



Enabling Academia to Innovate, Industry to Invest & space applications to Integrate, Indian Space Programme: A case Study

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Indian Space Programme : Evolution



Born in 60's with a vision of national development and benefit to common man through Space



Gradual Increase in Space Assets : Starting experimental in 60-70s

- **80's** : 4 Satellites : experimental to Operational
- **90's**: 40 Transponders in C, Ext C bands with the support of 4 Operational satellites in Communication & 4 Remote sensing
- **2000's**: Nearly 44 Satellites with approx 300+ Transponders and multiple sensors in space

First time in the Indian History of Space Programme



- Successful launch of **Chandrayaan-1** in with its major scientific findings in 2009
- Successful **Insertion of MOM** in Martian Orbit in 2014 in its maiden attempt
- **Bulk Satellite launches in One-Go** through versatile launch vehicles in 2017

Moving Ahead with Satellite Manufacturing & Advanced Research & Development Activities to meet **NATIONAL DEMANDS** in a **BIG WAY**

Realised 90 + Satellites



Innovation, Integration & Investment : Space , Academia & Industry



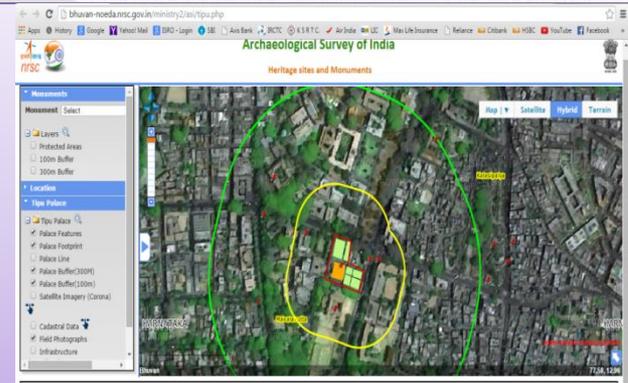
Promoting Space Technology Applications & Tools For Governance and Development



Promoting use of Space technology in Governance & Development

❖ Inventory & Site Management plans for Heritage Sites &

- Smart Smarac App for collecting :
Geo-coordinates & Demarcation of Zones
- Protected
- Prohibited (100m)
- Regulated (300 m)



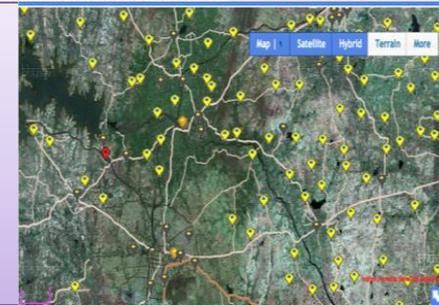
❖ Monitoring & Evaluation of Watersheds under IWMP

- Multi-date data, Platform & Application support
- Satellite Data: 966 out of 1038 projects uploaded
- 1.89 Lakh photos uploaded as on date.
- M & E conducted for 10 projects



❖ Geo-tagging of Post Offices & Citizen Centric Services

- Mobile App & Web Application deployed.
- 1.6 Lakh Post Offices Geo-tagged by D/o Post officials across the country
- Type of Post Office & Services



GEOSPATIAL TECHNOLOGY SUPPORT FOR NATIONAL MISSION FOR CLEAN GANGA

Comprehensive Geospatial Database

- High & very high resolution satellite data (both satellite/ aerial)
- Water Quality monitoring
- 3D Visualisation, Mobile apps
- Tools for community participation, Kiosks

Water Quality Monitoring

- Periodic spatio-temporal WQ map for specific WQ parameters using aerial/satellite measurements
- Hydrodynamic and Water Quality Modelling using field observed data

