



# EARTH STATION RECEIVING SYSTEM

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# INSAT-3D/3DR-INDIA's Advanced Weather Satellite

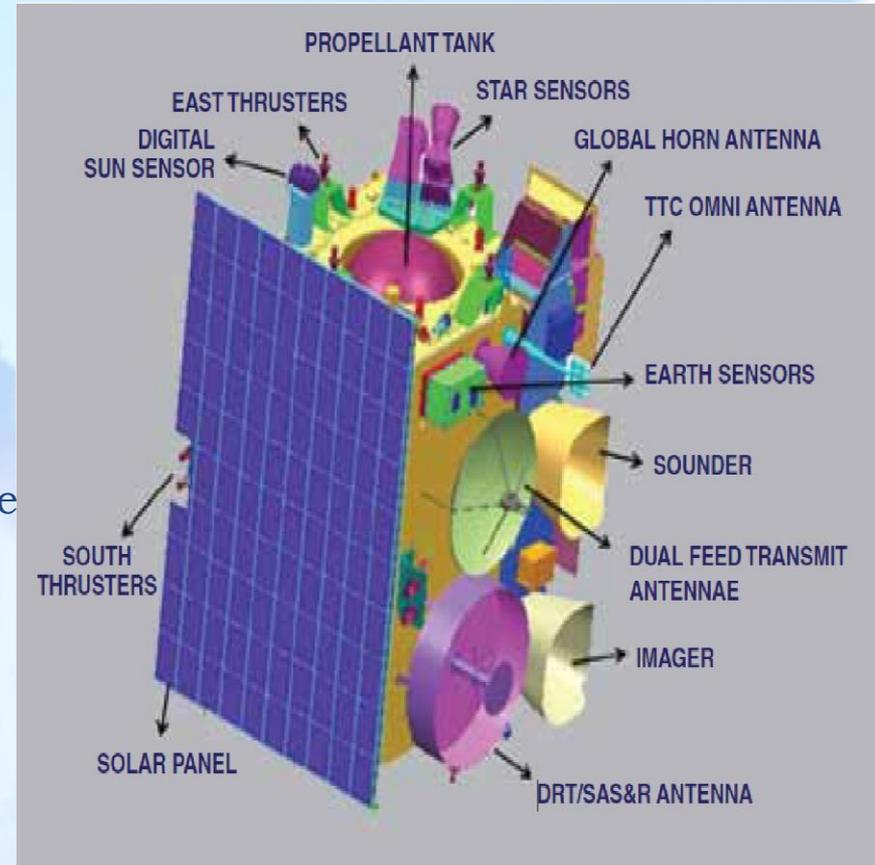
**INSAT-3D:** India launched an exclusive meteorological satellite on 26<sup>th</sup> July, 2013 from French , Guyana using ARIANE rocket. INSAT-3D is located at 82 Degrees East and INSAT-3DR at 74 degree East.

## Mission objectives:

- To monitor earth's surface, carryout oceanic observations and its environment in various spectral channels of meteorological importance.
- To provide the vertical profile of temperature and humidity parameters of the atmosphere.
- To provide the data collection and data dissemination capabilities from the Data Collection platforms (DCPs)
- To provide the satellite aided search and rescue services.

## Payloads

- Six channel imager
- Nineteen channel sounder
- Data Relay Transponder(DRT)
- Satellite aided Search and Rescue(S&SR) System.



