CGMS

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JMA REPORT ON THE STATUS OF CURRENT AND FUTURE SATELLITE SYSTEMS

MTSAT-2 (145°E) is now operational in imaging over the West Pacific region with MTSAT-1R (140°E) as backup. MTSAT-1R has continued to perform imagery dissemination and data collection services even after its imaging function was switched over to MTSAT-2 on 1 July, 2010. Its DCS (Data Collection System) has functioned properly since the satellite began operation.

JMA plans to launch Himawari-8 in 2014 and commence its operation in 2015, when MTSAT-2 is scheduled to complete its period of operation. The Agency also plans to launch Himawari-9 in 2016. The manufacture of Himawari-8 and -9 is currently in the build and integration phase.

Himawari-8 and -9 imagery will be delivered mainly via the Internet, and JMA has also finished a feasibility study on data dissemination using a commercial telecommunication satellite.

The Agency has set up a web page with information on Himawari-8 and -9 at http://mscweb.kishou.go.jp/himawari89/index.html.

JMA report on the status of current and future satellite systems

1 INTRODUCTION

The Japan Meteorological Agency (JMA) operates two geostationary satellites: Multi-functional Transport Satellite-1R and Multi-functional Transport Satellite 2 (MTSAT-1R and MTSAT-2). The operational use of MTSAT-1R's imaging function was switched over to MTSAT-2 on 1 July, 2010, as MTSAT-1R's earth imaging sensor had reached the end of its five-year design lifetime. JMA plans to launch the next-generation Himawari-8 and Himawari-9 satellites in 2014 and 2016, respectively. This working paper reports on the status of current and future satellite systems.

2 CURRENT SATELLITE SYSTEMS

2.1 MTSAT-2

MTSAT-2 was launched on 18 February, 2006, and placed in geostationary orbit at 145 degrees east. It was the backup satellite for MTSAT-1R from September 2006, and now acts as an operational satellite for observation over the West Pacific region.

No significant spacecraft anomalies on MTSAT-2 have occurred since CGMS-40. The satellite provides 24 full-disk images, 24 Northern Hemisphere images and 8 Southern Hemisphere images a day. Operational information can be accessed on JMA's Meteorological Satellite Center (MSC) website at http://mscweb.kishou.go.jp/operation/index.htm.

In 2013, MTSAT-1R imaging backup operation is scheduled for the period from the middle of October to late December due to annual ground system antenna maintenance.

2.2 MTSAT-1R

MTSAT-1R was launched on 26 February, 2005, and placed in geostationary orbit at 140 degrees east. It has acted as a backup satellite for the imaging function of MTSAT-2 since 1 July, 2010. During annual antenna or ground system maintenance, or in the event of problems with MTSAT-2, MTSAT-1R will take over its observation duties until recovery is secured. MTSAT-1R has continued to perform image dissemination and data collection services even after the switchover of its imaging function to MTSAT-2.

Since 2011, JMA has operated MTSAT-1R small-sector observation around Japan at five-minute intervals during the daytime (from 00 UTC to 09 UTC). The data collected are provided to aeronautical users for monitoring of severe weather conditions around airports and in airspace. As the MTSAT-1R imager is now being used beyond

its design lifetime of five years, this operation is limited to the summer period from June to September.

2.3 DCS (Data Collection System)

MTSAT-1R's Data Collection System (DCS) has been functioning properly since the satellite started operation. Harmful interference was frequently observed from August 2012 to April 2013 on a channel (402.0985 MHz), one of the former International DCS channels which were reallocated for EUMETSAT/JMA regional use, following the agreement at CGMS-36. There was, however, no negative effect on operation because no Data Collection Platform (DCP) is registered on this channel. Among the MTSAT-DCS international channels, four are currently allocated for ship stations but have not been used since March 2007.

Since the 2004 Indian Ocean Tsunami, the number of DCPs reporting tidal data has increased in MTSAT-1R's DCS. As of 30 April, 2013, MTSAT-1R collects tidal reports from 38 DCPs, including 6 in Southeast Asia that began reporting tidal data in 2012.

