S	401.1-401.4		300	RHCP	0.100
			DCP	E-S	402.0-402.1		100	RHCP	0.100
			Raw Data	S-E	1671.6-1691.6	20M0G1D	20000	Linear	14000
			Ranging (station-2)	S-E	1684-1685	1M00G2W	1000	Linear	500
			Ranging (station-1)	S-E	1686-1687	1M00G2W	1000	Linear	500

Satellite	Period of Utilization	Position/ LST	Service/ Application	Direction	Service freq. (MHz)	Emission	Bandwidth (kHz)	Polarization	Data Rate (kbps)
Current and future geostationary CMA satellite systems									
FY-2C			Ranging (primary-station)	S-E	1690-1691	1M00G2W	1000	Linear	500
			S-VISSR	S-E	1686.5-1688.5	2M00G1D	2000	Linear	660
			LRIT	S-E	1690-1691	1M00G2W	1000	Linear	150
			WEFAX (not in use)	S-E	1690.87-1691.13	260KFXD	260		
			S-WEFAX (not in use)	S-E	1699.487-1699.513	26K0FXD	26		
			Ranging (station 2)	E-S	2044-2045	1M00G2W-	1000	Linear	500
			Ranging (station1)	E-S	2046-2047	1M00G2W	1000	Linear	500
			Ranging (primary-station)	E-S	2050-2051	1M00G2W	1000	Linear	500
			TT&C	E-S	2056.5-2057.5	70K0FXD	70		
			S-WEFAX (not in use)	E-S	2059.487-2059.513	26K0FXD	26		
			LRIT	E-S	2050.87-2051.13	260KFXD	260	Linear	150
			S-VISSR	E-S	2046.5-2048.5	2M00G1D	2000	Linear	660
	FY-2D		86.5E	DCP	E-S	401.1-401.4		300	RHCP
			DCP	E-S	402.0-402.1		100	RHCP	0.100
			Raw Data	S-E	1671.6-1691.6	20M0G1D	20000	Linear	14000
			Ranging (station 2)	S-E	1684-1685	1M00G2W	1000	Linear	500
			Ranging (station 1)	S-E	1686-1687	1M00G2W	1000	Linear	500
			Ranging (primary-station)	S-E	1690-1691	1M00G2W	1000	Linear	500
			S-VISSR	S-E	1686.5-1688.5	2M00G1D	2000	Linear	660
			LRIT (not in use)	S-E	1690-1691	1M00G2W	1000	Linear	150
			WEFAX (not in use)	S-E	1690.87-1691.13	260KFXD	260		
			S-WEFAX (not in use)	S-E	1699.487-1699.513	26K0FXD	26		
			Ranging (station 2)	E-S	2044-2045	1M00G2W-	1000	Linear	500
			Ranging (station 1)	E-S	2046-2047	1M00G2W	1000	Linear	500
			Ranging (primary station)	E-S	2050-2051	1M00G2W	1000	Linear	500
		TT&C	E-S	2056.5-2057.5	70K0FXD	70			

Satellite	Period of tilization	Position/ LST	Service/ Application	Dire- ction	Service freq. (MHz)	Emission	Band- width (kHz)	Polarization	Data Rate (kbps)
Current and future geostationary CMA satellite systems									
			S-WEFAX (not in use)	E-S	2059.487-2059.513	26K0FXD	26		
			LRIT (not in use)	E-S	2050.87-2051.13	260KFXD	260	Linear	150
			S-VISSR	E-S	2046.5-2048.5	2M00G1D	2000	Linear	660
FY-2E	105E		DCP	E-S	401.1-401.4		300	RHCP	0.100
			DCP	E-S	402.0-402.1		100	RHCP	0.100
			Raw Data	S-E	1671.6-1691.6	20M0G1D	20000	Linear	14000
			Ranging (station-2)	S-E	1684-1685	1M00G2W	1000	Linear	500
			Ranging (station-1)	S-E	1686-1687	1M00G2W	1000	Linear	500
			Ranging (primary-station)	S-E	1690-1691	1M00G2W	1000	Linear	500
			S-VISSR	S-E	1686.5-1688.5	2M00G1D	2000	Linear	660
			LRIT (not in use)	S-E	1690-1691	1M00G2W	1000	Linear	150
			WEFAX (not in use)	S-E	1690.87-1691.13	260KFXD	260		
			S-WEFAX (not in use)	S-E	1699.487-1699.513	26K0FXD	26		
			Ranging (station 2)	E-S	2044-2045	1M00G2W-	1000	Linear	500
			Ranging (station1)	E-S	2046-2047	1M00G2W	1000	Linear	500
			Ranging (prim-station)	E-S	2050-2051	1M00G2W	1000	Linear	500
			TT&C	E-S	2056.5-2057.5	70K0FXD	70		
			S-WEFAX (not in use)	E-S	2059.487-2059.513	26K0FXD	26		
			LRIT (not in use)	E-S	2050.87-2051.13	260KFXD	260	Linear	150
		S-VISSR	E-S	2046.5-2048.5	2M00G1D	2000	Linear	660	
FY-2F	112E		DCP	E-S	401.1-401.4		300	RHCP	0.100
			DCP	E-S	402.0-402.1		100	RHCP	0.100
			Raw Data	S-E	1671.6-1691.6	20M0G1D	20000	Linear	14000
			Ranging (station 2)	S-E	1684-1685	1M00G2W	1000	Linear	500
			Ranging (station-1)	S-E	1686-1687	1M00G2W	1000	Linear	500
			Ranging (primary-station)	S-E	1690-1691	1M00G2W	1000	Linear	500
			S-VISSR	S-E	1686.5-1688.5	2M00G1D	2000	Linear	660
			LRIT	S-E	1690-1691	1M00G2W	1000	Linear	150
			WEFAX	S-E	1690.87-1691.13	260KFXD	260		

Satellite	Period of tilization	Position/ LST	Service/ Application	Dire- ction	Service freq. (MHz)	Emission	Band- width (kHz)	Polarization	Data Rate (kbps)
Current and future geostationary CMA satellite systems									
FY-2F			S-WEFAX (not in use)	S-E	1699.487-1699.513	26K0FXD	26		
			Ranging (station 2)	E-S	2044-2045	1M00G2W-	1000	Linear	500
			Ranging (station 1)	E-S	2046-2047	1M00G2W	1000	Linear	500
			Ranging (primary- station)	E-S	2050-2051	1M00G2W	1000	Linear	500
			TT&C	E-S	2056.5-2057.5	70K0FXD	70		
			S-WEFAX (not in use)	E-S	2059.487-2059.513	26K0FXD	26		
			LRIT	E-S	2050.87-2051.13	260KFXD	260	Linear	150
			S-VISSR	E-S	2046.5-2048.5	2M00G1D	2000	Linear	660
FY-2G		99.5E	DCP	E-S	401.1-401.4		300	RHCP	0.100
			DCP	E-S	402.0-402.1		100	RHCP	0.100
			Raw Data	S-E	1671.6-1691.6	20M0G1D	20000	Linear	14000
			Ranging (station -2)	S-E	1684-1685	1M00G2W	1000	Linear	500
			Ranging (station-1)	S-E	1686-1687	1M00G2W	1000	Linear	500
			Ranging (primary-station)	S-E	1690-1691	1M00G2W	1000	Linear	500
			S-VISSR	S-E	1686.5-1688.5	2M00G1D	2000	Linear	660
			LRIT	S-E	1690-1691	1M00G2W	1000	Linear	150
			WEFAX	S-E	1690.87-1691.13	260KFXD	260		
			S-WEFAX (not in use)	S-E	1699.487-1699.513	26K0FXD	26		
			Ranging (station 2)	E-S	2044-2045	1M00G2W-	1000	Linear	500
			Ranging (station 1)	E-S	2046-2047	1M00G2W	1000	Linear	500
			Ranging (primary- station)	E-S	2050-2051	1M00G2W	1000	Linear	500
			TT&C	E-S	2056.5-2057.5	70K0FXD	70		
			S-WEFAX (not in use)	E-S	2059.487-2059.513	26K0FXD	26		
			LRIT	E-S	2050.87-2051.13	260KFXD	260	Linear	150
			S-VISSR	E-S	2046.5-2048.5	2M00G1D	2000	Linear	660
	X and KA payloads for test								
FY-4	2015	TBD	DCPS	E-S	401.1-401.4			RHCP	
			DCPS	E-S	402.0-402.1			RHCP	

Satellite	Period of tilization	Position/ LST	Service/ Application	Dire- ction	Service freq. (MHz)	Emission	Band- width (kHz)	Polarization	Data Rate (kbps)
Current and future geostationary CMA satellite systems									
FY-4			DCPS	S-E	1686-1690			Linear	
			Raw Data	S-E	7450-7550			RHCP	
			HRIT	E-S	8175-8195			RHCP	
			HRIT	E-S	8195-8215			RHCP	
			HRIT	S-E	1675-1687			Linear	
			LRIT and WAIB	E-S	2056.5-2057.5			RHCP	
			LRIT and WAIB	S-E	1696-1698			linear	
			TARS	E-S	2042-2052			RHCP	
			TARS	S-E	1689-1697			Linear	
			TARS	S-E	2222-2232			RHCP	
			TT&C	E-S	2025-2110			RHCP	
			TT&C	S-E	2200-2290			RHCP	
Current and future polar-orbiting Fengyun satellite systems									
FY-1D	2004-2011	6.00	Not in use	S-E	1708.46	3M00G1D-	3	CL	3
			Not in use	S-E	1700.4	5M00G1D	5	CR	5
FY-3A	2008-	10.30	HRPT	S-E	1704.5	6M80G1W	6.8	CR	4
			MPT	S-E	7775	45M0G1W	45	CR	18700
			DPT	S-E	8145.95	149MG1W	149	CR	93000
FY-3B	2010-	13.30	HRPT	S-E	1704.5	6M80G1W-	6.8	CR	4
			MPT	S-E	7775	45M0G1W	45	CR	18700
			DPT	S-E	8145.95	149MG1W	149	CR	93000
FY-3C	2013	10:30	HRPT	S-E	1701.4	6M80G1W--	6.8	CR	4
			MPT	S-E	7780	60M0G1W--	60	CL	45000
			DPT	S-E	8175	300MG1W--	300	CL	225000
FY-3D		TBD	HRPT	S-E	N/A	N/A	N/A	N/A	T
			AHRPT	S-E	7820	N/A	N/A	RHCP	60000
			DPT	S-E	N/A	N/A	N/A	N/A	T

CGMS WGI thanked CMA for the efforts in providing an update of the information.

NOAA-WP-07 provides a description of current and future NOAA satellite networks as well as a list of radio frequencies used/to be used by these networks. The provided WP identifies the updates done to the CGMS-42 version of this paper and submitted to WGI for information. NOAA also informed CGMS WGI that official authorizations and frequency assignments are on file with the International Telecommunications Union (ITU) and the U.S. National Telecommunications and Information Administration (NTIA).

CGMS WGI thanked NOAA for the update of the information and used the opportunity to recall the ready availability of the WMO Observing System Capability Analysis and Review Tool (OSCAR -

(<http://www.wmo-sat.info/oscar/satellitefrequencies>), encouraging WGI members to provide and maintain updated WMO with the frequency information of their systems (present and future ones). WMO also took the opportunity to inform CGMS WGI on the plans to upgrade the OSCAR tool with additional features and capabilities (to be released before CGMS 44).

NOAA raised the point of accessibility to information by others than CGMS agencies to frequencies, instrument characteristics and applications based on them and requested clarification on the relation between OSCAR and the different ITU handbooks for MetSats and EESS. WGI considered with appreciation the question raised and noted that the current ITU practice is that any of these handbooks is subject to fees (either for hardcopies or for downloading it). Considering the relevance and importance of easiness and accessibility to information CGMS WGI agreed in a recommendation to foster the necessary capabilities in the next release of OSCAR to allow adequate reporting by applications, instrument types and set of frequencies. If necessary, hyperlinks in the CGMS web pages to the OSCAR based reports shall be ensured.

CGMS-43 recommendations - WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
WMO	WGI/3	R43.01	WMO to make the information on all (active, passive and comms) frequency use available and searchable in OSCAR/Space, such that pre-defined reports are easily accessible via external hyperlinks	CGMS-44	OPEN	HLPP # 1.3

With all WPs on frequency topics presented and discussed, CGMS WGI recalled that CGMS nominated the Frequency Manager of EUMETSAT as liaison officer between CGMS and SFCG. CGMS WGI noted with appreciation the work done so far by the liaison officer. In discussing how to better use time and resources of both SFCG and CGMS WGI, it is proposed to continue using the identified liaison officer to also report back from SFCG on the topics of relevance to CGMS allowing the concentration of all frequency management and coordination issues between CGMS members (but also members of SFCG) to be addressed in an expert forum like the SFCG. To ensure that CGMS is informed of any issue needing dedicated attention within CGMS WGI, the following action was agreed to be captured in the best practices of CGMS.

CGMS-43 recommendations - WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
CGMS members	WGI/3	R43.02	Recommends CGMS members to continue bringing all frequency management and coordination issues under the expert forum of SFCG and actions the liaison officer (from CGMS to SFCG) to report to CGMS WGI all aspects of SFCG discussions considered of relevance to CGMS.	CGMS-44	OPEN	HLPP # 1.3

CGMS-43 action - WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
EUM	WG/I	A43.02	CGMS Liaison officer to SFCG to report to CGMS WGI on the discussions and disposition of SFCG on all topics of interest to the different CGMS members. For achieving that a dedicated CGMS Secretariat WGI working paper will be prepared by EUMETSAT Frequency Manager (in the role of liaison officer from CGMS to SFCG) and will be released to the participants of WGI before end of the corresponding year. Based on the contents, CGMS members will decide the level of information they will include in their specific reports to CGMS for the corresponding WGI meeting	30 Dec 2015	OPEN	HLPP # 1.3

I/4 Optimisation/harmonization of direct readout dissemination (CGMS DB global spec)

I/4.1 Current systems

No papers were presented during CGMS 43. But the need to maintain this agenda topic is discussed (and confirmed) under the revision of the HLPP (parts relevant to WGI).

I/4.2 Transition to new direct readout systems (GOES-R, JPSS, FY-3, EPS-SG,..)

