GROWTH IN TELECOM SPACE SEGMENT AND GROUND SEGMENT

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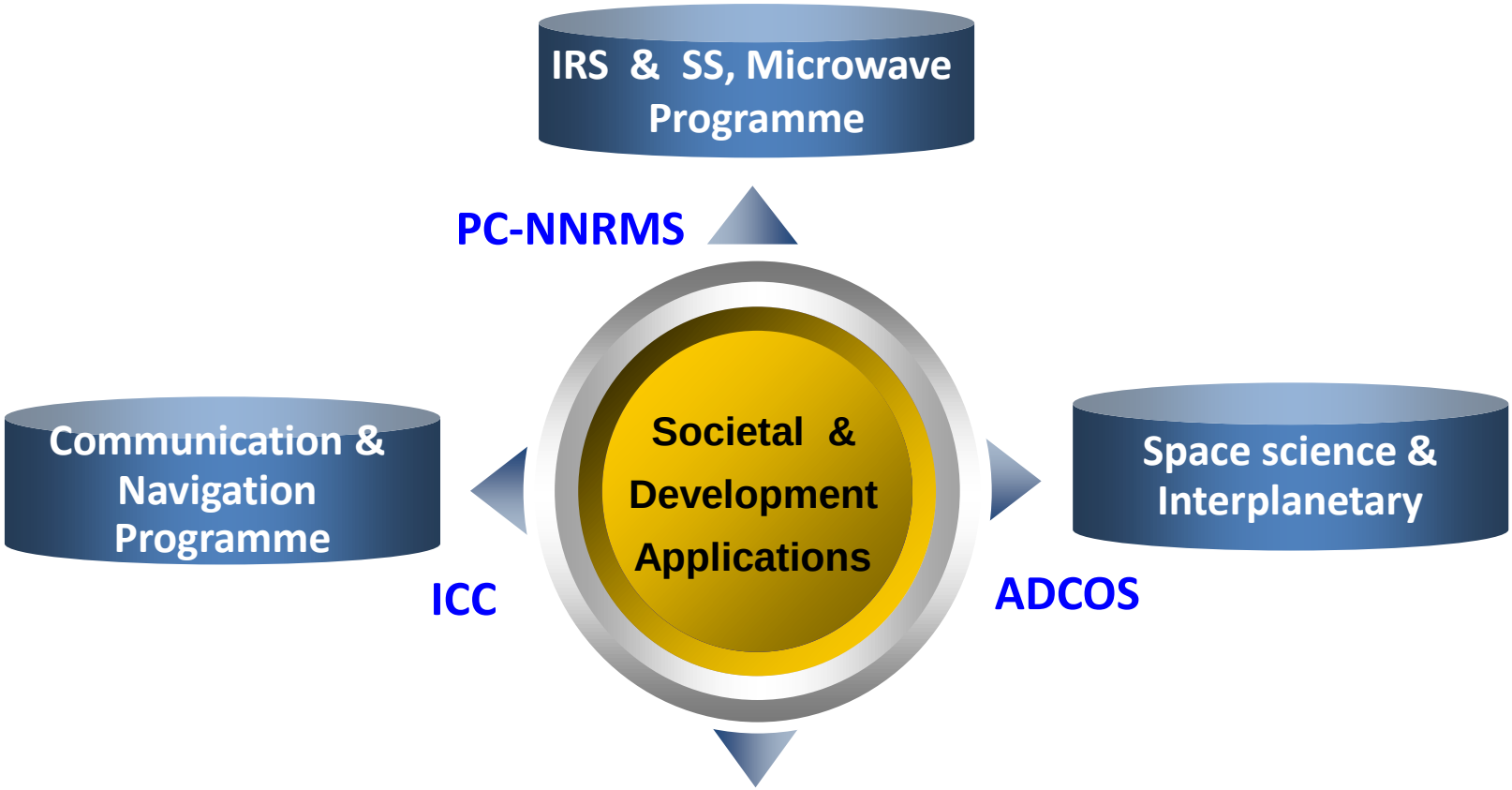
Contents

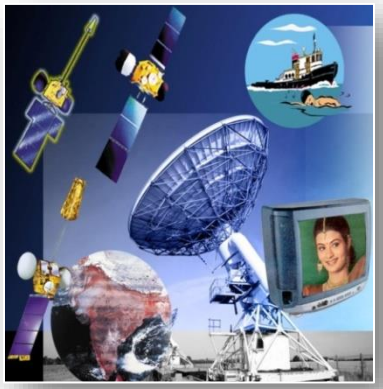
Indian Satellite Programme: Dimensions

Vision: Harness space technology for national development, while pursuing space science research and planetary exploration



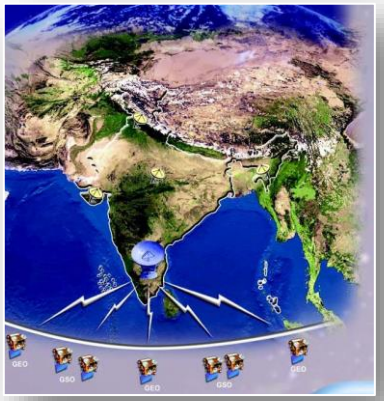
Natural Resources
Infrastructure- Communication & Navigation
Meteorology & Disaster Management, Space exploration

