Integration of Communication Technologies in Disaster Management

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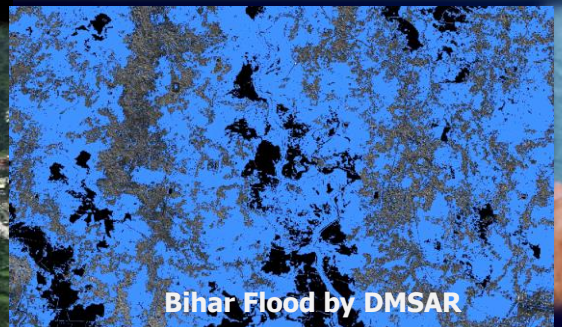


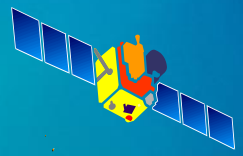
Presentation Overview

- Space & Disaster Management
- Disaster Management Support System
- Communication Support for Disaster Management
- Communication Tool for First Responders
- Disaster Management tool for Post Disaster
- Experiences of Uttarakhand and J&K Disaster Support
- Upcoming Hybrid Communication Network for DMS

Space and Disaster Management

Convergent solution

* COMMUNICATIONS
* MET IMAGING
* REMOTE SENSING DATA



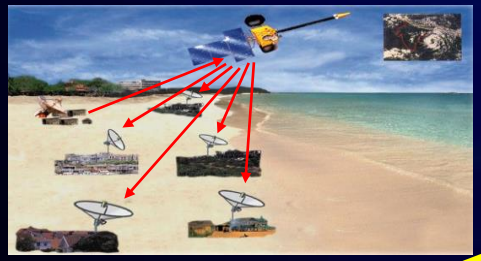
VULNERABILITY ANALYSIS

ZONATION

RESPONSE PLANNING

IMMEDIATE- & LONG-TERM

PREPAREDNESS



DISASTER-WISE

PREDICTION

FORECAST MODELS

OBSERVATION & WARNING

VIGILANCE SYSTEM

PRE-DISASTER

DISASTER IDENTIFICATION

OBSERVATION

IMMEDIATE RESPONSE

TIMELINESS

RELIEF

RECOVERY

LONG-TERM RESILIENCE

MONITORING

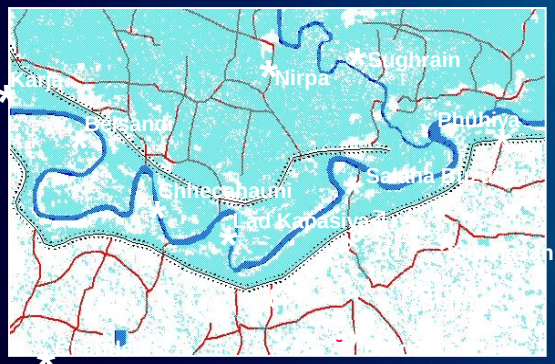
REHABILITATION

IMPACT STUDY

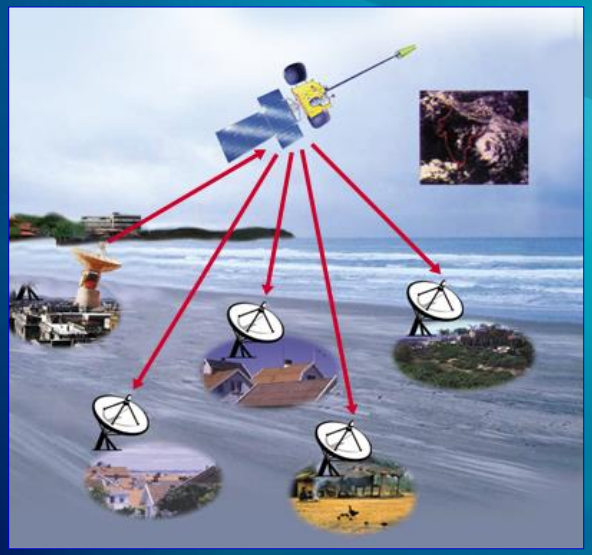
POST-DISASTER

Glimpses of Disaster Management Support Activities

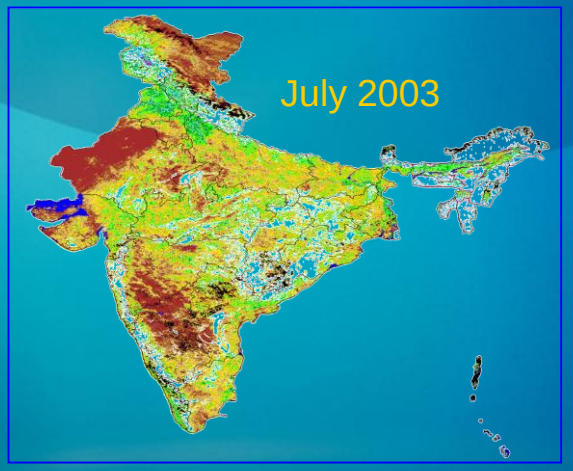
Flood Monitoring



Cyclone Warning

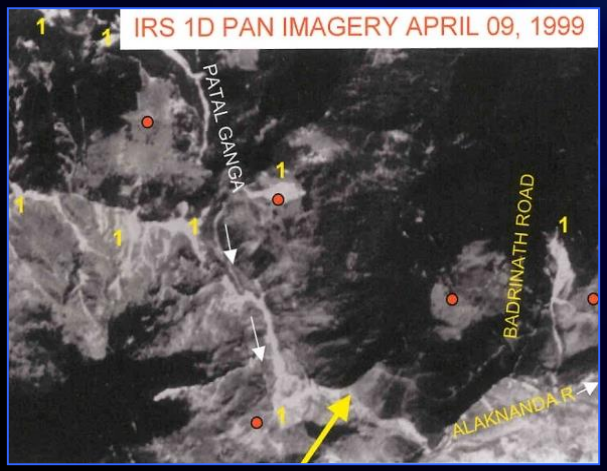


Drought Monitoring

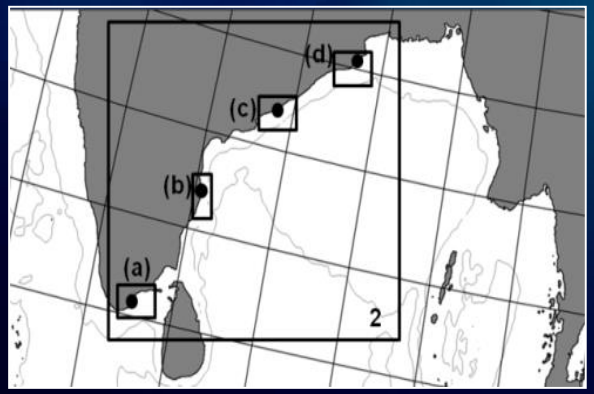


R&D: NDVI & Rainfall anomaly based

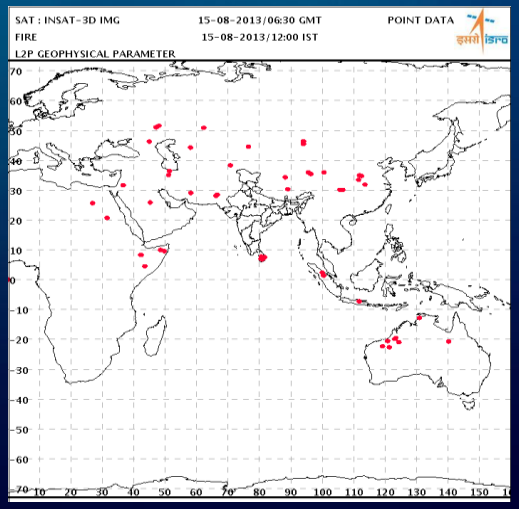
Landslide Hazard Zonation



Tsunami vulnerability



Fire Monitoring



Elements of Disaster Management Support (DMS) System

Assets and Infrastructure

Satellite, Aerial & Ground Systems

Met/ Ocean Observations

Emergency communication

High-Res. Imaging

Laser Terrain Mapper

Real Time Mapping

All weather mapping

Geo.

LEO

Aerial

AWS

Ground based

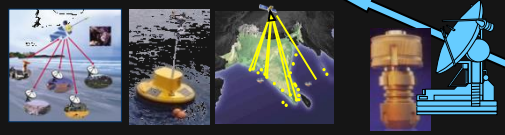
DWR

Delivery Mechanisms

CWC, IMD, GSI, MOES/ DOD, DST, FSI, ..

