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**CURRENT STATUS OF INSAT AND KALPANA-I (METSAT)
GEOSTATIONARY SATELLITES FOR METEOROLOGICAL
APPLICATIONS**

Current Status of INSAT and KALPANA-I (METSAT)
Satellites for Meteorological Applications

CGMS Members are invited to take note.

CURRENT STATUS OF INSAT AND KALPANA-I (METSAT) SATELLITES FOR METEOROLOGICAL APPLICATIONS

INTRODUCTION

INSAT is an operational multipurpose satellite system catering to the requirements of three different services, viz Television & Radio Broadcasting, Communications and Meteorology. The INSAT project is a joint venture of the Department of Telecommunications (DOT), the India Meteorological Department (IMD), Doordarshan and All India Radio (AIR). The responsibility for overall management and coordination of the INSAT system among the user agencies rests with the INSAT co-ordination committee (ICC).

The first satellite (INSAT-1A) of INSAT-1 series was launched in April, 1982 and it ceased to function totally from 6 September 1982 as a result of major anomaly on the satellite. The second satellite (INSAT-1B) was launched on 30 August 1983 and it became operational on 15 October, 1983. It was the main operational satellite all through the 1980s and provided very good services during its entire mission life. It was deorbited in July, 93. The third satellite of the series (INSAT-1C) was launched on 22 July 1988. Due to some technical problem it lost control on 22nd November, 1989 after which it was not available for operational services. The last satellite of INSAT-1 series (INSAT-1D) was launched on 12 June, 1990 and became operational on 17 July, 90. After providing very useful services for almost 12 years, the VHRR payload of this satellite was switched off from 14 May, 2002 due to non-availability of fuel for attitude control.

The 2nd generation of INSAT satellites (INSAT-2 series) were started from July, 1992 with the successful launch of the first satellite of the series (INSAT-2A) on 10th July 92. The 2nd satellite of INSAT-2 programme i.e. (INSAT-2B) was also launched successfully on 22 July, 1993. All INSAT satellites are three-axis body stabilised spacecrafts. The last satellite of INSAT-2 series i.e., INSAT-2E was launched successfully on 3 April, 1999 and was made operational from May 1999. It has a new payload, called Charged Coupled Device (CCD) camera capable of taking 1 km resolution images in 3 bands. The meteorological imaging capability in thermal IR Band has also been upgraded on this satellite, as compared to its predecessors, by providing a water vapor channel with 8 km resolution in the VHRR, the imaging instrument of the satellite. However, VHRR onboard INSAT-2E is not working due to anomaly in the scan-mechanism. A dedicated Meteorological Satellite METSAT (Kalpana-I) has been launched by India in September, 2002 for earth imaging with three channel Very High Resolution Radiometer (VHRR). A Data Relay Transponder (DRT) for collection of meteorological and hydrological data from automatic weather stations has also been provided on this satellite. METSAT is operational from 24 September, 2002.

The first satellite (INSAT-3A) with meteorological payloads, of 3rd generation of INSAT satellites (INSAT-3 series) was launched on 10th April, 2003. Its meteorological payloads are identical to those of INSAT-2E i.e. a 3 channel VHRR and a 3 channel CCD. INSAT-3A has also a data Relay Transponder. The satellite has been declared operational from May, 2003.

1.2 CURRENT OPERATIONAL STATUS

The imaging mission is working satisfactorily with METSAT(Kalpana-I) satellite and INSAT - 3A and they continue to be used operationally. High resolution (1km) images in 3 channels are also available operationally from INSAT - 3A and INSAT-2E CCD cameras. The activities like image processing, derivation of meteorological products, data archival and dissemination of products to field stations for operational use are being done on routine basis.

VHRR images are normally received at three- hourly intervals. More frequent images are taken for monitoring the development of special weather phenomena as and when the situation demands. CCD images from INSAT - 3A are also being taken every three hours for operational use during daytime. More frequent images are taken if situation demands. For the derivation of CMVs half hourly triplets at 00 UTC and 12 UTC are also received from INSAT - 3A and data processed. The INSAT derived CMVs are being disseminated operationally to the users through GTS.