Satellite Applications – Societal Benefits



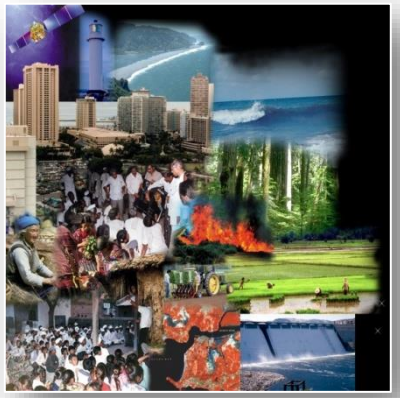
COMMUNICATION

- SPEECH CIRCUITS ON TRUNK ROUTES
- TV BROADCASTING
- BUSINESS COMMUNICATIONS
- MOBILE SATELLITE SERVICES
- RADIO NETWORKING
- SEARCH AND RESCUE SERVICES
- VSAT CONNECTIVITY
- METEOROLOGY IMAGING
- DISASTER WARNING SYSTEM



NAVIGATION

- IMPROVED POSITION ACCURACY
- NAVIGATION SERVICES : AIRCRAFT, SHIPS, VEHICLE, FLEET MOVEMENT, ROUTING / ALIGNMENT
- SCIENTIFIC RESEARCH APPLICATIONS FOR ATMOSPHERIC STUDIES
- IONOSPHERIC SCINTILLATIONS



REMOTE SENSING

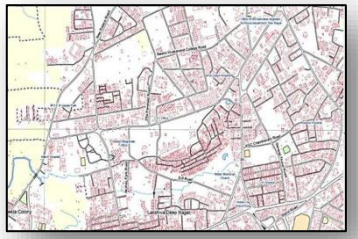
- AGRICULTURE & CROPS
- FOREST & BIO-RESOURCES
- WATER RESOURCES
- GEOLOGY
- OCEAN/COASTAL
- ENVIRONMENT
- RURAL DEVELOPMENT
- URBAN MANAGEMENT
- CARTOGRAPHY/MAPPING
- CLIMATE MODELLING
- GLOBAL CHANGE

National meet promoting space technology

- One day National Meet held on September 07, 2015 at Vigyan Bhavan, New Delhi.
- 60 Central Ministries/Departments, 28 States and 5 Union Territories participated.
- Prime Minister emphasized all Ministries to use space technology applications
- 160 projects encompasses applications across varied domains
  - Earth Observation & Geospatial (97)
  - Communication & Navigation (30)
  - Technology Development (10)
  - Meteorology (6)
  - Asset mapping & Mobile applications (8) & others (9)
- Some of these projects will also render support to Flagship Programmes of the Government of India viz. AMRUT, SMART CITY, HOUSING FOR ALL, CLEAN GANGA, PMKSY, DIGITAL INDIA etc.

Agriculture

Urban Development

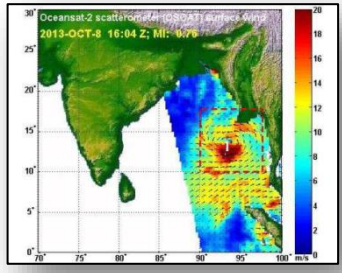


Tele education

Telemedicine

Fishing

Cyclone



Future Communication Satellites: Frontiers

Present domestic satellite communication is dominated by Fixed Satellite Services and Direct To Home services.

Future service growth areas :

- Internet, multi-media and personal communication services
- Direct to home high definition TV services
- Thematic missions such as Tele-Medicine, Tele-Education
- Bandwidth on demand services
- E-Governance and Strategic communications
- Satellite aided navigation
- VSAT Requirements

Future Communication Satellites: Frontiers

Communication payload configuration drive engines

- Ku-band DTH with national beam
- Ka-band broad band connectivity using multiple spot beams
- S-Band mobile communication using multiple spot beams with hand held terminals
- Broad band VSAT connectivity 0.512 - 4 Mbps data rates
- Onboard capacity building - 80-100 transponders
- High Throughput Satellites with 100 GBPS Capacity
- Spot Beam
- Spectrum reuse
- Reconfigurable payloads
- Steerable beams

Non GSO Communications

- MEO (8100 km) constellation of 12 satellites
- Ka band, weighs < 850 kg
- 70 beams from 12 satellites; up to 1.6 Gbps per beam throughput.
- Broadband data connectivity – satellite based 4G/LTE service
- Optimal coverage for $\pm$ 45^{o} Latitude
- Targets developing market – Africa, Asia pacific - the internet starved "Other 3 Billion"
- Pakistan is also a customer

- 648 satellites, Ku band; each weighing **110 kg**
- Deployed in 800-900 km non-stationery orbit- completion by 2019
- Small, low-cost user terminals talk to the satellites in the sky, and emit LTE, 3G and WiFi to the surrounding areas
- **Progressive Pitch** – a patented technology to avoid interference with GEO satellites.