NOAA-WP-10 (ppt) presented the NOAA plans to transition to New Direct Readout Systems for GOES-R & JPSS. The GOES Re-Broadcast (GRB) service will replace the GVAR transmission on the current GOES spacecraft. NOAA's current direct broadcast services will change dramatically in data rate, data content, and frequency allocation, and drives changes to field terminal configurations. Direct readout data users must employ new field terminal receivers unique to each particular broadcast service. JPSS plans the carry and X-band service similar to the NASA EOS and NOAA S-NPP spacecraft. The HRD service will transmit a full complement of instrument data. GOES-R will make available an HRIT/EMWIN service which will be a combination of the LRIT and NWS' Emergency Managers Weather and Information Network (EMWIN) services.

GOES-R will be located at a check out position of 89.5 deg W for the first 12 months and will provide improved data products for hemispheric retransmission:

- "GOES Rebroadcast" (GRB)
- Faster full disk images with 5 minutes (Mode 4) and 15 minutes (Mode 3)
- Full set of Level 1b data with data from six GOES-R instruments including all ABI channels

GOES-R data reception requires new antenna, receiver hardware, and processing system to handle the new data volumes:

- Receiver frequency shift from 1685.7 MHz to 1686.6 MHz
- Dual circular polarized signals
- Going from 2.11 Mbps (GVAR) to 31 Mbps (GRB)

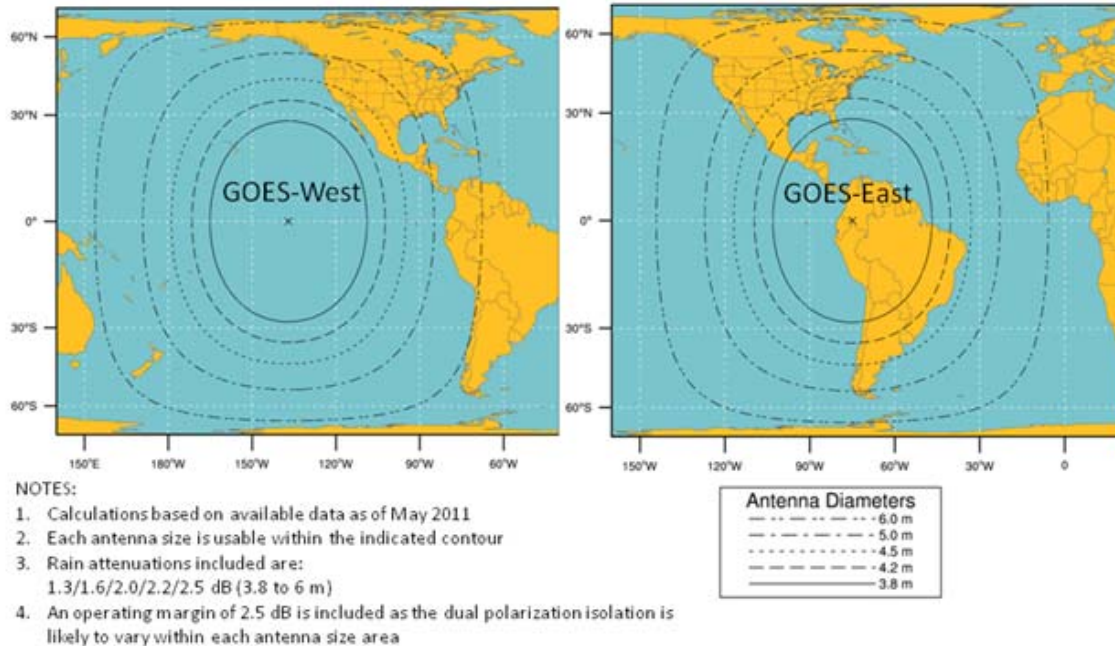


Figure 4 GRB Ground Antenna Sizes

GRB Downlink Specification Document for Users Provides GOES Rebroadcast radio frequency downlink characteristics, to enable the user community to develop GRB receivers

- <http://www.goes-r.gov/resources/docs.html>
- GOES-R Product Users Guide (PUG)
- Describes the format and content of GRB data
- <http://www.goes-r.gov/resources/docs.html>

Community Satellite Processing Package (CSPP) GRB Prototype 0.1 Release

- Prototype release of the CSPP Geo GRB software that will allow Direct Broadcast users to process GOES Rebroadcast (GRB) data received on their antennas from the GOES-R satellite, after it is launched in 2016.
- The main functionality included in this release is to ingest a simulated GRB data stream, recover Advanced Baseline Imager (ABI) Level 1 and Geostationary Lightning Mapper (GLM) Level 2 data payloads, reconstruct the datasets, and write output to mission-standard NetCDF files. Optionally, quicklook images can be generated from the ABI radiances.
- Later releases will add support for recovering data from the remaining GOES-R instruments: SUVI, EXIS, MAG and SEISS.
- This software is supported on 64-bit Centos6-compatible Linux platforms.

- Publicly available for download (and free to use) at:
http://cimss.ssec.wisc.edu/csppgeo/grb_v0.1.html

Transitioning HRIT/EMWIN from GOES NOP to GOES-R:

- NOAA NWS Emergency Managers Weather Information Network (EMWIN) is a priority-driven weather data broadcast service broadcast
 - Alerts/Watches/Warnings
 - Forecasts, Graphic Format Products and Imagery
 - Low cost ground receive stations
- The NOAA NESDIS Low Rate Information Transmission (LRIT) is a collection of reduced resolution GOES and MTSAT imagery and products
 - GOES Visible, Infrared and Water Vapor Imagery at 4 Km Spatial Resolution
 - MTSAT Visible, Infrared and Water Vapor Imagery on LRIT-West
 - Tropical Storm Information
 - Copy of GOES Data Collection Service (GOES-DCS)
- HRIT/EMWIN data service will be provided in the existing Global Specification for HRIT/LRIT
- The GOES-R HRIT/EMWIN service combines LRIT and EMWIN with GOES-DCS on a single ~ 1 Meter Antenna
- Improved data products for hemispheric retransmission
 - Faster full disk images: between 15 and 30 minutes
 - Warnings, Watches, Tropical Storm Information
 - Copy of GOES Data Collection System (GOES DCS)
 - Requires new antenna and receiver hardware
 - Receiver frequency shift to 1694.1 MHz from:
 - EMWIN 1692.7 MHz and LRIT 1691.0
 - BPSK Polarization; EMWIN shift from Offset QPSK
 - Data Rate to a combined 400 Kilobits per Second from: EMWIN: 19.2 Kbps and LRIT : 128 Kbps (combined 147.2)
- Documents and updates to be posted on the GOES-R web site:
 - <http://www.goes-r.gov/> -- <http://www.goes-r.gov/users/hrit.html>

Getting Ready for JPSS

- JPSS shall provide the DR community with software, documentation, and periodic updates to enable them to produce data products from JPSS, using their own hardware to receive the JPSS HRD broadcasts
- NOAA provides DR software packages under the JPSS Program Science. The software is called the Community Satellite Processing Package

Community Satellite Processing Package

Home	Download	Applications	History	Credits	Forum
<p>The Community Satellite Processing Package (CSPP) supports the Direct Broadcast (DB) meteorological and environmental satellite community through the packaging and distribution of open source science software. CSPP supports DB users of both polar orbiting and geostationary satellite data processing and regional real-time applications through distribution of free open source software, and through training in local product applications. CSPP is funded through NOAA JPSS.</p> <p style="text-align: center;">Suomi National Polar-orbiting Partnership (NPP) Products</p> <p>CSPP software to support Suomi NPP:</p> <ul style="list-style-type: none"> VIIRS, ATMS and CrIS calibration and geolocation software (Raw Data Records (RDRs) to Sensor Data Records (SDRs)); Learn more ... VIIRS Environmental Data Records (EDRs), including a subset of Land, Ocean and Atmosphere Products; Learn more ... VIIRS SDR reprojection software for the creation of GeoTIFFs and/or AWIPS NetCDF files; Learn more ... NOAA/NESDIS/STAR NOAA Unique CrIS/ATMS Processing System (NUCAPS) EDR Hyperspectral Sounding Retrieval Software; Learn more ... CrIS, AIRS and IASI University of Wisconsin dual regression single Field-of-View (FOV) Temperature, Moisture, Surface and Cloud Retrieval Environmental Data Record (EDR); Learn more ... S-NPP VIIRS, ATMS, CrIS and EOS Aqua and Terra HYDRA2 multispectral data analysis toolkit; Learn more ... NOAA/NESDIS/STAR Microwave Integrated Retrieval System (MIRS) supporting S-NPP ATMS, NOAA-18, 19 and Metop-A, B AMSU-A and MHS instruments; Learn more ... VIIRS Imagery Environmental Data Records (EDRs). Learn more ... VIIRS, MODIS and AVHRR (POES and Metop) Cloud and Land Surface Retrievals from CLAVR-x. Learn more ... International ATOMS Processing Package (IAPP) Retrieval Software, supporting 					<p>What's New</p> <ul style="list-style-type: none"> ACSPO SST Retrieval Software v1.0 IAPP Retrieval Software v1.0 NUCAPS CrIS/ATMS EDR Retrieval Software v1.0 VIIRS, ATMS, CrIS SDR Software v2.1 VIIRS EDR Software v2.0 VIIRS Imagery EDR Software v2.0 CLAVR-x VIIRS, MODIS and AVHRR Cloud Retrieval Package v1.0 MIRS Microwave Retrieval Software v1.0

Figure 5 Satellite Communication links

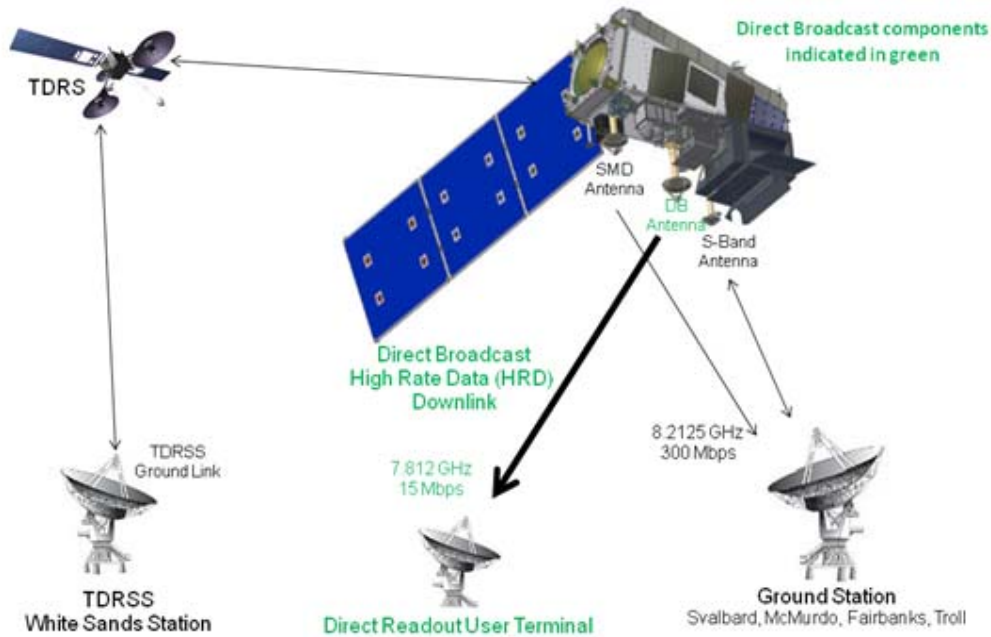


Figure 6 Field Terminal System (FTS) Level 1 Requirements

- JPSS Level 1 Requirements Document (JPSS L1RD) provides the fundamental requirements and scope of JPSS Field Terminal
 - JPSS-1 and JPSS-2 will provide High Rate Direct Readout (HRD) broadcast in X-band, ~15 Mbps downlink
 - JPSS shall provide the DR community with software, documentation, and periodic updates to enable them to produce data products from JPSS, using their own hardware to receive the JPSS HRD broadcasts
- The JPSS Program is not responsible for developing, testing, or deploying any JPSS capable field terminal
- JPSS will not perform encryption of the direct broadcast

Key Functions of FTS

- Hardware Specifications
 - Suggested field terminal configurations
- DFCB and RF-ICD
 - Containing specifics on direct broadcast data format
- Software to produce RDRs from packets
 - Provide and maintain RT-STPS
- Algorithms & Software
 - Used to create data products from direct broadcast
- Updated algorithms & software
 - Notification when updates are available
- Mission Support Data
 - Ancillary/auxiliary data
 - Maintain list of registered users
 - Condition for NTIA Frequency allocation approval
 - Mission status
 - Users are provided status of the JPSS direct broadcast
 - HRD Link status
 - Users are provided post-pass performance information
 - On-orbit checkout and special tests
 - Gather feedback from FTS community
 - User community prioritization of the HRD link
 - Provide feedback to the Program
 - Promote the use of the JPSS data products from HRD link
- The NOAA software interface to the direct readout community for software is the NOAA CIMSS Community Satellite Processing Package (CSPP)
- FTS will leverage existing annual workshops to provide a forum for the DB community to present, discuss, learn, and provide feedback to the JPSS Program

CGMS WGI thanked NOAA for the detailed presentation on the plans for transitioning to GOES-R and JPSS, and noted the approach proposed of annual workshops to gather feedback on the JPSS

program. In the discussions following the presentation of the WP, WGI agreed two actions. The first one relates to the possible inclusion of the GLM products in the HRIT stream. The second action relates to clarifying the need to register as user for Direct Broadcast.

WGI raised an action for the attention of WGIII for NOAA to consider including GLM products in the HRIT stream (see WGIII report)

CGMS-43 actions - WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
NOAA	WGI/4	A43.03	NOAA to assess the need for user registration for Direct Broadcast	CGMS-44	OPEN	HLPP # 1.4
CGMS space agencies	WGI/4.2	A43.04	CGMS members to comment on the work done in the context of the EUMETSAT provided VIIRS Regional Service, and to provide feedback on the proposal to define a standardised compact product format, generalised to cover the advanced imagers of the current and planned polar orbiting satellites.	CGMS-44	OPEN	HLPP # 2.6

EUM-WP-05 presented a summary of the assessment done by EUMETSAT on the potential of the global specification for HRIT for future GEO systems. The CGMS LRIT/HRIT Global Specification defines the global aspects of an architectural specification for standardised data dissemination from geostationary satellites towards LRIT/HRIT user stations. The role of this global specification may benefit from being re-evaluated in the context of the adoption by data providers of widely established standards for data dissemination and formats. EUM-WP-05 proposes a number of areas of the CGMS LRIT/HRIT Global Specification which should be considered for update.