Geomorphological Monitoring & Evaluation

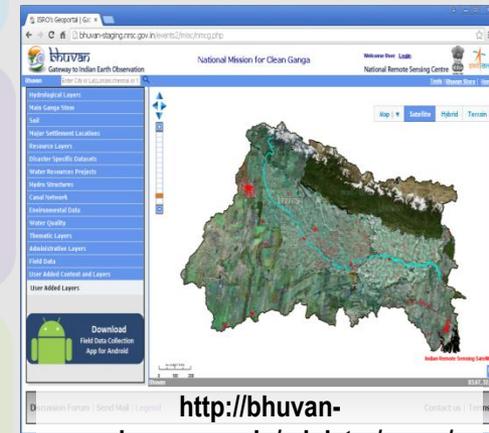
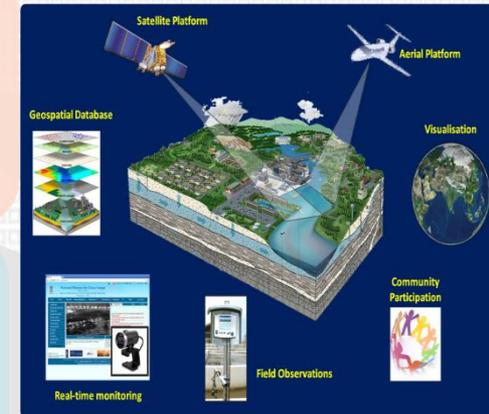
- Demarcate geomorphologic vulnerable areas
- Create a “*River Under Threat*” map
- Monitor post monsoon temporal dynamicity of the vulnerable areas

Hydrological Monitoring & Evaluation

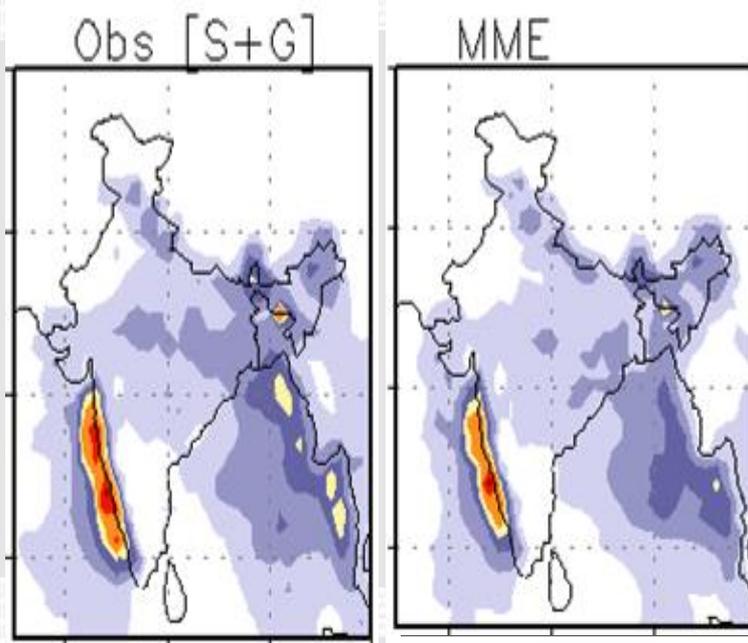
- Precipitation/Runoff, Hydrologic regime changes
- Flow Dynamics, Hydraulics
- Flood prone areas, sediment & Nutrients loadings
- River Front Development

Bio-resources Monitoring & Evaluation

- Monitoring of Aquatic plant invasions, algal blooms
- Riparian vegetation, Forest cover changes
- Forest fragmentation and Degradation



Economic Benefit- Few Examples

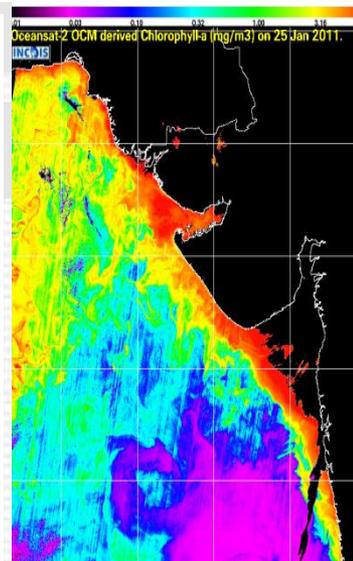
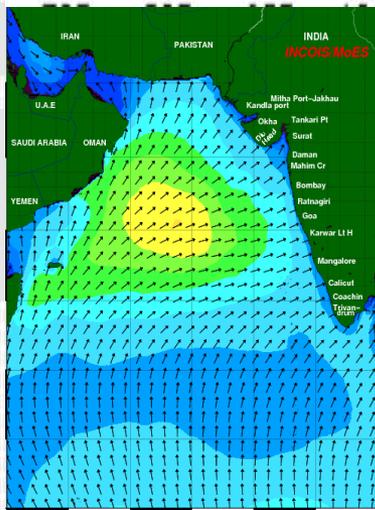


Agromet advisories

- Biweekly district-level weather forecast and crop specific advisory in local languages
- Provided through mobile to ~ 12 million farmers
- Annual Benefit of Rs 50,000 crores (NCAER, 2011)