1.3 METEOROLOGICAL DATA DISSEMINATION (MDD)

The processing system is also being used for generating analogue cloud imagery from METSAT(Kalpana-I) satellite and INSAT - 3A data which are transmitted to field stations using S-band broadcast capability of another satellite INSAT-3C. Along with satellite imagery data other conventional meteorological data and FAX charts are also being transmitted. This scheme is called Meteorological Data Dissemination (MDD).

There are about 100 MDD receiving stations in the country being operated by different agencies. Three MDD receiving stations are also operating in neighbouring countries like Sri Lanka, Bangladesh and Male under bi-lateral agreements. In general, the processed images are sent to these stations every three hours, and every hour during cyclone periods. These stations are receiving direct broadcasts of cloud imagery, weather facsimile charts and meteorological data on an operational basis through INSAT-3C satellite.

The frequency of transmission from ground to satellite (Uplink) is 5899.225 MHz and downlink is at 2599.225 MHz.

There is a plan to replace existing Analogue based MDD service with latest state of art Digital MDD system to transmit imagery data in digital form instead of analogue. It will take about 2 years for its implementation.

1.4 DATA COLLECTION PLATFORM (DCP)

The Data Relay transponder (DRT) on board METSAT(Kalpana-I) satellite and INSAT - 3A is being used for collection of meteorological, hydrological and oceanographic data from remote and inaccessible areas. IMD has installed 100 Data Collection Platforms (DCPs). Many of these DCPs have now become old and obsolete. There is a plan to replace them with latest state of art equipment during next 2 years or so. Other agencies have also installed about 100 DCP stations which are currently operational.

Characteristics of DCPs.

Frequency of transmission	402.75 MHz (uplink) \pm 100 Khz
Downlink frequency	4504.1 MHz
Bit rate	4.8 kbps
EIRP (uplink)	16.5 dbw
Mode of transmission	Burst mode
Burst length	87 milliseconds
Number of sensors	Max 16
Number of bits in one frame	422 bits

1.5 CYCLONE WARNING DISSEMINATION SYSTEM (CWDS)

For quick dissemination of warnings against impending disaster from approaching cyclones, specially designed receivers have been installed by IMD within the vulnerable coastal areas for direct transmission of warnings to the officials and people in general using broadcast capability of INSAT satellite. IMD's Area Cyclone Warning Centres (ACWC) generate these special warning bulletins and transmit them every hour in local languages to the affected areas. 350 such receiver stations have been installed by IMD. Out of these 100 are Digital CWDS (DCWDS) based on advanced digital technology installed during 2003 in one of the coastal Indian States. The DCWDS has been deployed with Acknowledgement Transmitters also to get confirmation at transmit from and receives about proper reception of warnings. CWDS has proved very effective system of warning people during the cyclone affecting the coastal areas. For this service the frequency of transmission from ground to satellite (uplink) is 5859.225 and 5885.0 MHZ and Downlink is at 2559.225 and 2585.0 MHz respectively.

1.6 TRAINING AND REASEARCH ACTIVITIES

IMD is providing training in satellite meteorology to Indian and foreign students under SAARC and other related programmes on a regular basis. The theory and practical classes are conducted by expert scientists. A new institute had been set up in 1998 at Ahmedabad (India) to teach Satellite Meteorology and other related subjects to national and foreign personnel. This institution is named as " Centre for Space Science and Technology Education for Asia and the Pacific (CSSTE-AP)" and is affiliated to the United Nations. IMD's experts are delivering lectures on satellite Meteorology in the Post Graduate training courses conducted periodically by this Institute.

IMD and other institutions namely, Space Applications Centre, Indian institute of Technology, National Centre for Medium Range Weather Forecasting (NCMRWF), Indian Institute of Tropical Meteorology (IITM). Indian Institute of Science and a few national universities are utilizing INSAT data for research in meteorology and Atmospheric Sciences.

