REPORT ON THE

NATIONAL WORKSHOP ON STRENGTHENING OF GEOSPATIAL ECOSYSTEM CONDUCTED BY SURVEY OF INDIA

Survey of India
भारतीय सर्वेक्षण विभाग
Department of Science and Technology
विज्ञान और प्रौद्योगिकी विभाग

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National Workshop on
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Introduction

National Workshop on Strengthening of Geospatial Ecosystemwas organised at Bharat Mandapam, New Delhi on 25th November,2024 with the theme "Geo-enabling the Nation Through Collaboration".

Various Central Government Ministries/Departments – nodal agencies of fundamental data themes, State representatives, Industry representatives and representatives from academia, were invited to be part of this National Event.

More than 50 delegates from various Central Government agencies, 80 delegates from 28 States and 5UTs and more than 40 participants from Industry and Academia participated in the event. 50 officers of Survey of India also participated in various capacities i.e. speakers, delegates and volunteers.

The aim of the Workshop was to provide a platform for discussion among various stakeholders of Geospatial sector from both Public and Private Sectors. The workshop aimed towards enhancing the cooperation and coordination between state government agencies and central government agencies for creation of foundational Geospatial infrastructure and data for the country to meet the needs of various Ministries, Departments and State Governments.

(Left to Right) Sh. Hitesh Kumar S Makwana, IAS, SGI; Prof. Abhay Karandikar, Secretary, DST; Sh. Manoj Joshi, IAS, Secretary, DoLR; Sh. Srikant Sastri, Chairman, GDPDC

The event focus was also on obtaining inputs from the diverse stakeholders about the need for modernisation and strengthening of National Geodetic Reference Frame, generation of high-resolution Ortho-Rectified Image (ORI) and Digital Elevation Model (DEM) and making available data and services online to all users.

The event was inaugurated by the Secretary Department of Science & Technology in presence of the Secretary Department of Land Resources as Guest of Honour. To achieve the aim of the National Workshop, the whole programme was divided in 4 sessions. The objectives of each session in brief are as under:

Session1: Central Ministries/State Government Perspective for Implementation of NGP:

The National Geospatial Policy (NGP) has been notified by Government of India in December -2022. NGP Plays down a comprehensive roadmap to strengthen the Geospatial sector to support nationaldevelopment, economic prosperity and a thriving information economy. It focuses on collaborativeapproach to achieve the visions and goals set out in the

policy to make India a global leader in Geospatial Sector. The Panellistfocus was to discuss upon the requirement of foundational Geospatial infrastructure and data by various Central Ministries/Departments and States, work being done in implementation of NGP and the importance of the collaborative efforts by States and Central government agencies to create and develop a robust GeospatialEcosystem in the country as envisaged in the NGP.

Session2: Operation Dronagiri:

On 13th November 2024, 'Operation Dronagiri' has been launched. This landmark initiative aims top position India as a global leader in geospatial technology, with a clear focus on driving innovation, supporting economic growth, and enhancing sectoral development.

With the guidance of DST & Survey of India, 'Operation Dronagiri' will harness the power of geospatial data to address critical national challenges in agriculture, transportation, infrastructure, and livelihood sectors.

By creating a collaborative ecosystem of government bodies, academia, and the private sector, the Survey of India is paving the way for a future where data-driven solutions lead to sustainable, inclusivegrowth across the country. The panellist discussed upon the benefits of implementation of Geospatial Technologies in real world applications in various sectorsin collaboration with the state governments.

Session3: National Geodetic Reference Frame –Challenges in implementation:

Geospatial data is increasingly recognized as a vital component of national infrastructure and a valuableinformation resource with significant societal, economic, and environmental benefits. National Geodetic Reference Frame (NGRF) serves as a core fundamental Geospatial data theme and act as a common reference frame at national level for integrating other national fundamental geospatial data themes and sectoral themes. Recognizing the critical role of NGRFin establishing and sustaining the geospatial ecosystem, the NationalGeospatial Policy 2022 (NGP)prioritizes the modernisation, strengthening and redefinition of the National Geodetic Reference Framework. This initiative leverages modernpositioning technologies and ensures online access to the framework, supporting the advancement ofgeospatial capabilities. The panellists in this session can discuss upon thenecessity of a modernised and strengthened Geodetic Reference Frame at the National level and the approach required for its modernization and implementation.

Session4: Capacity Development – National &International Perspective:

The NGP has focused on the requirement of standardization of Geospatial curriculum and adequateintegration of the Geospatial Education in the innovation system. The need of training Institute(s) for developing and nurturing of Geospatial professionals in all the diverse areas of Geospatial and allied technologies have also been highlighted. Establishment of Geospatial Skill Council for filling the skill gap in geospatial sector, development of online courses with help of IGOT Karamyogi platform, and development of NIGST, IIRS and other suitable institutes into centres of excellence has been provided as the way to achieve it. The Policy encourages development of international standard Geospatial Science education programs from the school still the level of the universities and promotes cutting-edge research in Geospatial Science and Technology for indigenous capacity building and

identification of new areas of application and solution. The panellists discussed about the actions being taken in nation and international perspective to imbibe the Geospatial Education and Skilling in Indian Geospatial Ecosystem.

The session-wise details of discussions and key recommendations are as follows:

Session1: Central Ministries/State Government Perspective for Implementation of NGP (11:45 – 13:00)

S.No.	Role	Name
	Chair	**Shri Srikant Sastri**, Chairman, Geospatial Data Promotion & Development Committee
1	Speaker	**Shri Vinay Thakur**, ADG, Bhaskaracharya National Institute for Space Applications and Geo-informatics
2	Speaker	**Shri Alok Prem Nagar**, IFS, Joint Secretary, Ministry of Panchayati Raj
3	Speaker	**Shri S K Sinha**, Additional Surveyor General, Survey of India
4	Speaker	**Shri Kunal Satyarthi**, IFS, Joint Secretary, Department of Land Resources
5	Speaker	**Dr. Pramod Kumar Singh**, DDG, Geological Survey of India, Kolkata
6	Speaker	**Shri Kaustav Nag**, Directorate General Hydrocarbons

Key Highlights of Discussion

1. **Digitization and Survey Challenges:**
   - A significant focus has been on digitizing land records over the past 15-20 years, addressing ownership disputes and improving clarity on land ownership information. Correct land record information is a major challenge to be addressed in present day scenario.
   - Overcoming the challenges would include standardization of survey methods, selection of appropriate technology for generation of ORI & DEM (drones vs. aircraft) and establishing uniform framework for land records.

Sh. Srikant Sastri, Chairman, GDPDC (Center) addressing the audience
From left to right-Dr. Pramod Kumar Singh, Sh. Vinay Thakur, Sh. Alok Prem Nagar, Sh. Srikant Sastri, Sh. Kunal Satyarthi, Sh. Kaustav Nag and Sh. S K Sinha

- There is a need to focus on property taxation, land registration, and valuation for better governance.
- Various states have adopted unique models for land digitization and urban planning, emphasizing the need for flexible yet standardized approaches.

2. **Pilot and Scale-Up Plans:**
   - NAKSHA National geospatial Knowledge-based land Survey of urban Habitations pilot under DoLR is being implemented for urban areas to launched in 150 cities and plans to scale to 1,000 cities annually.
   - Projects like SVAMITVA highlight the potential of geospatial data in rural development, helping panchayats with planning and revenue generation through property tax reforms.

3. **Technology-Driven Solutions and Best Practices:**

   The importance of National Geodetic Reference Frame, Standards, adoption of advanced Technologies in Geospatial and Information Technology & Communication, and potential benefits of emerging Technologies like AI/ML etc. were discussed. It was emphasized that for effective/innovative use of Geospatial Data, the data should be Findable, Accessible, Interoperable and Reusable. To achieve this robust Geospatial Platforms based on federated but integrated architecture should be developed by various Ministries/Departments/Organizations to provide easy access to Geospatial data.

4. **Collaboration and Stakeholder Engagement:**
   - Centralized projects like the NAKSHA, SVAMITVA and PM Gatishakti highlight the importance of collaboration between central and state governments, as well as private entities.
   - It was emphasized that states' active participation is critical as they need to align manpower, technology and workflows for effective involvement for utilising the foundation Geospatial infrastructure and data for Land records modernisation, survey/resurvey and up-dation activities.
   - An integrated approach should be adopted for country wide generation of ORI & DEM to facilitate the Land Records modernisation, urban mapping and planning & design of infrastructure.

Sh. P. Madhusudan Reddy, IAS, Director of Survey and Settlement, Tamil Nadu government, along with other esteemed guests and stakeholders in the audience

Coherence in Data and Platform:

- The vision of the National Geospatial Policy 2022 emphasizes the coherence of data and platform aspects, which should be adhered to across all National Fundamental Themes, with the relevant departments or ministries responsible for their implementation.
- The development of a National Geospatial Data Registry (NGDR) and Unified Geospatial Interface (UGI) is crucial, similar to UPI, enabling diverse applications to be built on its platform. PM-Gati Shakti platform demonstrates a similar data-sharing framework.
- Emphasis on creating a unified geospatial platform to integrate diverse data sources for better decision-making. Open-source technologies and APIs are being leveraged for interoperability and real-time data integration.
- Standardized processes should be adopted, such as aligning geospatial data with the National Geodetic Reference Framework, are seen as crucial. Like ULPIN and Addresses should be aligned with NGRF.
- The BHUKOSH portal, developed by the Geological Survey of India, is a collaborative initiative involving 40 organizations that share data in the geoscience and geology domains. It is ensured that all the data is maintained with standardized formats and protocols.

5. Energy and Mineral Exploration :

- Geospatial data plays a vital role in the energy and mineral exploration sectors. India, as a leading producer of oil and gas, contributes 88% of its production to 18% of the country's GDP and is Asia's largest petroleum exporter. Geospatial technology is critical across the entire value chain, from gas exploration to distribution, as well as in critical mineral mapping.
- It was highlighted that no single ministry is taking the lead in energy-related initiatives, underscoring the need to focus on utilizing geospatial technology in the energy sector.
- The offshore regions of the country, which constitute 99% of India's offshore territory, offer immense potential for the application of geospatial data and technology, not only in oil and gas exploration but also in the mineral sector.
- It was emphasized that inter-ministerial collaboration is essential and proper timelines to be set for effectively strengthening the geospatial ecosystem.

6. Capacity Building and Manpower:

- A major hurdle is the lack of trained personnel. Programs need to incorporate capacity building, including hiring technically trained staff and conducting skill-development workshops.
- Involving geospatial experts from the planning stage is essential to avoid inefficiencies during execution.

7. **Private Sector and Technology Integration:**
    - Private sector involvement, including startups, is vital for scaling and standardizing tools for geospatial data collection and processing. For capacity building also the Private sector should come forward.
    - It was requested to Association of Geospatial Industries to share a document of best practices in different aspects of implementation of geospatial technology with government departments.

Key Recommendations:

1. **Standardization and Accuracy in Land Records**
    - Establish **national standards** for selection of survey methods and technology.
    - Ensure **uniform frameworks** for land record digitization across states, to create a harmonized Land Records Data.
    - **Regular up-dation of Geospatial data** created under schemes like NAKSHA& SVAMITVA.
2. **Technology-Driven Geospatial Infrastructure and Best Practices**
    - Implement **National Geodetic Reference Framework (NGRF)** to ensure interoperability, integration and harmonization of data.
    - **Standards** should be identified and adopted for ensuring interoperability of data
    - **Latest advancements in Geospatial, Information Technology &Communication** should be made use of during the life cycle of data i.e. Data Acquisition, Management, Dissemination
    - **Robust Platforms** should be developed by various Ministries/Departments/Organizations. These platforms should be based on federated but integrated architecture to ensure easy unified access of Geospatial data.
    - **Use emerging technologies** like AI/ML, Block Chain, IoT, 3D Visualization, and advanced sensors for innovative uses of Geospatial data.
3. **Collaboration Between Government and Private Sector**
    - **Strengthen partnerships** between central, state governments, and private entities for effective implementation.
    - Encourage private sector participation in **capacity building** and **geospatial technology adoption** at grassroot level.
4. **Interoperable and Integrated Geospatial Platforms**
    - Development of robust**National Geospatial Data Registry (NGDR) and Unified Geospatial Interface (UGI)** for seamless data sharing.
    - Promote **open-source technologies and Open APIs** for interoperability.

5. **Energy and Mineral Exploration**
    - **Leveraging geospatial technological advancements** for applications related offshore and critical mineral mapping.
    - Establish a **lead agency for coordinating geospatial initiatives** in the energy sector.

6. **Capacity Building and Workforce Development**
   - Invest in **training programs for surveyors, geospatial analysts, and government officials** at all levels.
   - Involve **geospatial experts** in the planning stages of national importance projects.
7. **Adoption of Best Practices in Implementation**
   - **Standardisationof processes** for geospatial data integration across ministries.
   - The **Association of Geospatial Industries (AGI)** should document and share best practices with government agencies.

Session2: Operation Dronagiri (14:00 – 15:00)

Sl No.		Name
	Chair	**Shri D N Pathak**, Director, Survey of India
1	Speaker	**Dr. Roshan Srivastava**, IIT Tirupati
2	Speaker	**Shri Pankaj Mishra**, DSG, Survey of India
3	Speaker	**Shri Gopikrishna Konga**, National Spatial Data Infrastructure
4	Speaker	**Shri VK Sisodia**, Addl Director, Agriculture Department, Government of Uttar Pradesh
5	Speaker	**Prof. Inder Gopal**, Center for Data for Public Good, India Institute of Science, Bengaluru

(From left to right)-Sh. V K Sisodia, Prof. Inder Gopal, Sh. D. N. Pathak, Sh. Gopikrishna Konga, Sh. Pankaj Mishra and Dr. Roshan Srivastava

Key Highlights from the Session

1. **Purpose and Collaboration:**
   - Operation Dronagiri aims to leverage geospatial data for applications in agriculture, transportation, infrastructure, and livelihood.
   - Extensive consultations with stakeholders, including government agencies, startups, and private sectors, have shaped the project's objectives.

2. **Data Collection and Management:**
   - High-resolution images, soil data, historical agricultural data, meteorological data, administrative boundaries etc are key datasets collected for project implementation.

- Challenges include varied data formats and custodians, necessitating a unified and standardized geospatial data platform.

3. **Implementation Framework:**
   - Chairman GDPDC has been the driving force of the project and played a vital role in conceptualisation and implementation of the project.
   - Department of Science and Technology and Survey of India (GDPDC Secretariat) playing a vital role in the implementation of the program.
   - DST's Geospatial Innovation Accelerator Cell (GIC) will monitor the project's progress and facilitates collaboration.
   - Institutes like IITs and IIM technology hubs act as innovation accelerators, bridging skill gaps and supporting startups.

4. **Role of Geospatial Data Interface (GDI):**
   - GDI serves as a centralized platform for data cataloguing, and making accessible through API based mechanism.
   - It supports functionalities like data privacy, metadata integration, and analytics, making data accessible for all the stakeholders involved in the pilot.
   - Efforts are being made to harmonize data formats from various sources (e.g., ministries, private entities) through the GDI platform. Hence it promotes standardisation of data.
   - A federated data model ensures data remains with original custodians while being accessible through a unified interface.

5. **Pilot Projects:**
   - Pilots are being conducted in five states (Uttar Pradesh, Assam, Andhra Pradesh, and Maharashtra and Haryana & Gurgaon City), focusing on specific districts.
   - Industry, Startups and Geospatial Innovation Hub & Accelerators are involved to address region-specific problem and providing geospatial solutions.
   - Operation Dronagiri supports early-stage startups with proof-of-concept funding and growth-stage startups with implementation grants.
   - The initiative emphasizes translational research and scaling innovation through platforms like Sanchi Connect , where start-up challenges will be driven.