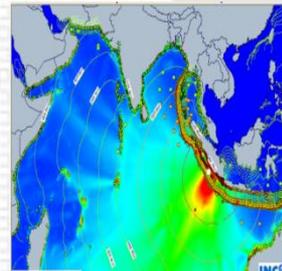
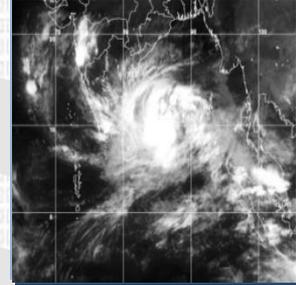
Ocean Services

- Potential Fishery Zone and ocean state (waves, currents) forecast (shipping, navigation)
- ~ 90 % fishermen are using forecast saving fuel & efforts
- Annual Benefit of Rs 34,000 crores- \$5 Billion (NCAER, 2011)



Societal Benefits – Disaster Management

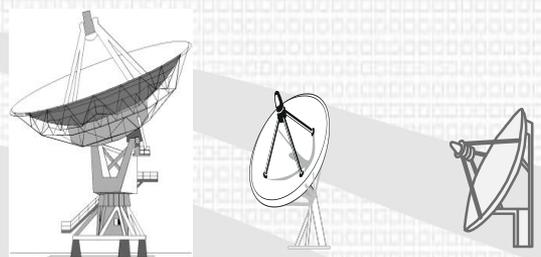
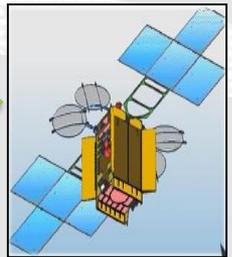
- **Weather** Advisories including severe weather alerts.
- **Cyclones:** Track, Landfall and associated rainfall, wind velocity, high waves, surge and inundation information 3-5 days in advance.
- **Tsunami:** Alert to 21 Indian Ocean Rim countries within 10 minutes of occurrence of an earthquake.
- **Drought:** Monitoring Helps in deciding relevant interventions at ground and policy levels.
- **Earthquake:** monitoring, Earthquake processes.
- **Flood:** Early warning & Flood Plain Zoning
- **Landslide:** Inventory / Susceptibility
- **Forest Fire:** Real time monitoring



Technology Advancements in SatCom



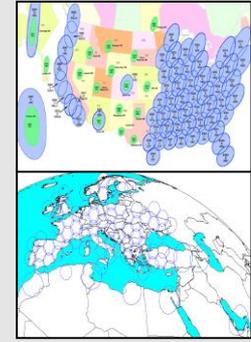
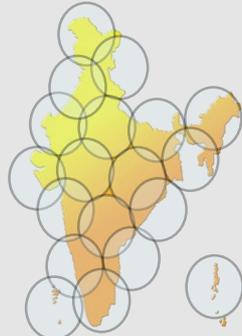
Bigger Platforms
Longer Life span