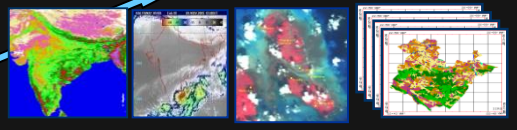
Decision Support Centre (DSC)

MHA, NDMA, MoA, PMO, State Agencies



Networking, Early Warning

Products & Services – Damage Assessment, Monitoring, ..



NDEM, Hazard Zonation, Risk Assessment, …

Technology Development & Research , Forecasting/ Simulation Models, ..

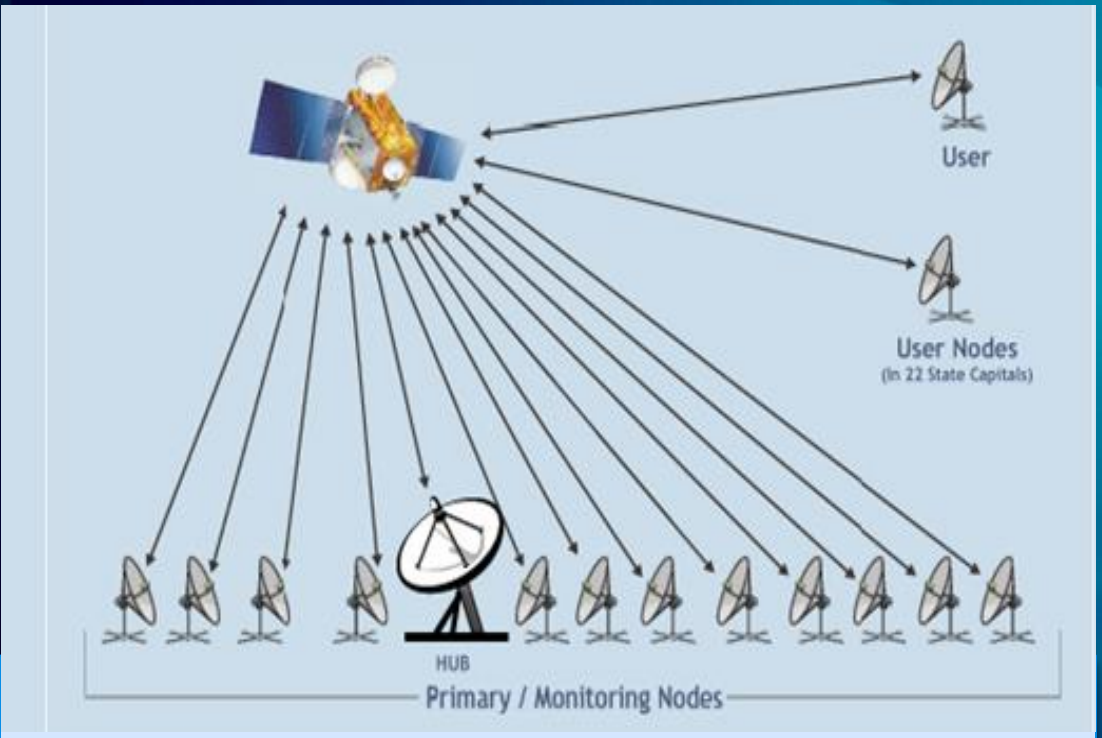
Emergency Communication Network - VPN; Support - MSS Terminal, WLL VSAT, …

Satellite Communication Technology & Disaster Management

- **Pre-Disaster** : Prevention by Surveillance and Early Warning
  - SATCOM is Most Effective *& Robust*
    - ✓ Nation wide coverage without gaps in communication
    - ✓ Relative immune from disasters
- **During Disaster** : Preparedness & Speedy Response
  - Handheld & Portable terminals for first responders – MSS Network
  - Communication network with minimum time for first response
- **Post Disaster** : Recovery & Rehabilitation
  - Communication support for trapped population & administrators
  - Provision for Integrated communication network e.g., Satellite with terrestrial systems like GSM/CDMA/Wi-Fi etc.

SATELLITE COMMUNICATION NETWORK IS MUST FOR EFFECTIVE DMS

ISRO's DMS Network: A dedicated Virtual Private Network Connecting Participating & Decision making agencies for Disaster Management Support operations



Satellite	: GSAT-12
Orbital Position	: 83 Degree East
Transponder	: Ext-C Band, Transponde#9
Bandwidth	: 36 MHz
Uplink frequency	: 6835±18 MHz
Downlink Frequency	: 4610 ±18 MHz
Access technology	: DVB-S / MF-TDMA

Hub Location:

Ministry of Home Affairs (MHA),
Samanvaya Sadan, Siri Fort Road,
New Delhi-110 049

Primary Nodes Location:

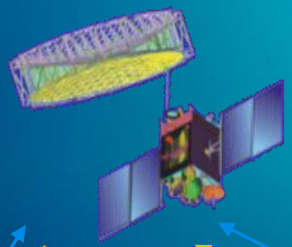
1) NRSC, Balanagar, Hyderabad
2) NRSC, Shadnagar, Hyderabad
3) Central Water Commission, New Delhi
4) Geological Survey of India, New Delhi
5) IMD, Mausam Bhawan, New Delhi
6) INCOIS, Hyderabad (Andhra Pradesh)
7) Space Applications Centre, Ahmedabad
8) Master Control Facility (MCF), Hassan
9)North-East Space Applications Centre, Shilong

User Nodes : 26 State Emergency Operations Centers (SEOCs) are connected using this network to provide communication support during disaster.

ISRO's MSS Network & Technology for First Responders

Satellite Phone

Portable Multimedia Terminal



GSAT-6

Camera

Hub

EPBAX

GSM Gateway

Network Diagram

NMS & Node for Remote Surveillance

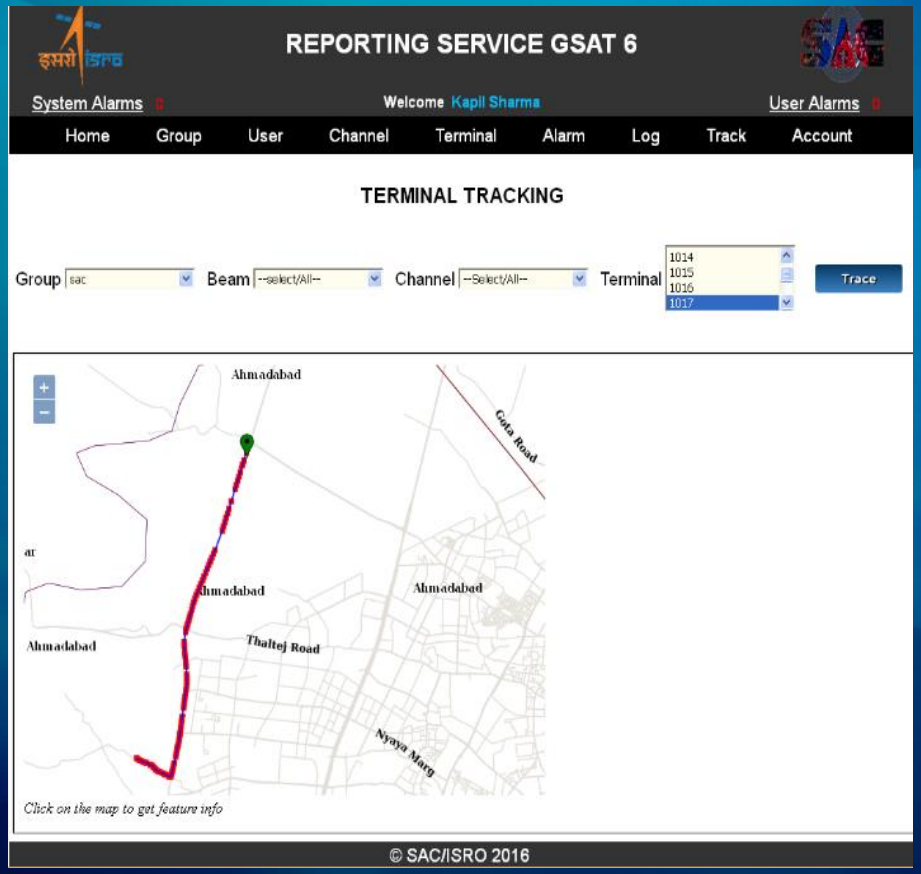
MSS Network for DMS:

- **Satellite Phone to support voice communication between terminal and any other telecom network**
- **Video Conferencing using Portable Multimedia Terminal**

ISRO's MSS Network & Technology for First Responders

Broadcast Receiver : Multichannel Audio-video and data reception terminal

Reporting Terminal : Transmitter for position and small message reporting.