Future Communication Satellites

High Throughput Satellite

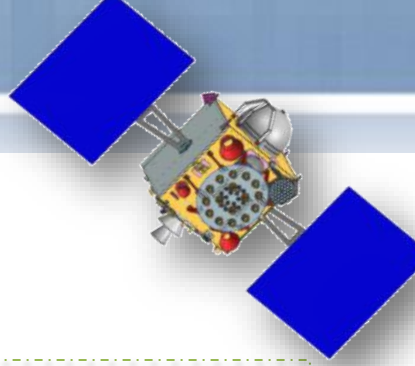
ISRO Ka-Band Objective:

- **To leap frog into next generation 6 Ton, 20KW bus development and realize Ka-band high throughput satellite of around 100 GBPS in multi beam star architecture for direct to home broadband services over Indian mainland and Islands.**

Salient Features

- **One firm Ka-Band HTS**
- **Coverage : India Mainland along with Andaman & Nicobar Islands**
- **Delivery Schedule of 36 Months**
- **Orbital location : TBD (Between 48 to 112 degree east)**
- **Spectrum Availability for Hub link 1 GHz and for User links: 500 MHz**
- **Service Availability for Hub link 99.9 % and for User Link 99.6 %**
- **4-6 steerable spot beams within or outside India**
- **Spacecraft configuration 6 Ton, 15 kW class satellite with mix of chemical and electric propulsion.**
- **Mission Life > 15 Years with 1 year margin & Design Life > 18 Years**

Navigation Programme – Future Frontiers

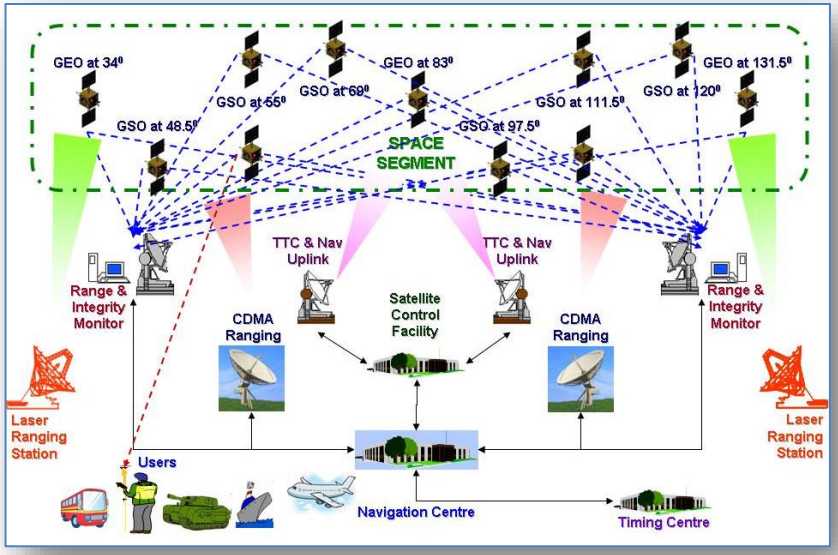


NAVIC

- Bus: ISRO's Standard I-1K Bus
- LOM: 1425 Kg; Power: ~ 1600w
- Payload : Navigation & Ranging Payload operating in S & L5 bands
- Mission Life: 10 years
- **IRNSS-1A,1B,1C,1D,1E,1F, 1G : In-Orbit**

IRNSS Constellation Completed – April 2016

Extension of Constellation



2nd Genx IRNSS Series

- Services in L1 besides L5 & S band for additional services, interoperability and compatibility with other GNSS operators.
- Spacecraft with spot-beams to handle interference and jamming signals.
- Inter-satellite links.
- Clock ensemble
- Electric propulsion.

Future Remote Sensing Satellites: Frontiers

The major thrust areas of Remote sensing programme are **Launch on Demand and to provide continuity of services** in the Land and water resource observation, Ocean and Atmospheric series, Cartography & large scale mapping application and Micro wave imaging

NEW TECHNOLOGIES

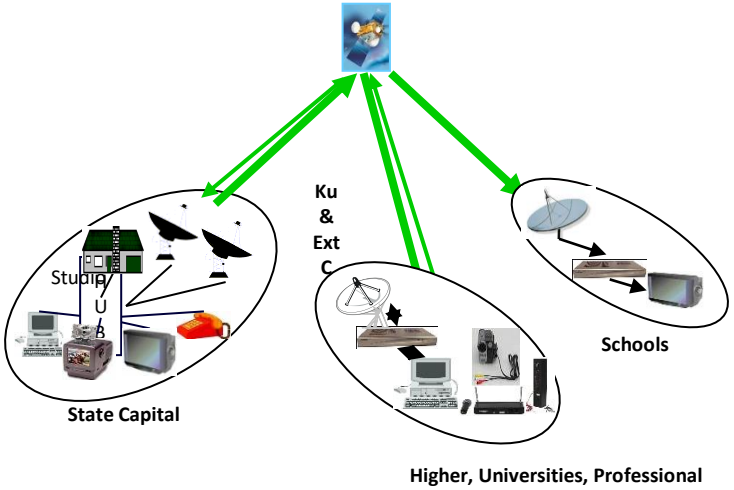
1. High Resolution Imaging Payloads - 0.1-0.3 m
2. Hyper spectral Imaging and Multi spectral Imaging payloads
3. Onboard Automation
4. Highly Stable & Agile platforms
5. High Data rates & Ka-Band Data transmission system
6. High Data Compression Ratio and encryption system
7. Advanced modular Data Handling and Storage System
8. Advanced Sensors like Star Trackers
9. Detector Development
10. Advanced Image processing system

SOCIETAL BENEFITS IN VARIOUS SECTORS

Tele-education (Edusat)

