CGMS

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Prepared by JMA
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JMA REPORT ON THE STATUS OF CURRENT AND FUTURE SATELLITE SYSTEMS

MTSAT-2 (145°E) is currently operational in imaging over the Western Pacific region with backup from MTSAT-1R (140°E), which 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 the middle of 2015, when MTSAT-2 is scheduled to complete its period of operation. The Agency also plans to launch Himawari-9 in 2016. The Pre-Shipment Review (PSR) of the Advanced Himawari Imager (AHI) for Himawari-8 was successfully finished in August 2013, and Himawari-8's manufacture is now in the final test phase. The PSR of the AHI for Himawari-9 is also scheduled to take place in a few months.

All Himawari-8 and -9 imagery will be delivered via an Internet cloud service, and primary sets of imagery will also be disseminated via the HimawariCast service using a communication satellite.

The Agency maintains updated web pages with information on Himawari-8 and -9 at http://mscweb.kishou.go.jp/himawari89/ and http://www.jma.go.jp/jma/jma-eng/satellite/.

JMA report on the status of current and future satellite systems

1 INTRODUCTION

The Japan Meteorological Agency (JMA) operates two geostationary satellites called 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 East Asia and Western Pacific regions.

No significant anomalies on board MTSAT-2 have occurred since CGMS-41. 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 2014, MTSAT-1R imaging backup operation is scheduled to take place over a period of a few weeks in November 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 takes over its observation duties until recovery is secured. MTSAT-1R has continued to perform image dissemination and data collection services since the switchover of its imaging function to MTSAT-2.

Since 2011, JMA has implemented MTSAT-1R small-sector observation around Japan at five-minute intervals during the daytime (from 00 to 09 UTC). The collected

data are provided to aeronautical operators to support the 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, operation is limited to the period from June to September.

In addition, from January to March 2014, JMA has implemented MTSAT-1R regional-sector observation around the Australian continent at 10-minute intervals throughout the day for an HIWC/HAIC international field campaign in Darwin[1]. The collected data are provided to the Australian Bureau of Meteorology via the online JMA Data Dissemination System (JDDS).

2.3 DCS (Data Collection System)

MTSAT-1R's Data Collection System (IDCS) has functioned properly since the satellite started operation. Although harmful interference was frequently observed on DCS channel 33 from May 2013 to February 2014, there was no negative effect on operation because no Data Collection Platform (DCP) is registered on this channel. Further information on MTSAT-DCS is available in the Monthly Operations Report section of the MSC website at http://mscweb.kishou.go.jp/operation/opr_report.htm.

Since the 2004 Indian Ocean Tsunami, the number of DCPs reporting tidal data has increased in MTSAT-1R's DCS. As of 28 February 2014, MTSAT-1R collected tidal reports from 40 DCPs; 2 of these are Indonesian platforms that started to report tidal data at this time.

JMA is also preparing to improve the collection of tidal data at six-minute intervals from 14 Southeast Asian DCPs installed by the University of Hawaii in order to contribute to the enhancement of tsunami monitoring over the Pacific Ocean with greater frequency. The Agency also plans to assist with the establishment of DCPs in Vietnam, Fiji and Myanmar.

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

2.4 MTSAT LRIT DATA DISSEMINATION FROM GOES-WEST

In collaboration with NOAA/NESDIS, provision of MTSAT LRIT full-disk images re-formatted into NOAA GOES LRIT data to Central Pacific island nations was commenced in 2012 using the GOES-West satellite. This service will continue to be provided after the start of Himawari-8's operation.

[1] http://www.haic.eu/the-1st-haichiwc-international-field-campaign-ended/the-1st-haichiwc-international-field-campaign-ended/

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[2]	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

[2] 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	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	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 2015. As an MTSAT follow-on, JMA plans to launch Himawari-8 in 2014 and begin its operation in the middle of 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 Western Pacific regions, as with the GMS and MTSAT series.

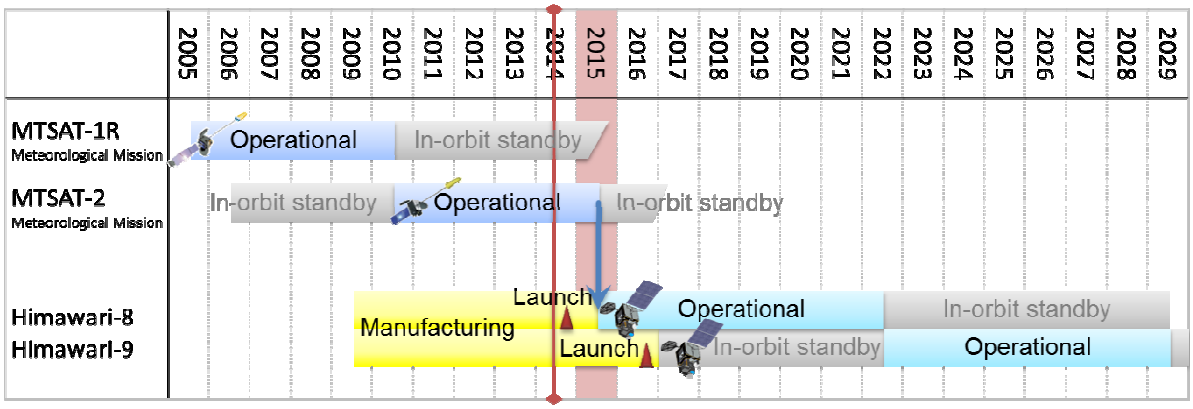

Figure 1: schedule for the follow-on satellites to the MTSAT series

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, and the CDR (Critical Design Review) stage was finished in December 2011. After a successful Pre-Shipment Review (PSR) of the main sensor for Himawari-8 in August 2013, the satellite's production is now in the final test phase. The two satellites have identical specifications, and will be operated in the same geostationary orbit 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 each carry a new unit called the Advanced Himawari Imager (AHI). Table 5 shows the specifications of the AHI, 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. In August 2013, the PSR of the AHI for Himawari-8 was successfully finished and its performance was proven to be as high as expected. The PSR of the AHI for Himawari-9 is also scheduled to take place in a few months.