6. **Sectors and Challenges:**
   - Agriculture: Issues like crop coverage estimation, soil fertility mapping, and advisory services are being addressed.
   - Transportation and Infrastructure: Data integration for planning and logistics optimization.
   - Livelihoods and Skilling: getting jobs on map and identifying local artisans just like we order food these days.

7. **Anticipated Outcomes:**
   - Enhanced agricultural productivity and resource use efficiency.
   - Better urban planning and infrastructure management.

- Scalable models for integrating geospatial technologies into governance and business.

8. **Long-Term Vision:**
   - Gradual expansion to more states and sectors based on learnings from pilots.
   - Creation of a sustainable geospatial data ecosystem to support national development goals.

Key Recommendations:

1. **Strengthen Multi-Stakeholder Collaboration**
   - **Foster partnerships** between government agencies, startups, private sectors, and academic institutions (IITs, IIMs) to drive innovation.
   - Utilize platforms like **Geospatial Innovation Accelerator Cell (GIC)** to monitor progress and enhance coordination.

2. **Development of Standardized Geospatial Data Platform**
   - Promote**Geospatial Data Interface (GDI)** as a centralized hub for data cataloging, access, and analytics with a federated data model where original custodians retain ownership while enabling unified access.
   - **Harmonize data formats** across ministries and private entities to ensure interoperability and ease of use.

3. **Scale Pilot Projects for Regional Implementation**
   - **Expand the initiatives** likeOperationDronagiri across more states, tailoring geospatial solutions to region-specific challenges.
   - **Engage industry and startups** in proof-of-concept funding and implementation grants to scale solutions effectively.

4. **Enhance Agricultural and Rural Development**
   - **Use geospatial technology** for crop coverage estimation, soil fertility mapping, and precision farming advisory services.
   - **Integrate livelihood mapping** to connect local artisans and workers with job opportunities.

5. **Optimize Transportation and Infrastructure Planning**
   - **Implement geospatial analytics** for logistics optimization, urban mobility planning, and smart city development.
   - **Improve real-time data sharing** for better resource allocation and disaster preparedness.

6. **Build a Sustainable Geospatial Ecosystem**
   - **Expand the initiative** to more states and sectors based on learnings from pilot programs.
   - **Ensure long-term sustainability** by integrating geospatial technologies into governance, business, and national development frameworks.

7. **Improve Accessibility and Data Privacy**

- Implement robust **OpenAPI-based data-sharing mechanisms** while ensuring data privacy and security.
- Develop **metadata integration tools** to enhance searchability and usability of geospatial datasets.

Session3: National Geodetic Reference Frame –Challenges in implementation (15:30 – 16:30)

S.No.	Role	Name
	Chair	**Shri Hitesh Kumar S. Makwana**, I.A.S, Surveyor General of India
1	Speaker	**Shri Jayaprasad**, Space Application Center, Ahmedabad
2	Speaker	**Shri P Madhusudhan Reddy**, I.A.S, Director of Survey and Settlement, Govt. of Tamil Nadu
3	Speaker	**Shri Pramod Sharma**, Director (Works), National High-Speed Rail Corporation Limited
4	Speaker	**Shri Neeraj Gurjar**, Director, Survey of India - Speaker
5	Speaker	**Shri Pramod Kaushik**, President, Hexagon India - Speaker
6	Speaker	**Shri Rajan Aiyyar**, MD, Trimble India - Speaker
7	Speaker	**Dr. Manish Saxena**, Indian Space Research Organisation - Speaker

From Left to Right;Shri Pramod Kaushik,Sh. Pramod Sharma, Sh. P. Jayaprasad, Sh. Hitesh Kumar S Makwana,IAS,SGI, Sh. P. Madhusudhan Reddy, Dr. Manish Saxena, Sh. Neeraj Gurjar, Sh. Rajan Aiyyar

Key Highlights from the Session

1. **National Geodetic Reference Frame (NGRF) and Continuously Operating Reference Stations (CORS):**
   - The NGRF is essential for defining precise locations on Earth using latitude, longitude, and reference systems. It provides a unified framework for applications like surveying, construction, infrastructure development, and disaster management.
   - CORS is a network of geodetic-grade GNSS receivers that operate continuously, offering high-precision positioning services.

- CORS eliminates the need for manual reference stations, improving efficiency, accuracy (1-2 cm), and cost-effectiveness for surveys.

2. Applications of the NGRF and CORS Network:

- Infrastructure projects: High-speed railways, highways, urban development, and smart cities rely on precise geospatial data for planning and construction.
- Agriculture: Precision farming, soil fertility mapping, and irrigation management.
- Disaster management: Monitoring subsidence and planning relief measures using accurate geospatial data.
- Other uses include mining, fleet management, logistics, and autonomous vehicle navigation.

3. Challenges in Implementation:

- **Infrastructure and Maintenance**: Establishing and maintaining CORS stations require reliable power, network connectivity, and secure locations.
- **Data Integration**: Harmonizing data from various agencies and ensuring consistency in formats and metadata.
- **Cost**: Initial setup of CORS networks is resource-intensive, though long-term benefits outweigh the costs.
- **Indigenization**: Dependence on foreign technologies for algorithms and equipment poses challenges; developing indigenous solutions is critical.

4. Success Stories and Collaborations:

- Tamil Nadu's network of 75 CORS stations facilitated cadastral surveys, mapping water bodies, and urban planning.
- The Mumbai-Ahmedabad high-speed rail project used a dedicated CORS network for precise alignment and construction.
- Survey of India and National High-Speed Rail Corporation Limited (NHSRCL) signed an MOU to integrate and share CORS data for national-level use.
- India has signed MoU with two countries and 13 countries are in pipeline. These MoU mark a significant step in enhancing bilateral ties, focusing on the exchange of expertise in geodesy , cartography and spatial data infrastructure and also creates avenues for training and capacity building.

5. Recommendations for Strengthening the Framework:

- Expand and densify the CORS network for broader geographic coverage and greater precision.
- Promote collaboration across government agencies, private players, and academia to share data and assets.
- Align with global standards (e.g., ITRF 2020) and continuously update geodetic references to account for tectonic shifts and other changes.
- Develop indigenous algorithms and equipment to reduce dependency on international technologies.
- Enhance capacity building through training programs and skill development in geospatial technologies.

6. **Future Pathways:**
   - Leverage the NGRF for integrating diverse datasets into a unified geospatial platform.
   - Enable precise geotagging of national assets for improved maintenance and management.
   - Scale up the use of geodetic data for advanced applications like autonomous navigation, smart infrastructure, and climate resilience.
   - Increase awareness of CORS and its benefits among government departments, private sectors, and the general public.
   - Use digital campaigns and public engagement to promote the adoption of geospatial technologies.
7. **ISRO Initiatives :**
   - Collaboration between ISRO and the Survey of India focuses on utilizing InSAR and CORS data.
   - ISRO provides geospatial data through its MOSDAC, VEDAS, and BHUNIDHI portals.
   - The NAVIC satellite constellation ensures PNT coverage across entire India, with integration of NAVIC capabilities with CORS enhancing precision in PNT services.
   - GAGAN, an augmentation system developed by the Department of Space in collaboration with the Airports Authority of India, improves ground-based geodetic accuracy and incorporates a CORS network which is established by ISRO for its specific applications.

Key Recommendations:

1. **Densification of the CORS Network**
   - Densify the **Continuously Operating Reference Stations (CORS)** network in hilly, coastal and urban areas for broader coverage, reliability and higher precision in positioning services.
   - Ensure reliable infrastructure, including power and network connectivity, for seamless operation.

2. **Develop Indigenous Geospatial Technologies**
   - Increase *Atmanirbharta* by developing **indigenous algorithms** and GNSS equipment for geodetic applications.
   - Encourage **R&D collaborations** between ISRO, Survey of India, and academic institutions to build domestic capabilities.

3. **Enhance Data Integration and Standardization**
   - **Harmonise geospatial data** across agencies by aligning with Global Geodetic Standards (e.g., ITRF 2020).
   - Develop a**UnifiedGeodetic Data Platform**integrating CORS, InSAR, and other datasets for seamless applications.
   - CORS stations established by other agencies to be **integrated into National Network**.

4. **Leverage NGRF for Infrastructure and Disaster Management**
   - Ensure all national infrastructure projects (highways, railways, smart cities) adopt **NGRF-based geospatial data** for precision mapping, interoperability and uniformity.
   - **Leverage geodetic data** for subsidence monitoring, climate resilience, and disaster management.

5. **Enhance Capacity Building and Workforce Development**
   - Develop **specialised training programs** and **skill development initiatives** to build expertise in geospatial technologies and implementation of NGRF.
   - Promote **collaboration** between government, academia, and private sector for knowledge sharing and research.

6. **Promote International Cooperation in Geodesy**
   - **Strengthen existing MoUs** with international partners and expand collaborations in geodesy, cartography, and spatial data infrastructure.
   - Leverage **global best practices** for enhancing India's geospatial ecosystem.

7. **Scale Geodetic Applications for Emerging Technologies**
   - **Integrate NGRF data** with autonomous navigation, fleet management, and smart city planning.
   - Ensure **precise geotagging of national assets** for improved governance and resource optimization.

8. **Increase Awareness and Adoption of CORS & Geospatial Services**
   - Conduct digital campaigns, workshops, and stakeholder engagement programs to **promote the use** of geospatial technologies. The private sector may also be roped-in for such initiatives.
   - Encourage government and private sectors to **integrate CORS-based solutions** in their workflows.

9. **Leverage ISRO's Capabilities for National Geospatial Development**
   - Enhance **collaboration** between ISRO and the Survey of India to utilize InSAR, NAVIC, and CORS data for high-precision geospatial applications.
   - Integrate **NAVIC and GAGAN** augmentation systems with the **CORS network** to improve Positioning, Navigation, and Timing (PNT) services.

10. **Future-Proof Geospatial Infrastructure for Advanced Applications**
    - **Scale up** geodetic data usage in climate resilience, smart infrastructure, and next-generation logistics.
    - Ensure **continuous upgrades** to geodetic reference systems to adapt to tectonic plate movements and other geophysical changes.

Session4: Capacity Development – National &International Perspective (16:30 – 17:30)

S.No.	Role	Name
	Chair	**Shri Adil Zainulbhai**, Chairman, Capacity Building Commission
	Co Chair	**Shri Mahavir Singhvi**, JS, NEST, Ministry of External Affairs
1	Speaker	**Dr. N. Prabhakar Reddy**, IAS, JS, Office of Chief Commissioner of Land Administration, Government of Andhra Pradesh
2	Speaker	**Dr. Pramod Kumar**, Dean, Indian Institute of Remote Sensing
3	Speaker	**Dr. Kamal Jain**, IIT Roorkee
4	Speaker	**Dr. MK Stalin**, AddlSG ,National Institute for Geoinformatics Science & Technology, Survey of India, Hyderabad
5	Speaker	**Prof. KS Rajan**, Indian Institute of Information Technology, Hyderabad

Figure 1-(From Left to right)- Dr. M. K. Stalin, Dr. Kamal Jain, Dr. N. Prabhakar Reddy, Sh. Adil Zainulbhai, Sh. Mahaveer Singhvi, Dr. Pramod Kumar and Prof. K. S. Rajan

Key Highlights from the Session

Continuous learning and ups killing are essential to keep up with rapidly evolving geospatial technologies. Capacity building enables individuals and organizations to make informed decisions and implement innovative solutions.

1. **Courses and Training Programs:**
   - A wide range of courses is offered by institutions like National Institute for Geo-Informatics Science and Technology (NIGST).
     - **Basic Courses**: Designed for entry-level professionals, lasting up to a year.

- **Advanced and Specialized Courses**: Focused on modern technologies like GNSS, photogrammetry, and AI, with durations ranging from weeks to months.
- **Short-Term and Project-Based Courses**: Targeted at specific skills or domains, lasting one to four weeks.
- **Custom Programs**: Tailored training based on the needs of state governments and private organizations.

2. Notable Initiatives and Examples:

- Andhra Pradesh's comprehensive training of 12,000 surveyors, resulting in improved land surveys and reduced jurisdictional complexity.
- Meghalaya's apprenticeship program trains local youth for geospatial tasks, involving them in village-level mapping projects.
- Mission Kakhtiya in Telangana trained engineers to manage and monitor 38,000 water bodies using GIS.
- As an initiative of IIT Guwahati, the OGC India Academic Network focuses on bridging the gap between geospatial standards and practical applications through programs like the annual Winter School during December
- The Karmayogi iGOT platform is a digital learning ecosystem designed to enhance the capacity and skills of government officials through curated content and personalized learning pathways.

3. Integration of Emerging Technologies:

- Quantum computing is being explored for faster processing of geospatial data.
- New courses on AI, Web GIS, and 3D data creation are being developed to cater to evolving demands.
- Adoption of advanced tools like drones, thermal cameras, and hyperspectral imaging is being promoted.

4. Collaborations and International Perspectives:

- Partnerships with international universities like Edinburgh and California aim to bring cutting-edge technology and knowledge to India.
- Open-source initiatives, such as the Open-Source Geospatial Foundation, encourage innovation and the creation of custom geospatial tools.
- India is expanding its geospatial leadership through international collaborations and programs like I-TECH, which provides training to participants from over 35 countries.

5. Challenges in Capacity Development:

- The need for targeted capacity building tailored to specific sectors and tasks.
- Bridging skill gaps by aligning technology education with real-world applications.
- Promoting ownership of projects by local stakeholders to ensure sustainability and scalability.

6. Industry and Market Potential:

- The geospatial sector is projected to grow to a $200 billion market by 2030, with India positioned as a leading exporter of geospatial services.
- Over 250 startups in the sector highlight India's innovation potential.

- Capacity building aligns with the goal of making India the largest exporter of geospatial technology and services.

7. Recommendations for Future Capacity Building:

- Develop skill optimization programs at various levels to address specific domain requirements.
- Enhance R&D capabilities through new academic programs like B.Tech in Cognitive Science and Masters in Geospatial Technology.
- Increase awareness of geospatial technologies and their applications through campaigns and outreach programs.
- Encourage institutions to participate in international programs to bring global best practices to India.

Key Recommendations:

1. Expand Training Programs to Address Skill Gaps

- Strengthen basic, advanced, and specialized courses in GNSS, photogrammetry, AI, and Web GIS to cater to evolving industry needs.
- Develop short-term, project-based courses for targeted geospatial applications in governance, urban planning, and disaster management.

2. Enhance Public and Private Sector Collaboration

- Encourage partnerships between government agencies, universities, and private industry to ensure workforce readiness.
- Leverage customized training programs for state governments and private organizations to enhance geospatial adoption.

3. Promote Local Capacity Building for Sustainable Implementation

- Empower local youth and professionals through apprenticeship programs like those in Meghalaya, ensuring geospatial projects are driven by local talent.
- Scale up initiatives like Mission Kakatiya in Telangana to train engineers in geospatial water management.

4. Leverage Digital Learning Platforms

- Utilize the Karmayogi iGOT platform to up skill government officials with curated, personalized geospatial learning content.
- Expand e-learning initiatives to offer remote and hybrid training programs for wider accessibility.

5. Integrate Cutting-Edge Technologies into Curricula

- Develop new academic programs in cutting edge technologies like Quantum Computing, AI-based Remote Sensing, 3D GIS, and Web GIS.
- Encourage hands-on training in advanced tools such as drones, thermal cameras, and hyperspectral imaging for high-precision data analysis.

6. **Boost India's Global Leadership in Geospatial Training**
   - Strengthen international collaborations with universities like Edinburgh and California to bring global expertise to India.
   - Expand participation in international training programs like ITEC, positioning India as a geospatial knowledge hub.
7. **Encourage Open-Source Innovation**
   - Promote the adoption of open-source geospatial software and tools through initiatives like the Open-Source Geospatial Foundation.
   - Support startups and research institutions in developing India-specific geospatial solutions.