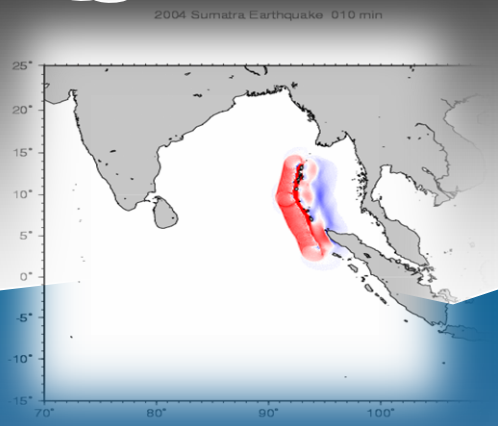
Features:

- **USB powered light weight Broadcast terminals with Android Phone to disseminate data (MAPS, Warning, Governance Related) to field persons from central control / decision makers**
- **Reporting Terminal with built-in GPS to support Personnel/Vehicle/Asset tracking and small message reporting from disaster site**

Tsunami Early Warning Communication System

INSAT

The Dec 26, 2004 Tsunami, originated near Indonesia, expanded to India, Maldives, Sri Lanka, Thailand, etc,



Antenna

HUB AT
NIOT/INCOIS

Tsunami Buoy

Sat Tx

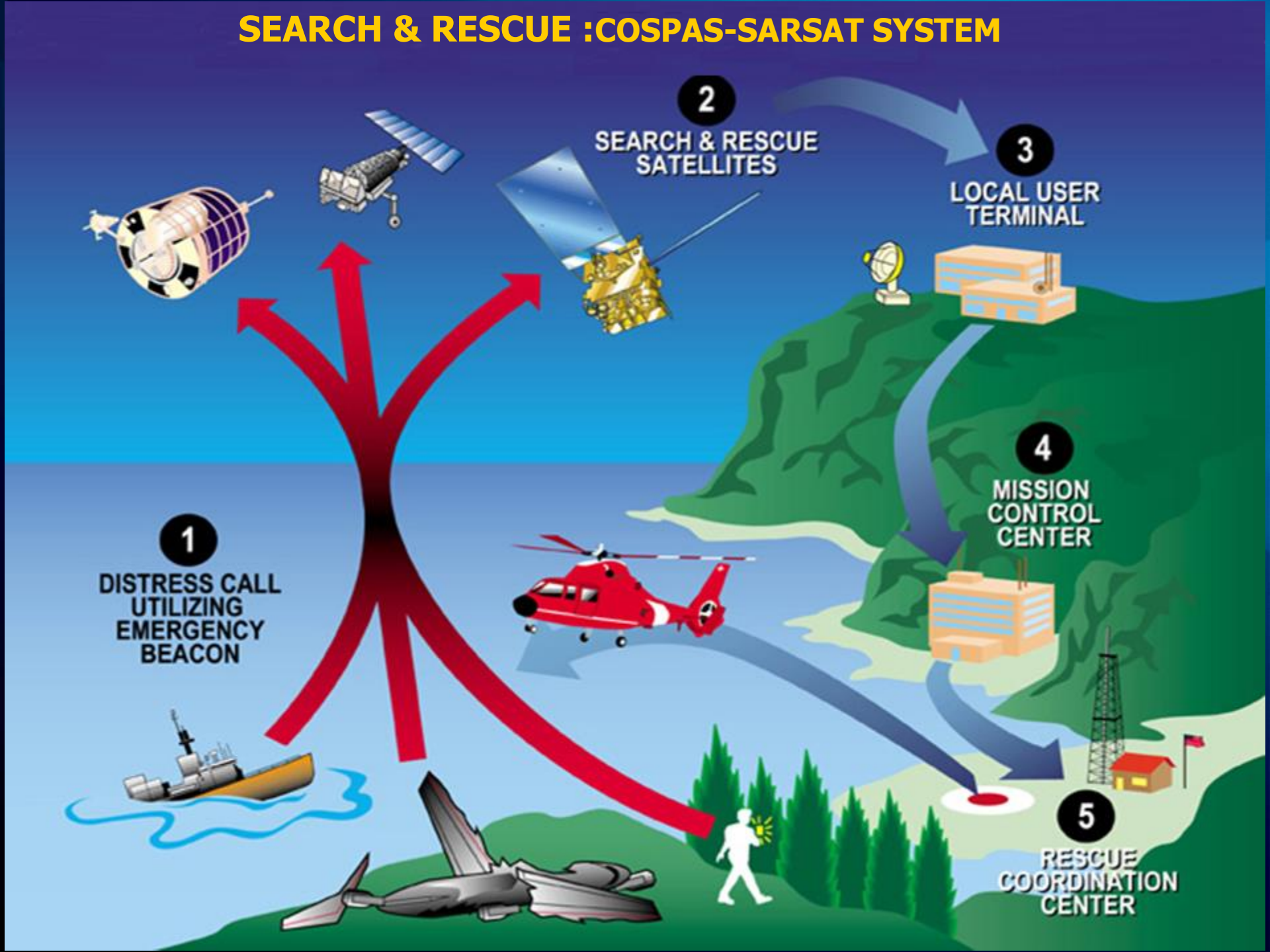
Acoustic
Transducers

Tsunami Early warning system

- Collection of Tsunami data from sea
- Collection of tide Gauge data from sea coast
- Used for prediction of Tsunami