With this inputs provided, WGI debated the need to evolve the existing CGMS Global specification for GEO systems (Global Specification 03) to efficiently format and disseminate L1 and L2 products in the future (beyond the systems already in operations and planned to enter into operations in the next 3-5 years – as they have consolidated their design already). Therefore CGMS WGI agreed to include in the HLPP a dedicated entry to work on the evolution of the documents (as necessary to keep up with new formatting standards and adapt it to potential evolutions on the dissemination systems). Progress will be achieved by specific inter-sessional meetings (e-meetings) of the task team nominated following action CGMS-WGI-42.05

I/5 Data collection systems

EUM-WP-06 presents the work performed on behalf of CGMS in the SATCOM Forum in the context of Data Collection Systems. The paper contains information about the DCS and A-DCS systems of the CGMS partners, this will be used as an input to the first SATCOM Forum planned for the end of 2015/beginning 2016.

BACKGROUND

The International Forum of users of satellite data telecommunication systems (SATCOM Forum) is an entirely self-funded body jointly sponsored by the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO, of the United Nations with the view to address the requirements of these two Organizations for the timely collection of environment data from observing platforms.

The following is an extract from the Executive Summary from the Ad Hoc International Forum of users of satellite data telecommunication systems (SATCOM Forum) held on Paris, France, 3-4 October 2013.

The ad hoc international Forum of users of satellite data telecommunication systems (Satcom Forum) was held at the headquarters of the Intergovernmental Oceanographic Commission (IOC) of UNESCO in Paris, France, from 3 to 4 October 2013, and was chaired by Mr David Meldrum (United Kingdom). 33 participants from 12 countries, and representatives of the satellite data telecommunication service providers, and the satellite equipment manufacturers also attended the meeting.

The objective was to build on the previous session (Toulouse, April 2012) to determine whether the Forum should become an established expert group, meeting on a regular basis. The future Forum is meant to provide an international mechanism, covering the wide user base that exists within the co-sponsoring Organizations, to address remote data communication requirements – including tariff negotiations as needed – for automatic environment observing systems using satellite data telecommunication systems (Satcom systems).

The meeting reviewed the World Meteorological Organization (WMO) and IOC user requirements for the collection of meteorological data from remote areas (including buoys, ship-based observing systems, seal level observing stations, Automatic Weather Stations, Polar Observations, profiling floats, and animal tracking). It reviewed the capabilities and the tariff schemes of the satellite data telecommunication systems that are mostly being used for the collection of environmental data from remote areas, and discussed the role that they could play in the future Forum. The meeting noted that the future Forum is meant to provide guidance to the WMO and IOC users on the use of Satcom systems, including guiding them on how to make the best arrangements for the purchase of airtime. The Forum will provide detailed information on satellite systems capabilities so that users will be able to make informed decisions on which system to use.

The meeting established an interim Executive Committee for the Satcom Forum to drive the work plan, which should lead to the formal establishment of the Forum by the sponsoring Organizations. The meeting reviewed the draft Terms of Reference of the Satcom Forum, proposed some changes to reflect the proposed reporting of the future Forum to the Executive Bodies of WMO and IOC through the Commission for Basic Systems (CBS) Management Group, and the GOOS Steering Committee respectively.

Satcom Forum Terms of Reference

The Terms of Reference agreed by the interim Executive Committee are:

- Provide proper coordination amongst the users of satellite data telecommunication systems and represents their collective interests in working with the satellite telecommunication service providers and the industry in order to advance the awareness and understanding of the user requirements;
- Advance the awareness and understanding of available and planned capabilities;
- Facilitate adoption of interoperability and quality standards and principles as needed;
- Investigate and propose as appropriate cooperative and tariff negotiation mechanisms on the use of satellite data telecommunication systems;
- Provide guidance to best meet user needs of each considered application;
- Report to the executive bodies of WMO and IOC through the Commission for Basic Systems (CBS), the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), and the GOOS Steering Committee respectively.

Membership is open to all representatives of the co-sponsors stakeholders. The Satcom Forum Terms of Reference have now been approved at CBS-15th session, and will be formalised at the next WMO Congress in June.

Satcom Forum and CGMS

EUMETSAT (Sean Burns) is the CGMS representative to Satcom and is also a member of the interim Executive Committee.

Information about the Data Collection Systems of CGMS members has now been collected and is contained in Annex I and Annex II. This data will be reviewed during the WG I discussions and will be used as an input into the first Satcom Forum. The first SATCOM Forum is planned for late 2015/early 2016.

CGMS WGI thanked EUMETSAT for the dedicated report and update of information regarding the status of preparation for the first SATCOM Forum and agreed to review the data collected by the CGMS representative in the SATCOM Forum on the Data Collection Systems of the different CGMS members. Due to the shortage of time during the WGI meeting it was decided to perform this review offline and a dedicated action is agreed at WGI level for performing this review before the end of summer 2015.

CGMS-43 actions – WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
CGMS member	WGI/5	A43.05	CGMS Members to assess, comment on the info package for the SATCOM Forum prepared by the appointed CGMS representative	30 Oct 2015	OPEN	HLPP # 1.2.1

CGMS WGI also agreed that, under the HLPP, the appointed CGMS representative in the SATCOM Forum will provide regular updates (annually) to CGMS WGI to confirm the status of preparation for SATCOM Forum, a WGI inter-sessional meeting (together with more general frequency coordination topics) is agreed to take place at the end of 2015.

JMA-WP-06 reports on the present status of the Japan Meteorological Agency (JMA)'s Data Collection System (DCS) and related future plans, highlighting a recent increase in the number of Data Collection Platform (DCP) stations for which DCS regional channels are used for better tidal/tsunami monitoring.

Introduction

JMA has operated the Data Collection System (DCS) since its first Geostationary Meteorological Satellite (GMS) was launched in 1977. As follow-on satellites to the current MTSAT-1R and MTSAT-2 units, Himawari-8 and Himawari-9 are scheduled to become operational in July 2015 and 2017, respectively. These satellites will continue to provide services for the DCS, which plays an important role in collecting meteorological information as well as earthquake and tidal/tsunami data.

The name MTSAT-DCS will also be changed to Himawari-DCS with the operational satellite switchover in July 2015. DCP stations using MTSAT-DCS will be able to use Himawari-DCS with no change in DCP antenna direction or DCP settings and no reapplication to JMA.

Current status of MTSAT-DCS

Figure 7 shows the expansion of tidal/tsunami DCPs for which MTSAT-DCS regional channels are used. In addition to this increase, more frequent collection (from every 15 minutes to every 6 minutes) is being implemented for some tidal/tsunami DCP stations in consultation with the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) to support enhanced monitoring.

In 2014, nine DCPs began operation, and five DCPs have shortened the collection time from every 15 minutes to every 6 minutes. In 2015, Fiji DCP began operation.

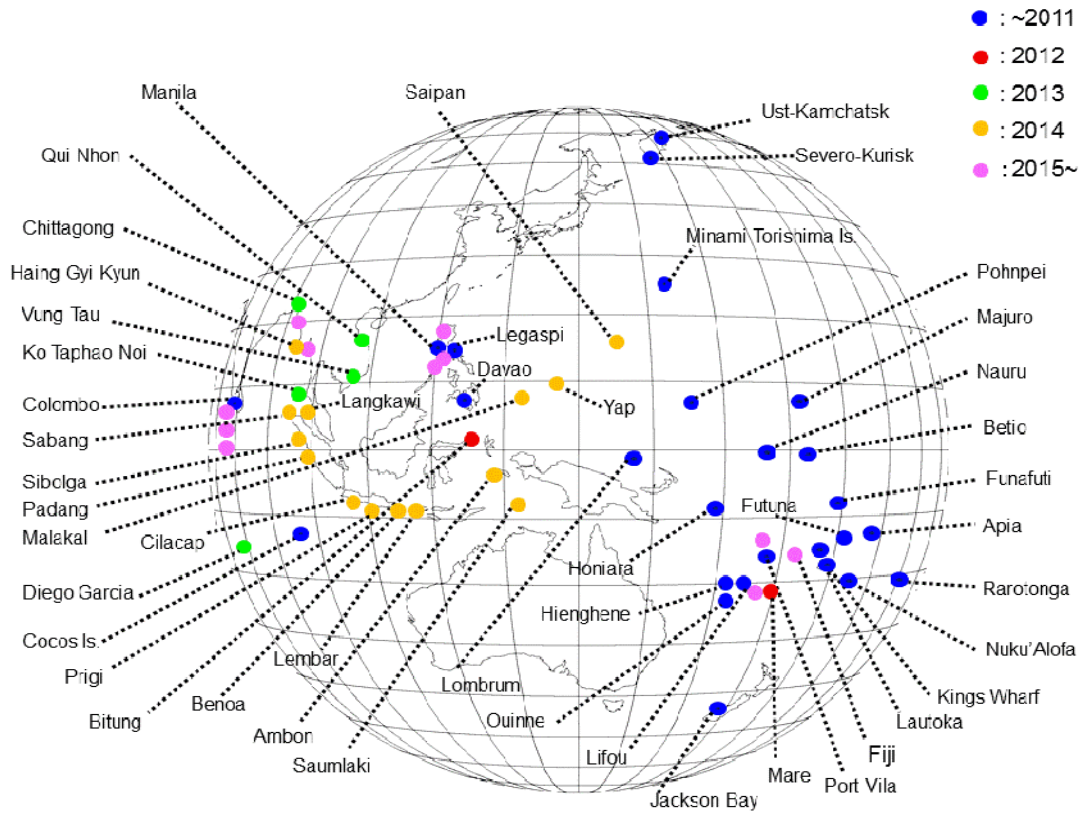


Figure 7 Expansion of tidal/tsunami DCPs for which MTSAT-DCS is used

Requests regarding the use of MTSAT-DCS and Himawari-DCS

JMA is receiving more and more requests regarding the use of its MTSAT-DCS. Based on the importance of disaster reduction/mitigation activities in the relevant regions and the significant role of the DCS in such work, JMA has positively responded to such requests. Recent instances have been related to:

- Vietnam's plan to install more than 100 hydrometeorological DCP stations for disaster prevention along the Mekong River
- Vanuatu's request for two new tidal DCP stations
- A request from France's Service Hydrographique et Océanographique de la Marine (SHOM) for new tidal DCP stations in the Indian Ocean and the western Pacific
- Requests from the University of Hawaii Sea Level Center (UHSLC) for developments including transition of the use of DCS from Meteosat-7 to MTSAT and enhanced data collection periodicity

Himawari-DCS data flow

JMA’s new satellite, Himawari-8, will assume MTSAT-1R’s DCP data relay duties when it begins routine observation in July 2015. As Himawari-8 is located at 140.7°E, which is very close to MTSAT-1R’s position at 140°E, DCP stations using MTSAT-DCS will be able to use Himawari-DCS with no change in DCP antenna direction or DCP settings and no reapplication to JMA. Himawari-8 and -9 will use the Ka band (up to 18 GHz) as the downlink frequency for relaying DCP data as opposed to the L band (up to 1.6 GHz) used on the current MTSAT-DCS. To cope with the effects of rain attenuation in the Ka band, JMA will introduce site diversity with two receiving stations in Tokyo and Hokkaido. As these stations are more than 800 km apart, they are unlikely to be affected by heavy rain at the same time. This is expected to guarantee 99.99% uptime in radio communication.

As shown in Figure 8, data transmitted from DCP stations to Himawari-8 are relayed to the Tokyo Station and the Hokkaido Station before being demodulated. The quality of data at both stations is compared, and the set with fewer errors is chosen for use. After format conversion, the data are distributed globally via GTS. Along with these distribution efforts, JMA provides online access to the data and an email transmission service as backup with the aim of creating redundancy in data distribution to users.

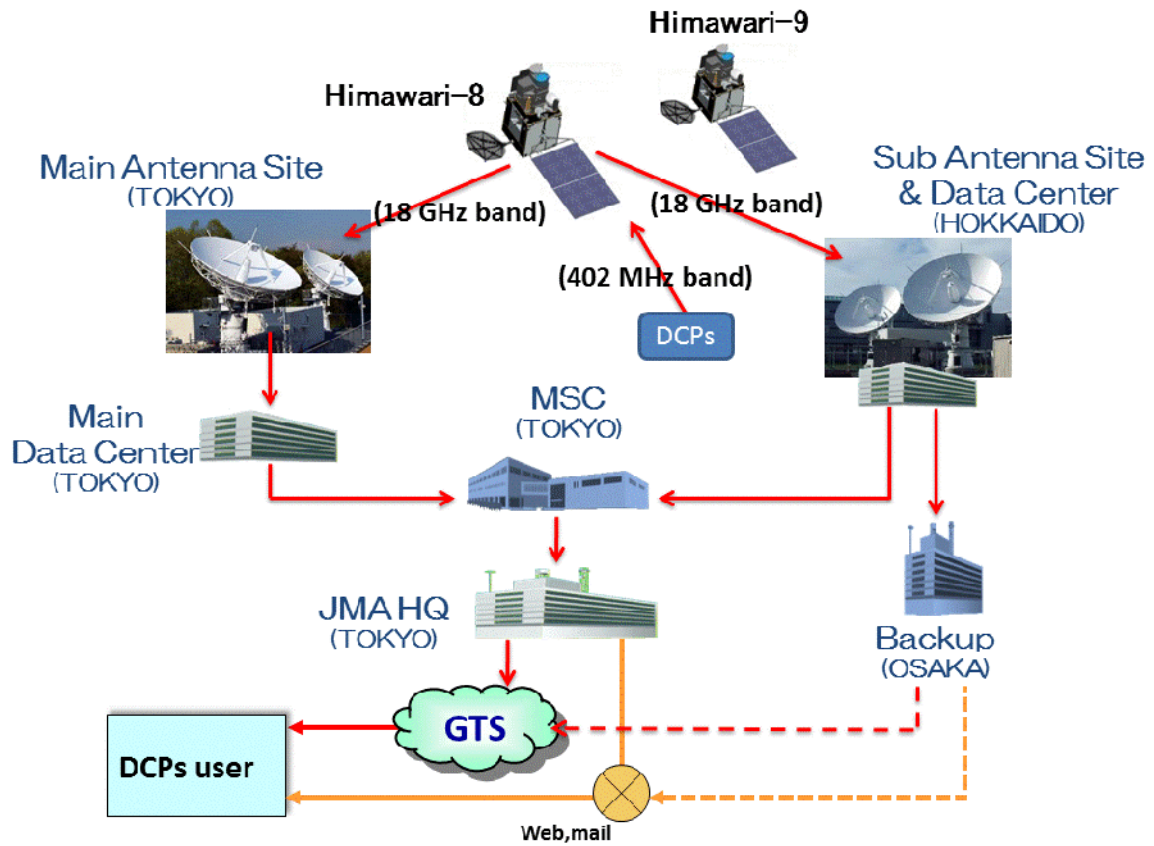


Figure 8 Himawari-DCS data flow

WGI expressed its appreciation for the dedicated report provided by JMA and asked JMA for confirmation on the plans to support HRDCPs in the evolved system using Himawari 8 and 9. JMA confirmed that currently there are no plans to introduce HRDCPs in the system.