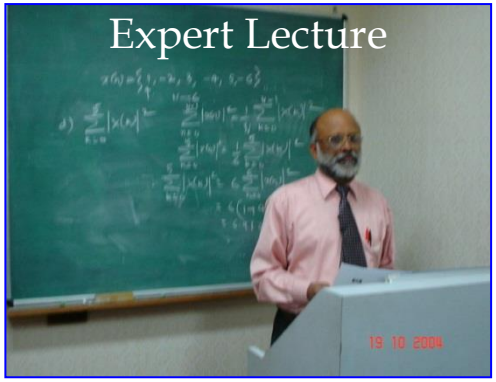
Users

- Primary/Secondary School Education
- Technical/Professional Education
- Distance Education, Adult Education
- Teacher's' Training
- Healthcare Programmes
- Vocational Training



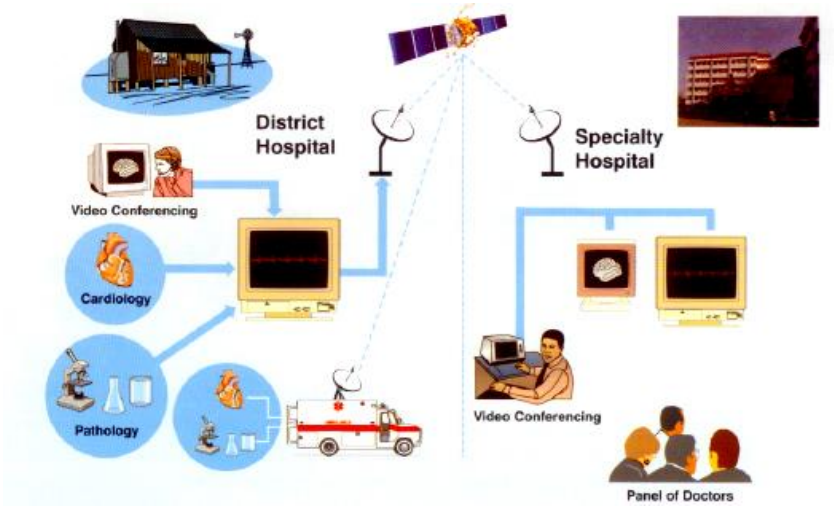
- 83 Networks
- 5000 Interactive Classrooms
- 55000 Receive Only Terminals
- 26 States & 4 UTs are covered

Receive Only Class



Telemedicine

- Technological solution proving access to quality & timely healthcare
- Cost effective solution to for remote and inaccessible places
- Extraordinary service from an ordinary doctor at remote end
- Mobile Telemedicine units to reach out to larger mass & area
- Extension education for Doctors in rural/remote areas
- Effective medium for controlling epidemics and training.



Telemedicine Services in

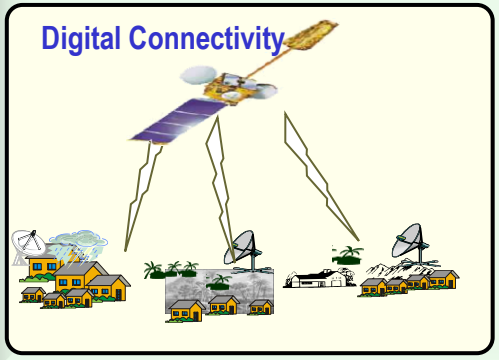
- Cardiology
- Radiology
- Pathology
- Ophthalmology
- Oncology
- …

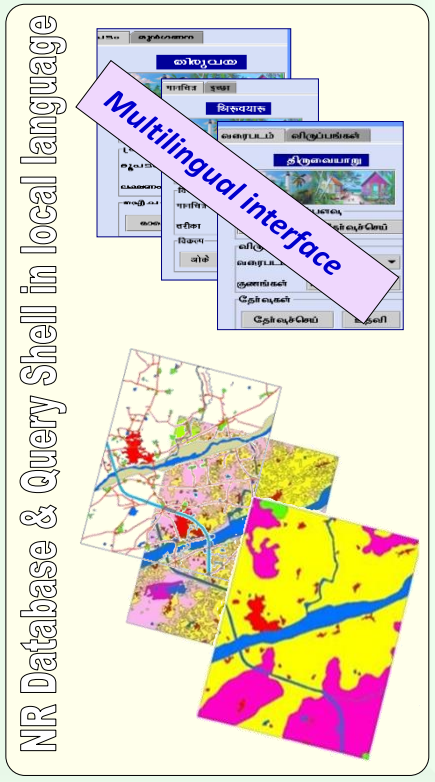
384 Hospital provided with Telemedicine Facility
64 Speciality Hospitals, 304 Remote Hospitals, 16 Mobile Vans

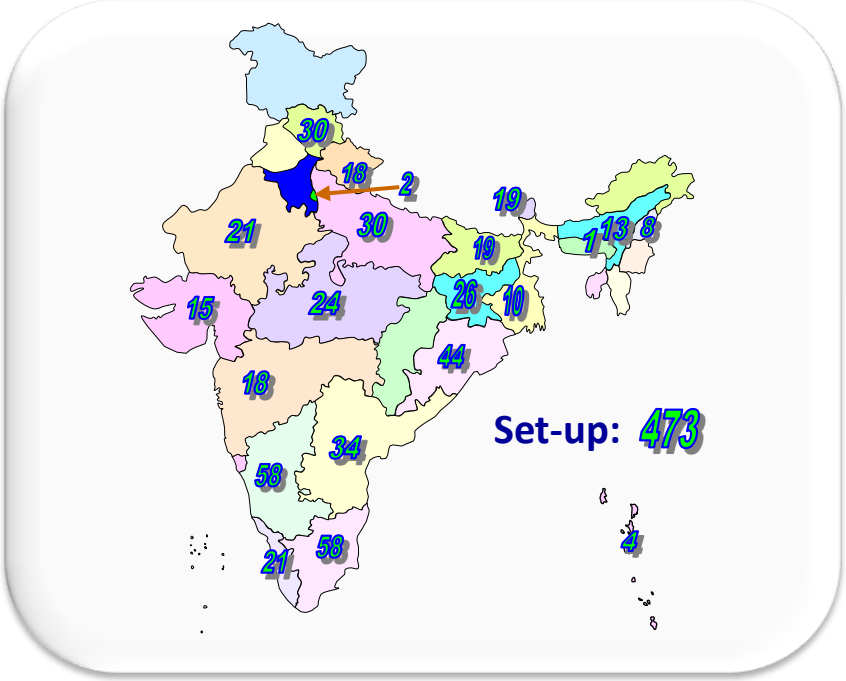
Village Resource Centre (VRC)