8. **Align Skill Development with Market and Industry Growth**
   - Tailor capacity-building programs to support India's goal of becoming a $200 billion geospatial market by 2030.
   - Encourage academic and industrial R&D collaborations to drive innovation in geospatial services.

9. **Increase Awareness and Outreach Programs**
   - Conduct nationwide awareness campaigns on geospatial applications in agriculture, disaster management, urban planning, and infrastructure.
   - Foster geospatial literacy at the school and college levels to build future talent.

10. **Develop Specialized Degree and Certification Programs**
    - Introduce new programs like B.Tech in Cognitive Science and Masters in Geospatial Technology to build expertise.
    - Establish certification programs for geospatial professionals, ensuring global recognition of Indian talent.

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Annexure-1

विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF
SCIENCE & TECHNOLOGY

विकसित भारत अभियान
1947 TO 2047

NATIONAL WORKSHOP

ON STRENGTHENING OF GEOSPATIAL ECOSYSTEM

Session-1

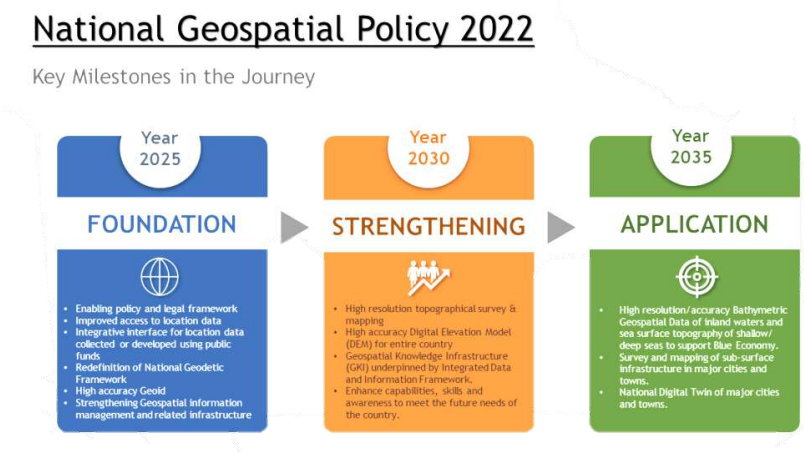
CENTRAL MINISTRIES/STATE GOVERNMENT PERSPECTIVE FOR IMPLEMENTATION OF NGP

25th November 2024

||Geo-enabling The Nation Through Collaboration||

Achievements and Impact of National Geospatial Policy, 2022

The National Geospatial Policy introduced by the Department of Science & Technology on 28th December 2022, has a clear vision of strengthening the Geospatial sector in India for National development and economic prosperity. The policy aims to position India as a global leader in Geospatial technology. The Policy also focuses on liberalisation of geospatial sector by making geospatial data generated by public fund available for all stakeholders, replacing the National Map Policy of 2005. The policy emphasizes the development of infrastructure, skills, and innovation to leverage geospatial data for national development.



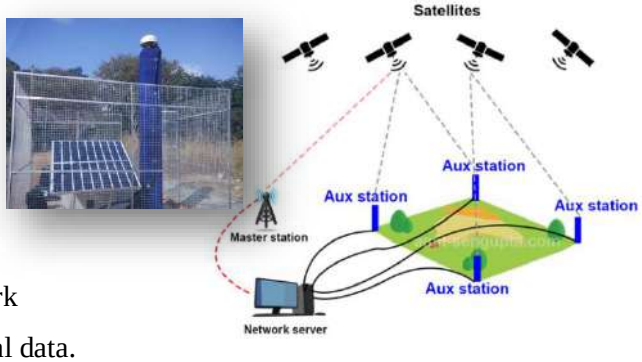
Below is a detailed overview of the achievements and actions undertaken under this policy:

1. National Geodetic Reference Frame (NGRF)

The National Geospatial Policy has significantly advanced India's geodetic capabilities by modernizing and enhancing its foundational geospatial infrastructure.

- **Launch of CORS Services**:

  A Pan-India **Continuously Operating Reference Station** (CORS) network was launched on August 25, 2023, across 26 states and 8 union territories. This network provides highly accurate positional data.



- Complementing this, 70% of **high-precision levelling** and 60% **gravity observation** tasks have been completed, further strengthening the accuracy of India's geospatial framework.
- **Geoid Model Development**: Geoid models for 25% area of the country has been developed, enabling accurate elevation measurements.
- **Tidal Infrastructure Upgradation**: Modernization for tidal gauge infrastructure in six observatories has been initiated.
- **Standards Working Group**: A dedicated working group comprising government agencies, academia, and industry has been constituted to develop standards through the Bureau of Indian Standards (BIS).
- **MoUs for Strategic Collaboration**: Apart from MoUs signed for large scale mapping with several state governments including Andhra Pradesh, Haryana, Karnataka, NCT of Delhi, Pudducherry, Tamilnadu etc., Memorandums of Understanding (MoUs) have been signed with the **Space Applications Centre (SAC), Ahmedabad**, to utilize CORS data for the **NASA-ISRO Synthetic Aperture Radar (NISAR) mission**, **Indian Meteorological Department (IMD)** to utilise CORS data for improving weather services, **National Highway Authority of India (NHAI)** for capacity building and use of CORS data for improvement of alignments of highways & better Land acquisition planning,and with the **Geological Survey of India (GSI), Ministry of Mines**,for the exchange of gravity and CORS data.

2. Administrative Boundaries and Functional Areas

Harmonization of administrative boundary data has been a critical focus:

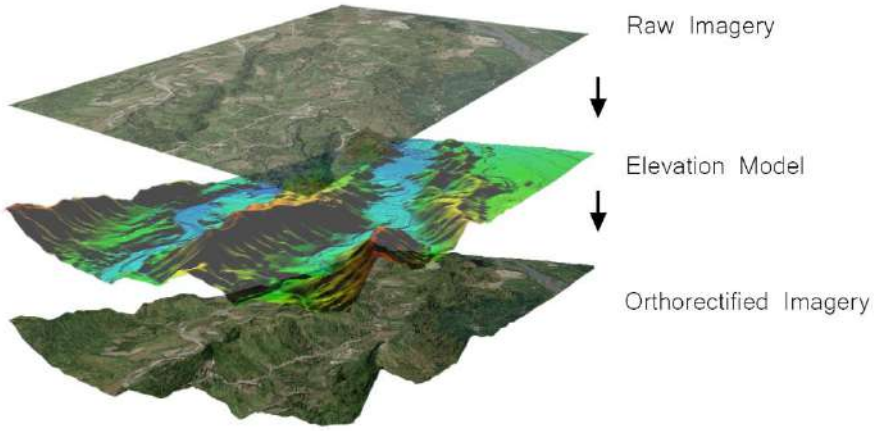
- **Boundary Data Harmonization**: SoI and the Office of Registrar General of India (ORGI) collaborated to refine data at the district, subdivision, and village levels for all states and UTs.
- Several other activities, like georeferencing of revenue maps, urban boundaries etc., have been taken up.

3. Toponymy and Geographic Names

Streamlining of geographical name change process has been undertaken by SoI in collaboration withMHA.

- **End-to-End Solutions:** Tools for capturing names on the ground, including voice recordings in local languages, are being developed.

- **Collaboration:** Work with the Ministry of Home Affairs (MHA) and Common Service Centres (CSCs) is underway to streamline data collection and verification.



4. Ortho Rectified Imagery (ORI) and Digital Elevation Model (DEM)

- **Extensive Coverage Achieved:** High-resolution Ortho Rectified Imagery (ORI) and Digital Elevation Model (DEM) data covering an area of about 7,00,000 square kilometers have been captured under various projects. Previously captured data are being consolidated into the National Geospatial Infrastructure.
- **Urban Mapping Initiatives:**
    - Deliberations are ongoing with the Department of Land Resources (DoLR) for urban mapping in 100 towns as a pilot project using advanced technologies.For other components of urban revenue mapping SoI would be in facilitator role.
    - The execution plan for the **AMRUT 2.0** project has been approved, and funds are under allocation by the Ministry of Housing and Urban Affairs (MoHUA).
- A stakeholder conference was organized by SoI to align and converge efforts among various stakeholders, emphasizing the applicability of the CORS network and the generation of ORI and DEM for nationwide socio-economic development.
- **Alignment with Government Priorities**: State-specific plans for ORI and DEM generation are being aligned with government priorities through active interaction between SoI and respective state government agencies.MoU signed for Uttarakhand, plans underway for Himachal Pradesh, J&K, and Ladakh, and support provided to Andhra Pradesh and Karnataka.

5. National Geospatial Data Registry (NGDR) & Unified Geospatial Interface (UGI)

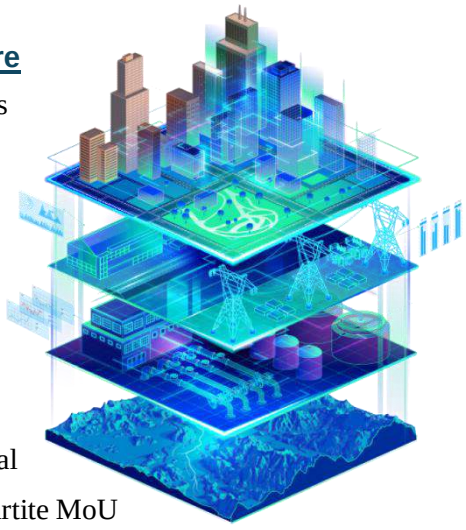
- DST had awarded a Proof of Concept (PoC) project to IISc, Bengaluru for developing an 'exchange' for Geospatial Data with a name of Geospatial Data sharing Interface (GDI), which has been launched on 13th November 2024.

6. National Topographic Database

- **Alignment with National Geospatial Themes:** Spatial Data Model Structures (SDMS) for topographic templates have been aligned with the National Fundamental Geospatial Data Themes, ensuring compliance with NGP-2022.

- **Development of SoI Geo-Portal:** The Survey of India (SoI) is developing a Geo-Portal in collaboration with BISAG-N, providing a centralized platform for geospatial data access and management.
- **Geo-ICT Infrastructure Transformation**: Significant steps have been undertaken to modernize SoI's Geo-ICT infrastructure, enabling end-to-end solutions for maintaining and harmonizing the Topographical Database in an enterprise environment.
- **Standards Development**: A dedicated working group comprising government agencies, academia, and industry has been constituted to frame and publish geospatial standards through the Bureau of Indian Standards (BIS).
- **Collaboration for Standards**: The working group ensures that standards reflect the needs of stakeholders, fostering innovation and interoperability.

7. National Digital Twin & Sub-surface Infrastructure



- Ministry of Housing & Urban Affairs (MoHUA) has been requested to take lead for National Digital Twin & Sub-surface Infrastructure.
- MoU between SoI and MoHUA has been signed regarding creation of Geo-database of towns under AMRUT 2.0. SoI to initiate process for 3d digital twin for 10 cities.
- PoC with Delhi Development Authority & Municipal Corporation of Delhi have been conducted and tripartite MoU

is under consideration.

8. Supporting vibrant Blue Economy

- Ministry of Earth Sciences (MoES) will take lead for drawing strategy for supporting vibrant Blue Economy via high accuracy Bathymetric Surveys.
- Bathymetric survey is being carried out in West Bengal under National Hydrology Programme.

9. Geospatial Innovation

- An MoU has been signed for establishment of a Geospatial Innovation Hub Pilot at the NIGST, for which the Principal Advisory Committee has been constituted.
- A call for proposals has been launched in the domain of Geospatial technology and solutions, requiring proposals in a consortium mode.
- 5 **Geospatial Innovation Accelerators** have been formed at IIT Ropar, IIT Kanpur, IIT Bombay, IIM Calcutta and IIT Tirupati, with IIT Tirupati as the lead Geospatial Innovation Accelerator.

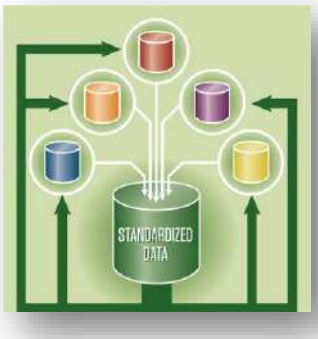
10. GDPDC Secretariat

- Duties, Roles and Responsibilities of Lead & Partnering Agencies in relation to Geospatial Data have been drafted and circulated to all Members of GDPDC.
- Three GDPDC meetings have been held and actions related to 'National Fundamental Data Themes' have carried out by respective Ministries like setting up a Thematic Working Group on Standards, developing and promoting standards , developing infrastructure for managing geospatial data etc.
- **'Operation Dronagiri'**officially Launched on 13th November 2024, a pilot project under National Geospatial Policy 2022 to demonstrate the potential applications of geospatial technologies and innovations in improving the quality of life of citizens and ease of doing business. Initiative is promoting liberalisation of geospatial data, developing geospatial infrastructure, geospatial skill and knowledge as well as standards which are highlights of the policy.

11. Data standards & interoperability standards

- Sectional Panels Established: Five sectional panels are actively working on data content standards for key themes such as geology, soil, forestry, LiDAR, cadastral data, and NAVIC receivers.

- Revision of Metadata Standards: Efforts are underway to revise IS 16439, the metadata standard for geospatial information, ensuring it meets modern requirements.
- Draft Indian Standard on Functional Areas: A draft standard on functional areas (administrative boundaries) has been prepared and circulated to committee members for feedback.
- **Thematic Working Groups (TWGs):** Formation of Thematic Working Groups was emphasized during the third GDPDC Meeting, involving nodal agencies for developing standards in fundamental data themes.

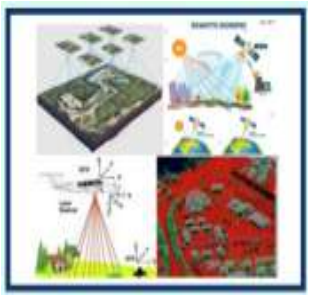


- Standards Submitted to BIS: 4 standards documents, covering Functional Boundaries, Ortho Rectified Imagery (ORI), Elevation, and Geodetic Reference Frame (GRF), have been submitted by TWGs to the Bureau of Indian Standards (BIS).
- Preliminary consultation on the Functional Boundaries theme has been completed, with plans for wide circulation.
- Bureau of Indian Standards has already published 19 Standards in Geosptial sector under LITD22.
- Collaboration Across Sectors: Working groups, including government agencies, academia, and industry, have been constituted to develop and publish geospatial standards.

12. Training and Skill Development

- The National Institute of Geo-Informatics and Surveying Technology (NIGST) has revised the syllabus of various courses to align with modern requirements in geospatial science and






technology.

- **Collaborative MoUs**:
  - Agreements signed with leading institutions like **IIT Kanpur**, **IIIT Hyderabad**, **IIT Roorkee**, and organizations such as the **Association of Geospatial Industry (AGI)**

and the **National Skill Development Corporation (NSDC)** to enhance geospatial training and skill-building initiatives.

- MoUs signed with **Andhra Pradesh Survey Settlement and Land Records (12.07.2024)**, **Anna University**, **Andhra University**, and **CSIR (NGRI)** to support advanced geospatial education and skill development.
- Collaboration with **NHAI (National Highways Authority of India)** signed on 02.07.2024 to leverage geospatial expertise for infrastructure projects.
- MoUs with Punjab Engineering College (PEC) and other institutions are under progress, expanding the reach and scope of geospatial education and research.

❖ Capacity Building for Civil Servants: Partnerships with the Capacity Building Commission to deliver advanced learning opportunities for civil servants in geospatial science and technology, including specialized programs on Drone Awareness.