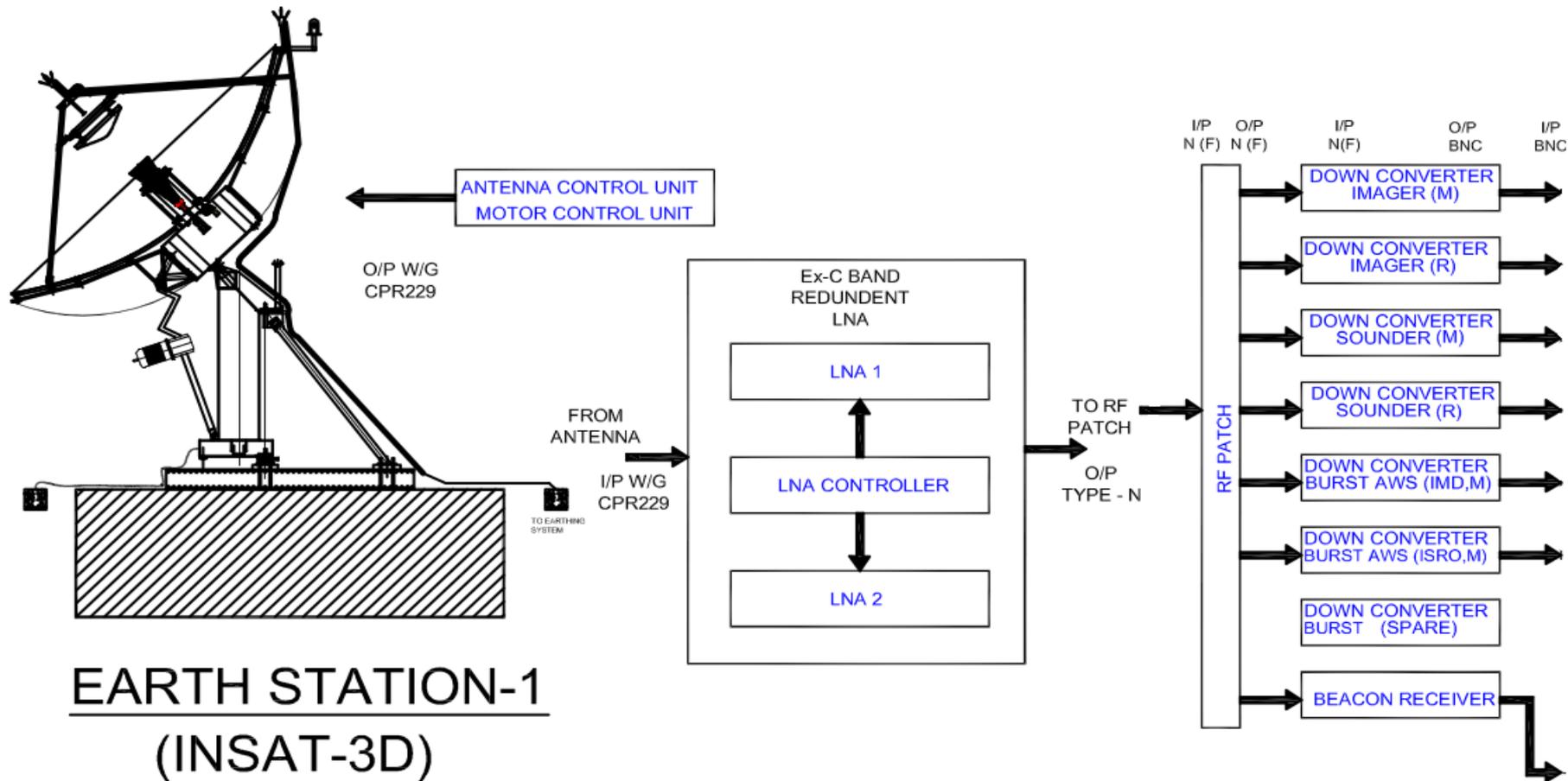
Meteorological payloads are state-of-art and have significant technological improvement in sensor capabilities and higher resolution compared to earlier INSAT missions



# Payloads on INSAT-3D/3DR

Payloads	Channel	Resolution	Data Rate	Frequency
Imager	visible (0.52-0.77 um)	1x1 Km	3.92725 Mbps	4781 MHz
	SWIR (1.55-1.70 um )	1x1 Km		
	MIR (3.8-4.0 um )	4x4 Km		
	WV (6.5-7.1 um )	8x8 Km		
	TIR-1 (10.3-11.3 um)	4x4 Km		
	TIR-2 (11.5-12.5 um)	4x4Km		
Sounder	LWIR -7 channel (14.71-12.02 um)	10x10 Km	40.00 Kbps	4798 MHz
	MWIR-5 Channel (11.03-6.51 um)			
	SWIR-6 Channel (4.57-3.74 um)			
	VIS (0.695 um)			
DRT	Up link 402.75MHz			4506.05MHz
S&SR	Up link 406.05MHz			4507 MHz

# Block Diagram of GROUND RECEIVING SYSTEM



# INSAT-3D/3DR Receiving and Processing System



# BEACON TRACKING RECEIVER

- It is a separate independent unit, support C band, for tracking of satellite for our RF chain.
- Beacon Receiver is used to lock a CW(continuous wave)/modulated carrier and provide accurate and reliable relative power measurement indicator for antenna positioning.
- The signal in beacon primarily has the call sign of the satellite. Antenna matching for the beacon frequency.