Terminals are becoming smaller

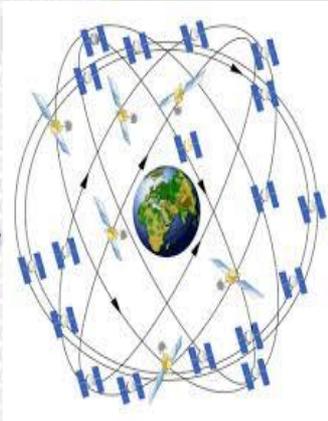


Optimized Coverages
Powerful Spot Beams
Frequency Reuse



Global Scenario

Moving towards constellation of LEO satellites



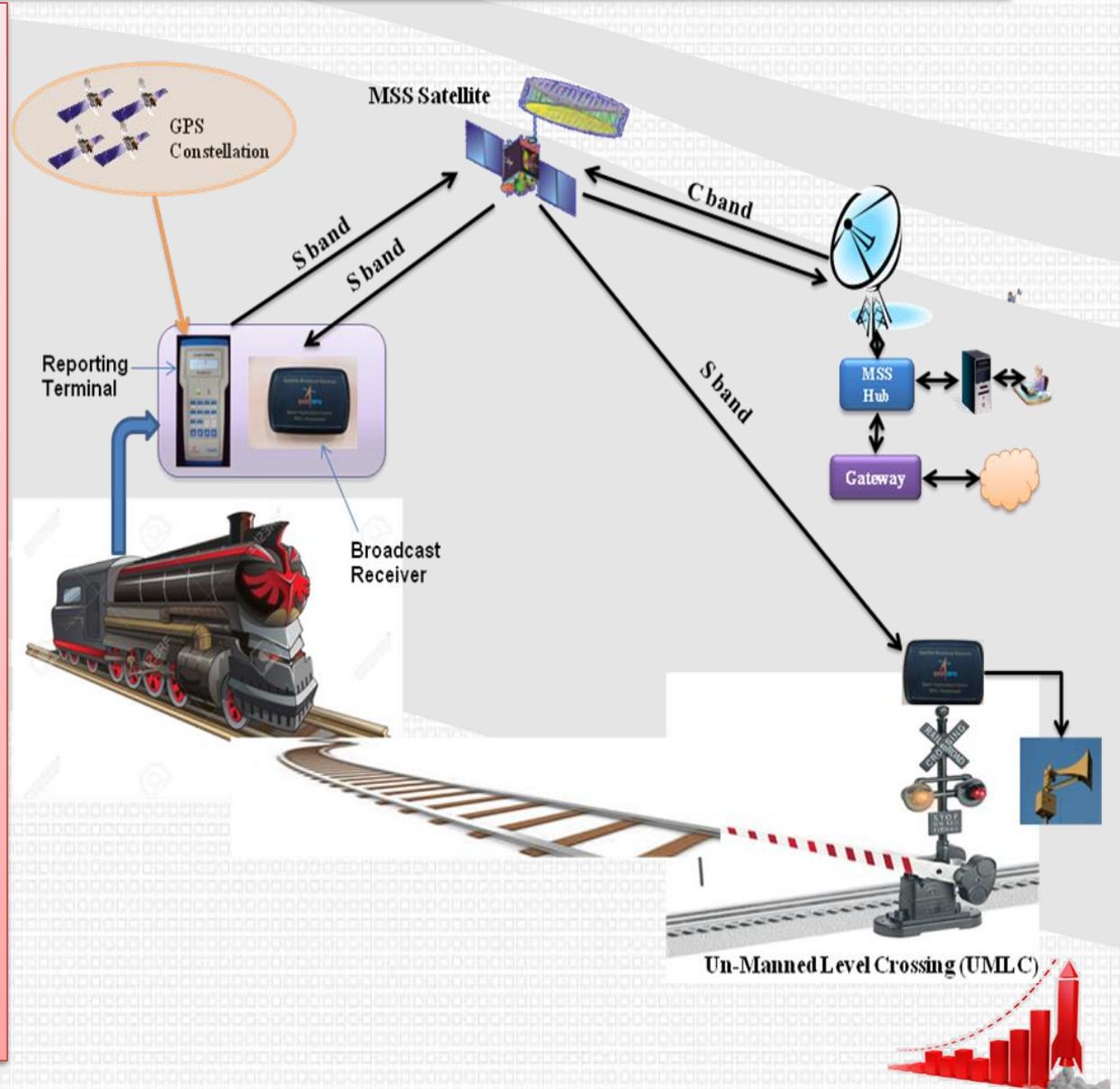
- Low Latency
- Smaller terminal
- Handheld devices
- Mobility services



Satellite Communication (SATCOM) and Satellite Navigation (SATNAV) based system for Warning at Level Crossing Gates.

The System is being developed with following objectives :

- Audio Visual Warning at the Level Crossing gates for Road users.
- Alarm for Driver in the Locomotive about approaching LC Gate.
- Navigation Aid to Loco Driver to draw his attention towards important mile-stones. These mile-stones may be next Signal/ LC gate, approaching gradient, neutral section or nearest Emergency Communication socket etc.
- Emergency messaging by Loco Driver (for concerned divisional control office).