❖ **Surveyors' Registration and Certification:** NIGST has been provisionally recognized as an 'Awarding Body' for Surveyors' registration and certification.

13. National Geospatial Mission

The SoI has submitted a concept paper for the **National Geospatial Mission**to DST, focusing on key components like high-resolution Ortho Rectified Imagery (ORI), Digital Elevation Models (DEM), upgradation of National Geodetic framework and the transformation of Geo-ICT infrastructure. It aligns with the objectives of the National Geospatial Policy to enhance geospatial capabilities, support socio-economic development, and position India as a global leader in geospatial sector. The proposal is currently under examination.

14. What is offered to the State Governments:

❖ Survey of India provides the authoritative foundational topographical database, which may be used by the state governments as base layer for strengthening other fundamental and sectoral data themes.

❖ Survey of India has presence across all the states, the state government agencies may collaborate with the regional Geospatial Directorates of SoI for assistance in their projects & activities related to Geospatial Surveying & Mapping.

❖ A network of more than 1000 Continuously Operation Reference Stations (CORS) has been established by SoI, the services of CORS can be used for accurate control survey and real time positioning applications.

- National Institute for Geo-Informatics Science & Technology, Hyderabad, which is the training institute of SoI offers training on the latest technologies in Geospatial Sector. The institute offers customised training modules as per the requirement of the state/central government agencies.
- Survey of India has skilled work force of more than 2000 employees, who can supportthe State/Central government agencies as per the requirement of training, technical consultation, handholding etc.

15. Conclusion

The achievements under NGP, like high-resolution mapping, high-resolution mapping,establishment of a robust geodetic framework, geodetic advancements, geospatial data standardization, and strategic collaborations, underline India's commitment to becoming a global leader in geospatial technology. As these initiatives continue to evolve, they will play a pivotal role in driving innovation, fostering economic growth, and enhancing India's global competitiveness in geospatial science.

SOIDST

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DEPARTMENT OF
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सत्यमेव जयते

IIT Tirupati
Navavishkār
I-Hub Foundation

भारतीय प्रौद्योगिकी संस्थान तिरुपति
IIT TIRUPATI

OPERATION DRONAGIRI

PILOT PROJECT UNDER NATIONAL GEOSPATIAL POLICY 2022

NOVEMBER 2024 - MAY 2025

IIT Bombay
SINE
Business Incubator

IIM CALCUTTA
INNOVATION PARK

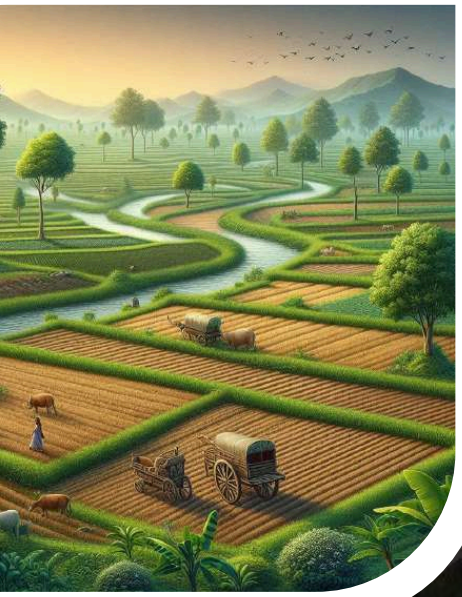
INCUBATION AND INNOVATION
STARTUP INCUBATION AND INNOVATION CENTRE IIT KANPUR

Introduction
"Operation Dronagiri"

Objective: Operation Dronagiri is planned to utilize modern Geospatial Data & Technology to enrich the lives of every citizen of Bharat especially Farmers, Youth , Women.

Approach and Methodology: Stakeholder consultations were held in Delhi between March and April 2024, leading to the identification of three key sectors—Agriculture, Transportation & Infrastructure, and Livelihoods & Skilling—and over 45 specific use cases/problem statements for our industry partners to address. Aligned with the National Geospatial Policy (NGP) 2022, which aims to position India as a global leader in geospatial technology, Operation Dronagiri employs several strategic components such as Geospatial Innovation Accelerators (GIAs): These regional hubs foster innovation by supporting startups and industry partners in solving identified problem statements across five states. **Grand Challenge**: A competitive platform that invites early- and growth-stage startups to develop geospatial solutions addressing critical needs. **Accelerator Program** Provides selected startups with mentorship, resources, and funding to implement and scale their solutions. **Integrated Geospatial Data sharing (GDI)** Ensures seamless data access and integration, forming the backbone of geospatial operations. **Geospatial Innovation Hub (GIH)** Serves as a centre of excellence, coordinating efforts and promoting collaboration across GIAs. **Geospatial Innovation Cell** Manages and oversees the entire process, ensuring alignment with NGP 2022 and smooth coordination between stakeholders, GIAs, and industry partners.

Expected Outcome: The program is expected to connect data providers to data consumers to enable use of geospatial technologies and data to benefit the end user like Farmers, Youth , Women.



Livelihoods and Skilling

Transport & Infrastruture

Agriculture

“Operation Dronagiri”

National Geospatial Policy 2022 was launched by the Department of Science & Technology to liberalize the Geospatial Sector and promote Innovation & growth of the domain in the country.

The Policy aims to promote the development and use of geospatial data and technologies to support the country's socio-economic progress, governance, and security.

Geospatial Data Promotion and Development Committee (GDPDC) is a national level apex body for formulating and implementing appropriate guidelines, strategies and programs for promotion of activities related to Geospatial sector.

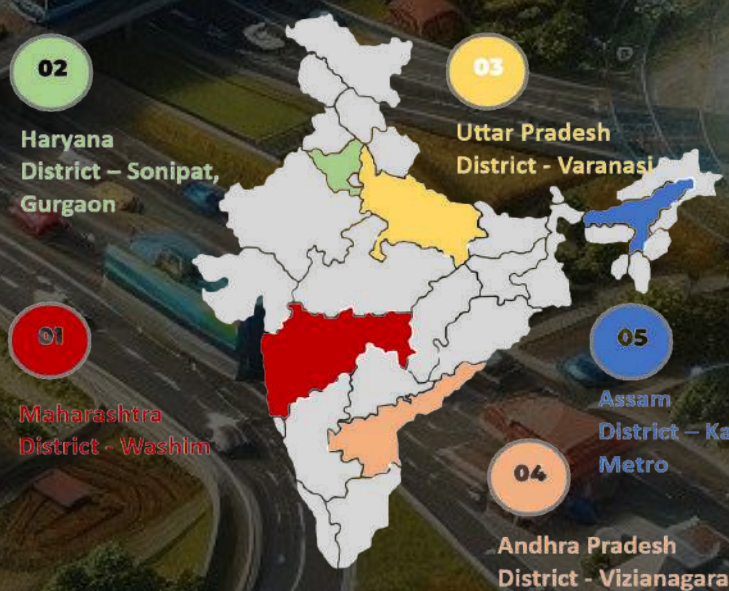
Operation Dronagiri- Why, What and How?

Why ?

Modern Geospatial Data & Technology can enrich the lives of every citizen of Bharat especially **Farmers, Youth , and Women.**

“Operation Dronagiri” is planned as a pilot operation for “National Geospatial Mission”.

To establish the use of Geospatial data and technologies with grass-root level issues.



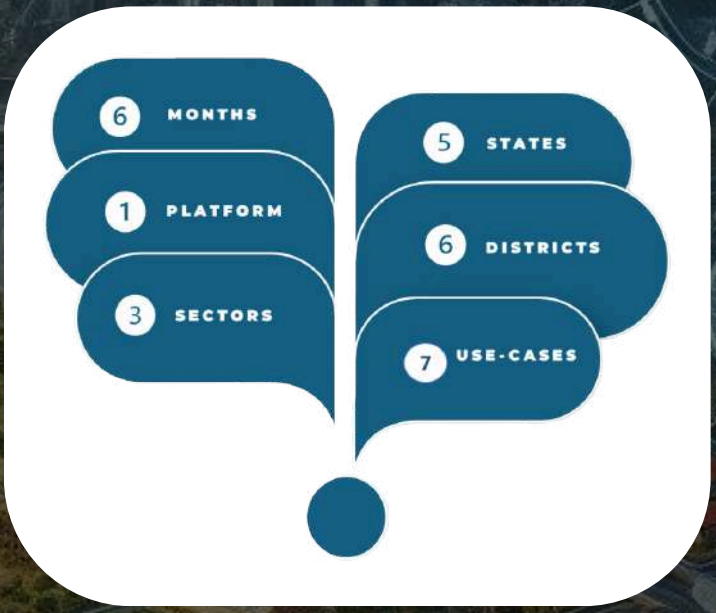
Operation Dronagiri- Why, What and How?

What ?

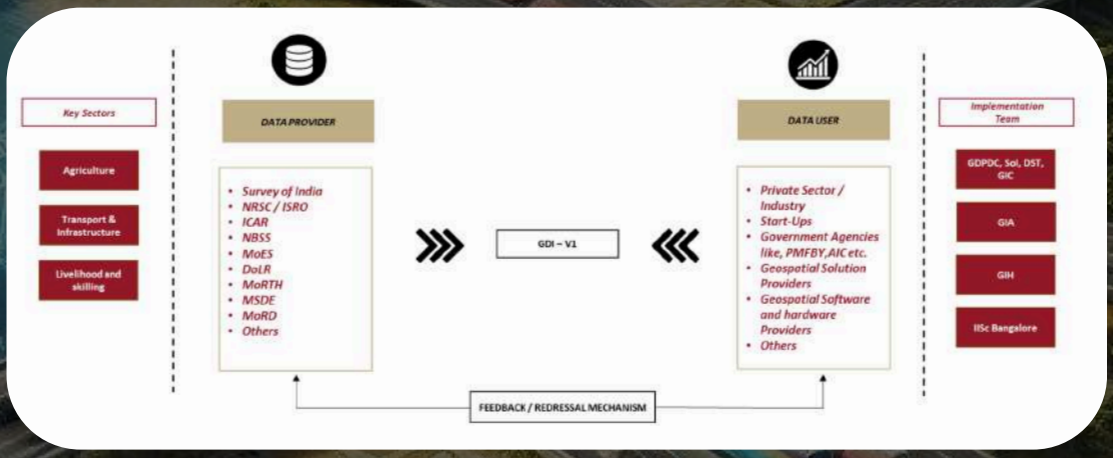
Operation Dronagiri is planned from November 2024 to May 2025, in 5 States and 6 Districts.

Three identified sectors, with more than 45 use cases/problem statement have been identified to be solved by our Industry partners.

Key data providers, on-ground implementation team and key stakeholders have been identified to implement Operation Dronagiri.



How ?



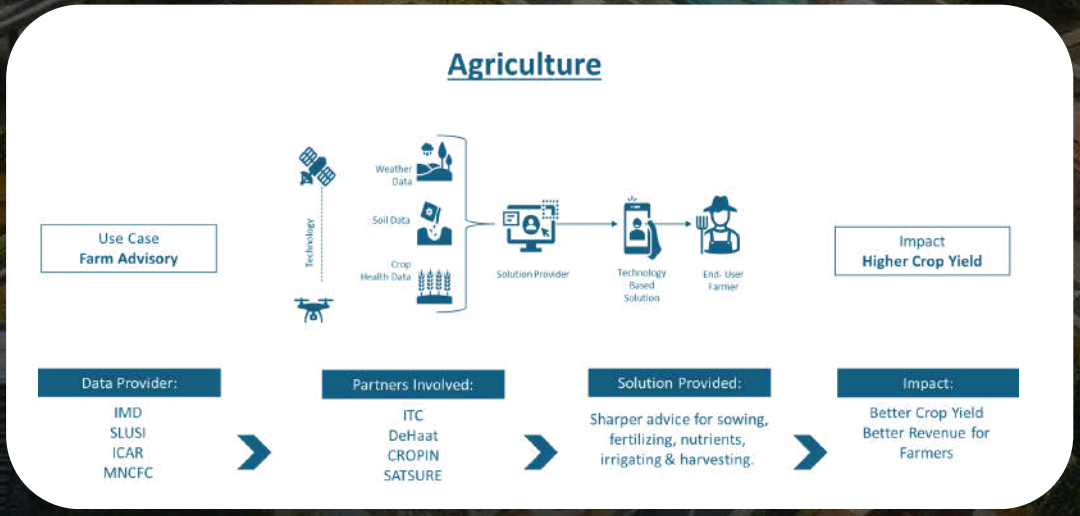
Operation Dronagiri data framework connects sectors like Agriculture, Transport & Infrastructure, and Livelihoods with data providers such as Survey of India,ISRO etc. Through the Integrated Geospatial Data sharing platform, data is made accessible to users—private industry, startups, and government agencies. An Implementation Team ensures smooth data flow and project coordination, supported by a feedback mechanism for continuous improvement. This setup drives innovation and impact across key sectors.

Concept and Conduct

Problem Statements for Operation Dronagiri were identified through extensive consultations led by the GDPDC Secretariat with sector experts, government agencies, corporate stakeholders, and startups. These consultations, aimed at defining specific challenges in Agriculture, Transportation & Infrastructure, and Livelihoods & Skills. The Grand Challenge is a platform to identify startups offering geospatial solutions to critical development issues. Early- and growth-stage startups present solutions, supported by Geospatial Innovation Accelerators (GIAs), which provide mentorship and resources and work closely with state stakeholders to meet regional needs. The Nodal GIA, IIT Tirupati Navavishkar I-Hub Foundation (IITTNiF), coordinates GIAs, aligns them with Operation Dronagiri's goals, and liaises with the GDPDC Secretariat, DST, and Survey of India. The Accelerator Program supports startups in deploying solutions, with early-stage startups testing proof-of-concept models and growth-stage startups scaling products, all benefiting from funding, technical support, and geospatial data.

Assessed Impact in Agriculture sector

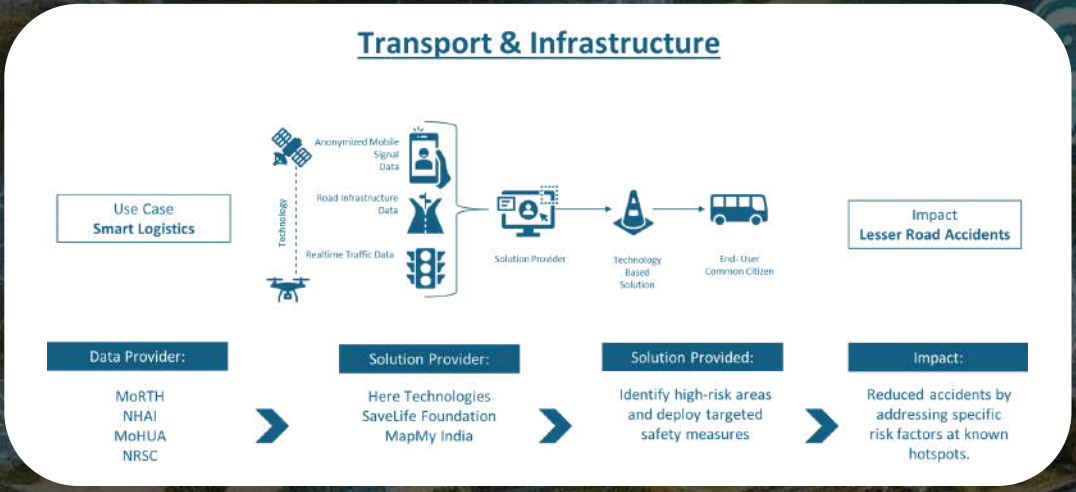
Farm advisory services empower farmers with actionable insights by integrating weather, soil, and crop health data from trusted providers. Through technology solutions, these services guide farmers in making informed decisions, leading to improved crop yields, increased revenue, and fostering sustainable agricultural practices that drive economic growth for farming communities.