Bottom Pressure Recorder

SEARCH & RESCUE :COSPAS-SARSAT SYSTEM



SATELLITE AIDED SEARCH AND RESCUE SYSTEM

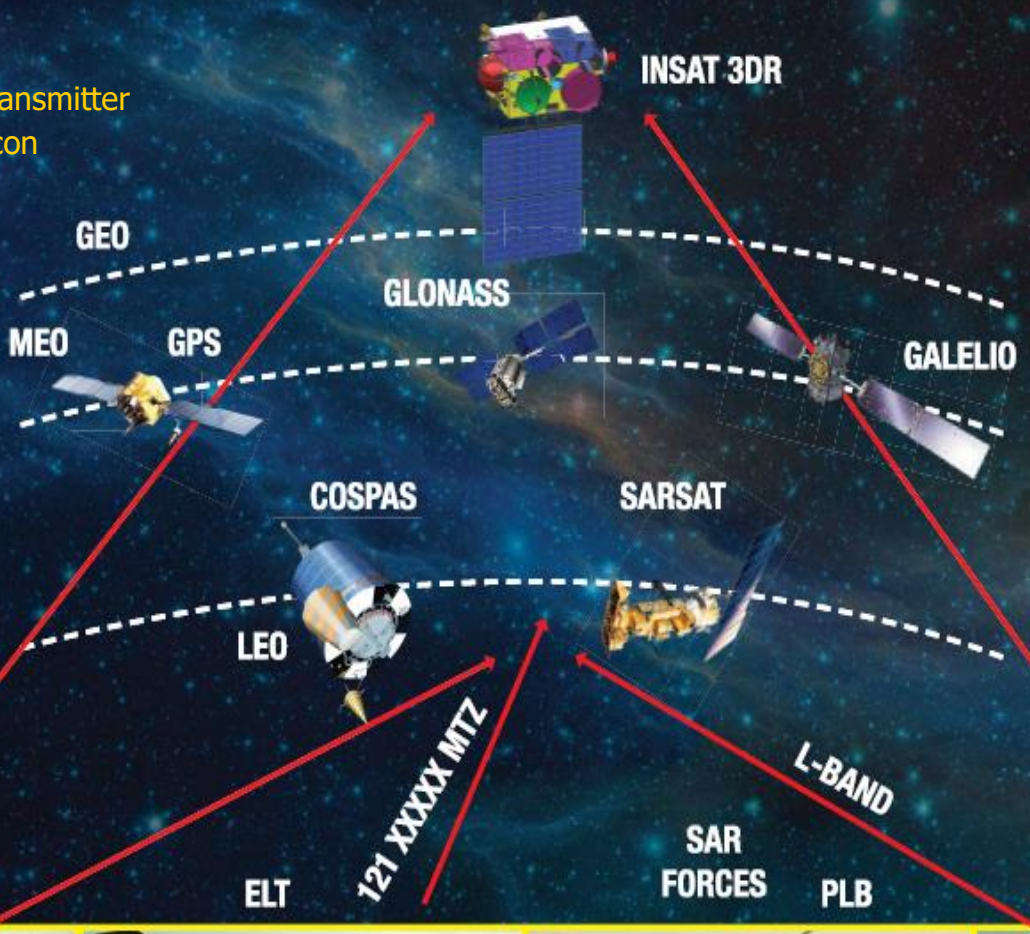
SAVIOURS IN SPACE

Radio Beacons – Types

EPIRB : Emergency Position Indicator Radio Beacon

ELT : Emergency Locator Transmitter

PLB : Personal Locator Beacon



DISTRESSED UNITS

RCC — MCC — LEOLUT

GEOLUT

DISTRESS ALERT TRANSMITTER

इसरो ISRO

SPACE APPLICATIONS CENTRE
INDIAN SPACE RESEARCH ORGANISATION

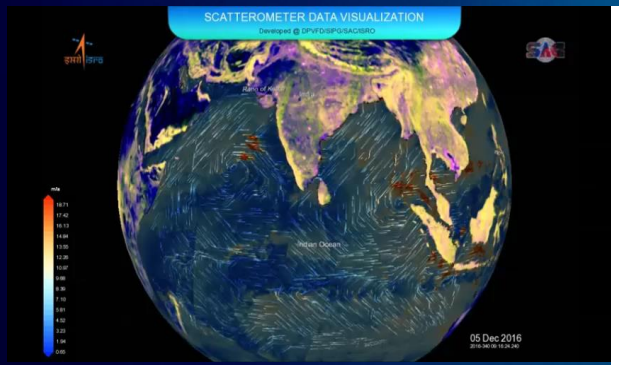
DISTRESS ALERT TRANSMITTER

- More than 10,000 terminals are operational.
- HUB Station operational with Indian Coast Guard
- Three Indian Industries are manufacturing terminal based on ISRO developed technology.

TRANSMITTER FEATURES

- *Low cost* and *affordable* to fisherman.
- In built *GPS* to give *position* and *time* information.
- Transmits type of *emergencies* like *fire, boatsinking, man overboard, medical health* on manual activation.
- *Transmission* lasts for *24hours*, with every *5min average* duration.
- Uses *omnidirectional antenna*, suitable for fishing fleet.
- *Test transmission* facility.
- Uses *lithium primary battery (7.2V/3.2AH)*
- *Floatable*

Tropical Cyclone Prediction using Satellite Imagery



Dec 15 2016 : The Times of India (Mumbai)

Isro satellites saved 10,000 lives in TN

Srinivas Laxman

Mumbai: Two Isro satellites played a key role in saving a large number of lives mainly in Tamil Nadu when Cyclone Vardah unleashed its fury on Monday.

An Isro official told **TOI** that data from the two satelli-

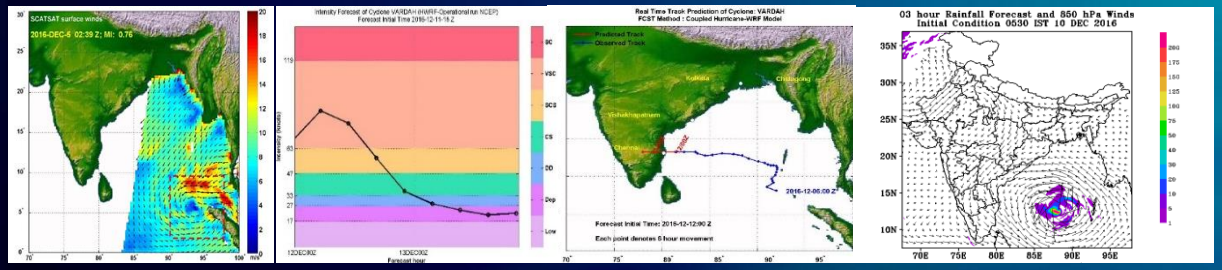
While more than 10,000 human

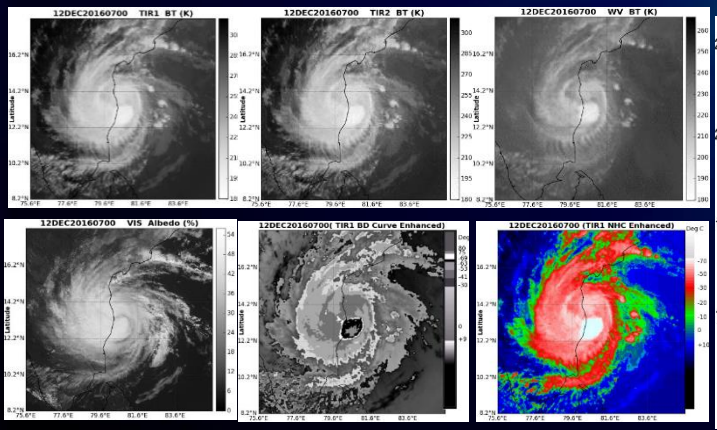
Real-time prediction of TC VARDAH

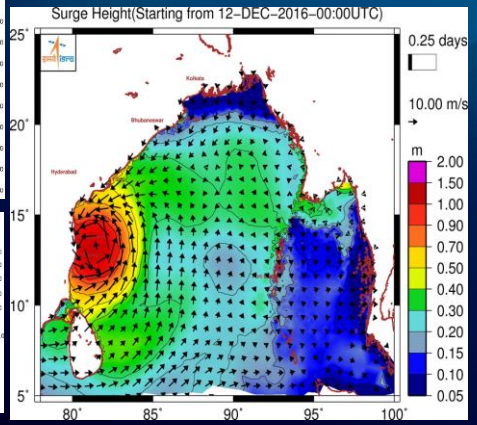
Cyclogenesis Prediction Time	Cyclone Formation Time
05-Dec-03 Z (3-Day lead)	08-Dec-00 Z

Cyclone Landfall Predicted (24-H lead)	Cyclone Landfall Occurrence
12-Dec-10 Z 80.4 E 13.4 N	12-Dec-11 Z **(1-H error)** 80.6 E 13.2 N **(~ 35 km error)**

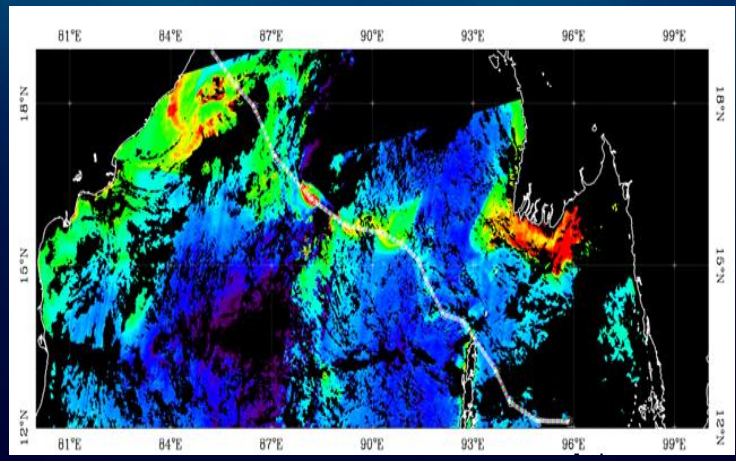
Cyclogenesis | Intensity | Track | Rainfall