## ANTENNA (TYPE- CASSEGRAIN)

- Three antennae of 7.5m, one pointing to INSAT-3D (Location: 82 degree E), second point to INSAT-3DR (Location:74 degree E ) and third for standby (In future will use for INSAT-3DS)
- All antennae are properly mounted as per design document.
- The foundation of all three antennae are as per given specifications.
- Installation of all antennae are completed and presently being used for MMDRPS Data Reception chains. Stand-by antenna is also verified with pointing to INSAT 3D satellite and verified with DR & DP data also (i.e. end to end Stand-by chain is verified).
- All antennae were located in such a way that clear sky view to point in Geo-stationary orbit INSAT-3D/3DR satellites.
- All antennae incorporate a small sub reflector at front and centre of dish. The Sub-reflector deflect waves back towards centre of reflector, where the feed-horn is actually mounted.





- In this antenna, a sub reflector is used to direct the energy into the parabolic reflector from a feed antenna located away from the primary focal point. The feed antenna is connected to the associated RF by means of coaxial cable or a hollow wave guide
- Also, LNA is placed at the back side so that there is not much maintenance problem

Satellite Name

Antenna

Satellite Position

	Azimuth (deg)	Elevation (deg)	
INSAT-3D	170.26	56.20	82
INSAT-3DR	186.44	56.11	74
HOT STANDBY	170.18	54.96	--



# ANTENNA CONTROL UNIT

- The ACU is used for steering the antenna either manually or automatically while the display shows the direction (azimuth and elevation) at which the antenna is pointed.
- ACU contains following tracking modes:
  1. Manual Mode
  2. Standby Mode
  3. Step Track Mode/Automatic
  4. Program Track Mode



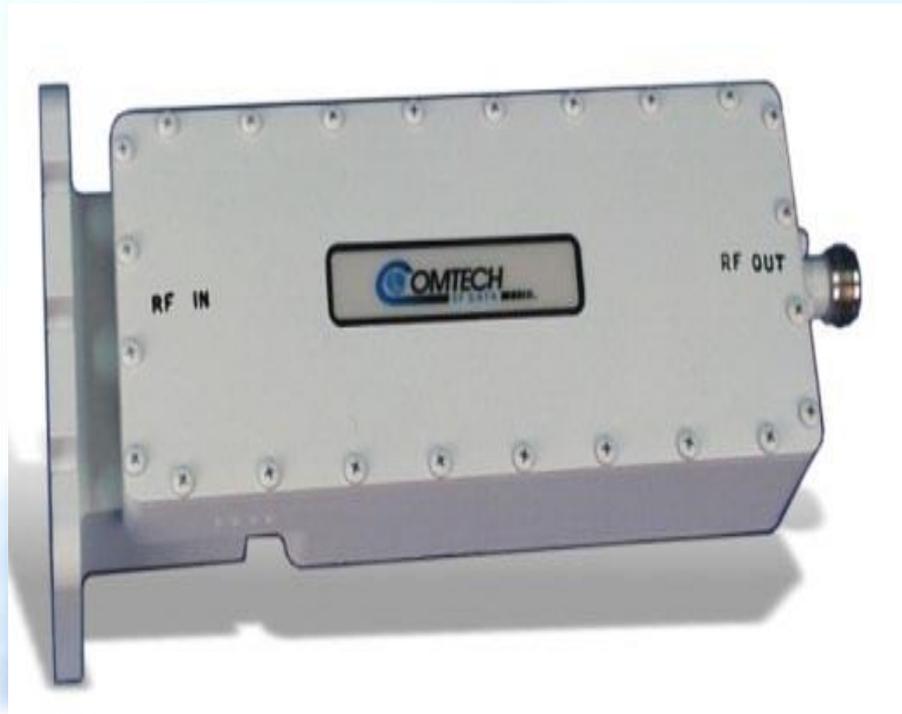
# MOTOR CONTROL UNIT

- The antenna is driven by an AC three-phase motor coupled to a screw-jack mechanism on each axis.
- It is use to control azimuth, elevation and polar angle.
- In case ACU goes faulty we can move antenna by using MCU.