Operation Dronagiri Nov 2024 - May 2025

Assessed Impact in Transportation & Infrastructure

Enhancing smart logistics by providing actionable insights through advanced data integration. By combining anonymized mobile signal data, road infrastructure details, and real-time traffic information from reliable sources, technology solutions help identify high-risk areas and implement targeted safety measures. This results in fewer road accidents, promoting safer travel and improving overall infrastructure resilience for communities.



Assessed Impact in Livelihoods and Skilling

Addressing urban employment by connecting job seekers with opportunities through location-based insights. Utilizing real-time mapping tools, this approach enables job seekers and employers to connect instantly, leading to quicker, skill-based job placements and faster hiring. This fosters greater employment efficiency and responsiveness in urban areas, supporting both job seekers and businesses in a streamlined manner. The solution providers for this initiative are TMI Group and Hands On.

Grand Challenge through Geospatial Innovation Accelerators

The Grand Challenge, through Geospatial Innovation Accelerators (GIAs) aimed at supporting local implementation across selected districts. Working with the GDPDC Secretariat, DST-NGP, and Survey of India, each GIA leverages regional expertise to advance the program's goals. The GIAs include:

AWaDH, IIT Ropar in Gurugram & Sonipat, Haryana
FIRST, IIT Kanpur in Varanasi
Innovation Park, IIM Calcutta in Kamrup
SINE, IIT Bombay in Washim
IITTNiF, IIT Tirupati in Vizianagaram

The Grand Challenge targets early- and growth-stage startups, supporting innovative geospatial solutions in Agriculture, Transportation/Infrastructure, and Livelihoods/Skills. Early-stage startups receive guidance and funding for proof-of-concept (POC) solutions, while growth-stage startups gain strategic support for regional integration. Corporate partnerships extend the impact and sustainability of these solutions.

Nodal Geospatial Innovation Accelerator

In October 2024, an agreement was executed between the Nodal GIA for Operation Dronagiri, IIT Tirupati Navavishkar I-Hub Foundation (IITTNiF) and other GIAs to ensure seamless operation of Operation Dronagiri. The Nodal GIA will carry out comprehensive planning, coordination, and execution of the Accelerator program across all Geospatial Innovation Accelerators (GIAs).

State Geospatial Directorates

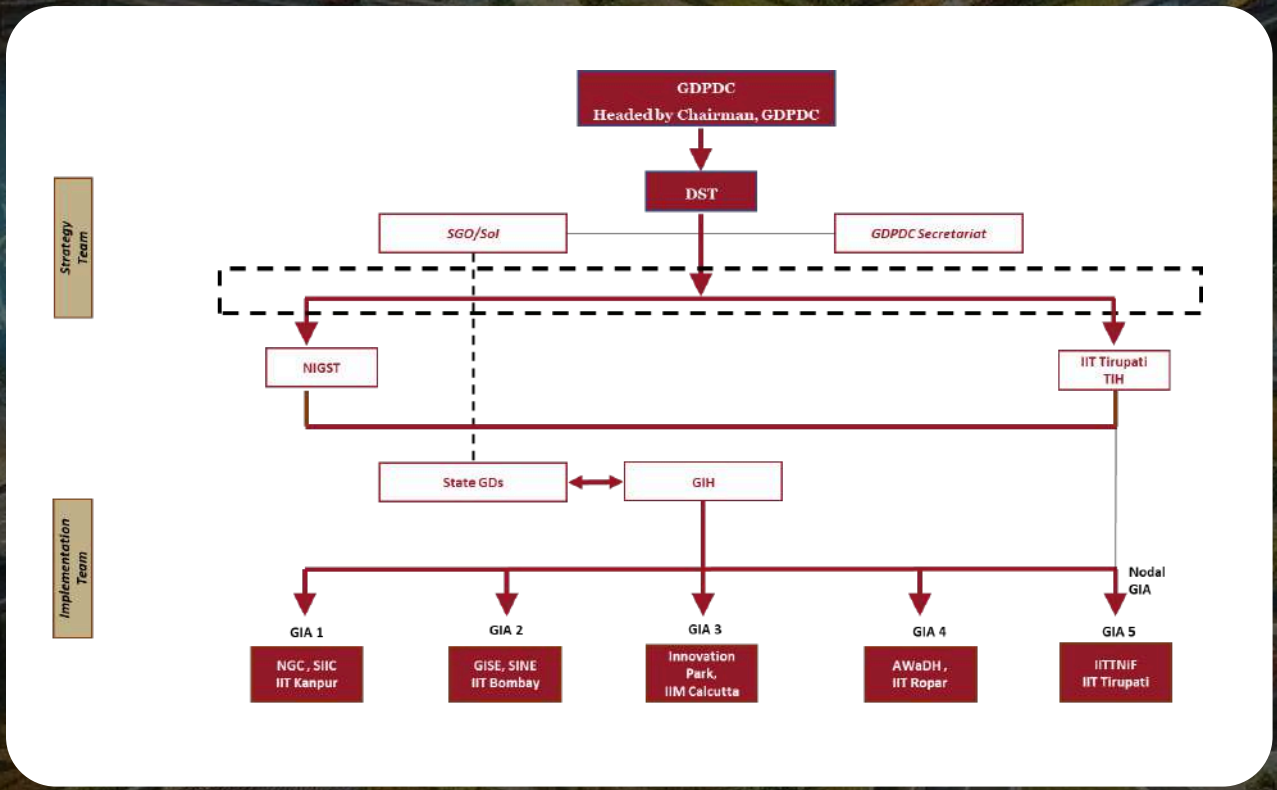
The State Geospatial Directorates (State GDs), managed by the Survey of India, are integral to the local implementation of Operation Dronagiri. These directorates, present across most states, act as pivotal agencies for coordination, using their technical expertise to drive the success of the initiative. Their key responsibilities include coordination and planning, data collection and management, providing technical support and capacity building, ensuring quality assurance, engaging stakeholders, and overseeing reporting and documentation.

GDI (The Integrated Geospatial Data sharing)

The GDI Team at IISc Bangalore has played a crucial role in Operation Dronagiri, developing a geospatial data exchange solution that included a data registry and catalog. This system aligned with the Geospatial Data Infrastructure (GDI) objectives set by DST, enabling seamless data access via APIs. The team is responsible for operationalizing and maintaining this solution, integrating relevant data repositories, and providing web hosting for previously offline datasets.

Governance Framework

Operation Dronagiri coordinates strategy, implementation, and geospatial expertise under the oversight of the GDPDC Secretariat, DST-NGP and Survey of India. The National Institute of Geospatial Science and Technology (NIGST) and Geospatial Innovation Hub (GIH) provide technical support, linking with State Geospatial Directorates for local implementation.



Data Requirement for Operation Dronagiri

Operation Dronagiri requires a comprehensive range of geospatial data across the sectors of Agriculture, Transportation & Infrastructure, and Skilling & Livelihoods. The mapping of data requirements to available sources ensures that relevant, high-quality data is accessible for informed decision-making and effective project implementation, ultimately supporting sustainable growth and innovation across these sectors. The table below details specific data requirements and corresponding data providers for each sector.

Sector	Name of Dataset	Provider
Agriculture	Soil dataset	ICAR
	Administrative Boundary Database for Entire Country upto Taluk Level with HQ Field Verified Village Boundary Database India	SoI
	Village boundaries in Varanasi district, Uttar Pradesh	SoI
	Geology and Lithology, Sonipat	GSI
	Irrigation dataset for Washim - Maharashtra, Vizianagaram- Andhra Pradesh, Varanasi- Uttar Pradesh, Sonipat and Gurugram- Haryana	NWIC
	City Weather forecast for 7 days, Automatic Weather Station (AWS)/Automatic Rain Gauge (ARG) Data, Port Warning.	IMD
	Details of warehouses of five districts as received from FCI: Kamrup metro, Sonipat, Varanasi, Vizianagaram, Washim	FCI
	LST, precipitation and NDVI for Varanasi, UP	Open Data (NASA)
	LST, precipitation and NDVI for Washim, Maharashtra	Open Data (NASA)
	LST, precipitation and NDVI for Kamrup metro, Assam	Open Data (NASA)
	Dronagiri Data Varanasi/Land Parcel	Board Of Revenue, U.P.
	Dronagiri Data Varanasi/Varanasi 25K	SoI (NHP)
	1. Forest Cover data for Gurugram, Kamrup, Varanasi, Vizianagaram, Washim 2. Large forest fire (LFF) for Kamrup and Washim 3. Near real time (NRT) forest fire for Gurugram, Kamrup, Vizianagaram, Washim	FSI
Transportation & Infrastructure	Administrative Boundary Database for Entire Country upto Taluk Level with HQ Field Verified Village Boundary Database India	SoI
	Village boundaries in Varanasi district, Uttar Pradesh	SoI
	City Weather forecast for 7 days, Automatic Weather Station (AWS)/Automatic Rain Gauge (ARG) Data, Port Warning.	IMD
	Dronagiri Data Varanasi/Varanasi SoI Data 50K	SoI
Livelihood & Skilling	Primary census abstract of India, 2011	ORGI
	Point of interest (School, Post office, Bank branch, ATM)	NIC_GSTS Division

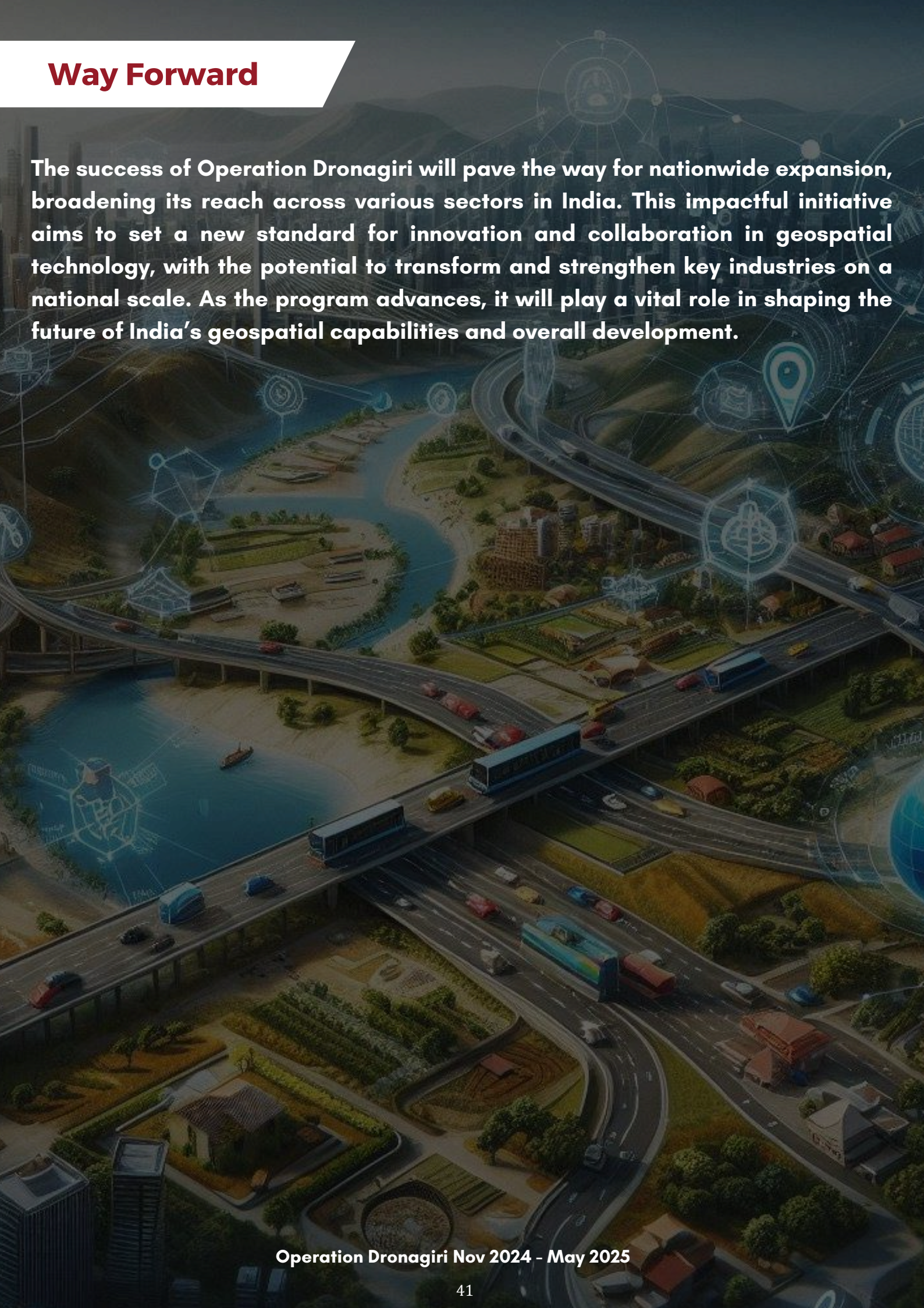
Time Line

Operation Dronagiri, in alignment with the National Geospatial Policy (NGP) 2022 and the vision of Atmanirbhar Bharat, demonstrates India's dedication to self-reliance and leadership in the geospatial sector. Operation Dronagiri aims to accomplish its objectives within the following timelines:

S.no	Activity	Start Date	Duration
1	Launch Call for Proposals	November 13, 2024	4 weeks
2	Level 1 - Screening	December 11, 2024	1 week
3	Pitch Deck Submission	December 18, 2024	1 week
4	Level 2 - Screening	December 26, 2024	1 week
5	Due Diligence and Equity Negotiation	January 2, 2025	4 weeks
6	Board Approval & Agreements	January 29, 2025	1 week
7	Shareholder Agreement Signing	February 5, 2025	1 week
8	Ministry of Corporate Affairs Upload	February 12, 2025	2 days
9	Admin Approval & Fund Disbursement	February 14, 2025	2 days
10	Project Commencement	February 16, 2025	24 weeks
11	Mentoring & Coaching, Workshop & Training, Investor Connect	March 02, 2025	
12	Demo Day & Showcase / Remaining Funds	June 22, 2025	
13	Evaluation by GDPDC Team & Account Closure by Nodal GIA	July 13, 2025	
14	Presentation of Results by GDPDC Team to DST	July 20, 2025	
15	MoU Closure	August 17, 2025	

Way Forward

The success of Operation Dronagiri will pave the way for nationwide expansion, broadening its reach across various sectors in India. This impactful initiative aims to set a new standard for innovation and collaboration in geospatial technology, with the potential to transform and strengthen key industries on a national scale. As the program advances, it will play a vital role in shaping the future of India's geospatial capabilities and overall development.



“THINK GEOSPATIAL ACT GEOSPATIAL, LET’S MAKE INDIA THE WORLD LEADER IN GEOSPATIAL”

Acknowledgements

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DEPARTMENT OF SCIENCE & TECHNOLOGY

SURVEY OF INDIA 1767

National Mission on Interdisciplinary Cyber-Physical Systems NM-ICPS

IIT Tirupati Navavishkār I-Hub Foundation

IIT Bombay SINE Business Incubator

IIM CALCUTTA INNOVATION PARK

INCUBATION AND INNOVATION

STARTUP INCUBATION AND INNOVATION CENTRE IIT KANPUR

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ITC Enduring Value

HDFC BANK

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LCB FERTILIZERS

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ideaForge

BLU SMART MOBILITY

Hands On

Partnerships

RBIH Reserve Bank Innovation Hub

ONDC

Pradhanmantri Fasal Bima Yojana

Agri Stack

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Annexure-3

विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF
SCIENCE & TECHNOLOGY

विकसित भारत अभियान

NATIONAL WORKSHOP

ON STRENGTHENING OF GEOSPATIAL ECOSYSTEM

Session: 3

NATIONAL GEODETIC REFERENCE FRAME

25th November 2024

Geo-enabling The Nation Through Collaboration

1. Introduction

Geospatial data is increasingly recognized as a vital component of national infrastructure and a valuable information resource with significant societal, economic and environmental benefits. It serves as a foundational reference frame for integrating government systems, services and sustainable development initiatives using "Location" as a common element. Acknowledging the importance of geospatial data, the Government of India introduced the **National Geospatial Policy (NGP)** on December 28, 2022. This policy aims to position geospatial data and technology as transformative tools for achieving the Sustainable Development Goals (SDGs).