JMA is also preparing to improve the collection of tidal data at six-minute intervals from 16 Southeast Asia DCPs installed by the University of Hawaii for greater frequency in order to contribute to the enhancement of tsunami monitoring over the Pacific Ocean. In addition, the Agency is planning to assist with the establishment of DCPs in Vietnam and Fiji.

See JMA-WP-08 for more information on MTSAT-DCS.

2.4 MTSAT LRIT DATA DISSEMINATION FROM GOES-WEST

In collaboration with NOAA/NESDIS, broadcasting of MTSAT LRIT infrared full-disk images re-formatted into NOAA GOES LRIT data started on 8 September, 2012, using the GOES WEST satellite for provision to Central Pacific island nations.

2.5 MDUS/SDUS USER NUMBERS

Table 1 shows numbers of currently registered MTSAT-1R MDUS/SDUS users.

Table 1: MDUS/SDUS user numbers

Station	Number
MDUS	59
SDUS	721

2.6 LIST OF FREQUENCIES USED BY MTSAT METEOROLOGICAL MISSIONS

Tables 2 and 3 provide basic information on the frequencies used for current MTSAT meteorological missions.

Table 2: Frequencies from earth to space used by the MTSAT system

Satellite	Frequency (MHz)	Direction	Emission[1]	Application	Status
MTSAT-1R	402.0 – 402.4	E-S	2K00G1D 4K00G1D 6K00G1D	DCP reports	In orbit
MTSAT-1R	2029.1	E-S	6M00G1D	HRIT	In orbit
MTSAT-1R	2033.0	E-S	250KG1D	LRIT	In orbit
MTSAT-1R	2034.2	E-S	300KGXX	TC	In orbit
MTSAT-1R	2034.925 2034.933 2034.974	E-S	6K00G1D	DCP interrogation	In orbit
MTSAT-1R	2100.164	E-S	550KGXX	TC, ranging	In orbit
MTSAT-2	402.0 – 402.4	E-S	2K00G1D 4K00G1D 6K00G1D	DCP reports	In orbit
MTSAT-2	2029.1	E-S	6M00G1D	HRIT	In orbit
MTSAT-2	2033.0	E-S	250KG1D	LRIT	In orbit
MTSAT-2	2034.2	E-S	300KGXX	TC	In orbit
MTSAT-2	2034.925 2034.933 2034.974	E-S	6K00G1D	DCP interrogation	In orbit
MTSAT-2	2100.164	E-S	550KGXX	TC, ranging	In orbit

[1] In accordance with Appendix 1 of the radio regulations

Table 3: Frequencies from space to earth used by the MTSAT system

Satellite	Frequency (MHz)	Direction	Emission	Application	Status
MTSAT-1R	468.875 468.883 468.924	S-E	6K00G1D	DCP interrogation	In orbit
MTSAT-1R	1677.0	S-E	10M0G1D	Raw data	In orbit
MTSAT-1R	1687.1	S-E	6M00G1D	HRIT	In orbit
MTSAT-1R	1691.0	S-E	250KG1D	LRIT	In orbit
MTSAT-1R	1694.0	S-E	400KGXX	TM	In orbit
MTSAT-1R	1694.3 – 1694.7	S-E	2K00G1D 4K00G1D 6K00G1D	DCP reports	In orbit
MTSAT-1R	2280.721	S-E	1M10GXX	TM, ranging	In orbit
MTSAT-2	468.875 468.883 468.924	S-E	6K00G1D	DCP interrogation	In orbit
MTSAT-2	1677.0	S-E	10M0G1D	Raw data	In orbit
MTSAT-2	1687.1	S-E	6M00G1D	HRIT	In orbit
MTSAT-2	1691.0	S-E	250KG1D	LRIT	In orbit
MTSAT-2	1694.0	S-E	400KGXX	TM	In orbit
MTSAT-2	1694.3 – 1694.7	S-E	2K00G1D 4K00G1D 6K00G1D	DCP reports	In orbit
MTSAT-2	2280.721	S-E	1M10GXX	TM, ranging	In orbit

3 FUTURE SATELLITE SYSTEMS

3.1 SCHEDULE

MTSAT-2 (also called Himawari-7) is currently operational and scheduled to complete its observation operation in around 2015. As an MTSAT follow-on, JMA plans to launch Himawari-8 in 2014 and begin its operation in 2015. To ensure the robustness of the satellite observation system, the launch of a second follow-on satellite, Himawari-9, into in-orbit standby is also scheduled for 2016. JMA will continue to operate Himawari-8 and -9 at around 140 degrees east covering the East Asia and West Pacific regions, as with the GMS and MTSAT series.