Bhuvan & Mobile apps for geo-Governance

Visualization Platform



Platform for Free Data Clearing House

Satellite Data & Products

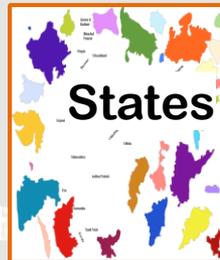
Platform for Building User Applications



Platform for Mapping and Analytics



Platform and Applications For States



Platform for Disaster Support



Platform for Building Mobile Applications



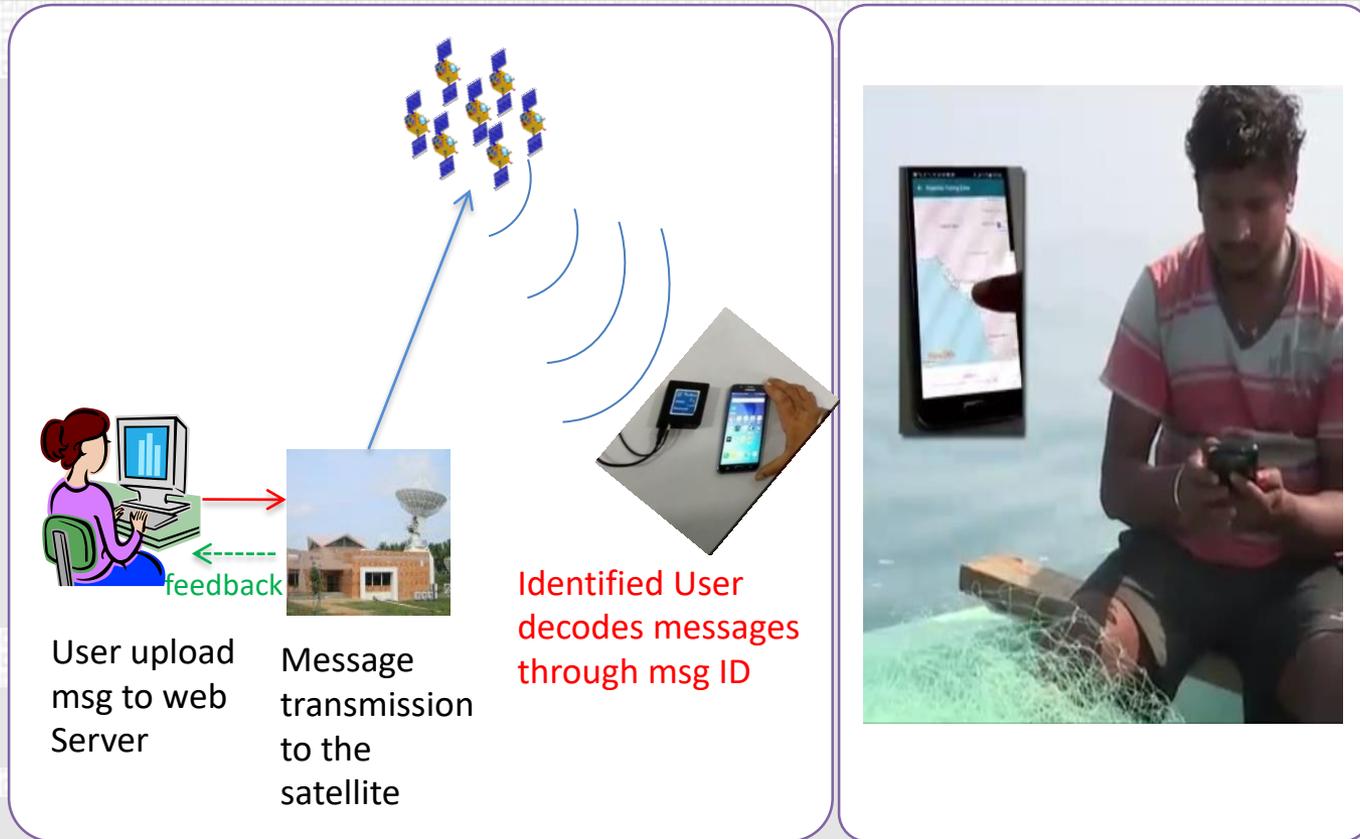
Bluetooth Based NAVIC (IRNSS) Receiver

- 80+ Mobile Apps.
- 25+ million data points
- Use of GAGAN & NavIC with mobile devices
- Crowd sourcing Applications using Mobile platforms



Registered users : > 150,000
Download: > 1 TB per month

Mobile App for Fishermen



- Messages on Potential Fishing Zone
- Navigation to desired PFZ
- Alerts on High Wave & Weather
- Alerts on approaching International water boundaries – to prevent inadvertent crossings



Innovation through Academia and Technology Transfer from Space Programme

- RESPOND – REsearch SPONsoreD in 56 Institutions
- SMART
- TREES
- Technology transfer : 300 technologies