Geodetic Reference Frames (GRF) are fundamental to the development of meaningful GIS products and services. They not only offer precise and efficient methods for positioning land information but also provide a standardized and effective framework for interpreting and sharing this information.

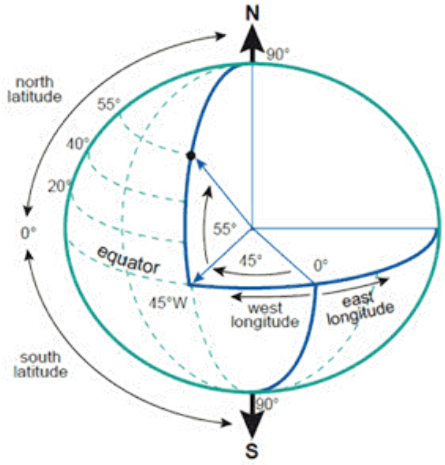

Figure: Reference System

Recognizing the critical role of GRFs in establishing and sustaining the geospatial ecosystem, the National Geospatial Policy 2022 (NGP-2022) prioritizes the redefinition of the National Geodetic Framework. This initiative leverages modern positioning technologies and ensures online access to the framework, supporting the advancement of geospatial capabilities. Location data is the foundation for our understanding and interacting with the spatial world. Whether we described it absolutely or relatively, it serves as a crucial reference for a wide range of human activities and scientific applications. Location refers to the specific position of an object, place, or point in space. In Mapping, Location on Earth is usually defined in two parts i) Geo Centric Coordinates describing the Horizontal Position of a point on the Datum Surface (i.e. Latitude- Longitude/ Easting- Northing) and ii) Geo-Potential coordinates describing the Vertical Position of a point above Datum Surface (i.e. MSL or Orthometric Height). MSL or Orthometric Height, is not mere Geometric distance from the Datum

Surface but represents the difference in potential energy between the point of interest and the Reference potential surface (Datum).Traditional land surveying uses local geographic identifiers or reference structures such as survey stone etc., to describe the location, shape, and size of land. These systems worked well when land records were created and maintained in physical form and in a discrete and localized manner. However, such maps are consistent only for local areas and introduce large errors when integrated with maps of adjacent areas.

It is also important to note that the Earth Surface is not fixed and continuously undergoes various deformations due to stress generated, due to various internal and external forces it interacts with. Due to these deformations, Coordinates do change over time, over different spatial and temporal scales. Normally for a short span of time and regional scale, these changes are insignificant, hence reference frames are usually treated as fixed surfaces. However, over a large period, these changes become very significant, especially when data is dealt with on a continental scale. Due to the increasing demand for land information for various government public welfare programs and commercial activities, a continuous and easily accessible multi-purpose land information system supported by a robust Geodetic Reference frame, is needed.

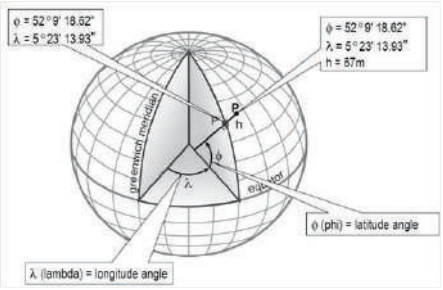

Figure: Geodetic Coordinate System

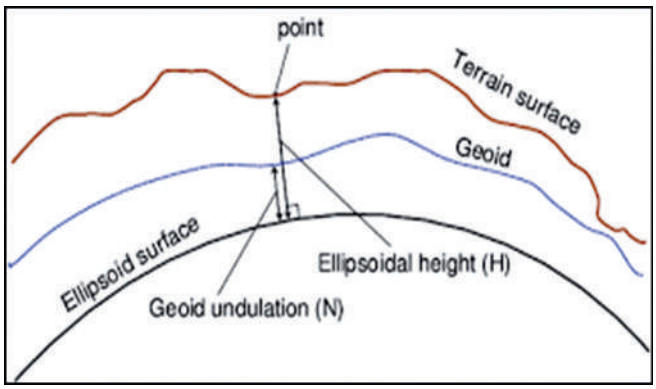

Figure: Geoidal Undulation (N)

2. Datum and Reference Frame

Actual surface of the earth is highly undulating with elevation varies from about +8848m (Mount Everest) to –429m (Dead Sea shore and surface) and undulation varies from point to point. It is difficult to define the Earth's actual surface which meets requirement of scientific mapping i.e. the adjacent maps matches with each other, sum total of area of all maps of earth should be equal to surface area of the earth etc. In order to achieve this, idea of approximation of earth by a mathematical surface was mooted as early as in the beginning of 19th century. Geodesists found that the earth can be approximated by an ellipsoid, and measurement on surface of Earth when reduced to surface of this ellipsoid, can be accurately placed and understood within a global or regional context and achieve necessary consistency required for scientific mapping.

Hence ellipsoidal Surface are used worldwide as reference datum for surveying and Mapping applications.

Over this ellipsoid, a geocentric reference system is defined to provide a consistent framework for defining coordinates (latitude and longitude) on the Earth's surface, whereas the third dimension i.e. elevation is measured with reference to another datum termed as Geoid. In geocentric reference system, the center of the Earth is taken as origin of Reference system and Earth's axis of rotation, equator, and prime meridian as reference directions. This reference system is used to describe geographic locations on the Earth's surface in terms of latitude and longitude. However, because these reference lines (Earth's axis of rotation, equator, and prime meridian) are not easily accessible and require long astronomical observations, hence accurate measurement of point of interests such as corners of land parcel etc., from these reference lines, is a tedious and expensive task.

To simplify measurement tasks, a set of control points are established, whose coordinates are measured with highest precision. Collectively these control points and reference system realized by them are is called a Geodetic Reference Frame (GRF). GRF serves as the fundamental building blocks necessary for the meaningful development of land information systems. It provides an accurate and efficient way to locate land information by providing start and end points for survey works.

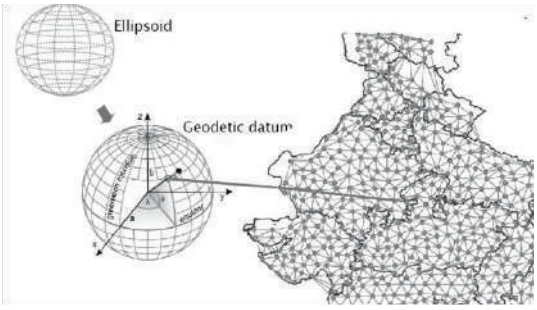

Figure: CORS network

3.Horizontal Datum and Reference Frame

Survey of India, as the National Mapping Agency has established a spatial reference frame for the country, first during the 19th century through the Great Trigonometric Survey. Under the Great Trigonometric Survey, a Network of GTS stations established across the country and distances and angles between them were measured using Geodetic observations. During this exercise, the shape of Earth in this part of the globe was determined and Everest Ellipsoid was defined. The reference ellipsoid for Indian subcontinent was originally derived by George Everest in 1830 based on the Great Trigonometrical Survey and was named as Everest Ellipsoid on the name of George Everest. It was subsequently updated in 1888 and then in 1956 and renamed as Modified Everest ellipsoid.

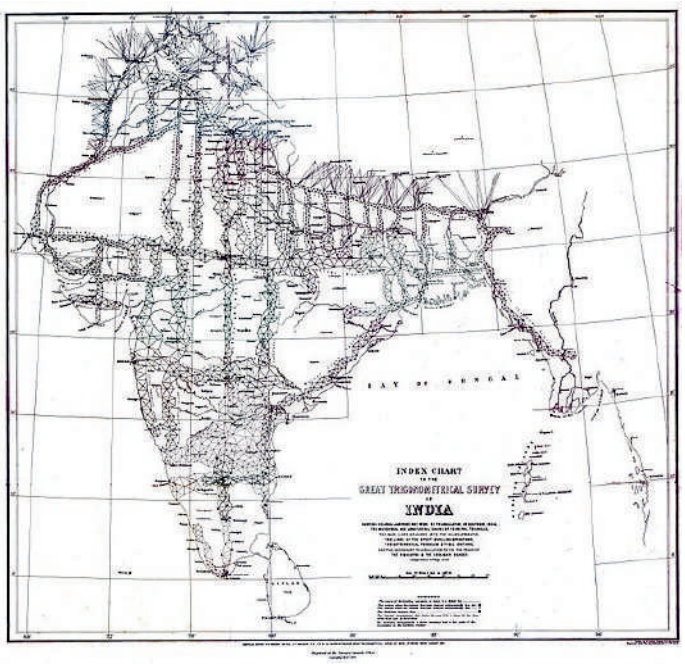

Figure: GTS Survey

There was total 3015 nos. GT stations, well monumented underground concrete structures, generally located on hill tops or erected towers, for easy sighting through theodolite from one station to another.

Civilian applications of Satellite based Global Positioning System started in 1990s, and with advent of new millennia, other satellite-based products such as Imageries have revolutionized Geospatial sector, by shortening data acquisition cycle. SoI Everest Datum and Reference Frame realized through GT stations and other triangulation stations, served fairly well for surveying and mapping in India and adjoining countries till the end of 20th century in traditional survey techniques, they were not compatible with satellite based systems.

Realizing the importance of Geospatial Data in socio-economic developmental activities, conservation of natural resources, disaster mitigation and infrastructure development, Government of India issued National Map Policy in 2005, which aimed to promote the use of geospatial knowledge and intelligence. For making its map compatible with Satellite based services and products, in 2006 Survey of India switched over from The Everest system to WGS-84 system. SoI decided to establish horizontal (Planimetric) control stations using GNSS on WGS-84 ellipsoid datum and in International Terrestrial Reference Frame (ITRF) using GNSS observations. For this realization more than 2500 GCPs at spacing of about 25 to 30 km were erected all across India. Coordinate system of GCPs (which have replaced the erstwhile GT stations for control work) is in ITRF 2008 and at epoch 2005 (plate position 01/01/2005). Seven parameter transformation models were also Computed which helped in converting all old 1:25,000 and smaller topographical

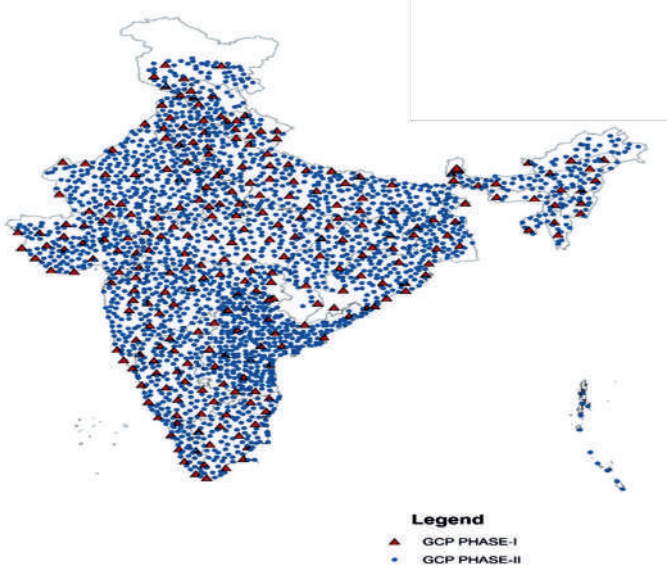

Figure: NSRF based on passive reference marks i.e. GCPs

maps of India from Everest ellipsoid datum to WGS- 84 datum. Traditionally Geodetic Reference Frames, are accessed through the physical occupation of Geodetic stations/ Reference Marks/Bench Marks. However with fusion of Information and Communication technologies with latest Geodetic techniques such as GNSS, access to the Reference Frame can be achieved, without physically occupying the reference station. In order to capitalize improved communication technology to boost automation in Geospatial sector, SoI started upgrading its Spatial Reference frame infrastructure in 2018-19. Under which more than 1000 CORS stations have been installed all over India, to make positional infrastructure accessible via online media. In addition to providing a reference frame, these CORS stations are also capable of generating Network RTK corrections. Currently, CORS stations are established at every 60-80 km interval, which are capable of providing 3 to 4 cm accurate real-time positioning. The continuous tracking of active control points (CORS) will provide spatial and temporal variation in crustal deformation, making Geodetic frame, precise and

consistent for High resolution Geospatial data requirements. Currently, SoI CORS stations are assigned co-ordinates in International Terrestrial Reference Frame 2008 (ITRF 2008) at the reference epoch of 01st January, 2005, consistent with existing coordinate system of GCPs. However, movement of tectonic plates beneath the Earth's surface, strains caused due to earthquakes, volcanic eruptions, and disturbance caused by anthropological activities, precision and consistency of the reference frame, get diluted over time.

To account for plate motion and crustal deformation, reference frame will be updated with Plate Fix Coordinates in ITRF 2020 at latest epoch, related to the GGRF/ APREF through a Rigid Plate Rotation Model. In order to track future deformation in continental surface, Intra-plate Deformation Model will also be generated, so that scientific users measuring Earth Systems, may estimate the change in coordinates at any given epoch.

These models will be required to re-evaluate frequently (about every decade), to keep position of control points good and useful during indeterminate time afterward.
The continuous tracking of active control points (CORS) will provide spatial and temporal variation in crustal deformation. Hence, the primary access points to the new spatial reference frames will be through CORS. Passive control or GCPs will be reduced in function to provide secondary access to the spatial reference frame. GCPs will remain primary access points in regions where necessary infrastructure required for operating CORS (such as High hill areas, marshy land, dense Jungles etc.) are not available.

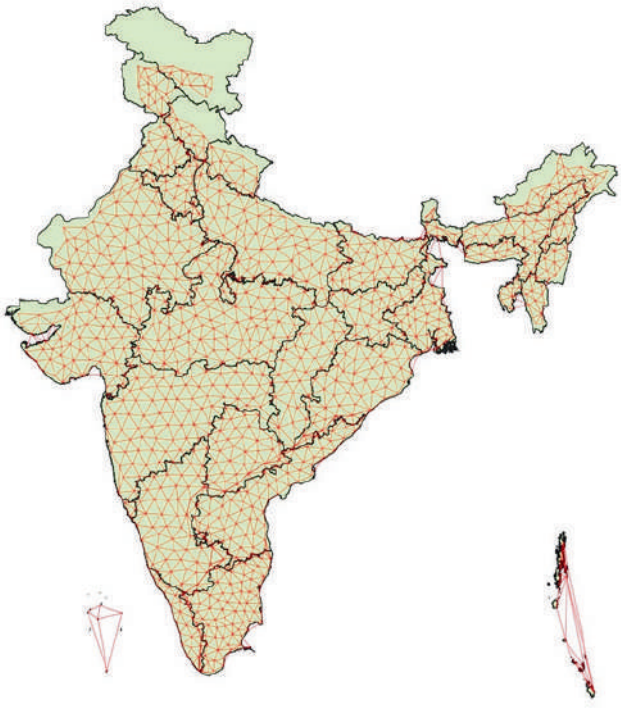

Figure: NSRF based on Active CORS

In order to utilize legacy data, Nationally consistent transformation models will be made available, to enable users to transform spatial data between reference frames. These transformation models will be comprised of a conformal transformation component (primarily due to plate tectonic motion), as well as a non-conformal distortion component. The distortion component can be attributed to several effects, such as deformation of crust due to earthquakes, land subsidence etc., improvement in the realization of the global reference frame over time; and lack of rigour in the computation of earlier datum/reference frame and it will be very difficult to estimate deformation in all parts of the country with same consistency, hence non-conformal distortion model will be available with limited accuracy.