Services through VRC

- Natural Resources Info.
- Advisory related to Agri., Fisheries, …
- Tele-Education, Tele-Healthcare
- General info. on Govt. schemes
- Disaster related
- Training and Skill Dev.
- Livelihood opportunities



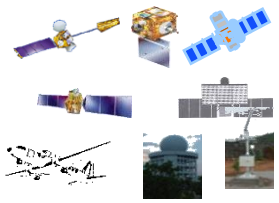




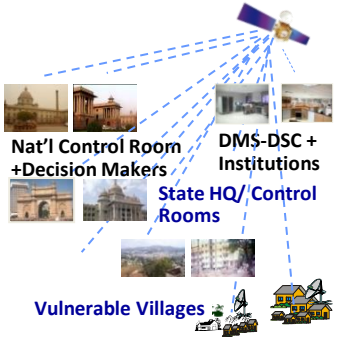
~ 45 partner agencies
~75 Expert Centres/ Hospitals are linked in the network

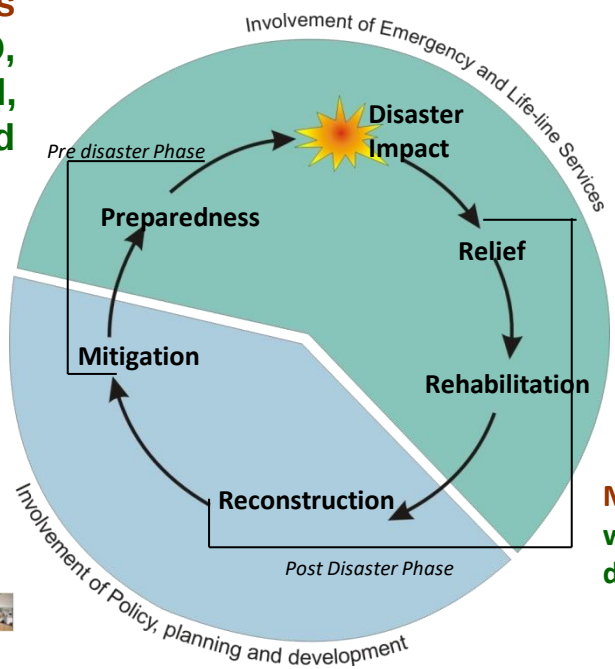
Disaster Management Support (DMS) System

Observational Systems
Satellite (GEO, LEO, All-weather), Aerial, Ground



Secured Commn
VPN – 34 Nodes

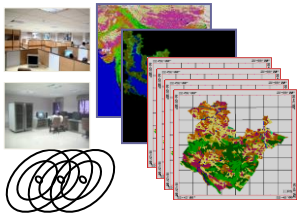




Emergency Communication
CWDS, Type D Sat phones, DDWS, Fishermen DAT…

Single-Window for Services Delivery DMS-DSC

Multi-tier databases with query/ decision tools



Disasters - Operationally addressed

Flood

Inundation monitoring
Damage assessment
Hazard zonation
Bank erosion studies

Drought

Monthly & End-of-Season
Agri Drought Assessment

Earthquake

Damage Assessment

Cyclone

Intensity & Track predictions
Inundation mapping
Damage assessment

Forest Fire

Active fire detection
Damage assessment

Landslide

Damage Assessment
Hazard zonation

R&D on early warning
Cyclone, flood, Earthquake, Landslides, Drought,….

International Activities
Charter, Sentinel Asia, UN Spider…

Satellite Benefits : Agriculture

Satellite based Images are used by various ministries like Agriculture,Textiles, Fertilisers, Food & Public distribution and Commerce for :

1. National Crop Forecast
2. Pre-harvest Conditions for Crop production assessment
3. Multiple Crop Production Forecasting of Major Crops under FASAL Project (Rice (K&R) - Generation of Soil Fertility maps useful for Soil health card
4. Groundwater Mapping in Haryana
5. Drought Assessment under NADAMS project
6. Digital Soil Mapping (*Present availability 1:50,000 scale)*
7. Identification of Silkworm food plants (Mulberry)
8. SILKS (**S**ericulture **I**nformation **L**inkages & **K**nowledge **S**ystems) Developed by ISRO - Identification of Potential areas for development of silkworm food plants

