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

- **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

http://bhuvan-noeda.nrsc.gov.in/ministry/nmcg/
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
- Optimized Coverages
- Powerful Spot Beams
- Frequency Reuse

Terminals are becoming smaller

Moving towards constellation of LEO satellites

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

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

The System is being developed with following objectives:

a) Audio Visual Warning at the Level Crossing gates for Road users.

b) Alarm for Driver in the Locomotive about approaching LC Gate.

c) 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.

d) Emergency messaging by Loco Driver (for concerned divisional control office).
Bhuvan & Mobile apps for geo-Governance

- Visualization Platform
- Platform for Building User Applications
- Platform for Building Mobile Applications
- Platform for Mapping and Analytics
- Platform and Applications For States
- Satellite Data & Products
- For Free Data Clearing House

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

Bluetooth Based NAVIC (IRNSS) Receiver

Registered users: > 150,000
Download: > 1 TB per month
Mobile App for Fishermen

- User upload message to the web server
- Message transmission to the satellite
- Identified User decodes messages through msg ID

- 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
- LOWER ATMOSPHERIC WIND PROFILER-LAWP
- SILICA CLOTH (ISROSIL)
- DUAL POLARIZATION LIDAR-DPL

AND OTHERS ... totalling over 300
South Asia Satellite

Broadcasting and telecommunication applications in member countries.

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

KU BAND PAYLOAD

<table>
<thead>
<tr>
<th>No of Transponders</th>
<th>12 (140W LTWTAs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Shaped Antennae</td>
<td>2.0m*2.2m Transmit (East)</td>
</tr>
<tr>
<td></td>
<td>1.4m dia Receive (West)</td>
</tr>
<tr>
<td>Freq</td>
<td>U/L - 13000 – 13250MHz</td>
</tr>
<tr>
<td></td>
<td>D/L - 11200 – 11450MHz</td>
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</tbody>
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Coverage over Afghanistan, Nepal, Bhutan, Bangladesh, Sri Lanka, Maldives and India

Higher level Objective /Goal

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 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