3.1 Why CORS Infrastructure is required

With the advent of new technology, surveying techniques and instruments have evolved significantly, becoming more accurate and faster. Global Navigation Satellite System (GNSS) or Global Positioning System (GPS) is one of these surveying technologies. This has revolutionized our ability to access location information.

It uses radio signals to estimate its position on Earth by measuring its distance to a series of satellites hovering in predetermined orbits above the Earth. This makes it a fast, accurate, and easily accessible positioning technique. However, this system has its own error budget due to orbit errors, satellite clock errors, receiver noise, ionospheric and tropospheric delays, satellite geometry through receiver and multipath, etc due to which Accuracy of direct GPS measurement is limited upto ~2-3 meters, depending upon sky conditions and instrumentations.

This level of accuracy is not suitable for the most of surveying and mapping applications. To overcome this accuracy limitation, the geospatial community uses a variety of surveying techniques, including DGNSS, GPS/GNSS static surveying, RTK, SBAS, GBAS, and PPP. However, these techniques have limitations in terms of access to references, time to positioning solution, and accuracy. It is important to note that the accuracy achievable with each of these methods varies by geographic region and depends on the support infrastructure available in that region.

Hence in order to upgrade its positional infrastructure, Survey of India has established a network of Continuous Operational Reference Points (CORS) across the country. This, together with a network of permanently marked elevation control points/benchmarks, forms the country's robust national geodetic reference frame.

A CORS infrastructure is essentially a network of fixed reference stations (or geodetic-grade GNSS receivers) that continuously stream raw satellite observations to a central server. The CORS infrastructure consists of three main components.

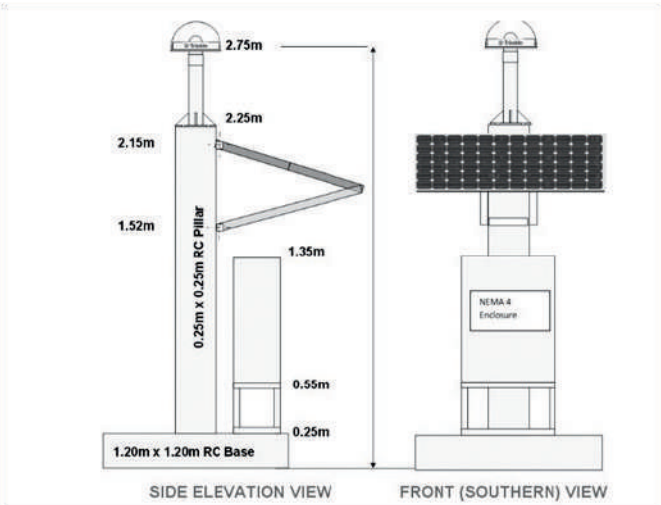

Figure: Conceptualized depiction of CORS monument

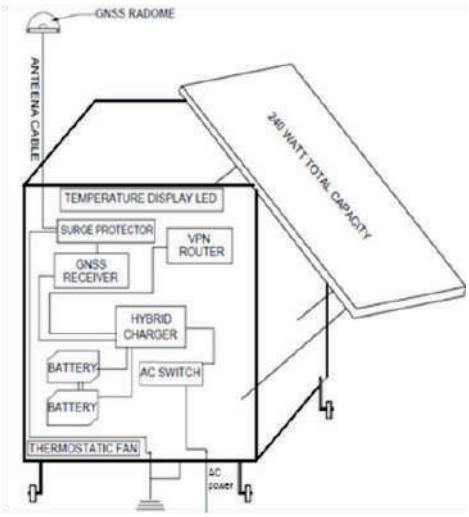

Figure: Enclosure comprising peripherals

A. Network of Reference Stations

A continuous GNSS reference station (also known as a permanent reference station) consists of a GNSS receiver and antenna stably installed in a safe location with reliable power. For power redundancy, CORS stations are also equipped with solar panels, UPS, and battery banks. The receiver operates continuously, recording raw data and (continuously) streaming the raw data to a central server for archiving and processing. A CORS network consists of multiple GNSS stations connected by reliable communications, enabling real-time calculations and control. At least two independent communication media are used for improving stability and reliability of system.

B. Communication

Communication is a very important part of the CORS infrastructure. It is used to control and monitor health of the receiving station, download its log data files, and distribute RTK and DGPS data. SoI CORS use Internet for communication between Reference stations to servers and further to recipients. Hence, to access the SoI CORS services and retrieve the required data, user's GIS rover receivers must be equipped with an Internet-enabled device, such as a GPRS or CDMA telephone modem. Software running on the server calculates the required RTK/DGPS data in the required format and sends it over the Internet.

Figure: Typical CORS station

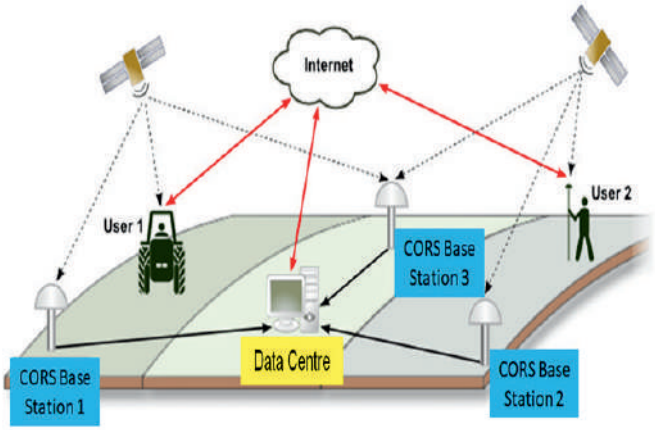

Figure: NRTK network and User interaction

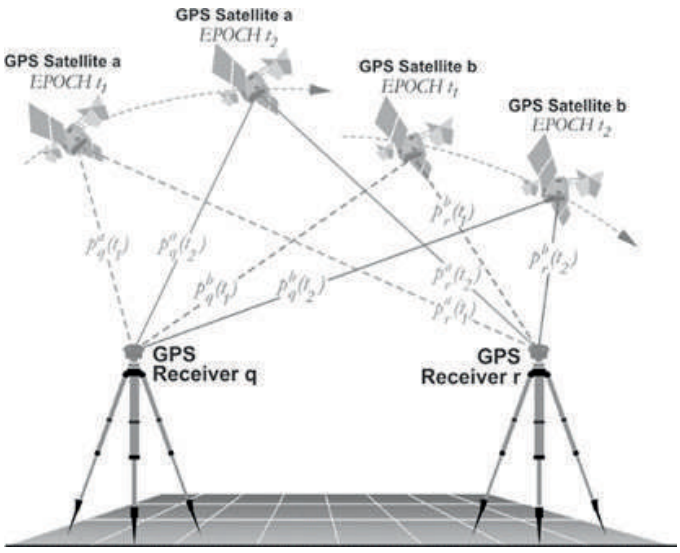

Figure: Differential positioning

C. Processing and Monitoring Center

The raw data collected by the reference station is continuously streamed to a central server via a permanently open communication connection. Network processing and monitoring software runs on this central server to check the integrity of the raw data, compress and archive the raw data. This pushed raw data is converted to an open, non-proprietary format (RINEX file) on an FTP server for easy access to the GPS user community.

Network software also monitors receiver operation, data quality, communications links, and overall network functionality, generating alerts and reports as necessary. It runs on a server and controls the receiver and automatically downloads data files at regular intervals.

For real-time positioning solutions, raw data that is continuously streamed from the receiver to the server is processed in real-time and a baseline between reference stations is continuously calculated. This computational process continually analyze the state of the environment within the network and creates distance-dependent error models to calculate network correction parameters.

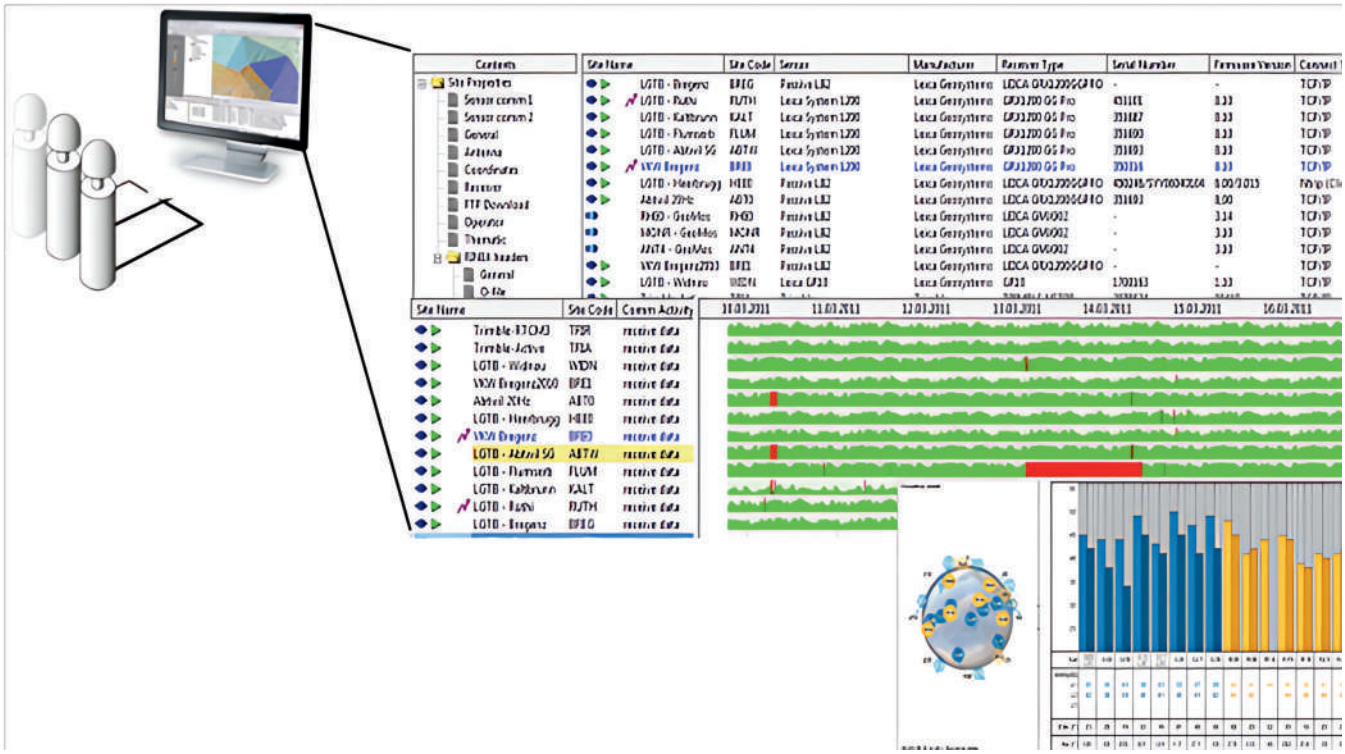

Figure: CORS Processing and Monitoring Centre

3.2 Positioning Services and Products offered by CORS Network

CORS network is available 24 hours per day, 7 days a week and 365 days a year. Its data and corrections are hosted on web in form of open non-proprietary Data streaming standards for easy consumption. These data/services are available on https://cors.surveyofindia.gov.in
At present following positioning services are being offered:

A. Real Time Services

- **Network RTK Services for 3 – 4 centimeter real time positioning:**

Real-time kinematics (RTK) is a widely accepted technology for precise positioning and navigation. This method is an extension of single-base RTK surveying techniques, where a GNSS rover connects to a single base station or reference station with known coordinates. This measurement technique allows positional accuracy in the centimeter range. However, by networking several such reference station areas, the accuracy and reliability of RTK surveying techniques can be increased many times. These network correction parameters are hosted on a static IP address using a mount point.
SOI hosting IP and mount point details are available on the CORS website https://cors.surveyofindia.gov.in/connection-settings.php. Login credentials are issued to users on registration with respective CORS service provider.
To use this service, a user needs the RTK-compatible dual/multi-constellation GNSS, controller, field survey software, internet connection, and valid credentials from the respective CORS service provider.

- **D-GNSS (Code based) Services for 30 – 40 centimeter accurate real time positioning:**

GIS users can use DGNSS service to get decimeter level accurate positioning in real time. The standard DGNSS technique consists of the determination of the GNSS position from an accurately-surveyed position known as reference station. These DGPS corrections improve the accuracy of the Standalone position data by eliminating errors in satellite range measurements using these differential corrections, and provide a horizontal accuracy of 30 – 40 centimeters. Similar to Network RTK service, this service is also hosted on static IP with DGNSS mount points indicating its solution type. User will be required DGNSS compatible dual / multi constellation GNSS, controller, field survey software, internet connectivity and valid login credentials from CORS service provider to consume this service.

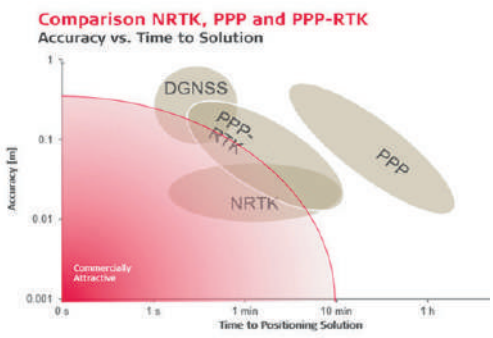

Figure: Comparative among positioning techniques

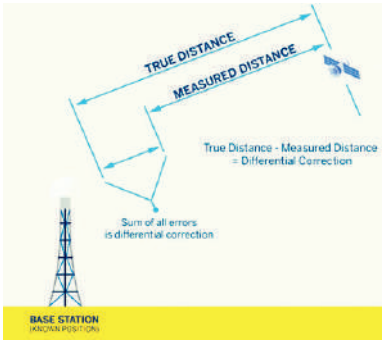

Figure: GNSS (Code) corrections

B. Reference Data Services

- **Downloading of RAW Data of CORS Stations:**

Traditional GNSS observations are performed in static observation mode. This is the recommended method for establishing high-precision survey reference points and making sub-centimeter level measurements.
With CORS in place, there is no need to use paired GNSS equipment or forming geometrical networks as being done in traditional GNSS surveys. Using single GNSS equipment, control points with respect to National Reference frame can be established with much less observation period and better reliability and consistency in Survey work. User can put his GNSS rover, on his point of interest, collect data in static survey mode and use nearby CORS stations for master or base station for static survey. CORS stations raw observations can be downloaded in non-proprietary open RINEX format or virtual rinex data (i.e. RINEX files for a virtual reference station that can then be used for post processing calculations), and used to process static GNSS survey data collected in filed, in GNSS processing software. These data can also be used as base data for Drone survey in PPK mode operations.
To access this service, users must have valid credentials from their CORS service provider. Using these credentials, the user can log into the respective CORS web portal and create custom orders. Customize data format, data frequency, number of observation stations, observation date, observation time, observation period, etc.

- **Online Data processing of static observation with respect to CORS:**

Online Data Processing Service provides online access to high-accuracy National Geodetic Reference System coordinates. To use this service User will be required valid login credentials from CORS service provider. Using these credentials users can log into CORS web portal and simply upload a GPS data file (collected with a survey-grade GPS receiver) to the CORS online processing upload page. Computed positions can be downloaded in form of computation report from CORS web portal or can be asked to receive through email.