# LNA 1:1 (LOW NOISE AMPLIFIER)

- Low-noise amplifier(LNAs), are used for amplifying the RF signal, that have very good noise performance.
- LNA 1:1 is active LNA, if one fail automatically switch over, no need to change physically.
- The LNA is mounted as close to the antenna feed as possible to give optimized performance, so that the transmission line losses to the LNA will be minimum.
- The operation band of LNA supports C band.



*In the present operational set up 6-pin LNA – C-Band (4.5 to 4.8 GHz) of the make Comtech of model number is used. In a present setup two LNA are used in a hot redundant mode (LNA1:1 is active LNA, if one fail automatically switches over to another through LNA redundancy switch Controller, no need to change physically). The LNA is mounted as close to the antenna feed as far as possible to give optimized performance, so that the transmission line losses between feed horn and LNA to be minimized. LNA are powered by 15-volt DC supply from a dedicated power supply.*



# Down Converter

It converts the frequency of RF signal (Imager- 4781 MHz, Sounder- 4798 MHz & DRT- 4506.5 MHz) to Intermediate Frequency (IF) (70+/-20MHz) as per super heterodyne receiver concept. A total of 18 Down Converters are available for catering to the overall system requirement out of which 2 number of down converters are kept as a spare. The down converted (IF) signal is fed to the corresponding demodulator 'Continuous' and 'Burst' types of demodulators have been utilized in the system. In present setup the signal strength is high because large size of Antenna and high LNA gain, hence the Output is attenuated in the range of 0-30 dB (as per requirement) by using attenuator so that output IF level is suitable for demodulator input (otherwise chances of failure to demodulator exist). Down converter has two mode of setting (local or remote and either one is used as per requirement).



# Demodulator

At the payload, the data is transmitted by superimposing it on RF signal by using (QPSK type of modulations for Imager and BPSK type of modulation for Sounder) and we have extract out this data from IF signal at Ground. There are two type of demodulator- Continuous and burst Type. The Continuous demodulator is used for Imager/Sounder data streams and Burst demodulator is used for DRT data stream. Demodulator extract the Base Band image signal/Data from IF signal (70+/-20MHz).



# DECODER

IT IS AN INDIGENIOUS EQUIPMENT , DATA RECEIVING FROM DEMODULATOR IS IN THE FORM OF RS 422 SIGNAL AND THESE SIGNAL ARE CONVERTED IN TO THE T T L FORMAT FOR C. C.D SIGNAL I & Q SEPRATED AND AGAIN CONVERTED IN TO THE RS 422 FORM AND T T L . I AND Q SEPRATION NOT REQUIRED FOR V.H.R.R SIGNA , THESE ARE TWO TYPES WHICH IT CONVERTED .

V.H.R.R BPSK NRZ - S WITH BIT RATE 526.5 KBPS

C.C.D QPSK NRZ – L WITH BIT RATE 1.28875 MBPS

## CODING TECHNIQUES :

NRZ - NON RETURN TO ZERO ENCODING IS USED IN SLOW SPEED DATA WITH LOGIC 1 BIT IS HIGH LOGIC 0 BIT IS LOW VALUE AND REQUIRES A LARGE BAND WIDTH .

NRZ – L IT USED WHENE POLARITY OF SIGNAL FROM 1 TO 0 OR FROM 0 TO 1.

NRZ – M THE POLARITY OF SIGNAL CHANGES WHEN INCOMING SIGNAL IS 1 AND INCOMING 0 WOULD NOT CHANGE .

NRZ – S IT IS JUST LIKE NRZ – M EXCEPT THE SIGNAL CHANGES WHEN THE INCOMING DATA SIGNAL IS 0 , NOT WHEN SIGNAL IS ONE .



# DIFFERENTIAL TO TTL CONVERTER

The output of demodulator is differential, it is required to convert TTL for suitable input of Bit-synchronizer.

- The TTL logic levels are 0V and 5V.
- It will take differential input from demodulator and convert into TTL form and gives it to bit synchronizer.