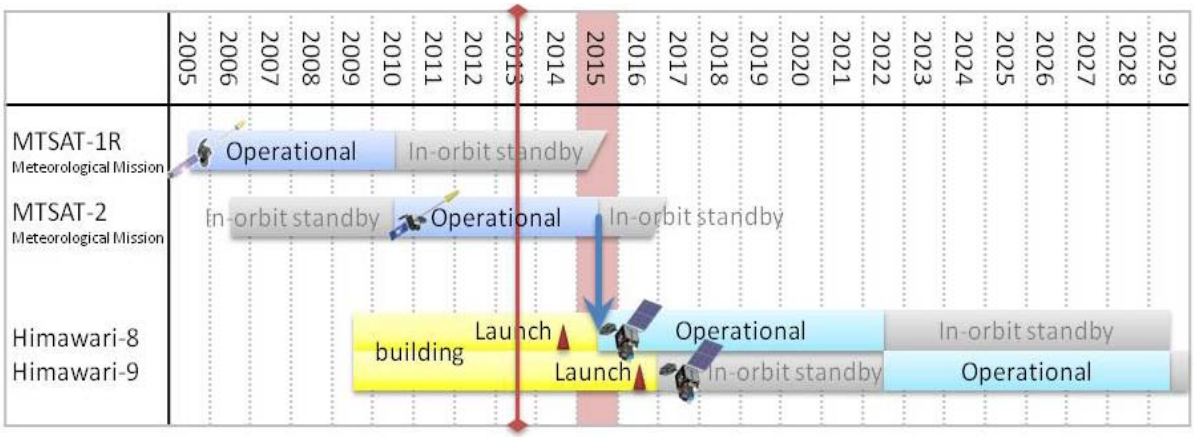

Figure 1: Schedule for the follow-on satellites to the MTSAT series

3.2 SPACE SEGMENT

Table 4 lists the major specifications of Himawari-8 and -9. JMA completed contract arrangements for the manufacture of these satellites in July 2009. The CDR (Critical Design Review) stage was finished in December 2011, and production is now in the build and integration phase. The two units have identical specifications, and will be operated in the same geostationary orbit position at around 140 degrees east.

Himawari-8 and -9 will have a dedicated meteorological mission, whereas the MTSAT satellites perform both meteorological and aeronautical functions. They will carry a new unit called the Advanced Himawari Imager (AHI). Table 5 shows JMA's requirements for the imager, which has capabilities comparable to those of the ABI imager on board GOES-R. The functions and specifications are notably improved from those of the imager on board the MTSAT units, and enable better nowcasting, improved numerical weather prediction accuracy and enhanced environmental monitoring. JMA-WP-07 outlines plans for new products created from Himawari-8 and -9 observation data.

New frequency bands will be introduced for communication between the satellites and ground stations. The Ka-band will be used for downlinking of meteorological data, and the Ku-band will be used for telemetry and command operations.

The satellites will each carry a transponder to relay meteorological/tsunami data from data collection platforms (DCPs) to sustain the data collection system (DCS) currently operated using the MTSAT units.