NOAA-WP-11 provides a status report on the performance of the International Data Collection System (IDCS) and NOAA's domestic DCS. NOAA's DCS Administration and Data Distribution System (DADDS, serving GOES DCS users) now has approximately 1500 individual users, with almost 800 organizations using the system.

NOAA has continued with populating user and platform tables, registering and training users, and has recently completed the task of upgrading browsers, including implementing a framework structure to simplify this task in the future. Soon NOAA will be rolling out an automated System Use Agreement processing system and online registration database for users of all NOAA satellite data, and will be developing a Machine to Machine Interface to simplify bulk updates for larger users.

NOAA has been using newer Version 2 transmitters (requiring half the bandwidth of existing transmitters) and already has integrated almost 5000 in the system. Implementation of 300 baud transmitters was fairly simple as they could be placed on existing 300 baud channels. However, the 1200 baud channels do not line up with existing channels, so NOAA has been clearing channels at the lower end of the spectrum to make room for new 1200 bps channels. NOAA continues to use a borrowed channel from EUMETSAT to ease this transition. The ultimate goal is to relocate the 1200 baud channels to the lower end of the spectrum, where channels have almost been vacated by 100 baud transmitters. The transition to high data rate (HDR) is officially complete, with approximately 50 of the 24,800 platforms that are active still reporting at 100 bits/sec. NOAA has communicated with owners of the still operating platforms to arrange termination. NOAA plans to continue to investigate the use of two way communications to better command and control platforms and has recently kicked off a study to capture the current state of technology before proceeding. Use of the international channels is minimal. NOAA is using the channels assigned to us for our domestic use by CGMS, and has already made assignments on all of them. A fully redundant backup system has been located in Suitland, Maryland since 2010, and is being fully utilized by users and by developers who continue to roll out enhancements to DADDS by testing them at the Suitland site first. In the near future we will add a more reliable feed to the LRIT (and eventually HRIT) systems, with the ultimate goal of phasing out our DOMSAT rebroadcast. Use of the GOES DCS continues to flourish in the U.S. The POES DCS (aka Argos) has 21,000 active platforms, supporting 2,000 programs/users in 100+ countries. The Argos space segment currently consists of NOAA-15/18/19, Metop-A/B, and SARAL. Future launches include Metop-C (~2018) and Metop-SG-B1 (~2022) by EUMETSAT, with additional launches by ISRO & NOAA also being planned (~2018-2019), and with exact details still being determined.

DADDS Status

NOAA's DCS Administration and Data Distribution System (DADDS) was placed into operation in October 2009. The system was brought on line with minimal capability, but has grown to be a highly functional system. Enhancements have continued, but the system is now considered almost complete, and NOAA is now moving into refresh mode. The tasks of capturing and maintaining user

and platform information and registering and training users to employ the system continue to be a major focus, but NOAA's priority for the past year has been to refresh operating systems and database tools, and make required enhancements to meet IT Security requirements.

The backup DADDS in Suitland, Maryland is operable, but is also the test-bed for system modifications. Both Wallops and Suitland have duplicate systems, so at least one system should be available for use at all times at each site. In an emergency the test system can be quickly reconfigured and available for use. The major change from DAPS to DADDS is the requirement for each user to have an individual login (instead of agencies sharing one among all their users). DADDS has now authorized more than 1500 individual users in the system. DADDS manages all platform and user information and automatically distributes data to most rebroadcast circuits. It can also be used by individual users to download message data, and improving that capability has been a focus this past year. NOAA has improved the download capability by reinstating the "network list" function from DAPS, which is a capability to store a list of id's of interest to each individual user (or agency). This will make selection of message data from specific platforms easier to manage. NOAA is also working to integrate our online System Use Agreement (SUA) processing system into DADDS. The SUA processing system was taken offline 3 years ago due to security issues, and has had a lower priority in the DADDS implementation than other tasks, but is moving up in the queue. These tasks were completed in 2014, but new IT security scanning reviews must be completed before the new capabilities are rolled out. In 2013 a task to update the html code to a standardized html5 was begun, but we quickly realized that the standard was still far from being universal. The task of keeping code up to date has been challenging due to the speed of advancement of Internet browsers. DADDS can be used with Internet Explorer 8, and with newer versions of Chrome, but most users find using Firefox to be more reliable at the moment. We have completed our next step to implement a "framework" tool, Bootstrap, to simplify management of code for use of multiple browsers. These improvements are also awaiting security scanning before rollout.

Version 2 (v.2) Transmitter

NOAA finalized new transmitter Certification Standards (designated as "Version 2" or v.2) in 2010, which allow transmitters to use smaller channels. This will double the capacity of the system when fully implemented. All existing high data rate vendors are now "Version 2" certified, and vendors are now prohibited from selling Version 1 transmitters. Changes to the digital demodulators have been implemented, allowing new transmitters and legacy transmitters to operate on the same channels at 300 baud. Changes to the filter from the legacy "Bessel" filter to the new "Square Root Raised Cosine" (SRRC) filter have been deployed onto both the NSOF and the Wallops DADDS. (A study several years ago identified the SRRC filter as the best choice for NOAA's system, but verified that the new transmitters could continue to operate using the Bessel filter in the receive system with minimal impact to data reception.) NOAA's ground system is now completely v.2 compatible. As new platforms are deployed and legacy transmitters are removed from the system, the channels will eventually become realigned. Once the existing channels are realigned, we will insert new channels between them. This approach to transition will minimize the impact on users of existing systems. Users will be given a 10-year timeframe to upgrade their existing transmitters to the new standard. Most transmitters may be upgradeable through a software change. Users have begun utilizing the new transmitters. The system is now populated with almost 5000 of the new models. The final step

in NOAA's transition, the development of tools to identify and track v.2 transmitter use in our ground system, has been completed. This tool will allow to monitor the transition, and to insert new channels as they become available. It is expected that the addition of new channels will be gradual, rather than instantaneous, so purchasing of additional demodulators will be an incremental process. In early 2014 NOAA implemented the first v.2 1200 baud channels, 1 in NOAA's existing bandwidth allocation, 1 in borrowed bandwidth from EUMETSAT after a user accidentally deployed v.2 transmitters into v.1 1200 baud allocations. The transmitters (which are used for tide monitoring) report too frequently for use in NOAA's multiuser allocation, and required a dedicated channel for management. We have now begun to clear new channels at the other end of the spectrum, and have begun implementing the new 1200 bps channels. NOAA should be able to move the user out of EUMETSAT's allocation within the next year.

High Data Rate Transition

The transition to high data rate is almost at an end, with 24,800 platforms actively using NOAA's DCS at the time of this writing. Of that number only 50 are 100 bits per second (bps). NOAA has held discussions with the few remaining users of 100 bps transmitters who have not met the deadline of May 31, 2013 to have all 100 bps transmitters removed from the system. A few have requested a few more months to work with upgrading those systems. We are using the new channels allocated to NOAA by the CGMS and have some assignments on most of them. Several of these are allocated to international tsunami warning networks which have requirements for very frequent transmissions (in most cases transmitting every five minutes.) During the past year this requirement has continued to grow. This high demand has challenged NOAA to seek other ways to increase capacity, and we are hopeful that EUMETSAT's implementation of a high data rate capability will make it possible for the 2 systems to cooperate in supporting the Caribbean for the future.

Rebroadcast of DCS Data

Due to the critical nature of data sent through DCS in the U.S. NOAA provides many ways of rebroadcasting data to ensure reliability of delivery. Two such rebroadcasts are through a commercial satellite service called DOMSAT, and through the Low Rate Information Transfer (LRIT) system off of GOES. NOAA continues to investigate the possibility of dropping the commercial rebroadcast over a long period of time (6 years) by making the LRIT, and the follow on HRIT (High Rate Information Transfer) system more reliable and efficient.

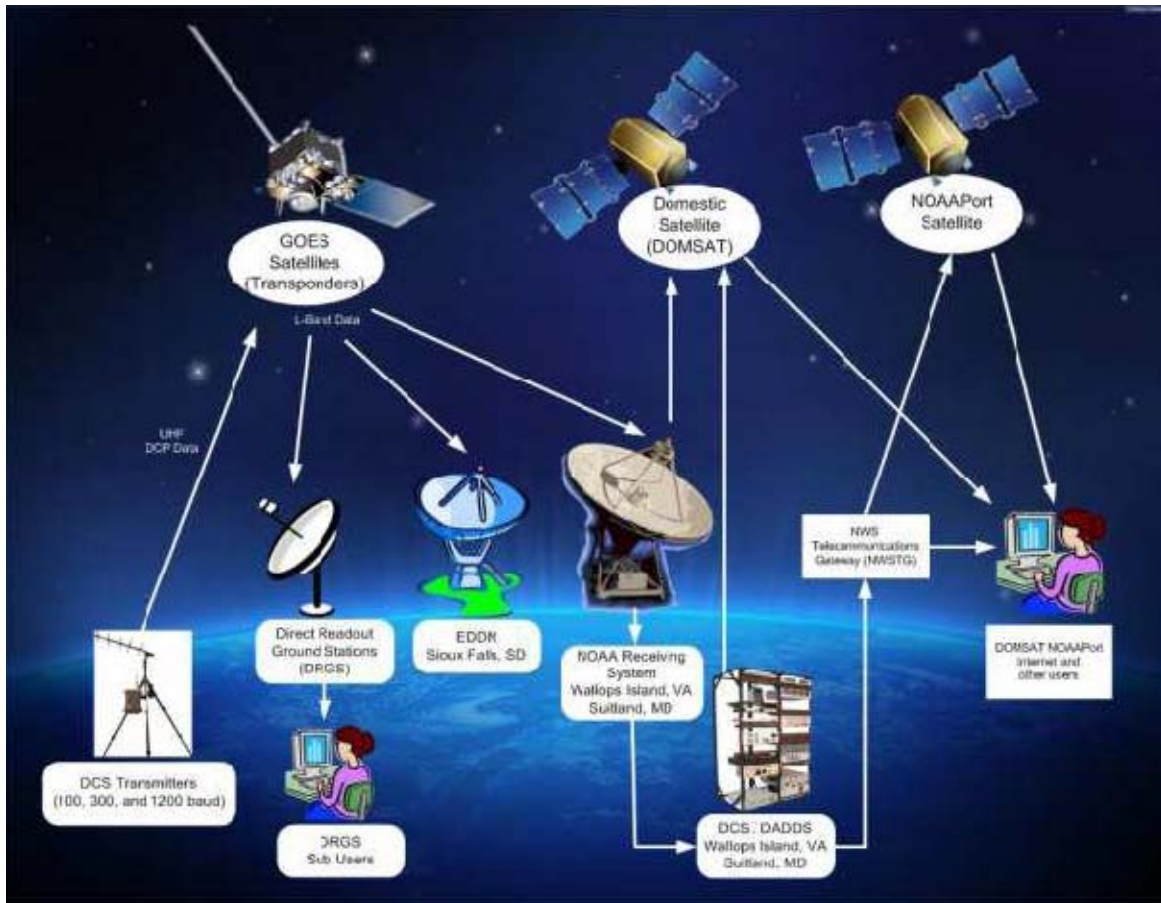


Figure 9 Rebroadcast of DCS Data

Commitment to funding the DOMSAT appears to be strong by both U.S. and neighbouring international agencies, so NOAA expects to continue this rebroadcast until we have fully tested and made required improvements to alternative methods. The administrative burden to perform this activity is high, so NOAA is continuing to look forward to replacing it with a less unwieldy process. U.S. users have continued to fund the DOMSAT rebroadcast through May 2016.

Data Collection Platform Command (DCPC) development

With progress in many NOAA priorities, including DADDS and Version 2 transmitters, NOAA is looking forward to continuing research into this area and to providing a successful implementation in the next few years. More resources will be devoted to the project once other development activities are completed. In 2015 NOAA kicked off a study task to define the state of technology and make recommendations in the best way to proceed with this task. A report will be made to the NOAA user groups and to NOAA management at the end of April. The report will document for NOAA management that a requirement for this activity continues from the NOAA user community. In the meantime, some vendors and users have begun to use Iridium as an alternate means of providing the platform control users require. NOAA is looking forward to seeing where this

cooperative venture might lead. Once NOAA reviews the study report, a best path forward will be determined.

Frequency Concerns

A broader push from the commercial sector and from other government agencies to look at using spectrum used by NOAA has surfaced over the past several years. A small band of frequencies used by NOAA polar orbiting satellites was just auctioned for approximately \$2.4B U.S. With those sums of money available this problem is not likely to go away. The band used by GOES is under review. NOAA and other U.S. users are rallying to document the functions performed by NOAA satellites and to make known potential impacts. NOAA continues to monitor this activity closely, to minimize potential impact to operational systems. This topic will be addressed in other presentations. An additional concern to NOAA is the question of how to identify and manage unknown interference issues. Over the past several months interference has impacted NOAA systems significantly. Fortunately most events resolve themselves quickly, but a few have been long term in nature. One instance was determined to be interference from an entity interested in gaining access to NOAA’s bandwidth. The FCC and other U.S. officials continue to press government agencies to find new technologies that will allow sharing of bandwidth.