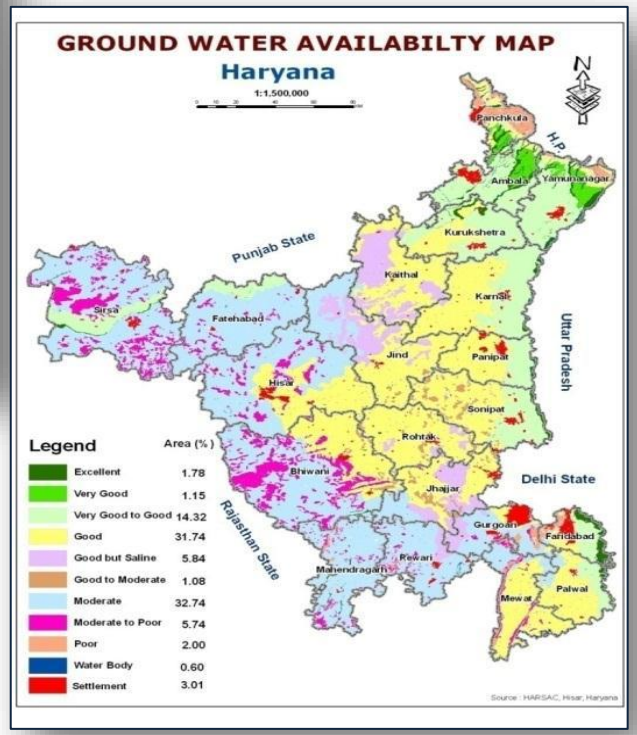
Agriculture

Silkworms

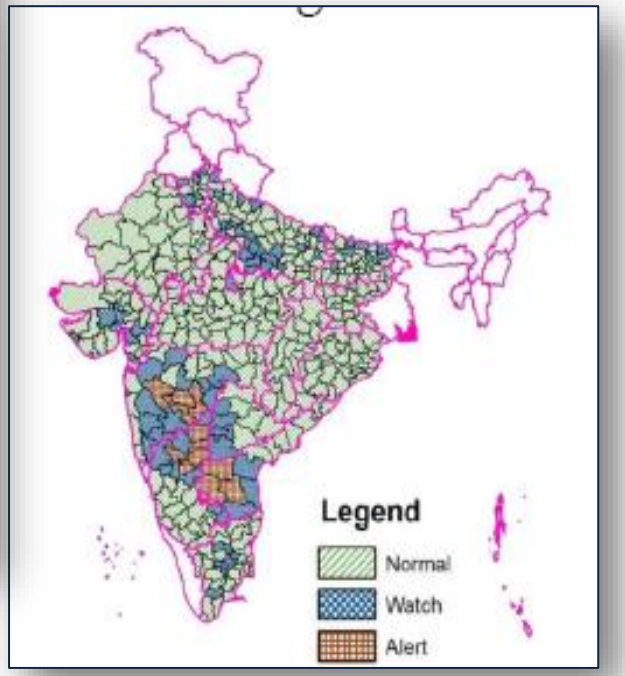
Satellite Benefits : Agriculture

Soil Mapping

Ground Water Availability mapping



Agricultural Drought Assessment Mapping



Crop acreage & production estimation

Satellite Benefits : Infrastructure Planning

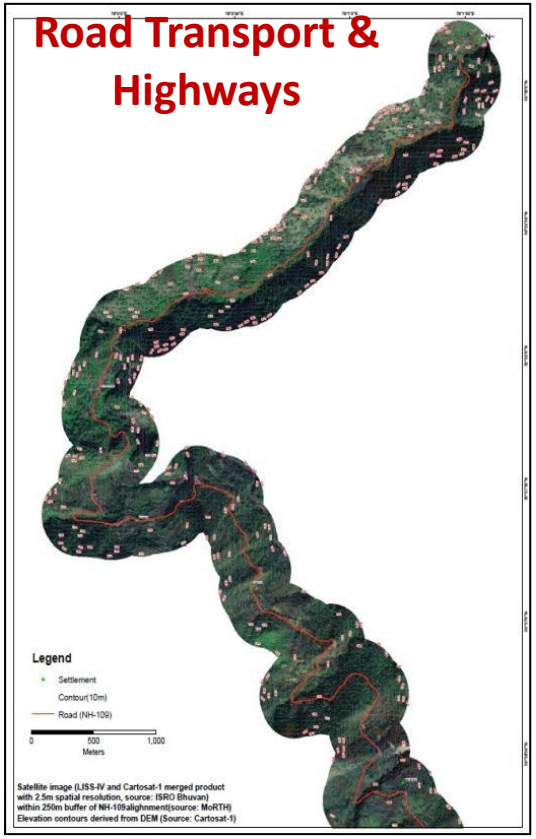
Satellite based Images are extensively used for Infrastructure Planning in the areas of:

1. **Urban development:**
   - National Urban Information System
   - GIS based Planning

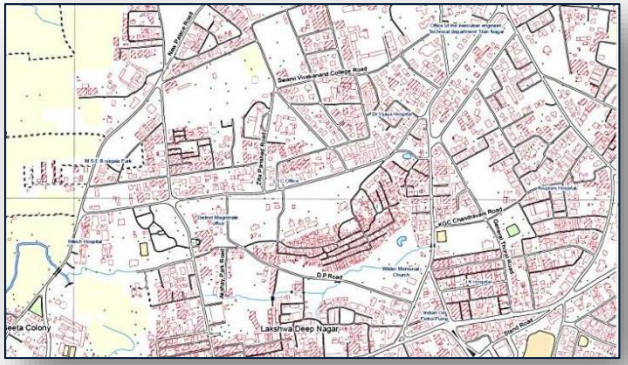
2. **Indian Railways**
   - Alignments in Project Design
   - SATCOM for Communication