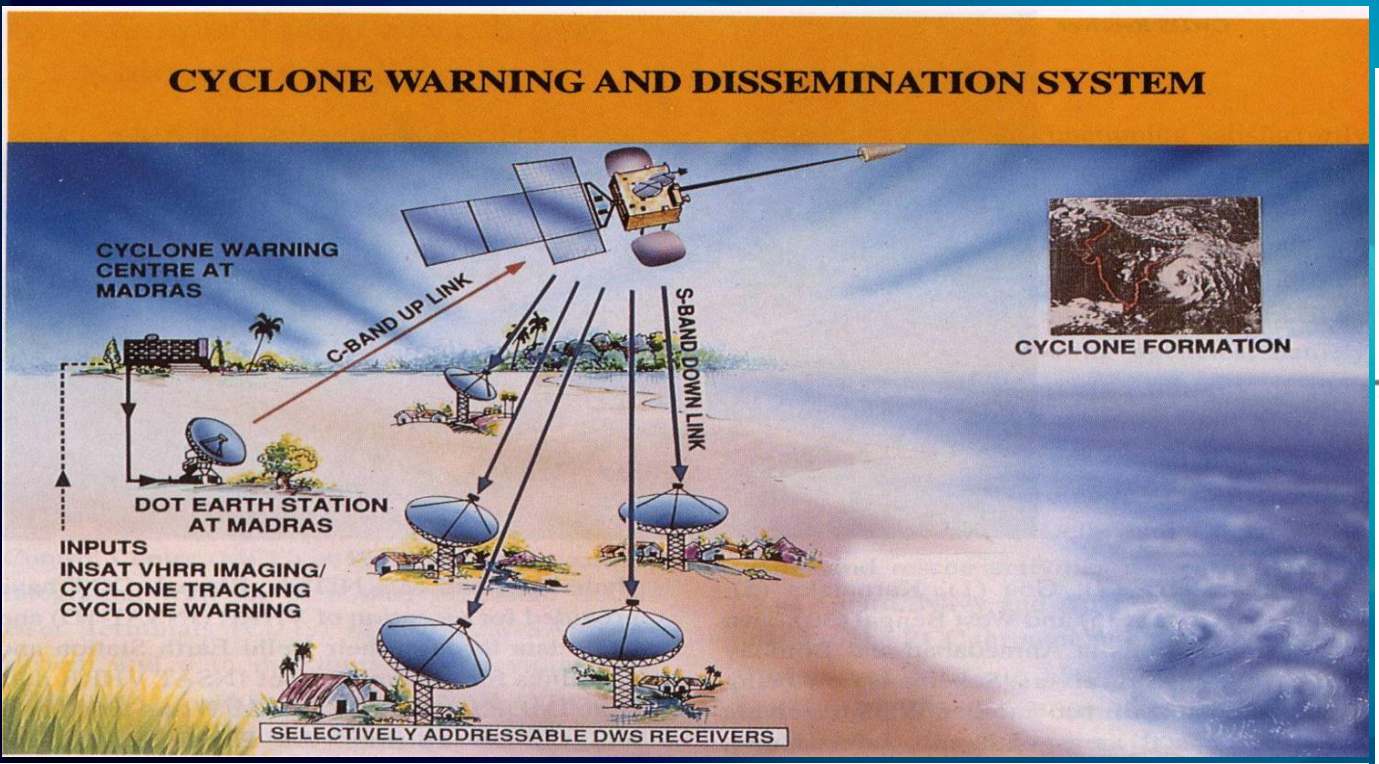


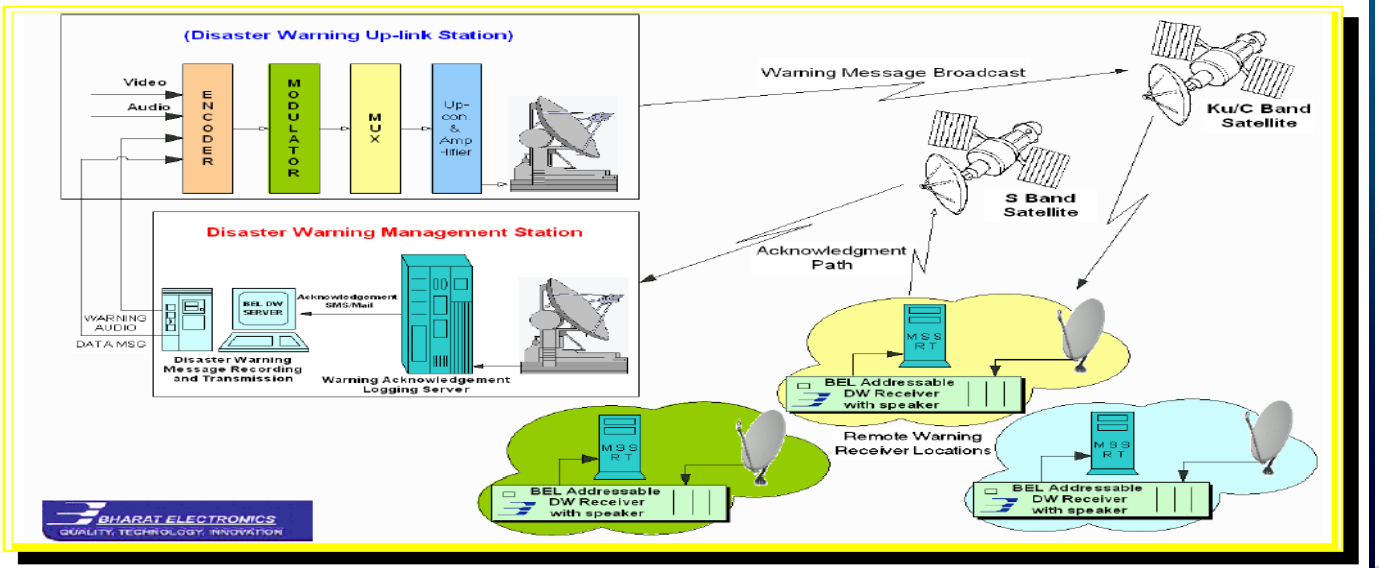
Cyclone Induced Primary Productivity : Phailin Cyclone



Cyclone centric satellite products from different channels of INSAT-3D satellite for TC VARDAH (0700 Z 12 DEC 2016).

Cyclone Warning System





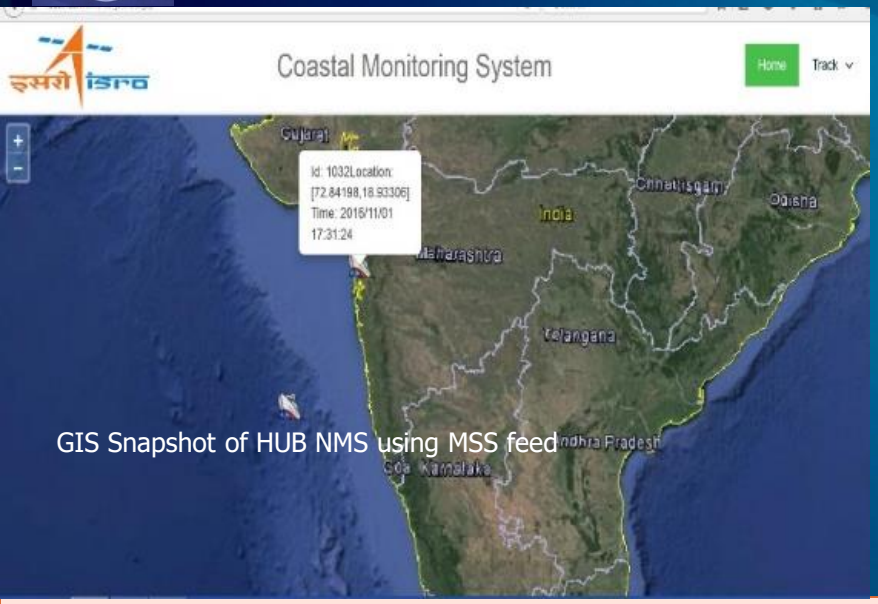
Genesis of CWS

1980-90 : 3.6m Antenna

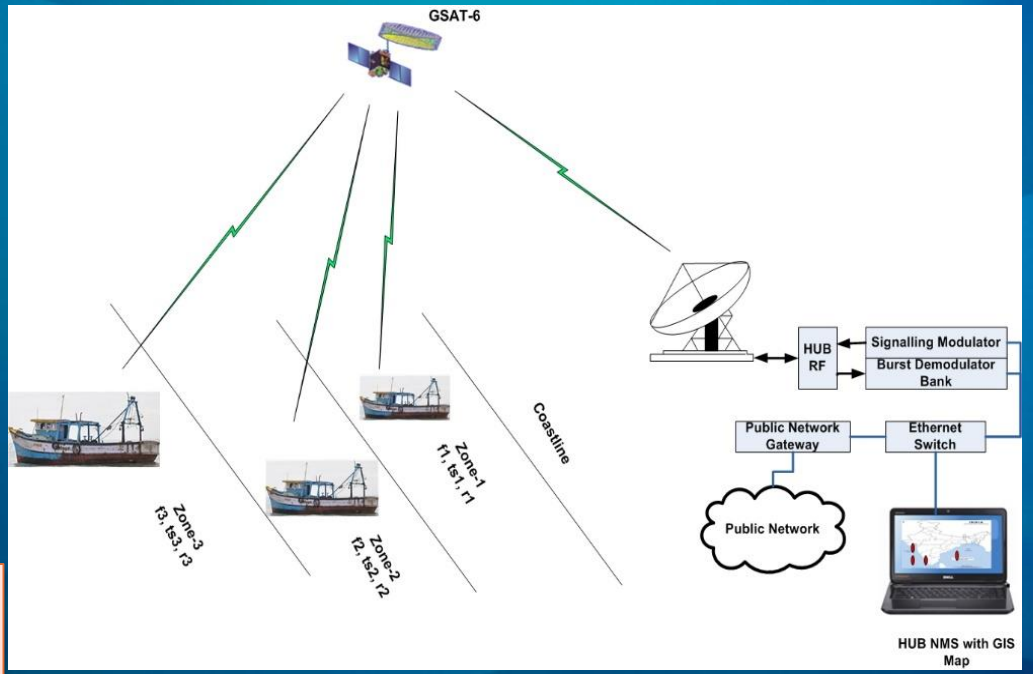
2000 : 1m Antenna – DCWDS Receiver With MSS- Type-C