Interference from “Ionospheric Scintillation” from Solar Activity

Near the end of 2011 NOAA began noticing interference to transmissions from a small number of platforms, primarily those near the North and South Poles (Canada and South America.) The data losses were not widespread, but instead seemed to be constrained to small areas, narrow time frames and specific platforms. After much investigation we concluded that the interference was coinciding with increased solar activity. This pattern seemed to be traced to a phenomenon called “Ionospheric Scintillation”, an ionization of a specific layer of the ionosphere that causes refraction and diffraction of radio waves. The pattern has also been tied to GPS interference.

The activity has appeared to decrease slightly in 2015, as the most active period dies down. While NOAA has continued to monitor this activity, and to understand it a little more, we have made little progress in finding ways to mitigate it. NOAA will continue to study this event, with the hope that we can be prepared to respond to the next cycle, expected in about 9 years.

STATUS OF IDCS

No new assignments have been made in the last year. Current allocations include:

New International Channels	224	226	228	230	232	234	236	238	240	242	244
Channel #	01	02	03	04	05	06	07	08	09	10	11
# of PLT(s)	0	0	0	1	1	0	0	0	4	0	0

A query of the DADDS message table showed no transmissions from any of these platforms.

INTERFERENCE TO THE IDCS

Due to the current limited use of the IDCS no monitoring is performed. If the usage expands NOAA's DADDS provides tools to make it easier to monitor interference.

CONSOLIDATED LIST OF IDCS ALLOCATIONS

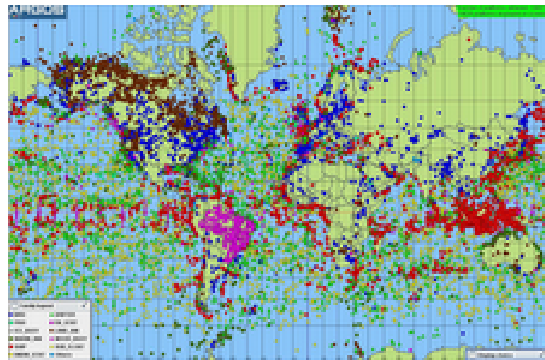
There have been no new allocations.

STATUS OF THE ARGOS DCS

The Argos Data Collection and location System (DCS) provides global coverage and platform location for government and non-profit agencies (which are reviewed and approved by CNES and NOAA), and for non government organizations with a vested government interest. The Argos program is administered under a joint agreement between the National Oceanic and Atmospheric Administration (NOAA) and the French Space Agency, Centre National d'Etudes Spatiales (CNES). Additional partners include EUMETSAT and the Indian Space Research Organisation (ISRO).

The system consists of in-situ data collection platforms equipped with sensors and transmitters and Argos instruments aboard NOAA, EUMETSAT, and ISRO polar-orbiting satellites. The global environmental data sets are collected at telemetry ground stations in Alaska, Virginia, Norway and Antarctica; and pre-processed by the National Environmental Satellite, Data, and Information Service (NESDIS) in Suitland, Maryland. Regional data sets are collected via a global network of HRPT stations. Two CNES subsidiary companies, Collecte Localisation Satellites (CLS) in France and CLS America in Maryland process the data and deliver it to users (and for met-ocean data, post it to the GTS).

Flying the Argos system aboard polar-orbiting satellites provides worldwide coverage. Additionally, incorporating the Argos instrument on a moving satellite allows a platform to be located using Doppler shift calculations. This positioning capability permits applications such as monitoring drifting ocean buoys, wildlife migrations, and commercial fishing vessels, among many others.



There are currently more than 21,000 active Argos Platforms being tracked by over 1,900 users in 118 countries. Argos use has steadily risen since its inception over 30 years ago, and especially in the last decade (subject to seasonal variation). The data latency requirement for the system is 60-

minutes, with 30-minutes strongly preferred. This is achieved by a robust spacecraft constellation and ground system.

Frequency uses include Platforms to Spacecraft – 401.65 MHz; Spacecraft to Platforms (for Metop-A and SARAL with operational Argos-3 instruments) – 465.9875 MHz; and Spacecraft to Ground Stations – 1695-1710 MHz. Future use of 399.9-400.05 MHz is anticipated for non-environmental applications, beginning with the next Argos launches by ISRO & NOAA (~2018-19), with the first Argos-4 instruments.

WGI thanked NOAA for the detailed and comprehensive report covering all aspects of the DCS and A-DCS under NOAA responsibility. It was also noted that any update of information regarding the status of these systems can be found at: <http://www.noaasis.noaa.gov/DCS/> & <http://www.noaasis.noaa.gov/ARGOS/>.

ROSHYDROMET-WP-02 addresses the current status and technical specifications of Russian data collection system, and related future plans. The DCS is established to provide collection and distribution of meteorological data from the remote areas and to support natural hazards warning systems.

Russian data collection system (DCS) has been established to provide satellite channels for meteorological data transmission from data collection platforms (DCPs) via meteorological satellites (backup option – via Luch communication satellites).

The DCS was developed according to the international requirements of WMO and CGMS and has to provide transmission of the messages every 3 hours (standard synoptic hours), and also storm warnings at any time. The development of the national DCS was started in SRC Planeta in 1990s. In the absence of national geostationary meteorological satellites (GMS) until 2011, the initial testing and experimental operation of DCS was based on Meteosat satellite (under the bilateral agreement between Roshydromet and EUMETSAT).

Technical specifications

DCP signals are transmitted via dedicated satellite channels at frequency ranges of 401.5-402.5 MHz (uplink) and 1696.5-1697.5 MHz (downlink) with transmission rate of 100 or 1200 bps. The message size is up to 15 000 bit. The transmission time is synchronized with GLONASS/GPS signals. System capacity allows data transmission from 300 DCPs simultaneously that provides throughput of 3000 DCPs in 10 minutes. The Russian DCS is developed for data transmission via the meteorological satellites: series of Electro-L GMS (constellation of three spacecraft to be located at 76E, 14.5W and 166E), series of Meteor polar-orbiting satellites (constellation of three spacecraft), series of Arctica highly elliptical orbit satellites (constellation of two spacecraft), and also series of Luch geostationary communication satellites.

The constellation of Electro-L GMS (with backup option via Luch communication satellites) provides coverage of the territory from about 75S to about 75N, the highly elliptical orbit satellites will give the coverage of high Arctic latitudes, polar-orbiting satellites will cover the regions outside the area mentioned above, but less frequently (see Figure 10).

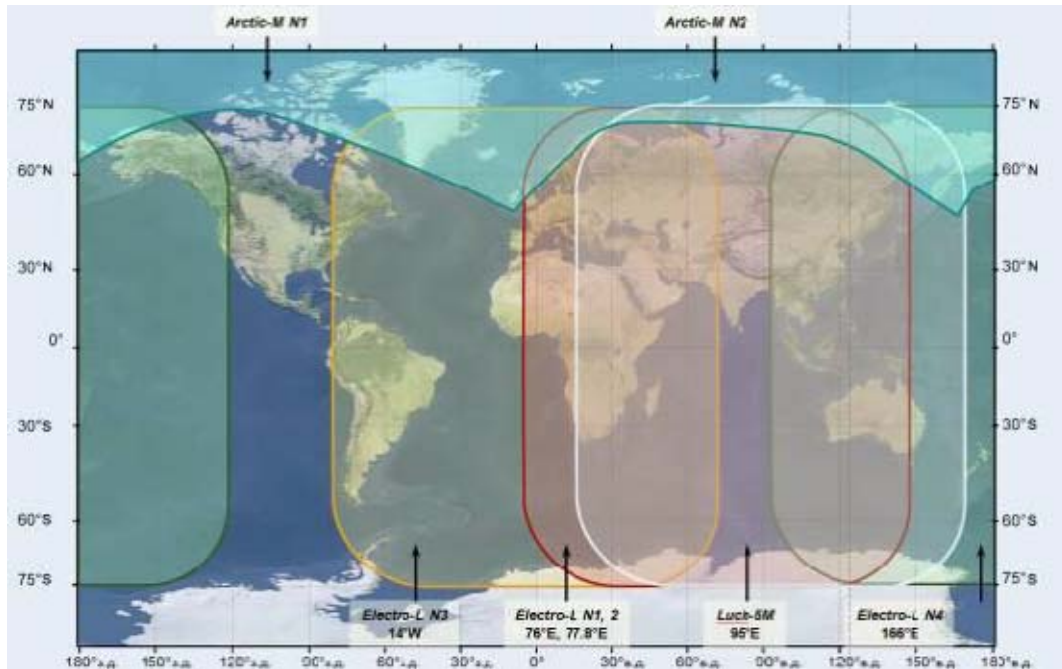


Figure 10 The coverage of Russian geostationary and highly elliptical orbit satellites.

Current status

At the present time national Data Collection System is in experimental operation based on Electro-L N1 GMS (with backup option via Luch-5B communication satellite) in SRC Planeta.

As shown in Figure 11, messages transmitted from DCPs to Electro-L N1 and Luch-5B are relayed to the European (Moscow region), Siberian (Novosibirsk) and Far Eastern (Khabarovsk) regional centres of SRC Planeta.

There are now about 530 DCPs allocated (April, 2015). DCPs are distributed all over the whole territory of Russia, including the remote areas and northern regions with extremely low elevation angles (about 3 degrees) (Figure 12). The national DCS currently has a reliability of 99.8 % based on the number of messages successfully received.

International DCS channels on Electro-L N1 satellite could be provided to WMO members for data transmission from DCPs.

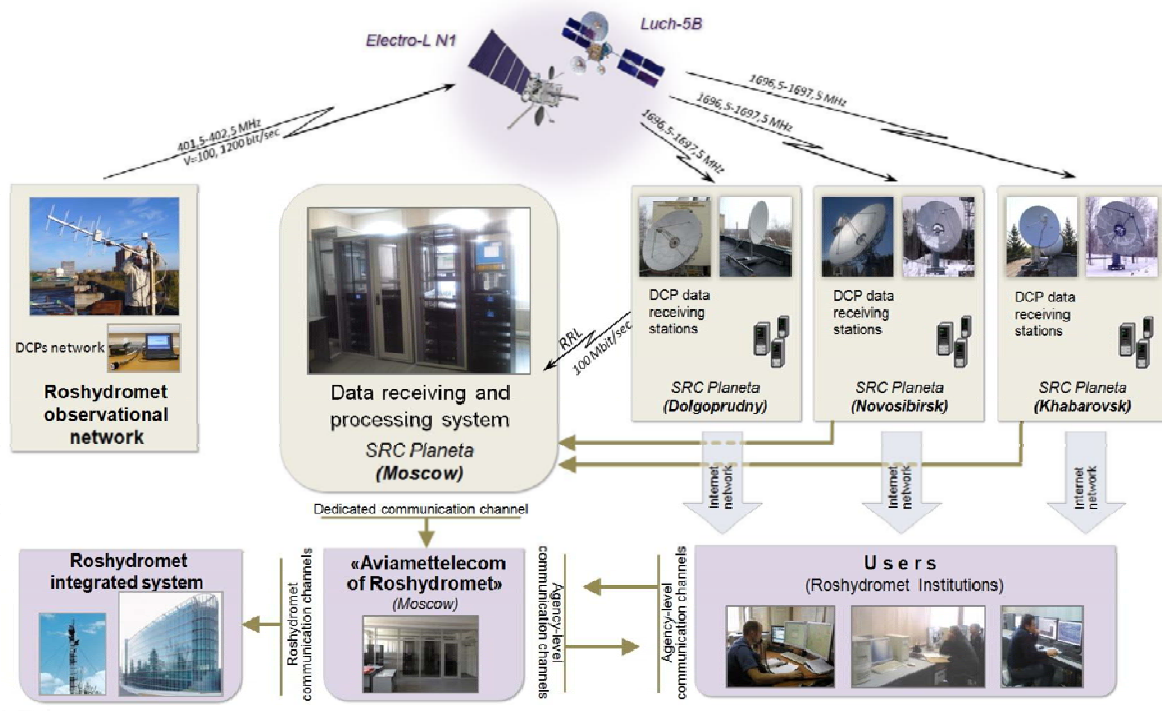


Figure 11 Flowchart for current status of Russian DCS.

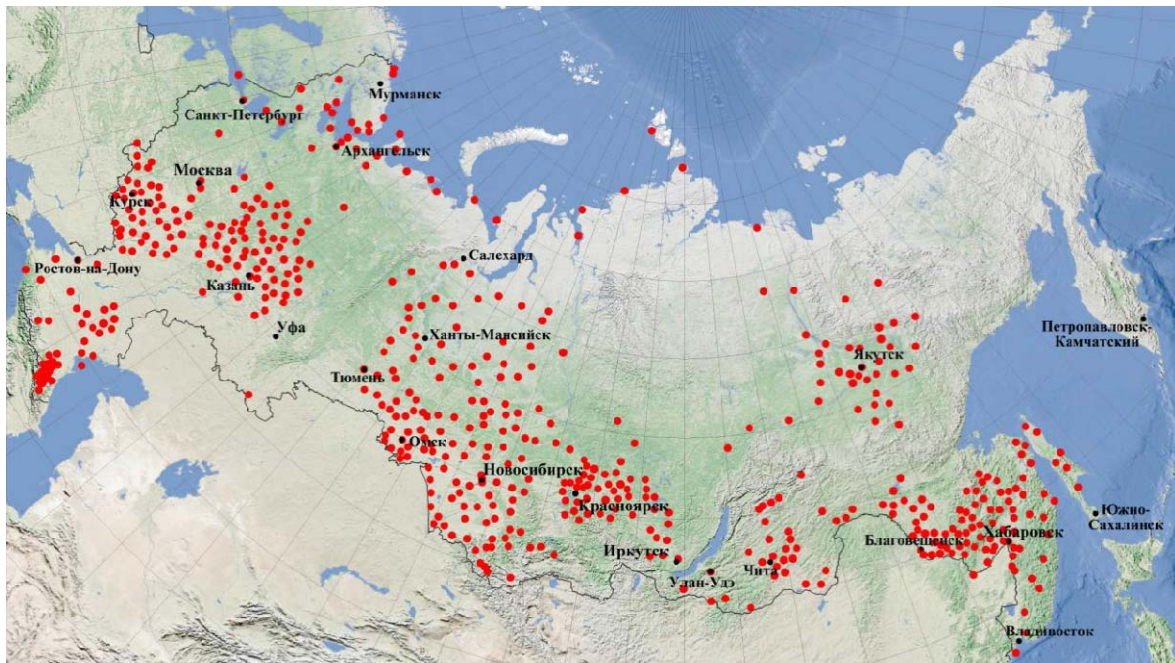


Figure 12 Geographical distribution of DCPs (532 DCPs, 21 April, 2015).