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) in order 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: AHI specifications

Imaging channels		
Band	Central wavelength* (μm)	Spatial resolution (km)
Visible	0.47	1
	0.51	
	0.64	0.5
Near-infrared	0.86	1
	1.6	2
	2.3	
Infrared	3.9	
	6.2	
	6.9	
	7.3	
	8.6	
	9.6	
	10.4	
	11.2	
	12.4	
	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	

*Latest values for the AHI on board Himawari-8

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[3]	Application	DBIU[4]
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 has constructed 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 is located in the Kanto region (in the middle of Japan), and the secondary one is in Hokkaido (in the north of Japan).

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

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. The data received at the Hokkaido station will also be sent to the Osaka Regional Headquarters, and products generated in Osaka will be distributed in the event of any malfunction in the Kanto area's systems. Figure 2 shows an overview of the ground segment for Himawari-8/9.

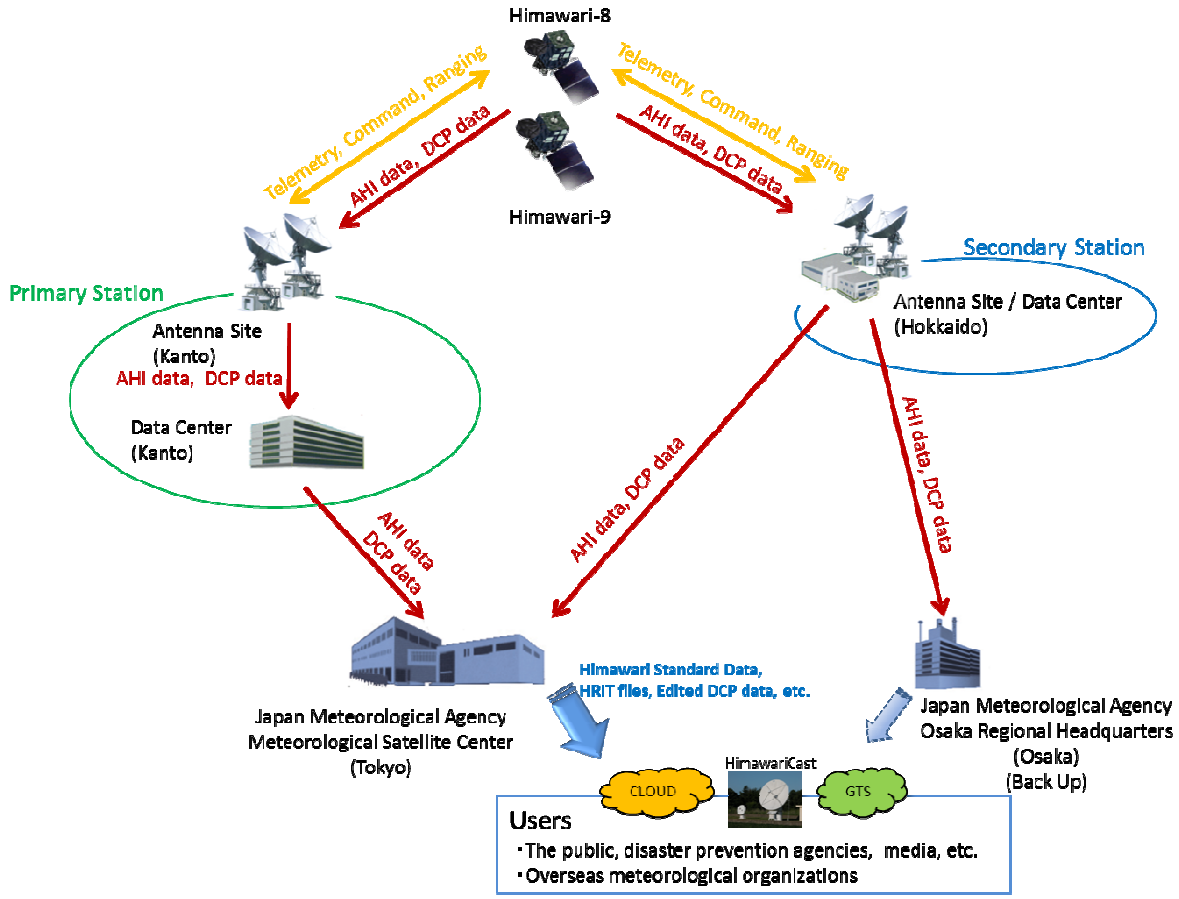

Figure 2: overview of ground segment for Himawari-8/9

3.5 Dissemination

All imagery derived from Himawari-8 and -9 will be distributed to NMHSs via an Internet cloud service. JMA also plans to start the HimawariCast service, by which primary sets of imagery will be disseminated to NMHSs via a communication satellite using Digital Video Broadcasting – Satellite – Second Generation (DVB-S2) technology.

See JMA-WP-09 for more information on dissemination, such as details of content, formats and service schedules.

3.6 Web page

JMA maintains updated Himawari-8 and -9 information web pages at http://mscweb.kishou.go.jp/himawari89/* and http://www.jma.go.jp/jma/jma-eng/satellite/. The pages provide information on the schedule and spacecraft/AHI specifications, including estimated spectral response functions (SRF) and sample data in several file formats. JMA will populate the page with further important information for user readiness in the future.

*: http://www.jma-net.go.jp/msc/indexe.html as of 4 September 2014