3. **Road Transport & Highways**
   - Highway Alignments
   - Designing Ring Roads and Bypasses

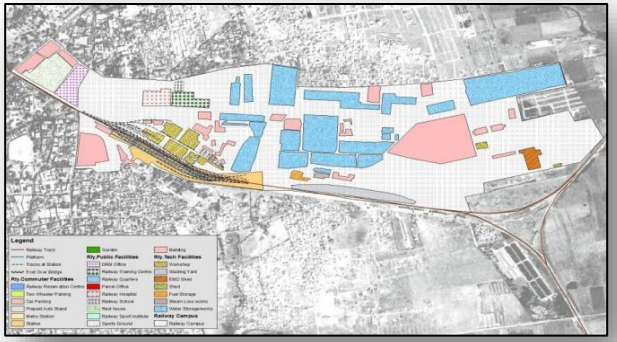
4. **Rural Development**



Urban Development



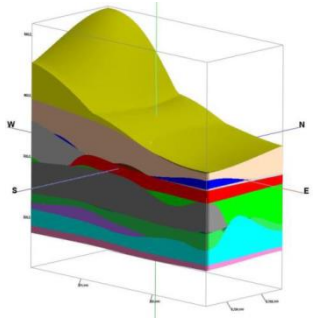
Indian Railways

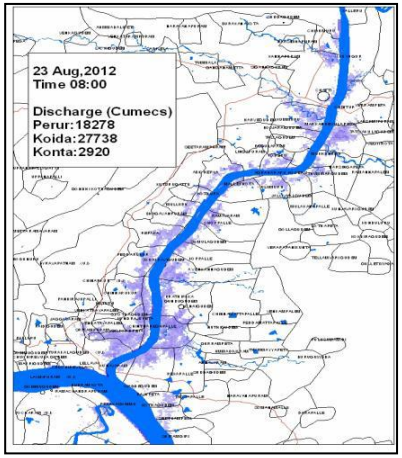


Satellite Benefits : Water Resources

Satellite based Images are extensively used by Ministry of Water Resources, River Development & Ganga Rejuvenation , Ministry of Drinking Water and Sanitation , Ministry of Tribal Affairs etc for -

- Water Resources Information System (India-WRIS)
- Assessment of water resources
- 3D Aquifer mapping integrating ground water information with satellite derived spatial layers
- Flood Forecasting and Flood Prone Area Imaging
- Assessment of Irrigation Potential Utility
- Sustainable Management of Fishery resources:
  - •Potential Fishing Zone information (Marine)
  - •Water bodies & ground water prospects mapping
  - •Weather assessment, forecasting & Forewarning
  - •Real time monitoring & tracking of fishing vessels
- Land use maps for fodder lands for animal husbandry and dairy.





Satellite Benefits : Weather & Disaster Management

Satellites play a vital role in Weather Forecasting, Disaster Management and Mitigation Activities.

Weather, Cyclone, Tsunami, Earthquake:

- Space data is the mainstay for weather & ocean services; Multi-hazard early warning and glacial monitoring.
- Annual Economic Benefit from Agro-meterological Advisories and Potential Fishery Zone Advisories are estimated to be ~50,000 Cr. and 34,000 Cr. respectively. (NCEAR, 2011).

Flood

- Satellite Data is used for Near real time flood inundation mapping, Flood hazard zonation, Glacial Lake Outburst Flood (GLOF) studies and Flood Forecasting

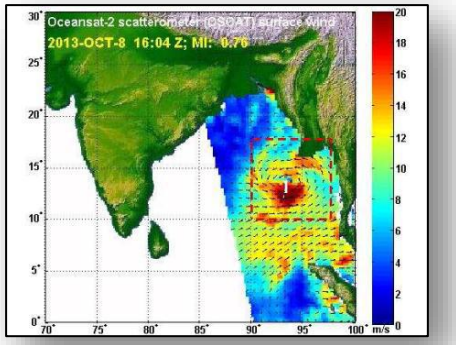
Landslides

- Landslide inventory/ susceptibility and geological/structural mapping using of Remote Sensing and Navigational Data.

Forest Fire

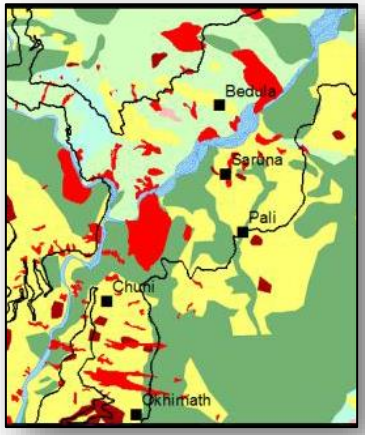
- Operational space based monitoring & dissemination of fire alerts since 2006. Daily 4 observations of active forest fires from Bhuvan Geo-portal.

Cyclone



Flood

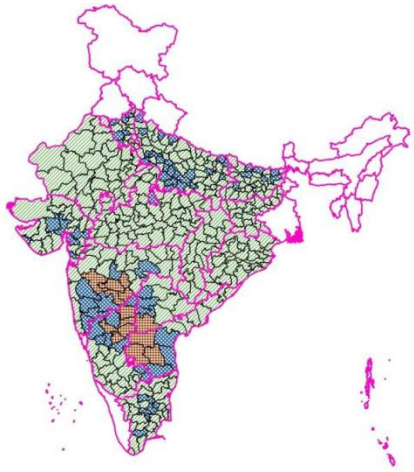
Landslides



Satellite Benefits : Weather & Disaster Management

Satellites play a vital role in Weather Forecasting, Disaster Management and Mitigation Activities. They are used by Ministry of Earth Sciences, Water resources, Mines, Environment & Forests , Agriculture & Cooperation , Home Affairs.