SPIN-OFFS AND TECHNOLOGY TRANSFERS

ARTIFICIAL POLYURETHANE
FOOT

ADHESIVES

FIRE EXTINGUISHING
POWDER

SPIN OFF &
TECHNOLOGY
TRANSFER

LOWER ATMOSPHERIC
WIND PROFILER-LAWP

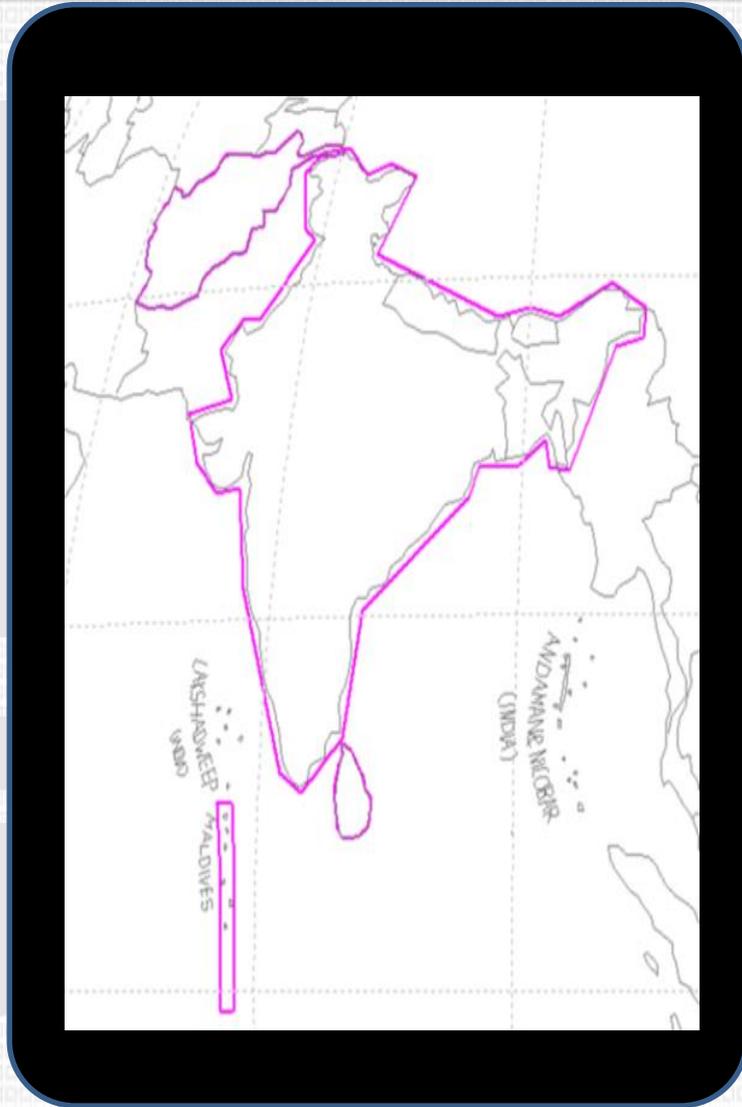
SILICA CLOTH
(ISROSIL)

DUAL POLARIZATION
LIDAR-DPL

AND OTHERS ...
totalling over 300



South Asia Satellite



KU BAND PAYLOAD

No of Transponders	12 (140W LTWTAs)
Highly Shaped Antennae	2.0m*2.2m Transmit (East) 1.4m dia Receive (West)
Freq	U/L - 13000 – 13250MHz D/L - 11200 – 11450MHz

- **Coverage** over Afghanistan, Nepal, Bhutan, Bangladesh, Sri Lanka, Maldives and India

Higher level Objective /Goal

Broadcasting and telecommunication applications in member countries.

- Television/Direct-to-Home channels,
- VSAT services,
- e-governance & banking,
- cellular backhaul,
- Tele-medicine & Tele-education etc..

In addition, the satellite will support applications of common interest to all the member countries







Prime Minister Narendra Modi said, “With this launch we have started a journey to build the most advanced frontier of our partnership. With its position high in the sky this symbol of South Asian cooperation would meet the aspirations of economic progress of more than 1.5 billion people in our region and extend our close links into outer space.”