DIFFERENTIAL TO TTL CONVERTER &  
DACQ CONVERTER UNIT

M.No: SY482MDR-DIU

S.No: 004



ASTRA MICROWAVE PRODUCTS LTD.  
HYDERABAD

TTL O/P 5V O/P POWER



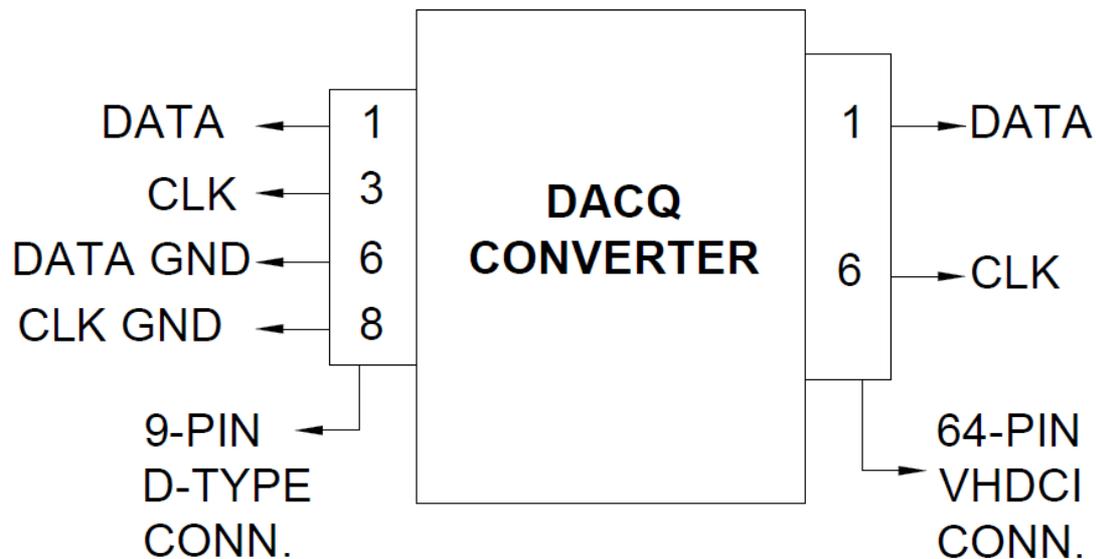
# BIT SYNCHRONIZER

From the payloads of satellite only data is transmitted and clock is not transmitted. A bit sync unit extracts synchronized clocks from incoming serial data. The bit sync includes multiple inputs and allows the ground station to select any one input from multiple inputs. If one input fails, other input can be taken. Differential to TTL Converter unit provides the TTL output for the Bit Synchronizer.