Table 4: Major specifications of Himawari-8 and -9

Geostationary position	Around 140°E
Attitude control	3-axis attitude-controlled geostationary satellite
Imaging sensor	Advanced Himawari Imager (AHI)
Communications	1) Raw observation data transmission Ka-band, 18.1 – 18.4 GHz (downlink)
	2) DCS Uplink from DCP stations 402.0 – 402.4 MHz (uplink) Transmission to ground segments Ka-band, 18.1 – 18.4 GHz (downlink)
	3) Telemetry and command Ku-band, 13.75 – 14.5 GHz (uplink) 12.2 – 12.75 GHz (downlink)
Contractor	Mitsubishi Electric Corporation
Launch vehicle	H-IIA rocket

Table 5: JMA's requirements for the Himawari-8 and -9 imager

Imaging channels		
Band	Central wavelength (μm)	Spatial resolution (km)
Visible	0.46	1
	0.51	
	0.64	0.5
Near-infrared	0.86	1
	1.6	2
	2.3	
Infrared	3.9	
	6.2	
	7.0	
	7.3	
	8.6	
	9.6	
	10.4	
	11.2	
	12.3	
	13.3	

Observation		
	Scan capability	Full disk: normal operation Area: definable schedule and location
	Imaging rate	< 10 min (full disk)
Lifetime of meteorological mission		
	8 years of in-orbit operation out of a 15-year in-orbit period	

3.3 LIST OF FREQUENCIES TO BE USED BY HIMAWARI-8 AND -9

Tables 6 and 7 show basic information on the frequencies to be used by Himawari-8 and -9.

Table 6: Frequencies from earth to space to be used by the Himawari-8 and -9 system

Satellite	Frequency (MHz)	Direction	Emission[2]	Application	DBIU[3]
Himawari-8/9	402.0 – 402.4	E-S	2K00G1D 4K00G1D 6K00G1D	DCP reports	2014/2016
Himawari-8/9	13750 – 14500	E-S	TBD	TC, ranging	2014/2016

Table 7: Frequencies from space to earth to be used by the Himawari-8 and -9 system

Satellite	Frequency (MHz)	Direction	Emission	Application	DBIU
Himawari-8/9	18100 – 18400	S-E	TBD	Raw data	2014/2016
Himawari-8/9	18100 – 18400	S-E	TBD	DCP reports	2014/2016
Himawari-8/9	12200 – 12750	S-E	TBD	TM, ranging	2014/2016

3.4 GROUND SEGMENT

JMA plans to use two ground stations for site diversity in the interests of mitigating the rain attenuation effect on the Ka-band to be used for imagery data downlink. The primary ground station will be located in the Kanto region (in the middle of Japan), and the secondary one will be in Hokkaido (in the north of Japan).

Imagery and DCP data collected at these stations will be sent to the Meteorological Satellite Center in Tokyo via dedicated lines for processing to support the generation of satellite products for users.

[2] In accordance with Appendix 1 of the radio regulations
[3] DBIU: Date of bringing into use

3.5 Dissemination

JMA plans to provide all imagery data from Himawari-8 and -9 via the Internet as the primary dissemination method. In addition, the Agency has finished a feasibility study on data dissemination using a commercial telecommunication satellite as a secondary method, and is now researching the optimal parameters and content for operational dissemination. In this regard, JMA has sent out a questionnaire to gather input on users' requirements for Himawari-8/9 imagery and to clarify the situations of their telecommunication infrastructures. The Agency tentatively plans to begin the service using a commercial telecommunication satellite in 2015 in parallel with the direct dissemination of imagery from MTSAT-2 via the remaining MTSAT-1R. Several data formats are planned to support skilled users, current MTSAT users and GIS users. Table 8 shows the relationship between observations, formats and dissemination methods.

Table 8: Himawari-8/9 imagery data formats (tentative plan)

Observation	Format	Dissemination	Notes
Full-disk observation	Name: TBD	- Internet	- Based on current Hi-res format - Headers extended to contain more meta data - All channels - Full spatial resolution
	Hi-res format (Low-res format)	- Internet - Communication satellite	- The same format as current MTSAT files broadcast as specified in the H/LRIT regulations for supporting current MTSAT users - 5 channels corresponding to MTSAT - 4 km for IR, 1 km for Vis - 10 segments for full-disk images
Regional observation	Name: TBD NetCDF	- Internet	- All channels - Latitude/longitude square grids for NetCDF

3.6 Web page

JMA has set up a web page with information on Himawari-8 and -9 at http://mscweb.kishou.go.jp/himawari89/index.html. The page provides information on the schedule and spacecraft/AHI specifications, including estimated spectral response functions (SRF).