Present : 0.6/0.8 DTH with STB

MSS Network for Coastal Surveillance, Emergency Messaging & Disaster Warning for Sub-20m Boat



GIS Snapshot of HUB NMS using MSS feed



HUB NMS with GIS Map

Demonstration of Ship Vessel Tracking at Maritime India Summit -2016- Mumbai

Network Block Diagram

Terminal Developed by SAC-ISRO

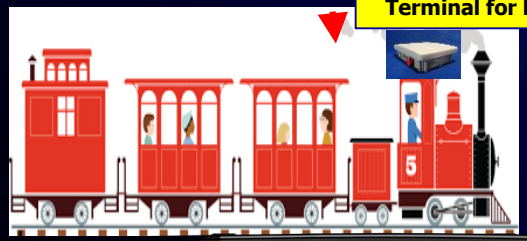
MSS Network For Indian Railways

GSAT-6

ISRO MSS HUB
/GATEWAY
@ DELHI

CRIS
DATA CENTRE

Railway MSS
Terminal for loco



GPRS

Terrestrial
Network

GPRS

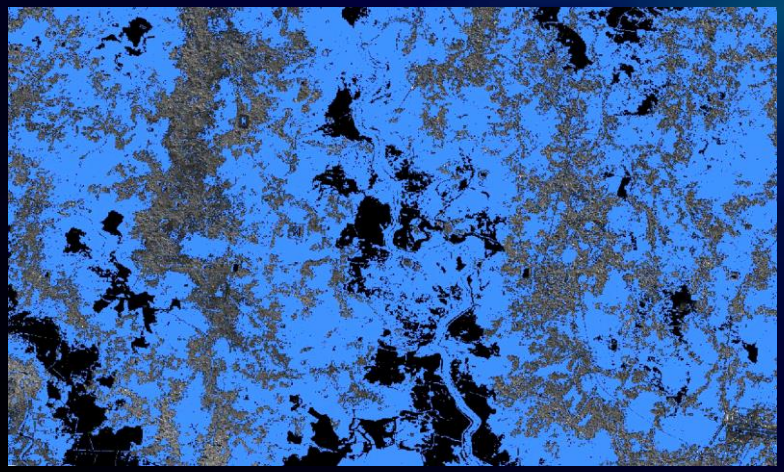
MSS Terminal

Rail Navigator

DMSAR

C-Band DMSAR (Ver-1)
FIRST FLOWN ON NOV 26, 2005

C-Band DMSAR
(Ver-2), 2011



Extent of Flood over Dharbhanga, Bihar in 2007 (Blue: Flood) As viewed by DM-SAR

Operating frequency	5350 MHz
Polarization	HH, VV
Slant range resolution	<2 m (Exp), 3 m, 5 m, 10m
Azimuth resolution	<2 m (Exp), 3 m, 5 m, 10m
Swath coverage	6 Km (Exp), 25 km, 45 km, 60 km

ISRO Disaster Management SATCOM Support in Jammu & Kashmir

Discussion with Minister

Chief Minister trying Wi-Fi gadget to reach unreached using SATCOM

Kashmir: An Aerial; View after flood

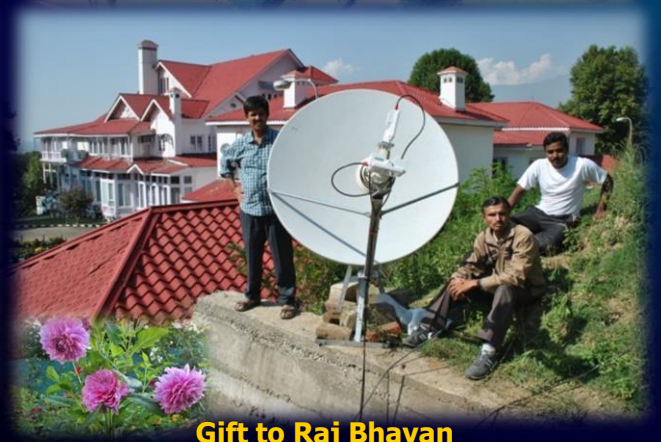
SATCOM to help in governance at Rajbhawan

VSAT-Installation at Sri-Nagar

Kashmir: Seven days after initial flooding

Our system @ use

SAC Team @ WORK



Gift to Raj Bhavan

Our onsite effort

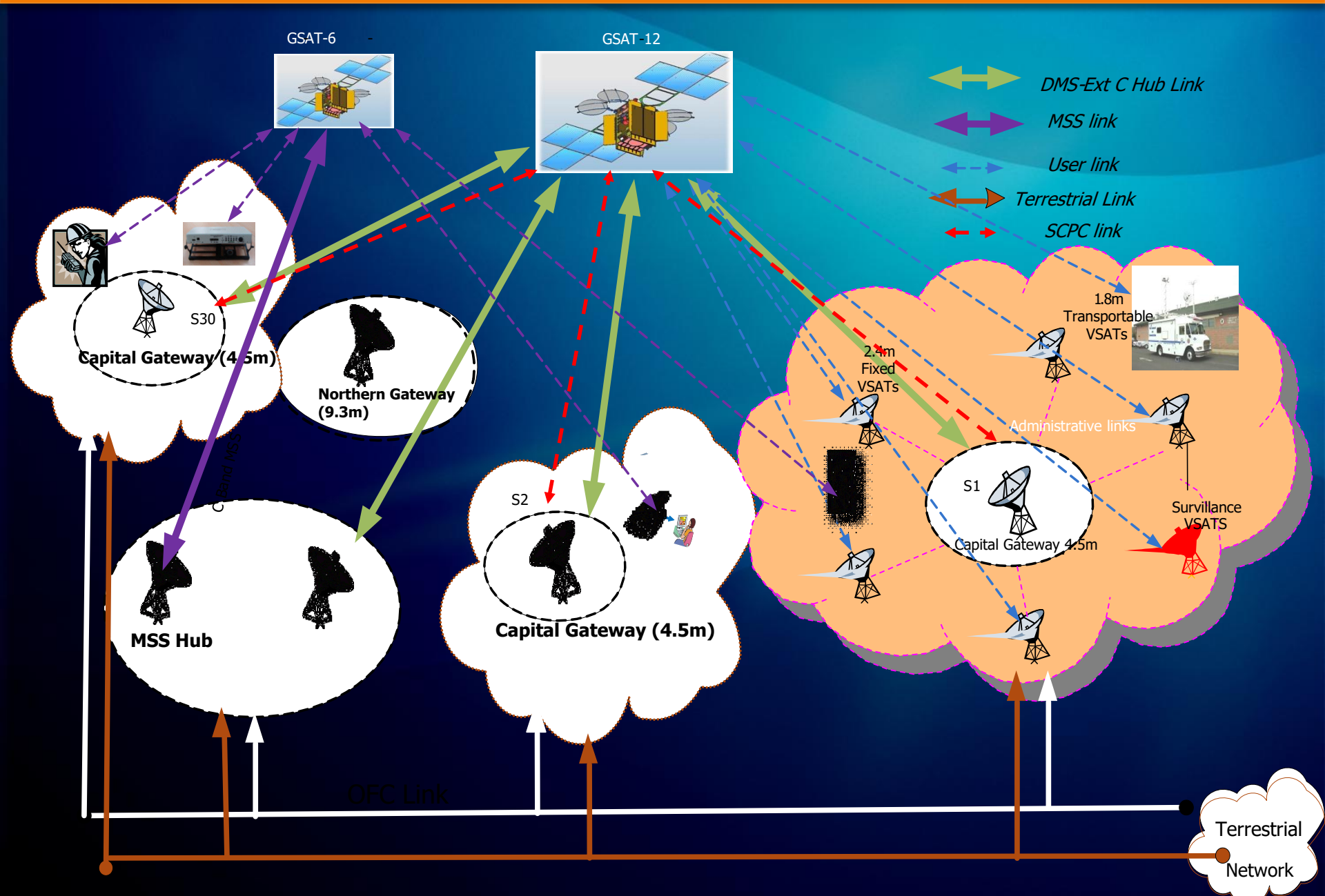
Lessons Learnt from J&K and Uttarakhand

- Long Response Time (ERV's required)
- Nodes provided only point to point service
- No effective tool for first responders (MSS needed)
- Absence of Technological convergence between different communication technologies & services (Hybrid Network Needed : Terrestrial & SATCOM)