WGI thanked Roscosmos/Roshydromet for the detailed report and suggested they keep CGMS informed of their continued success, confirming also the plans to make DCS related data available in the GTS.

I/6 Regional Retransmission Services (RARS) incl. support for NPP and Metop

WMO-WP-13 reports on the WMO work done in response to the requests from the satellite sounding community at the 19th International TOVS Scientific Conference (ITSC-19, Jeju, April 214) and to Recommendation 42.11 from CGMS-42, a coordination meeting was convened by WMO on 11-13 March 2015 with representatives of all RARS regional components, of the EUMETSAT EARS project, and of the NOAA Direct Broadcast Real Time Network (DBRTN) in order to investigate the steps to be taken to integrate the RARS, EARS and DBRTN initiatives.

At this meeting the participants agreed on the objective to build a global, integrated network of Direct Broadcast and near real-time relay services for advanced sounder and other LEO data which will be named “DBNet” and will unify the three initiatives above. In particular, NOAA and EUMETSAT will collaborate to ensure compatibility of the NOAA and EUMETSAT contributions to DBNet. The meeting reviewed an outline of a WMO Guide to DBNet which will document the agreed high-level service specifications of the system, and the best practices and standards to be complied with in order to ensure the required product quality and consistency. It is planned to present the draft version of the Guide to DBNet in October 2015 to the joint APSDEU-NAEDEX meeting and to ITSC-20 to seek feedback from these communities on the proposed specifications. It was furthermore proposed to replace the existing RARS Implementation Group by a DBNet Coordination Group with a wider membership. (See the final report of the meeting: http://www.wmo.int/pages/prog/sat/documents/DBNet-01_Final-Report.pdf.)

BACKGROUND

RARS history

In 2001, EUMETSAT initiated the EUMETSAT ATOVS Retransmission Service (EARS) project to improve timeliness/availability of ATOVS data in Europe. WMO convened Global workshops on Regional ATOVS Retransmission Services (RARS) in Dec 2004, Dec 2005, and Sept 2006. These workshops discussed the requirements for a global ATOVS retransmission service, planned and initiated a RARS in Asia-Pacific through APSDEU discussions, planned and initiated a RARS in South America through RA III discussion, and established a RARS Implementation Group.

A first RARS Implementation Group (IG) meeting was held in July 2007 to agree file naming convention, BUFR identifiers, data categories/subcategories for RARS. In May 2008 the IG discussed the implementation plan for global coverage, and software issues (AAPP). A third IG meeting in Feb 2009 provided guidance for filling gaps and monitoring. In Mar 2010 the IG discussed a plan for extension to advanced sounders, and actions on user outreach (RARS Poster at ITSC-17, Monterey). In May 2011 a 5th RARS IG meeting was convened as a side-meeting to the APSDEU-NAEDEX in Boulder, USA and discussed monitoring and operational coordination issues, as well as the extension to hyperspectral sounders and FY-3 sensors.

The need was expressed for more feedback from ITWG, which was considered as the most representative entity of RARS users. A RARS Technical Subgroup was thus convened during ITSC-18 (Toulouse, March 2012). This meeting showed that RARS/ATOVS products were used by an increasing number of NWP centres; it stressed that RARS products should be as close as possible to the global products; it encouraged the extension of RARS to advanced sounders of METOP, NPP and FY-3; and defined a roadmap for integrating METOP/IASI and NPP/CrIS.

In Oct 2012, the 6th RARS IG meeting was held at the Met Office in Exeter, UK collocated with APSDEU-NAEDEX. The meeting reviewed the roadmap for integrating IASI and CrIS, and addressed coding and data dissemination issues.

In 2013, CGMS-41 was informed of the NOAA Direct Broadcast Real Time Network initiative and agreed the following action:

- *Action 41.54: NOAA and WMO to discuss the relation of the Direct Broadcast Data Initiative (see NOAA-WP-13) to RARS, and how RARS can take advantage of this initiative.*

ITSC-19 actions (April 2014)

A technical subgroup meeting was jointly convened by NOAA and WMO during ITSC-19, which led in particular to the following actions:

- *SSEC (Univ. Wisconsin), NOAA, EUMETSAT, WMO should coordinate on data formats, software versions, and latency requirements and come up with a plan to provide the DBRTN products for inclusion in RARS*
- *The draft Guide on RARS which defines the RARS procedures, software, formats, data exchange convention, service requirements, etc. should be finalized, published, and shared widely with potential data providers*
- *There is a need for reactivating the RARS Implementation Group within WMO with a broader scope to include NOAA DBRTN*

CGMS Recommendation R42.11 (May 2014)

- *R42.11: CGMS Satellite operators to support the definition and implementation of community agreed operational procedures for LEO satellite data direct read-out, acquisition, and relay in the context of the DRARS Implementation Group.*

(Note: DRARS was the tentative name designating the new project beyond RARS)

WMO Commission for Basic Systems (Asunción, September 2014)

The Commission for Basic Systems (CBS-Ext(2014)) "*welcomed the steps taken to develop the Direct Readout Acquisition and Relay of Satellite Data (DRARS) which will follow and enhance the Regional ATOVS Retransmission Services (RARS) and recommended to complete a Guide to DRARS as part of the WIS reference documentation.*"

DRARS/DBNET COORDINATION MEETING

A coordination meeting was convened by WMO in Geneva on 11-13 March 2015 with representatives of all RARS regional components, of the EUMETSAT EARS project, and of the NOAA Direct Broadcast Real Time Network (DBRTN) in order to address the requests from ITSC, CGMS and CBS. It was chaired by Anthony Rea (BOM, Asia-Pacific RARS Coordinator). The meeting reviewed the status of RARS and the new projects, investigated the steps to be taken to integrate the RARS, EARS and DBRTN initiatives, and discussed the outline of a future Guide to DRARS.

RARS status

The objective of RARS is to organize the global availability of near real-time ATOVS data received by a collection of Direct Broadcast stations distributed around the world. Global consistency should be ensured by using common software (AAPP), standardized coding and file naming, and by quality monitoring. Global availability should be ensured by the WMO GTS and possibly additional means (e.g. satellite rebroadcast). The initial goal is to achieve the distribution of ATOVS data level 1b from 90% of the globe in less than 30 minutes.

To-date the RARS network includes three components: EUMETSAT EARS, Asia-Pacific RARS, South America RARS, with a total of 39 stations representing a total coverage of about 80% of the globe. Most of the data are available on the GTS within 20 minutes from acquisition.

Three stations were added to the RARS network during the past year, all in the Asia-Pacific region:

- Papeete (French Polynesia) by Météo-France
- Delhi and Chennai (India) by IMD.

The RARS concept is excellent and should be pursued. This concept must however be: expanded to other sensors, broadened to accommodate the NOAA DBRTN initiative if agreement is reached on common high-level requirements and specifications; documented to be fully operational and sustainable; and integrated into the WMO Information System (WIS).

Towards DBNet

The participants agreed the objective to build a global, integrated network of Direct Broadcast and near real-time relay services for advanced sounder and other LEO data which will be unify the three initiatives above. In particular, NOAA and EUMETSAT will collaborate to ensure compatibility of the NOAA and EUMETSAT contributions. It was agreed to name the new system “**DBNet**” instead of DRARS.

The meeting reviewed an outline of a Guide to DBNet which will introduce the DBNet network components and services, document the agreed high-level service specifications of the system (including timeliness, availability, coverage, for each Service, to be defined in consultation with the user community), and the best practices and standards to be complied with in order to ensure the required quality and consistency of the products.

DBNet is composed of regional networks coordinated by regional or sub-regional nodes and a global DBNet Coordination Group. Global monitoring of product consistency is performed by the EUMETSAT NWPSAF (hosted by the Met Office, United Kingdom).

Regional Network	Regional or Sub-regional Node
DBNet - Europe	EUMETSAT
DBNet - Asia-Pacific	JMA
	BoM
DBNet - South America	INPE
	SMN Argentina
DBNet - North America	NOAA

Each DBNet regional network would contribute to one or more “Services”. A DBNet Service consists of Direct Broadcast acquisition, processing and relay of a certain category of satellite data. The existing RARS (ATOVS) will remain, as one of the DBNet Services.

Categories of services	Services/Instruments
IR/MW sounding	RARS (AMSU-A, MHS, HIRS) ATMS, VASS (MWTS, MWHS, IRAS)
Hyperspectral IR sounding	CrIS, IASI, HIRAS
IR/VIS imaging	VIIRS, AVHRR, MERIS

The best practices and standards will be related to the reception (priority scheduling), the acquisition and processing (L0/L1 software suite, orbital elements, product definition, quality control), the data coding and registration (data and metadata format, file naming, WIS registration), the distribution (in particular through WIS) as well as to the overall coordination, monitoring, and user information and support.

A number of technical points requiring further clarification or investigation were raised at the meeting, which showed the importance of developing such documentation.

Finally, it is proposed to replace the existing RARS Implementation Group by a DBNet Coordination Group with a wider membership. Draft Terms of Reference are provided in Annex to this paper.

The final report of this first DBNet coordination meeting is available at:

http://www.wmo.int/pages/prog/sat/documents/DBNet-01_Final-Report.pdf

DIRECT BROADCAST X-BAND POLARIZATION ISSUE

The CGMS-WG I requested feedback from the DRARS community about the possible use of LHCP instead of RHCP polarization for some X-Band Direct Broadcast services (e.g. FY-3). The matter was discussed by the DBNet meeting. RHCP was used initially by all meteorological satellites. There is however an increasing risk of interference in X-Band as the same frequency range is used by the meteorological satellites. In order to mitigate this risk, CMA is using LHCP polarization on FY-3C and announced the intention to use LHCP on every other spacecraft of the FY-3 series in the future.

The understanding of the group was that as of FY-3E, the spacecraft of the FY-3 series would be launched alternatively on an early morning and on an afternoon orbit. The early morning satellites would thus have LHCP while the afternoon satellites would have RHCP. If they used the same polarization, interference among these two series could only occur at high latitude (80°) in case of simultaneous overpass. With two different polarizations, this would not occur, however users worldwide may not be able to receive all satellites on the same antenna, unless the polarization is made configurable on their receiving system. This issue would become critical with FY-3E, which is planned to transmit all data in X-Band only, tentatively in LHCP.

In order to evaluate the impact of this potential measure on the user side, all station operators should be asked to indicate the type of receiving station they are operating and should investigate the feasibility of adapting their station to make the polarization configurable (LHCP/RHCP) to be able to acquire future FY-3 Direct Broadcast.

Feedback could be consolidated by WMO, for the DBNet Coordination Group. As a rule, satellite operators should provide details on DB services several years in advance of new systems, including for instance frequency, polarization, encoding, G/T requirements, and conformance with CCSDS standards.

CONCLUSIONS

RARS is a highly successful initiative, now operationally receiving, processing and distributing ATOVS data in near real-time from 80% of the Earth surface. Building on the RARS partnership, DBNet provides a framework for implementing services based on new sensors (IASI, CrIS, ATMS, VIIRS, MWTS, MWHS, IRAS, HIRAS, etc.) and fully integrating the NOAA DBRTN initiative. The DBNet coordination group will drive forward the DBNet implementation and further consolidate the existing ATOVS services. The *Guide to DBNet* will provide visibility by the user community and enable formal recognition by WMO/CBS. It is an excellent model of collaborative undertaking by satellite operators and user groups, fostered by CGMS and WMO.

CGMS has been instrumental for the convergence of RARS and DBRTN initiatives into DBNet. Satellite operators and their partners are playing a crucial role to provide and maintain processing software such as AAPP, CSPP, FY3PP, which are core building blocks of DBNet. Integration into WIS through data/metadata registration and common format implementation are other key elements for interoperability and wide user uptake.

The DBNet Coordination group recommended consulting the Direct Broadcast users on the feasibility to accommodate a configurable polarization. It should be noted that as the DBNet specifications will be developed, some future recommendations may be directed to satellite operators as regards the standardization of DB services.

PROPOSED CGMS ACTIONS/RECOMMENDATIONS:

WG I is invited to consider the DBNet implementation status and to formulate specific CGMS actions/recommendations as appropriate. WG I members (former RARS task team) are invited to actively contribute to finalizing the Guide to DBNet.

- (Updating R 42.11) CGMS satellite operators to support the definition and implementation of community agreed operational procedures for LEO satellite data direct broadcast, acquisition, and relay in the context of the DBNet Coordination Group.
- WMO to present the Guide to DBNet to CGMS-44 WG I for feedback in advance of the submission to CBS.
- Following the drafting of the DBNet guide, further actions/recommendations may be proposed at CGMS-44.

WGI thanked WMO for the detailed and comprehensive report covering the different aspects of the RARS and the proposed evolution. In the WP presented WMO proposes a number of actions. WGI fully supports the definition and implementation of agreed operational procedures for LEO satellites and supports WMO DBNet Coordination Group in such an initiative by means of the established CGMS RARS Task Team (fully part of the WMO RARS Implementation Group and of the new DBNet Coordination Group). Review of progress of the activities of these groups will be followed up by WGI via dedicated inter-sessional meetings, one in Oct 2015 and one in Jan/Feb 2016 to secure adequate preparation for CGMS 44.

WGI also debated how to better document some of the activities and their end results and it is proposed to use best practices (at CGMS level) instead of generating additional global specifications (where relevant). With the agreement of all WGI participants a number of recommendations are drafted in this report (see below) and the inter-sessional meetings of WGI will seek ways of progressing in this direction (and in coordination with the WMO DBNet Coordination Group).