Capacity Building



India's current Space Assets

Communication Satellites

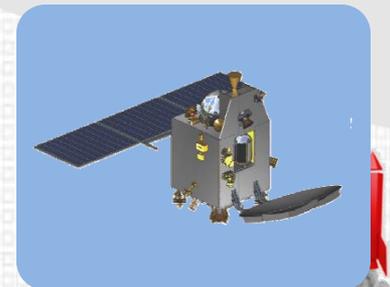
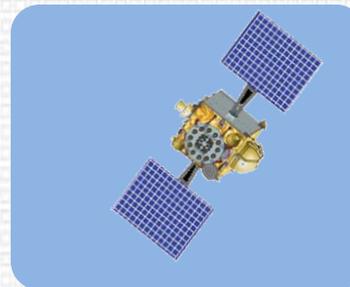
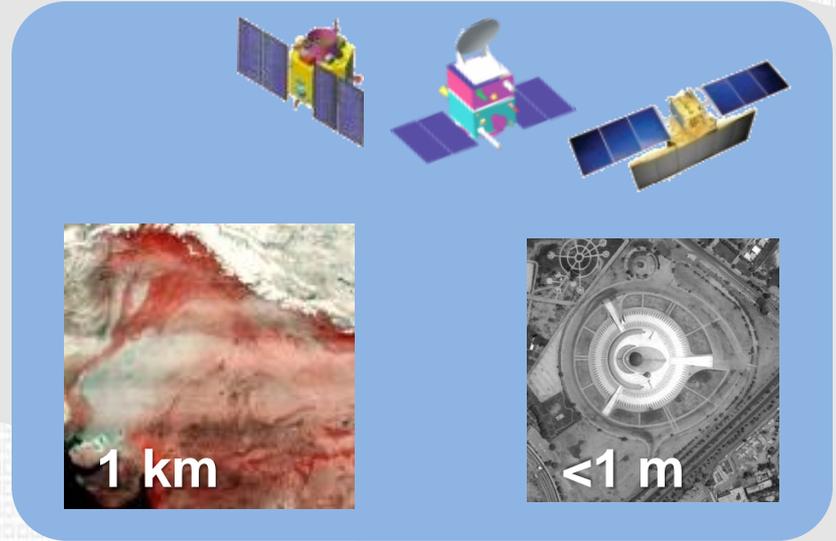
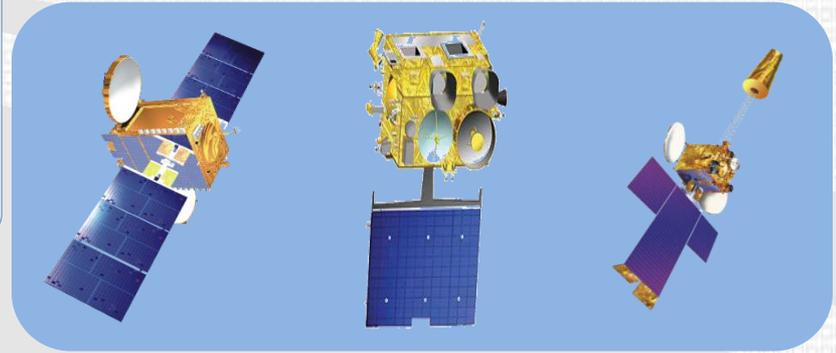
- **15 Operational** (INSAT / GSAT Series)
- **>300 Transponders** in C, Ext C & Ku bands
to be augmented with G-7A,G-1111,G-6A,G-20-30...

**Navigation Satellites : 7 (IRNSS 1A - IG)
& GAGAN Payloads in GSAT 8, 10 & 15**

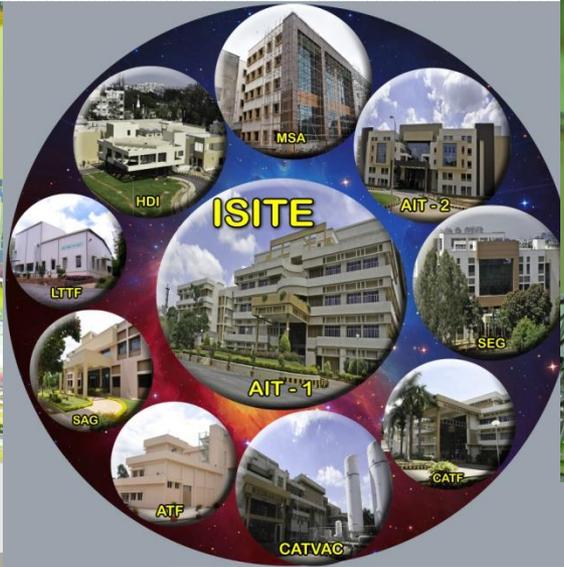
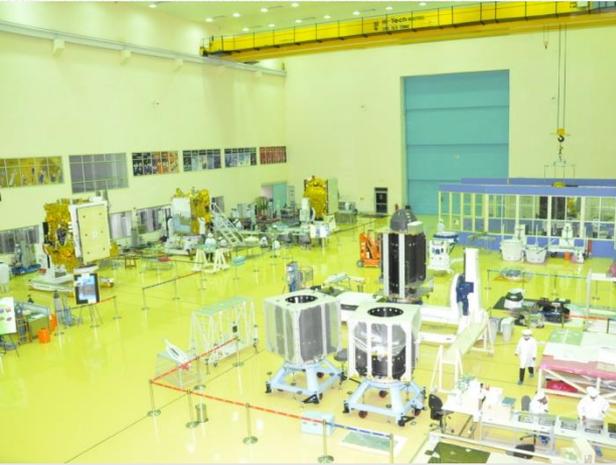
Remote sensing Satellites