ISRO's Initiatives

- Designing Network architecture with high survivability using advanced technologies
- Addition of new dimensions like efficient disaster warning, surveillance, prevention etc.
- Communication system for first response (MSS based system like voice & data terminal)
- Developing and integration of diverse technologies like GSM/CDMA/Wi-Fi /FM broadcast with satellite on-field VSAT nodes for wide area communication
- Provision for extending the reach of on-field VSATs by 5-10 km to extreme remote locations through simple low cost appliances
- Rapidly Deployable and Transportable VSATs

Proposed Upgraded National Satcom Network for Disaster Prevention and Disaster Management (DPDM)



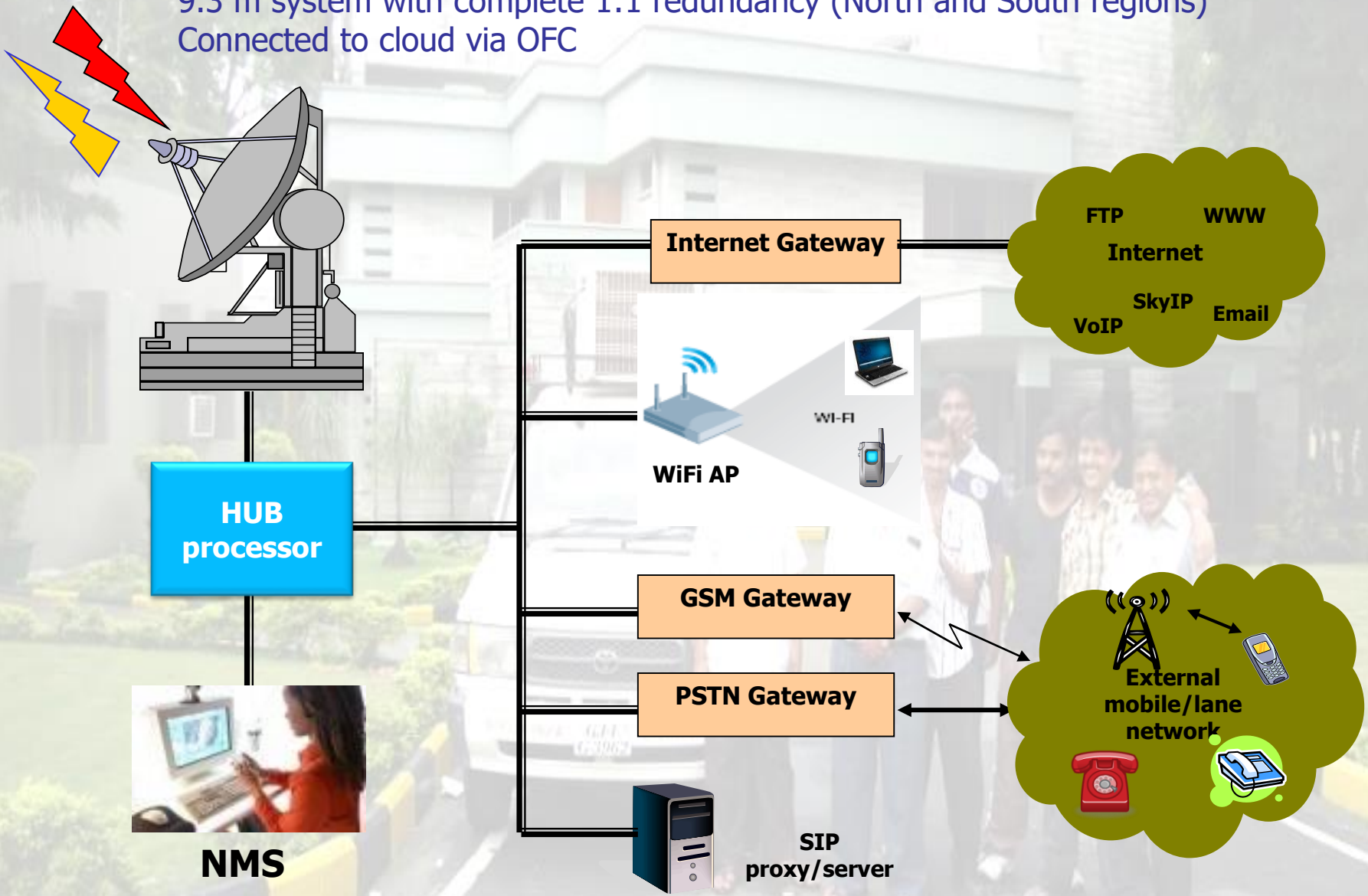
Any knowledge is worth only when it helps to solve problems & aspirations of mankind…