Finally, at the proposal of WMO an action was raised by WGI for WG IV to the CGMS Task Team on Metadata to support the definition of discovery metadata for products produced by RARS/DBNet and delivered to the user community via the WIS.

CGMS-43 recommendations - WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
WMO	WGI/6	R43.03	WMO DBNET Coordination Group to report annually to CGMS WGI on status and progress	CGMS-44	OPEN	HLPP # 1.4.5
CGMS space agencies	WGI/6	R43.04	CGMS agencies to publish details on their SG-ICD with enough lead time to allow RARS/DBNET operators to plan their technical systems in advance (to be included in CGMS best practices)	CGMS-44	OPEN	HLPP # 1.4.2
CGMS space agencies	WGI/6	R43.05	CGMS agencies to make use of RH circular polarisation for future Direct Broadcast systems, if technically feasible.	CGMS-44	OPEN	HLPP # 1.4.2

EUM-WP-08 presents an update of the information regarding a Regional Advanced Retransmission Service (RARS) in Africa.

The document provides a brief summary of the overall RARS status and it discusses the rationale for developing a RARS network in Africa. The rationale being based on:

- Need expressed by WMO RA-I community
- Willingness to develop NWP in Africa (e.g. SWFDP)
- In-line with the integrated African Strategy on Meteorology (Strategic pillar #2): *to invest in ground systems, training and analytical tools to make best use of existing satellite and model information available from international partners*

The technical approach selected is based on:

- 4 RARS stations (in Africa)
- Complementary to EARS coverage
- Operated by African entities and independent from EARS

In addition, the working paper provided a summary of the progress achieved since last CGMS meeting:

- June 2014: First workshop with African entities in June 2014. Outcomes:
 - ACMAD responsible for the RARS Africa implementation
 - 4 locations for the RARS stations pre-identified (Gabon, Niger, Kenya and South Africa)
 - ACMAD and other regional centres responsible for increasing NWP capabilities in Africa (regional and national level)
- July 2014: Fund identified for the project (intra-ACP programme on Disaster Resilience – through African Development Bank (AfDB))
- November 2014: Concept note for the project submitted by ACMAD to African Development Bank. Assessment started.
- November 2014: EUMETSAT Council approved EUMETSAT support for the programme (technical advice for RARS, based on EARS experience)
- April 2015: Workshop with ACMAD and potential hosting sites

Main outcomes:

 - Confirmation of hosting site and list of site-survey activities to be implemented
 - Agreed procurement approach (single procurement for the four stations)
 - Satellites (NOAA, CMA and EUMETSAT) and instruments (all sounders) to be acquired
 - High-level architecture design (processing of L1 data at each station, telecommunication architecture, including inter-regional communication)

The way forward is therefore defined as follows:

- Assessment of ACMAD proposal by the African Development Bank
- Obtain firm commitment of hosting sites for long term
- Signature of the contract between ACMAD and AfDB – before end of 2015

And with a tentative calendar that will:

- initialize design study (2015-2016)
- Start procurement (2016)

- Installation in 2017
- Operation in 2018

In summary, and to be considered by CGMS members, it can be concluded that:

- Funds and main partnerships are now identified and consolidated for RARS Africa. But key challenges remain to make RARS Africa a reality (e.g. deployment, assimilation of data in NWP, timeliness, sustainability),
- CGMS members operating polar orbiting meteorological satellite are invited:
 - to allow access to their sounding instruments to RARS Africa, and
 - to support the implementation in the RARS stations of the relevant data software for processing L0 and L1 RARS products (training, user support)

WGI noted with appreciation the report by EUMETSAT on the status of progress for the RARS Africa and confirmed the willingness and readiness to support access to instrument data over Africa (subject to the necessary data policy/access arrangements).

JMA-WP-07 reports on the status of Asia-Pacific Regional ATOVS Retransmission Services (RARS) with a particular focus on JMA's involvement.

JMA provides ATOVS data from the two direct readout stations of Kiyose in Japan and Syowa Station in Antarctica. JMA also operates a RARS monitoring website that provides operational information on its direct readout stations and the status of Asia-Pacific RARS data regarding navigation, calibration and timeliness.

Within the Asia-Pacific RARS, ATOVS files are exchanged via the GTS network using WMO's FTP (put) protocol. BoM (RTH Melbourne) and JMA Tokyo (RTH Tokyo) act as sub-regional coordination centres. The benefit of RARS data is confirmed by the expansion of data coverage for NWP usage.

The Asia-Pacific RARS is coordinated by the Australian Bureau of Meteorology (BoM). Since June 2006, the Japan Meteorological Agency (JMA) has exchanged ATOVS data via the Global Telecommunication System (GTS) in its role as a sub-regional network coordinator. As of April 2015, ATOVS data from 15 stations are available at JMA.

JMA plans to continue these RARS activities and extend its data exchanges to Metop/IASI, Suomi-NPP/ATMS and CrIS under the DBNet project.

CURRENT STATUS OF DIRECT READOUT STATIONS AND DATA PROCESSING AT JMA

JMA provides ATOVS data from the two direct readout stations of Kiyose in Japan and Syowa Station in Antarctica (Table 1; highlighted on the RARS network map in Figure 13). The ATOVS data are processed using the ATOVS and AVHRR Processing Package (AAPP).

Metop/IASI data have also been processed using OPS-LRS since July 2013, and Suomi-NPP/ATMS and CrIS data have been processed using CSPP since June 2012 and January 2013, respectively.

Note that there are no data from Syowa Station for around a year from 28 December 2014 due to a hardware problem.

Direct readout station information:

Station (identifier)	Kiyose (kiy)	Syowa Station (syo)
Operator	Japan Meteorological Agency (JMA)	National Institute of Polar Research (NIPR)
Location (latitude, longitude)	Kiyose, Tokyo (35.77°N, 139.53°E)	Syowa Station, Antarctica (69.00°S, 39.58°E)
Satellites	NOAA-18, 19 Metop-A, B Suomi-NPP	NOAA-18, 19
Average number of acquisitions per day	20 (NOAA and Metop) 3.5 (Suomi-NPP)	4.5 (NOAA)

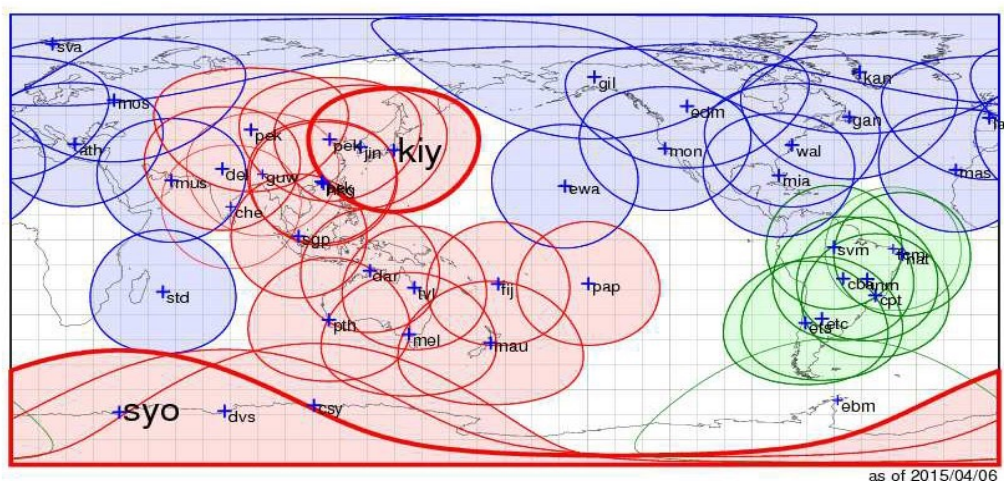


Figure 13 The RARS network with Japan’s Kiyose (kiy) and Syowa Station (syo) highlighted. Blue: EARS; red: Asia-Pacific RARS; green: South-American RARS. Filled circles indicate currently operational stations.

ASIA-PACIFIC RARS MONITORING WEBSITE

JMA operates a RARS monitoring website that provides operational information on JMA's direct readout stations and the status of Asia-Pacific RARS data regarding navigation, calibration and timeliness. The site can be accessed at: <http://ds.data.jma.go.jp/mscweb/data/rars/index.html>

Comparison with Global ATOVS Data

On the website, comparisons of Asia-Pacific RARS data and global ATOVS data (from NOAA) are shown to enable checking of consistency in terms of navigation and calibration. Figure 14 shows a time-series representation of Metop-B/AMSU-A averaged geo-location differences as an example of the information provided. An anomaly at Tahiti (Papeete) caused by a problem with TLE data ingestion after a Metop-B manoeuvre was detected by the increase of geo-location difference.

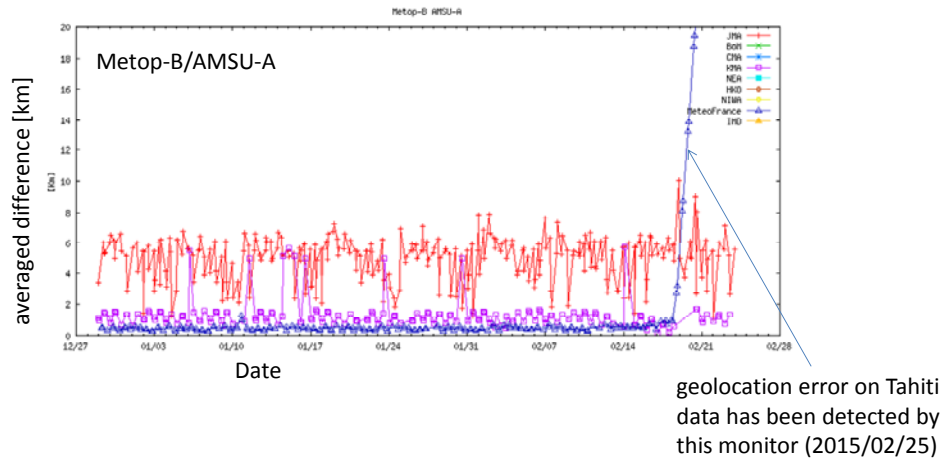


Figure 14 Time-series representation of Metop-B/AMSU-A averaged geo-location difference

Timeliness of RARS Data in Tokyo

Under the RARS project, efforts are made to deliver ATOVS data received at direct readout stations within 30 minutes. The timeliness of data arriving at RTH Tokyo is monitored on the website to enable checking of project target achievement. Figure 15 shows monthly statistics on timeliness (from data acquisition to delivery) for Kiyose station. The website also gives a breakdown of timeliness statistics to support identification of bottlenecks. The breakdown shows times from the start to the end of observation (i.e., the time taken for satellite passage), from the end of observation to the end of processing (i.e., the time taken for processing), and from the end of processing to the end of transfer (i.e. the time taken for transfer).

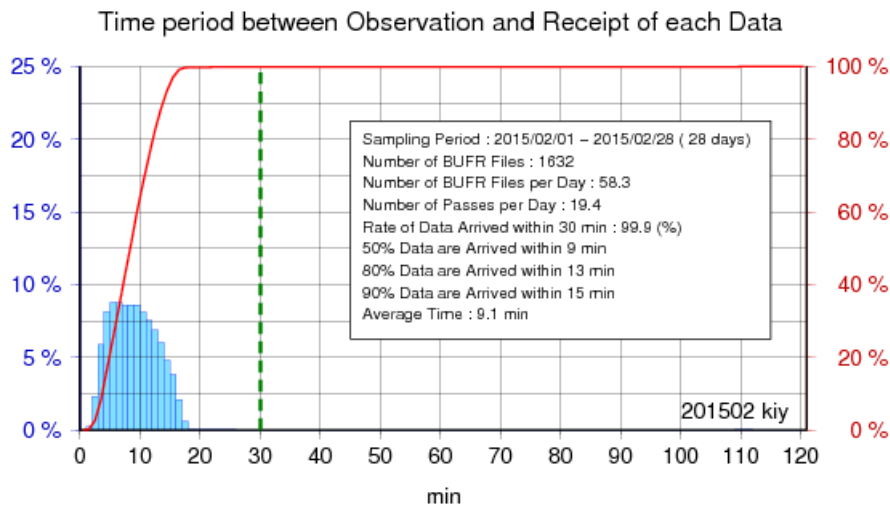


Figure 15 Monthly statistics on timeliness for Kiyose station

ASIA-PACIFIC RARS CONNECTIVITY

Figure 4 (1) shows a schematic view of the Asia-Pacific RARS network within which ATOVS files are exchanged via the GTS network using WMO’s FTP (put) protocol. BoM (RTH Melbourne) and JMA (RTH Tokyo) act as sub-regional coordination centres for this network, collecting ATOVS data received at direct readout stations and relaying them to centres in the Asia-Pacific RARS. The data collected are also exchanged inter-regionally to Exeter and Washington. Figure 4 (2) shows the bandwidth (network speed) of the Asia-Pacific RARS. The speeds from Melbourne to RMDCN and Tokyo to RMDCN are 4 and 10 Mbit/sec respectively. Those from Exeter to RMDCN and from Washington to RMDCN are 20 and 50 Mbit/sec, respectively. The daily traffic volume from Melbourne to Tokyo and Tokyo to Melbourne is around 50 to 80 Mbyte/day.

In 2014, new stations Tahiti (Papeete) and New Delhi were added to the network on July 2nd and 19th, respectively.

USE OF RARS DATA IN NWP

The benefit of RARS data is confirmed by the expansion of data coverage for NWP usage. The maps in Figure 16 show the coverage area of NOAA-19/AMSU-A data as used in two JMA global data assimilation systems for global analysis at 18 UTC on 17th February 2015. The panel on the right shows a map of data coverage for delayed analysis with a sufficient cut-off time (7 h 50 m plus analysis time). All assimilated data were obtained from NOAA (global data) and covered the maximum area. The panel on the left shows a map of data coverage for early analysis with a shorter cut off time (2 h 20 m) for daily forecasting. The data with yellow dots are from NOAA. The data coverage area in the panel on the left is clearly much smaller than that on the right. However, data with dots in colours other than yellow were obtained via RARS in time and used in the early analysis.