Drought Assessment Map



Drought

- Fortnightly/ Monthly District Level Agricultural Drought Assessment for 14 states.
- Large number of Remote Sensing based Indices are used for Drought Assessment.

Disaster Response

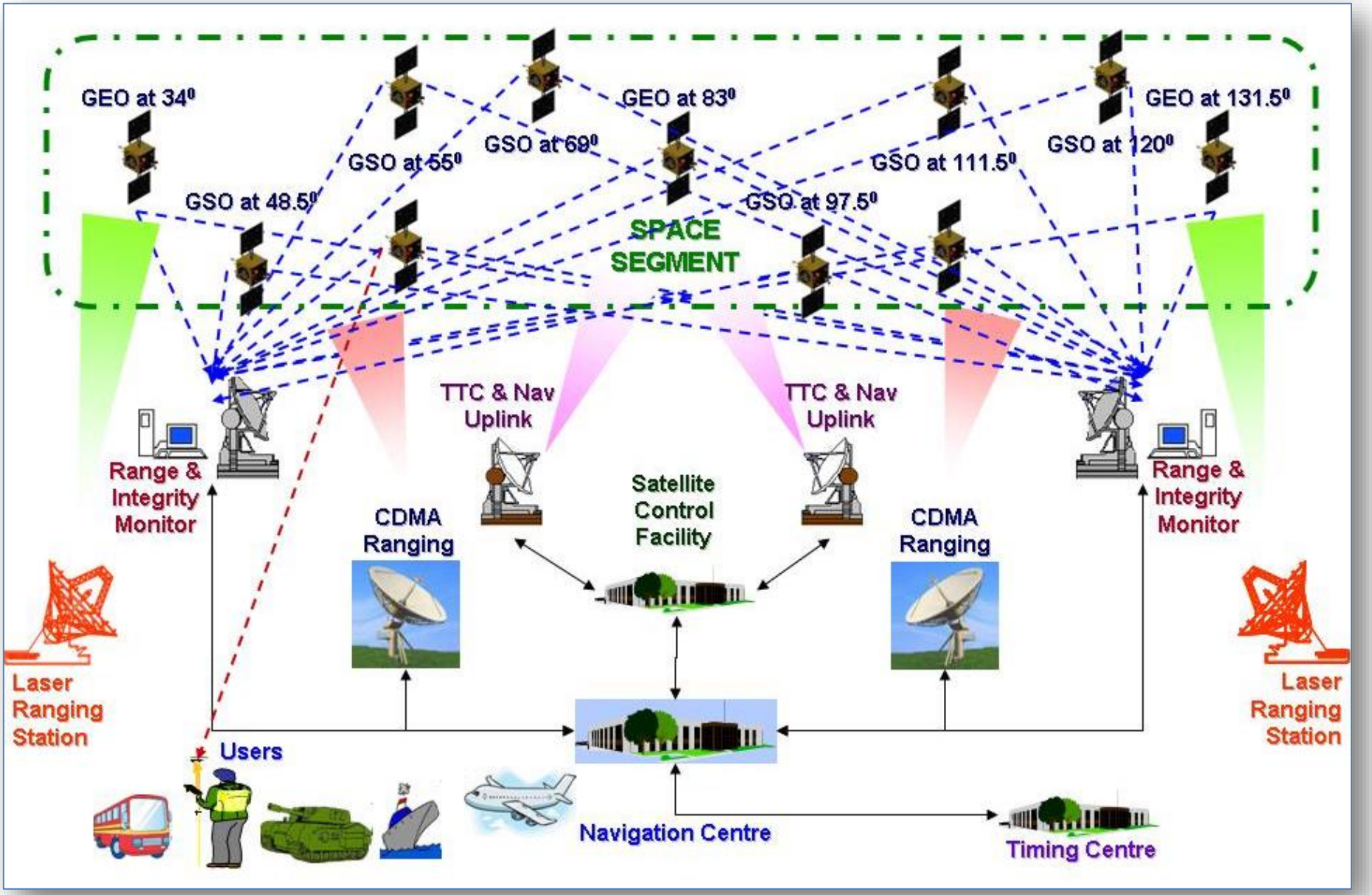
- Aerospace Products & Services are being utilised for Disaster Response and Mitigation, NDEM database for online visualisation and analysis.
- Satellite based Communication network for Emergency Communication.

Cyclone Phailin,Orissa

Case: Indian Ocean Tsunami 2004 & Orissa Cyclone Phailin, 2013

- Satellite data and flood inundation maps in GIS platform extensively used for Decision Support and pinpoint air dropping operation during floods.
- During Cyclone Phailin Satellite data helped in reducing the risks.

Ground Segment



CONCLUSIONS

- ISRO has positively responded to all the needs of the country in Space related activities.
- Next few decades we have many challenges, both technical and managerial.
- Several mind-boggling technological innovations which can bring in drastic changes in the life of common man are essential.
- We need to bring the full power of the technology to improve the life of everyone in our country.
- Each one of us need to strive to bring a change that will make a better India.
- ISRO in large will have do everything required to meet the expectations of the country.

Thank You!