SAC/ISRO-Using Space as a tool to Reach the Un-reachable

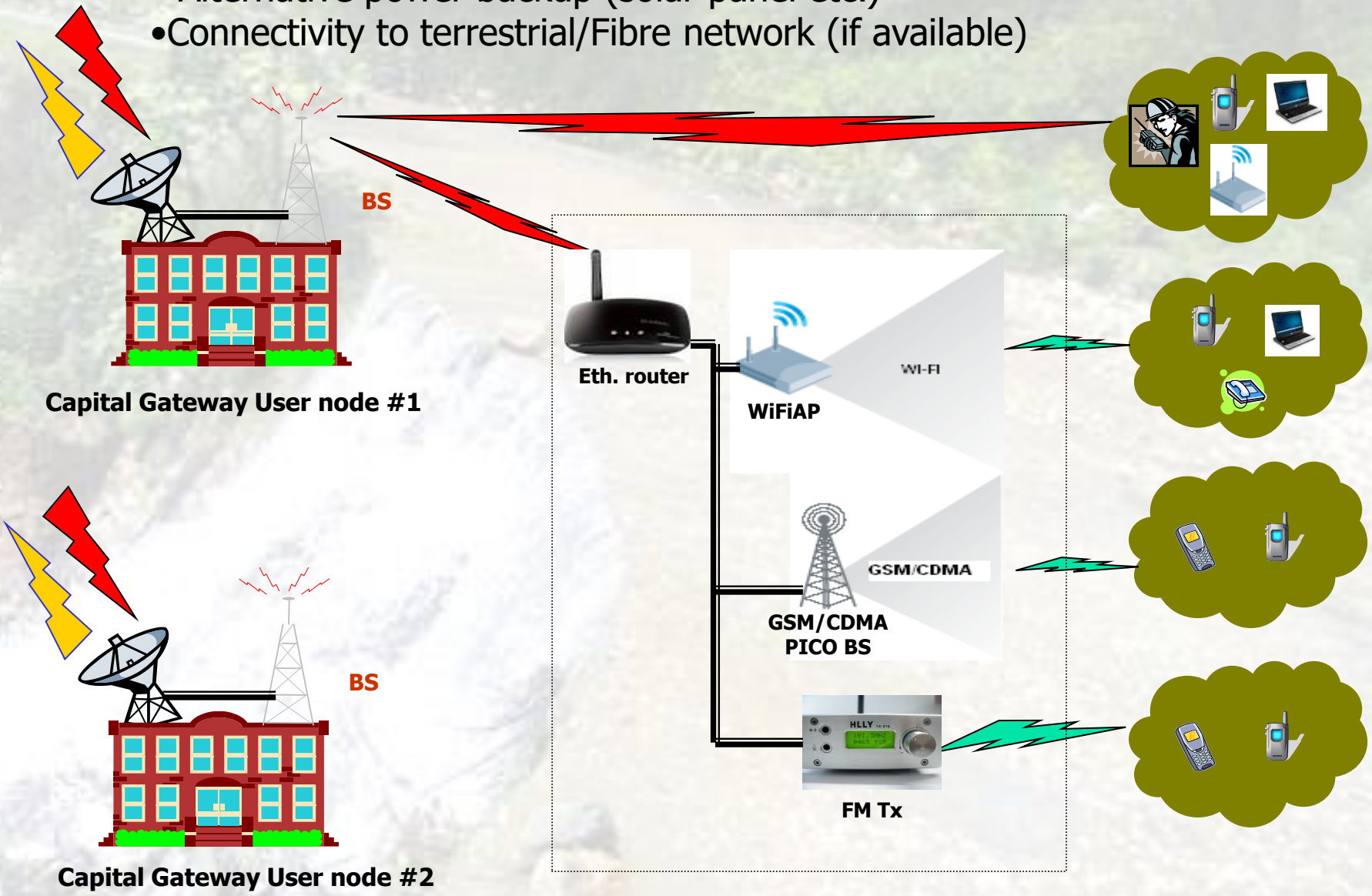
Thank You …

HUB configuration

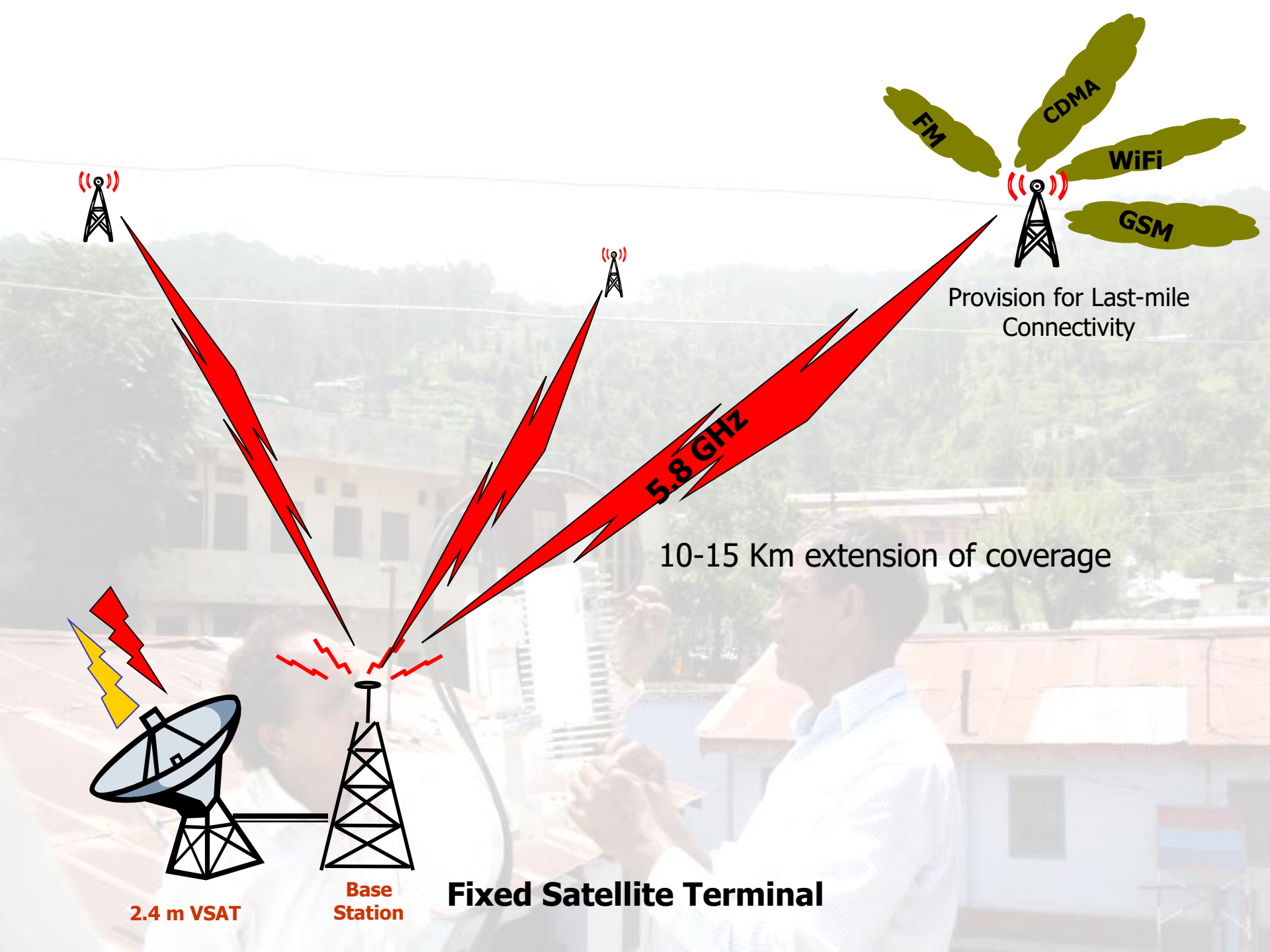
9.3 m system with complete 1:1 redundancy (North and South regions)
Connected to cloud via OFC



- 4.5/2.4/1.8 m antenna fixed/portable VSAT
- Last mile connectivity (WiFi, GSM, CDMA, FM)
- Alternative power backup (solar panel etc.)
- Connectivity to terrestrial/Fibre network (if available)



Capital Gateway With Last-mile Connectivity-wide area coverage

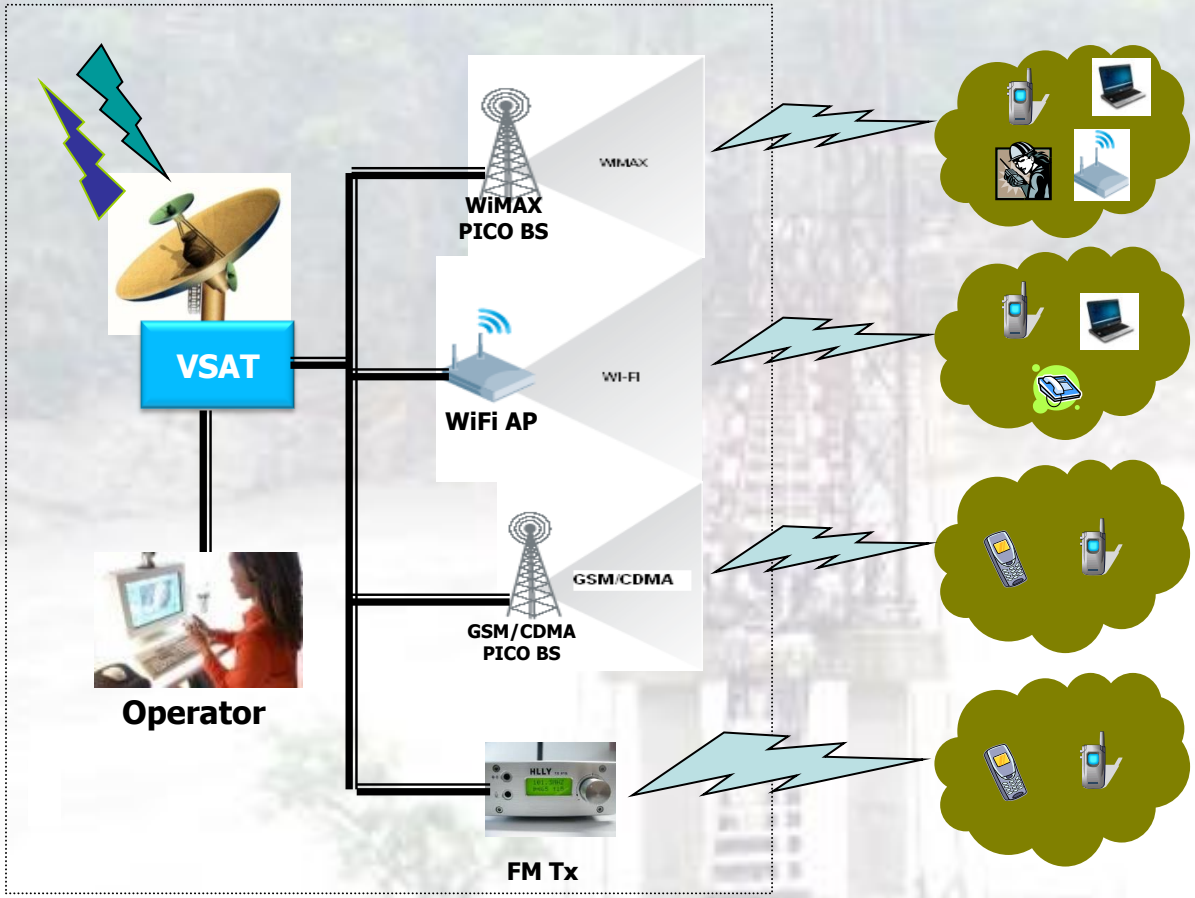


Provision for Last-mile Connectivity

10-15 Km extension of coverage

Fixed Satellite Terminal

1.8 m Portable Satellite Terminal



- 1.8 M VSAT, compact and easily transportable
- Low power consumption with sufficient power backup
- Simple & speedy installation
- Provision for last mile connectivity (WiFi, Wimax, GSM, CDMA, FM)