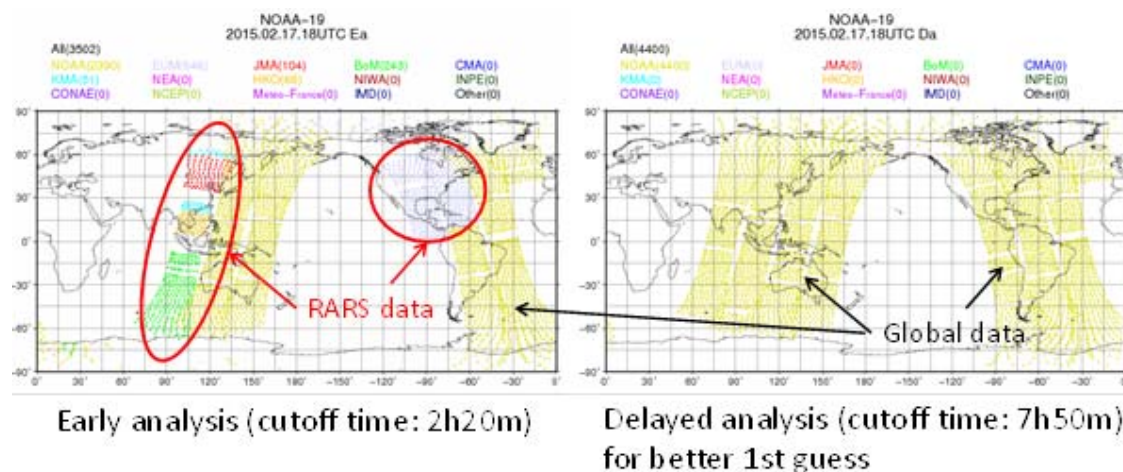


Figure 16 Maps of NOAA-19/AMSU-A originating centers in NWP analysis (JMA/GSM 2015/02/17 18UTC). Left: early analysis; right: delayed analysis.

JMA plans to continue the above RARS activities. In addition, JMA will extend its data exchanges to Metop/IASI, Suomi-NPP/ATMS and CrIS under the DBNet project.

WGI thanked JMA for the detailed report provided on the status of the Asia-Pacific RARS and noted with appreciation the JMA plans to continue the RARS activities and even further expand them for the new sounders like, for example, SNPP ATMS and CrIS.

CGMS-43 NOAA-WP-12 reports on the NOAA plans and status of implementation for a SNPP Direct Broadcast Network (DBNet). The NOAA Direct Broadcast Real-Time Network is a demonstration of a method for providing low latency infrared and microwave sounder data to the NOAA National Weather Service. It started as a Sandy Supplement project to reduce risk of a SNPP/JPSS gap by providing all available sounder data with much lower latency than stored mission data. It is being sustained by JPSS Program Science until NOAA decides on operational commitment based on a formal value assessment by NWS to NESDIS. NWS will complete the evaluation by 2017 – efforts include developing CrIS and ATMS assimilation steps in the regional forecast model. The sounder data will be assimilated by the National Centers for Environmental Prediction (NCEP) and will increase the percentage of polar data used in NCEP NWP models, as well as provide backup in case of anomalies in polar global processing.

The project presents an opportunity to expand the coverage of the WMO Direct Broadcast Network, particularly for advanced sounders (CrIS, ATMS, IASI, AIRS).

Station	Operator	Status	Satellites
Monterey	NOAA	Sustained Demo	SNPP, Metop, POES
Gilmore Creek	NOAA	April 2015	SNPP, Metop, POES
Madison	NOAA/CIMSS	Sustained Demo	SNPP, Metop, POES
Honolulu	NOAA/CIMSS	Sustained Demo	SNPP, Metop, POES
Miami	NOAA/CIMSS	Sustained Demo	SNPP, Metop, POES
Mayaguez	NOAA/CIMSS	May 2015	SNPP, Metop, POES
Corvallis	Oregon State University	Sustained Demo	SNPP
New York	City College	Sustained Demo	SNPP
Greenbelt	NASA	Sustained Demo	SNPP

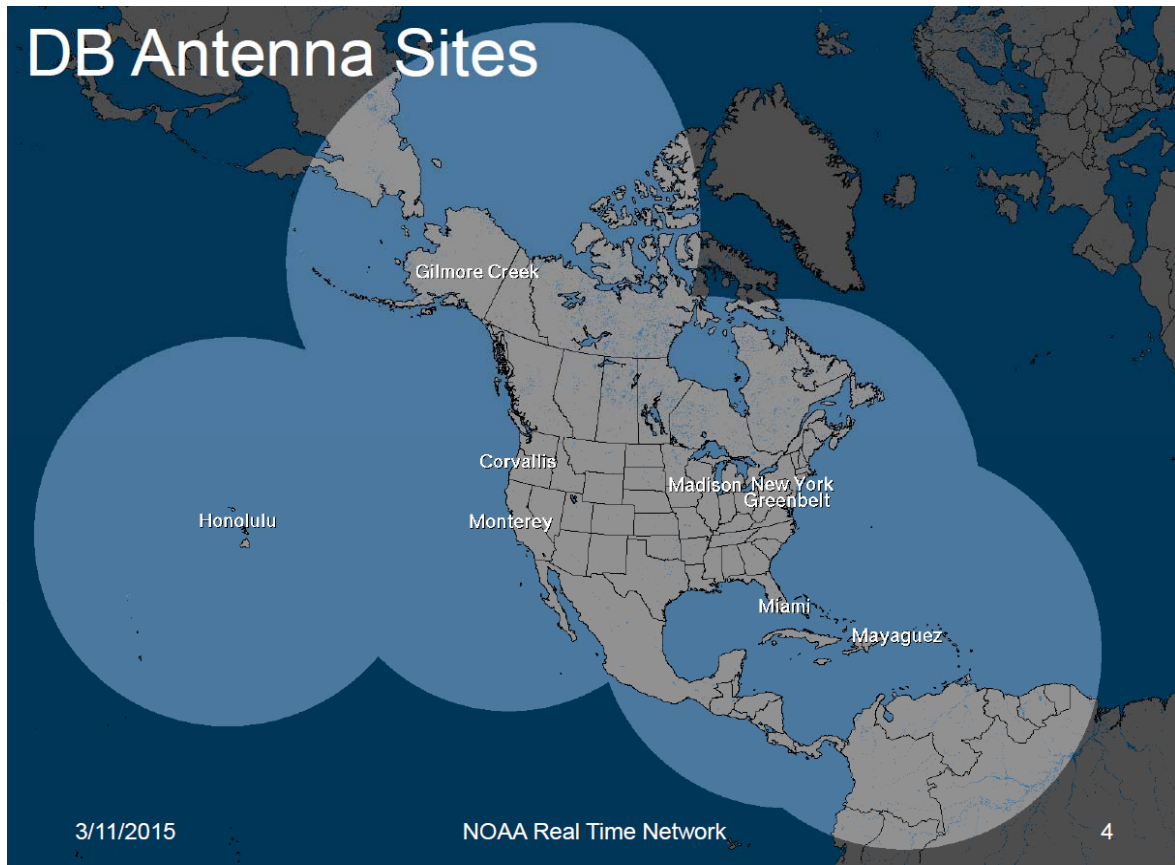


Figure 17 WMO Direct Broadcast Network

Future Guam station is under consideration, along with direct download of SNPP data from JMA to cover nearly all of the NH Pacific.

NOAA/CIMSS would be responsible for operating and monitoring:

- the network of DB reception stations
- the processing of ATMS, CrIS, ATOVS and IASI to level-1
- BUFR encoding of all Products
- FTP push over the Internet to NWS/NCEP & EUMETSAT of all BUFR products

As a EUMETSAT trial service (start TBD) for a duration of 1-2 years it is proposed that data are disseminated to EUMETSAT Member States and ECMWF via EUMETCast (services will not be operational on the CIMSS side); There is no product processing required at EUMETSAT, but simplified monitoring of the data flow. The NOAA Real-Time Network represents an opportunity to increase the coverage and availability of advanced sounder data (including CrIS, ATMS, IASI and ATOVS). NOAA/CIMSS have offered to EUMETSAT the possibility to collect this data from NOAA network and disseminate it through EUMETCast.

WGI thanked NOAA for the report on the plans and status of implementation of the SNPP Regional Retransmission Service and appreciates the efforts done to develop this new system. In the

discussions following the presentation by NOAA two points attracted the attention of WGI, firstly the need identified by NOAA to articulate the impact/improvement in the models through the use of the new RARS by NOAA. Secondly the need to make this data available to the full user community for which use of the WIS is the natural approach. For the first point an action was agreed, for the second point it is considered to be covered by the best practices of the CGMS agencies that WGI will be working on in the future

CGMS-43 actions - WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
WMO	WGI/6	A43.06	WMO to assess the impact of improved data latency from polar orbiters on NWP (WMO Impact Workshops) and other applications	CGMS-44	OPEN	HLPP # 1.4.5

I/6 Review and updating of the HLPP

The WG considered the status of implementation of the High-Level Priority Plan (HLPP), and identified that 1.3.1 was considered to be achieved. The rest of the entries in the HLPP under the responsibility of WGI are in progress.

Following detailed discussions on the planned evolution of the future GEO systems, the WG proposed the following priority for inclusion in the new version of the HLPP:

"Evolution of GEO Global Spec for future systems (beyond 5 years from now) taking into account their planned characteristics, the products to be dissemination and the availability of new standards regarding product formats."

With this amendment, the WG recommended to the CGMS Plenary the proposal for an update in the High-Level Priority Plan.

I/7 Any other business

WGI discussed nominations for CGMS-44 and agreed in proposing to plenary the following:

Co-chairs:

- Vanessa Griffin (NOAA)
- Sergey Uspensky (Roshydromet)

Rapporteur:

- J. Gonzalez (EUMETSAT)

CGMS-SFCG Liaison Officer:

- M. Dreis (EUMETSAT)

CGMS Representative at SATCOM Forum:

- S. Burns (EUMETSAT)

I/8 Planning of inter-sessional activities/meetings [CGMS-42 - CGMS-43]

Three groups of Inter-sessional meetings are agreed by WGI:

- WGI.IS-1.x: First group of Inter-sessional meetings will be dedicated to Global Specs for GEO direct broadcast (meeting quarterly starting mid-Nov 2015).
- WGI.IS-2.x. Second group of Inter-sessional meetings will be dedicated to RARS best practices, and it is agreed to have a quarterly frequency, starting mid-October 2015.
- WGI.IS-3.x: Third group of Inter-sessional meetings will be dedicated to preparation of the first SATCOM Forum (2015), including harmonisation of global Data Collection Systems and any Freq related issues, it is agreed to have one meeting in Dec 2015.

I/9 Review of actions, conclusions, preparation of WG report for plenary

CGMS-42 actions and recommendations:

All actions and recommendations raised by Working Group I on the occasion of CGMS-42 were closed. The final status of all CGMS-42 actions and recommendations (plenary and working groups) following CGMS-43 discussions is available [here](http://www.cgms-info.org/documents/CGMS-42_LoAandLoR_final.pdf) (http://www.cgms-info.org/documents/CGMS-42_LoAandLoR_final.pdf).

Actions open following CGMS-43 Working Group I deliberations:

CGMS-43 actions - WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
EUM	WG/I	A43.01	EUMETSAT to contact IROWG Chair to confirm needs for dedicated frequency protection for GNSS (Closed during CGMS-43 following discussions between EUMETSAT and IROWG).	CLOSED	OPEN	HLPP # 1.3
EUM	WG/I	A43.02	CGMS Liaison officer to SFCG to report to CGMS WGI on the discussions and disposition of SFCG on all topics of interest to the different CGMS members. For achieving that a dedicated CGMS Secretariat WGI working paper will be prepared by EUMETSAT Frequency Manager (in the role of liaison officer from CGMS to SFCG) and will be released to the participants of WGI before end of the corresponding year. Based on the contents, CGMS members will decide the level of information they will include in their specific reports to CGMS for the corresponding WGI meeting	30 Dec 2015	OPEN	HLPP # 1.3

CGMS-43 actions - WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
CGMS space agencies	WGI/4.2	A43.03	CGMS members to comment on the work done in the context of the EUMETSAT provided VIIRS Regional Service, and to provide feedback on the proposal to define a standardised compact product format, generalised to cover the advanced imagers of the current and planned polar orbiting satellites.	CGMS-44	OPEN	HLPP # 2.6
NOAA	WGI/4	A43.04	NOAA to assess the need for user registration for Direct Broadcast	CGMS-44	OPEN	HLPP # 1.4
CGMS member	WGI/5	A43.05	CGMS Members to assess, comment on the info package for the SATCOM Forum prepared by the appointed CGMS representative	30 Oct 2015	OPEN	HLPP # 1.2.1
WMO	WGI/6	A43.06	WMO to assess the impact of improved data latency from polar orbiters on NWP (WMO Impact Workshops) and other applications	CGMS-44	OPEN	HLPP # 1.4.5

Recommendations following CGMS-43 Working Group I deliberations:

CGMS-43 recommendations - WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
WMO	WGI/3	R43.01	WMO to make the information on all (active, passive and comms) frequency use available and searchable in OSCAR/Space, such that pre-defined reports are easily accessible via external hyperlinks	CGMS-44	OPEN	HLPP # 1.3
CGMS members	WGI/3	R43.02	Recommends CGMS members to continue bringing all frequency management and coordination issues under the expert forum of SFCG and actions the liaison officer (from CGMS to SFCG) to report to CGMS WGI all aspects of SFCG discussions considered of relevance to CGMS.	CGMS-44	OPEN	HLPP # 1.3
WMO	WGI/6	R43.03	WMO DBNET Coordination Group to report annually to CGMS WGI on status and progress	CGMS-44	OPEN	HLPP # 1.4.5
CGMS space agencies	WGI/6	R43.04	CGMS agencies to publish details on their SG-ICD with enough lead time to allow RARS/DBNET operators to plan their technical systems in advance (to be included in CGMS best practices)	CGMS-44	OPEN	HLPP # 1.4.2

CGMS-43 recommendations - WGI						
Actionee	AGN item	#	Description	Deadline	Status	HLPP ref
CGMS space agencies	WGI/6	R43.05	CGMS agencies to make use of RH circular polarisation for future Direct Broadcast systems, if technically feasible.	CGMS-44	OPEN	HLPP # 1.4.2

The status of CGMS-43 actions and recommendations will be maintained on the [CGMS website](#) under MEETINGS and CGMS-43.