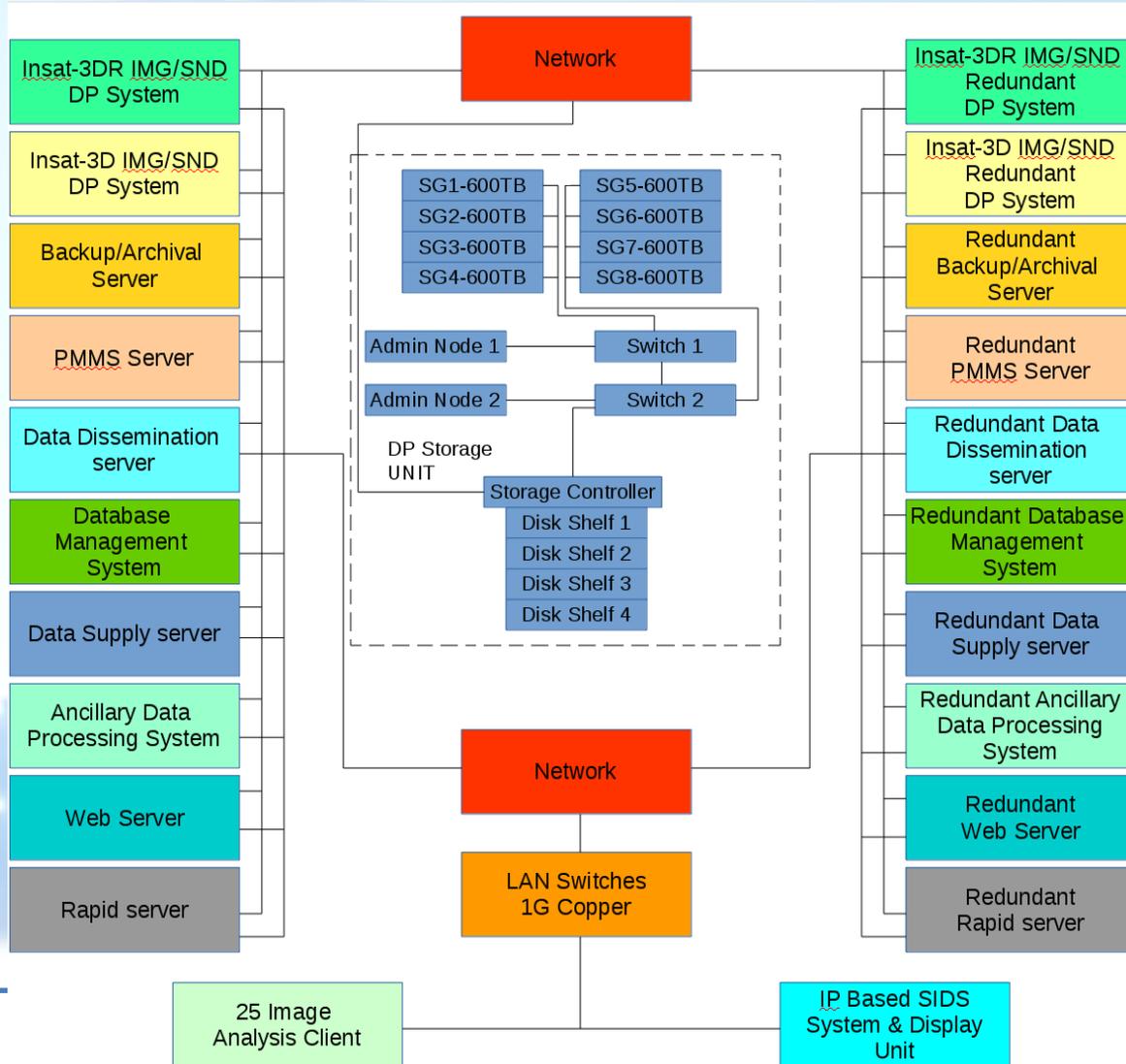
## DACQ CONVERTER

The serial data streams for Imager and Sounder received from Bit Synchronizer are fed to the DACQ Card/Frame synchronization through BNC to 9 Pin D connector. DACQ convertor is a compatibility card for signal connection between bit synchronizer and data acquisition card which is inserted in data acquisition server from NI (National Instrument)). Pin setting diagram for DACQ Converter.



# NI CARDS & DR SERVERS

- NI CARD with VHDCI connector
- NI Card receives baseband data and clock signals from DACQ converter
- Acquisition and Application software runs on Individual Servers for each chain of Imager and Sounder systems



# MMDRPS Storage infrastructure

	SINGLE PASS		ONE DAY PASS		ONE MONTH	TOTAL SIZE
3DIMG_RAW	1006MB		47.2GB		1.4TB	3.1TB
3DIMG_H5	961MB		45GB		1.3TB	
3DIMG_JPG	303MB		14.2GB		426GB	
3RIMG_RAW	1006MB		47.2GB		1.4TB	3.1TB
3RIMG_H5	961MB		45GB		1.3TB	
3RIMG_JPG	303MB		14.2GB		426GB	
3DSND_RAW	SA1	SA2	SA1	SA2	19.5GB	145.5GB
3DSND_H5	15MB	19MB	360MB	304MB	96GB	
3DSND_JPG	76MB	91MB	1.8GB	1.4GB	30GB	
	25MB	25MB	600MB	400MB		
3RSND_RAW	15MB	19MB	360MB	304MB	19.5GB	145.5GB
3RSND_H5	76MB	91MB	1.8GB	1.4GB	96GB	
3RSND_JPG	25MB	25MB	600MB	400MB	30GB	
DAILY PRODUCTS	....		180MB		5.3GB	6.7TB
TOTAL	5.1GB		222GB		6.7TB	



**DEPARTMENT**



& 3DR (Imager & sounder) is works out to be approx for one month would be around 6.7 TB  
MMDRPS have storage capacity of the order of 2.0/2.0PB( Main/ Mirror) & 324TB SSD which will facilitate online sharing of processed data for all Indian meteorological satellites to the registered users as per IMD data policy through Web based secured satellite Data Supply System.

# Thank You



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