- **3 in Geostationary orbit** (Kalpana-1, INSAT 3D & 3DR)
- **14 in Sun-synchronous orbit**
(RESOURCESATs / CARTOSATs / OCEANSAT-2;
RISAT-2; MEGHA-TROPIQUES; SARAL,SCATSAT-1)
*to be augmented with CARTOSAT 3; OCEANSAT-3,
GISAT, HRSAT...*

Space Science: MOM & ASTROSAT



A special initiative on Spacecraft Assembly Integration and Test support from Industry

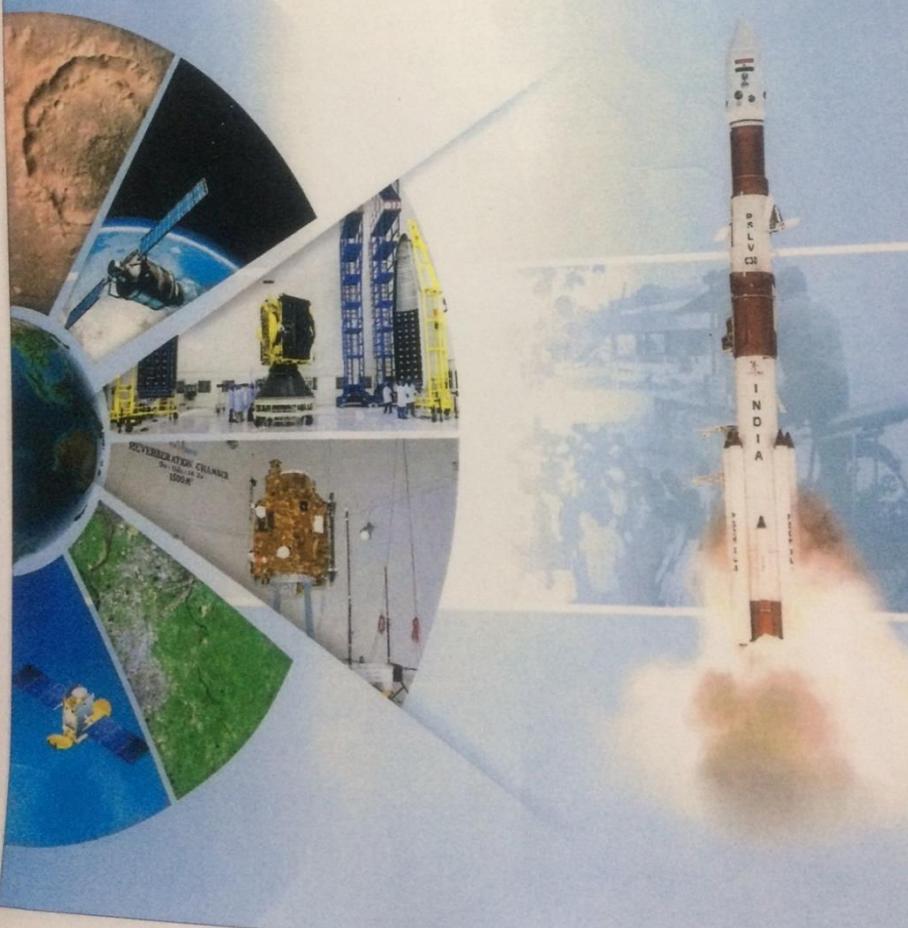




International Seminar on
INDIAN SPACE PROGRAMME

TRENDS & OPPORTUNITIES FOR INDUSTRY

NOVEMBER 20-21, 2017
THE ASHOK HOTEL, NEW DELHI



**International Seminar on Indian
Space Programme: Trends &
Opportunities for Industry;
November 20-21, 2017
New Delhi**



The most important factor in survival is neither intelligence nor strength but adaptability.

Charles Darwin

This is true for an Individual , an Organisation , a Nation & the Globe

Space – Academia – Industry :

An Opportunity for the Co-existence of

- Cost, Quality, Competition, Sharing and Collaboration





Space Enables us to get Connected & United
To have equitable prosperity