1.7 RECEPTION OF NOAA SATELLITE DATA

The data from NOAA series of polar orbiting satellites are being received and processed by IMD at Delhi and Chennai. Both AVHRR and TOVS data are processed in real time and the cloud imagery and derived products are being utilized by the weather forecasters. The derived products are archived for distribution on demand basis to the scientists for use in research work. The vertical temperature and moisture profiles derived from the NOAA satellite have shown positive impact on forecasts generated with numerical models. The old HRPT receiving station at New Delhi has been replaced with a new system, which is also capable of receiving data from new generation of NOAA satellites.

1.8 PDUS for METEOSAT-5 data reception :

A new PDUS receiving station had been installed at IMD, New Delhi for reception of high resolution imagery data from METEOSAT-5 SATELLITE LOCATED AT 63 deg E over the Indian Ocean. This system is operational since March, 2000.

1.9 INDO –US data Exchange Centre

Under the bilateral programme of co-operation with USA, an INDO-US data Exchange Centre has been established at IMD, New Delhi in November, 99 for exchange of satellite data with USA. Processed INSAT imagery data is being transmitted every three hours to the USA. GOES imagery data is also being received from USA.

Data exchange takes place through dedicated communication links. Under another collaborative programme with EUMETSAT, an agreement has been signed for reception of METEOSAT-5 data at IMD, New Delhi.

Appendix-A**INDIAN NATIONAL SATELLITE (INSAT) – PAST****INSAT-1 : Geostationary Satellite Series**

Satellite	Launch Date	Met. Payload with Wavelength Bands	Major Applications
INSAT-1A	April10, 1982	Very High Resolution Radiometer (VHRR) Vis : 0.55-0.75 μ m IR : 10.5-12.5Km Vis (2.75 Km) IR (11 KM)	<ul style="list-style-type: none"> • Monitoring cyclones & monsoon • CMV Winds • OLR • Rainfall Estimation
INSAT-1B	August30, 1983	-do-	-do-
INSAT-1C	July 22, 1988	-do-	-do-
INSAT-1D	June12, 1990	-do-	-do-

INSAT-2 : Geostationary Satellite Series

Satellite	Launch Date	Met. Payload with Wavelength Bands	Major Applications
INSAT- 2A	July10, 1992	Very High Resolution Radiometer (VHRR) Bands : 0.55 - 0.75 μ m 10.5 - 12.5 μ m	<ul style="list-style-type: none"> • Monitoring cyclones & monsoon • CMV Winds • OLR • Rainfall Estimation • Mesoscale features • Flood/intense precipitation advisory • Snow detection
INSAT-2B	July23, 1993	Very High Resolution Radiometer (VHRR) Bands : 0.55 - 0.75 μ m 10.5 - 12.5 μ m	-do-
INSAT-2E	April,1999	1. VHRR : As	-do-

		above + WV Band : 5 -7.1 μ m 2. CCD Payload Bands : 063 - 0.79 μ m 0.77 - 0.86 μ m 1.55 - 1.70 μ m	

Appendix-B**INDIAN NATIONAL SATELLITE (INSAT) and METSAT****INSAT-3: Geostationary Satellite Series – PRESENT**

Satellite	Launch Date	Met. Payload with Wavelength Bands	Major Applications
METSAT (Kalpana -I)	September,2002	VHRR : Similar to INSAT-2E/3A	<ul style="list-style-type: none"> • Monitoring cyclones & monsoon • CMV Winds • OLR Rainfall Estimation
INSAT-3A (Similar to INSAT-2E)	April, 2003	1. VHRR : As above + WV Band :5-7.1 μ m 2. CCD Payload Bands : 063.0.79 μ m 0.77-0.86 μ m 1.55-1.70 μ m	<ul style="list-style-type: none"> • Monitoring cyclones & monsoon • CMV Winds • OLR • Rainfall Estimation • Mesoscale features • Flood/intense precipitation advisory • Snow detection • Crop discrimination • Aerosols studies Temperature/humidity profile (with INSAT-3D)