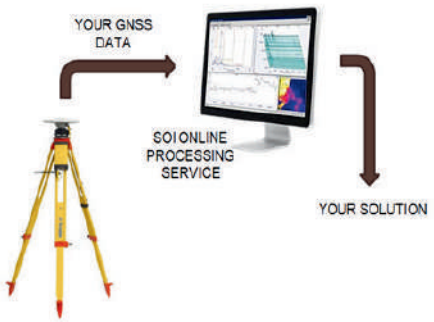

Figure: Online Data Processing Service

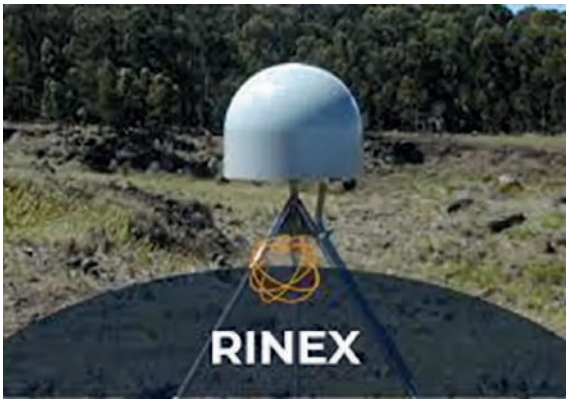

Figure: CORS (RINEX) data download

3.3 Procedure for utilizing CORS data

User can choose service as per their accuracy requirement. To access these services, user requires login ID credentials. For which user users are required to get them registered on https://cors.surveyofindia.gov.in/registration.php and subscribe for requisite services. CORS services to all Central and State Government Departments and Organizations are available on free of cost basis. Charges for said services for private users are available on https://cors.surveyofindia.gov.in/subscriptionCharges.php

Users can subscribe to services of CORS network on monthly or yearly basis to get real time corrections and/or static reference station data openly accessible through internet, instead of having to set up their own base station. SOP, Guidelines and Video Tutorials are available on website https://cors.surveyofindia.gov.in/cors-services.php

3.4 Benefits of the CORS Network

1. Accuracy Positional accuracy: is improved as the distance-dependent component (ppm) is reduced significantly through network processing, providing more homogenous positioning accuracy at different distances from the stations.
2. Reliability: The reliability of ambiguity fixed RTK rover positions is improved, even when operating at long ranges and under difficult ionospheric conditions. Permanent stations, fixed communication lines, and redundant server architecture ensure near 100% uptime 24/7. Conversely, local bases are subject to communication outages and have no redundancy in case of failure.
3. Availability: The proportion of time a system is in a functioning condition, such as providing continuous and reliable RTK corrections and data services to all users. The network software is designed for distributed server architecture, with automatic data archival and hardware redundancy.
4. Stability: Networks are monitored continuously for station movements, thus ensuring that they truly define the correct reference datum.
5. Scalability: The ability for the technology to accept increased workload without impacting performance Supporting GPS, GLONASS, GALILEO and BeiDou and future systems such as NaVIC.
6. Flexibility: Centralized server can support multiple users and applications simultaneously, for real time services as well as for more precise reference data services.
7. Compatibility: CORS data and services are transmitted in open and non proprietary formats, making them independent from specific make and model instrumentation.

4. Vertical Datum

Determination of direction and velocity of liquid flow is one of the most important tasks of engineering projects aim for the welfare of citizens. Fixation/Identification of vertical datum is the most vital aspect in the fulfillment of this task. The task is achieved through a process known as leveling and gravity measurement and it is based on the concept that says "liquid flows from high gravity potential to low gravity potential". Vertical reference datum is the point with reference to which geo-potential (gravity potential) of all other points is determined. In order to ensure it being fairly static, the choice falls on either spheroidal level or rock cut bench mark or Mean Sea level. However, most countries including India have adopted Mean Sea level as the datum for height.

4.1 Evolution of Vertical Datum in India

Determination of vertical datum and evaluation of heights of points with reference to it throughout the main land and elsewhere in India is a saga of utmost human endeavor and effort. While achieving this gigantic task, a number of course corrections have also taken place as the scientific knowledge has improved with elapse of time.

Figure: RIVD network

Like elsewhere in the world, in India also initially the elevations (height) were widely determined using vertical angle measured through theodolite which was later on, since 1858, achieved through spirit leveling using leveling instruments. The leveling lines acquired during leveling operation in India from 1858 to 1909 were least square adjusted and christened as First level Net of India. The adjustment was constrained to Mean Sea Level (MSL) of 9 ports (four ports each in east and west coast and one at Karachi). The leveling was accomplished by leveling by two surveyors-one followed by another for same leveling line independently under practically identical conditions and normal gravity was used. Through the First level network, it was extended in the entire Country by constructing Standard Bench Marks all over India. Primary Level Network was laid by 86 leveling lines that were adjusted in 29 circuits for a total of 19,775 km observed from 1858 to 1909. Subsequently, over the years, the network was further extended and densified in other parts of the country. This leveling was called by the name normal leveling of Precision and carried out in the form of simultaneous double leveling. About 10,000 bench marks were established in First Level Net.

The leveling data of first level net which is more than 100 years old is still in use. During this period most of the Bench marks have been destroyed/ disturbed due to plate tectonics and developmental activities. Precision of levelling work done during that period was limited by available technology and scientific understanding of era. Much of which can be removed using modern surveying techniques and improved understanding of physical world, hence

revision of Indian vertical datum needs to be carried out in conformity with the global standards. Considering which, Survey of India has taken up task to Redefine Indian Vertical Datum (RIVD). In this work, the geo-potential numbers and Helmert orthometric heights have been computed taking type 'P' standard bench mark of Mumbai as a fixed point for entire leveling Network (about 19450 km) which was connected with vertical datum, the local mean sea level of Apollo Bunder Tidal observatory, Mumbai (1978-1994). A long pending requirement of applying observed gravity values to the observed geometrical heights was applied by observing gravity values at every bench mark at a spacing of 3 to 5 km. Gravity at intermediate bench marks have been interpolated as a linear function of elevation and horizontal distance. A least square adjustment method was adopted to adjust leveling network in terms of Geo-potential Numbers and subsequently Helmert orthometric heights have been computed.

All the precision measurement for observing leveling sections, gravity values and computational procedures are taken into account with utmost precautions. Digital Leveling instruments like Trimble Dini-12 and Leica DNA -03 digital levels which has reading resolution 0.1 mm and relative gravimeters CG-5 and CG-3M with reading resolution 1 µgal have been used. The skeleton of leveling lines all along coastline and in the middle of India has been completed with 29 lines, no of junctions 19 and in 11 number of circuits with maximum closing error of a circuit 0.2504 gpu and minimum closing error of a circuit 0.0010 gpu which is considered very good.

In the Second Phase of IVD 2009 Total of 95,000 x 2 lin. km HP Levelling work has been proposed to densify this HP level net and extend it to further regions of India. In addition, about 40,000 Km of additional leveling is being carried out to support the development of the Geoid Model for India. Out of this total of about 2,00,000 Lin Km densification work has been completed.

4.2 Path ahead

Currently, there are more than one hundred different height reference systems worldwide that are inconsistent to each other. Generally, two different approaches of height datum and reference systems exist.

1. MSL/Levelling based height reference system:-

Until GNSS era, the MSL/levelling height reference system was the only possible option to use physical heights over large distances. Therefore, it was most common way of realization of vertical reference surfaces throughout the world. Traditionally, averaged observations of tide-gauge/s are used as a zero reference surface (height datum origin), which is extended inward by connecting a grid of fixed benchmarks, by means of precise levelling. Problem with MSL/levelling height reference system is that, Leveling yields sub-millimeter differential errors in local areas, however in continental scale, it builds up large systematic errors. To control such errors, levelling network is required to tie at multiple tide gauge stations.

However, Mean Sea Level at different points on shore has different potential, due to, gravity anomaly in area as well as other elements such as currents, differences in temperature, salinity and density of ocean water etc. These elements create a Topography, with bumps and hollows, in mean sea level surface. Hence, to measure potential difference between tide gauges, an accurate sea surface topography model will be required.

2. GEOID/GNSS based height reference system:-

The gravimetric geoid is an equipotential surface that is determined from the measurements of the Earth's gravity field and serves as a reference surface for the most physically meaningful orthometric heights. A geoid-based height reference system can be realized by GNSS measurement for ellipsoidal height and a high-resolution gravimetric geoid undulation model. With CORS Network, it is possible to measure ellipsoidal height with few cm accuracies. Hence, if it is possible to develop gravimetric geoid Undulation model with 1-2 centimeters vertical accuracy, Height reference systems realized solely by GNSS measurement and Geoid Undulation model, will be much more accurate than MSL/levelling height reference system.

A country wide consistent and accurate Geoid Model will require, high resolution DEM as well as dense surface gravity and airborne gravity survey, which are not available till recently. Hence, a Hybrid methodology is proposed to realize and access Vertical reference frame. In which, in first phase, Indian height system under RIVD is proposed be connected to global Mean Sea Surface (Wo), for which Mumbai tidal observatory (WoL using the most accurate Global Geoid Model (GGM) is proposed to be considered as datum and all the RIVD network will be adjusted with reference to it. Choice of Mumbai observatory as base of Adjustment is made considering its continues data availability as well as other properties such as, it is not burdened with effects of channels, rivers, gulfs and creeks etc. and closest to the average MSL trend of the Indian peninsula. Geo-potential numbers as well as Helmert Orthometric Heights of each bench marks will be computed. For the general use of surveying and mapping purpose Helmert Orthometric Heights will be provided, but for crustal dynamic, seismic, plate tectonic studies and for high accuracy requirement mega projects like inter-linking of river etc. geopotential numbers may be used.

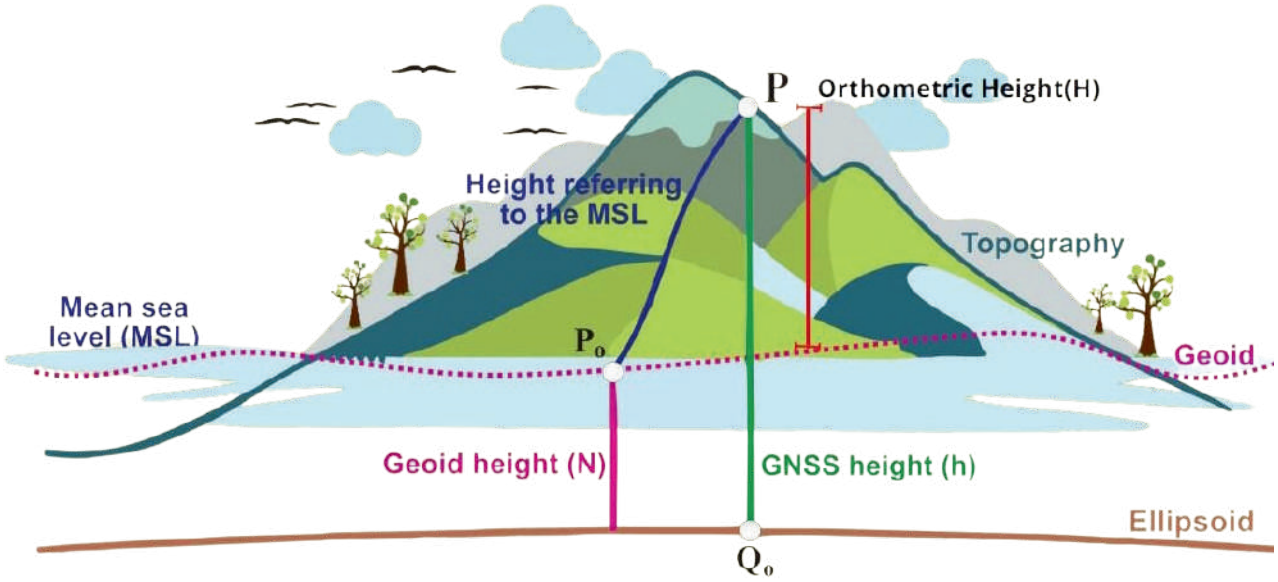

Figure: Geoidal Undulation (N) relation

In second phase, using CORS Network, RIVD benchmarks and surface and airborne Gravity data, a 10 cm accuracy, hybrid Geoid Undulation model will be developed, which will be used to access Vertical Reference frame. However primary access to Vertical reference frame will continue to be provided by array of Benchmarks established through High precision Levelling. Monuments at CORS stations will also be connected to vertical reference frame to study change in Geoid Model via continuously tracking change in ellipsoidal heights. In third phase Terrestrial Gravity model will be prepared using surface and airborne Gravity survey and Gridded Deflection of Vertical.

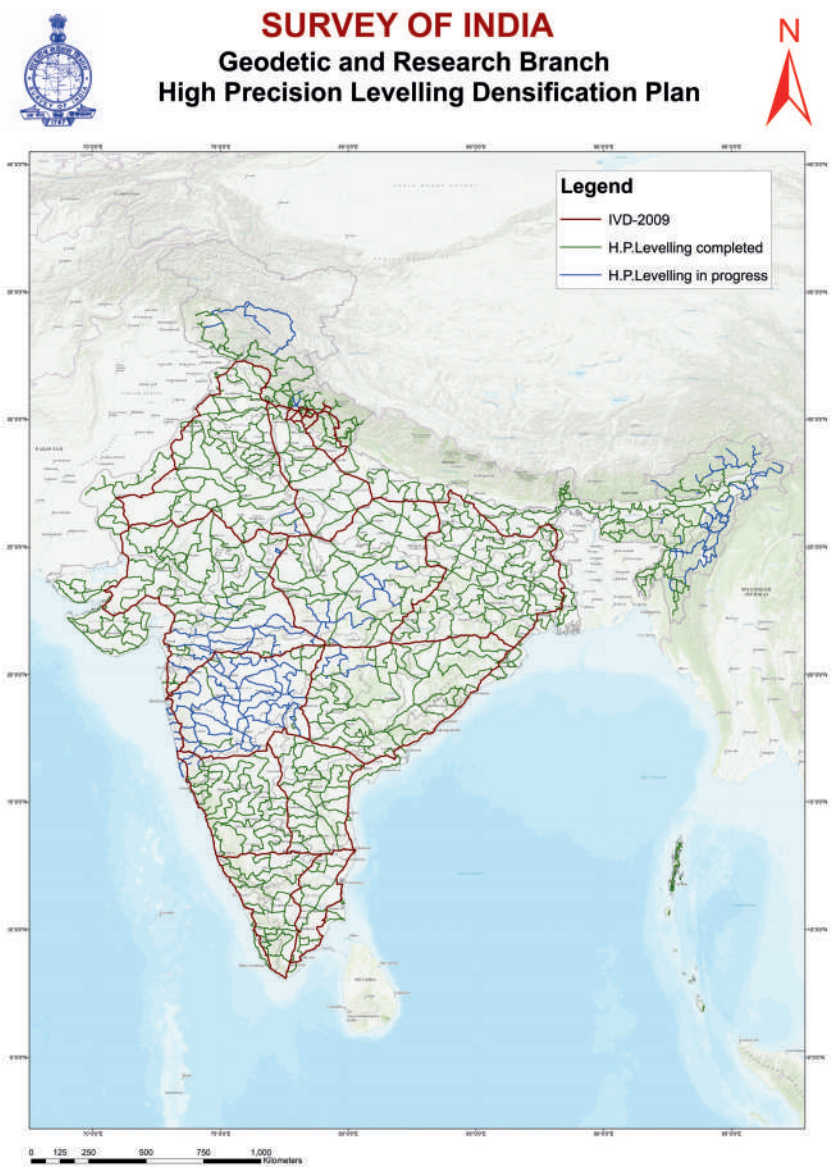

Figure: High Precision Levelling status

Geoid Undulation Model of 1-2 cm accuracy for plain and undulated terrain and 5-10 cm accuracy for hilly terrain, will be developed using Terrestrial Gravity model data and high resolution DEM, which will enable access to vertical reference through CORS Network.

Although for higher accuracy at local level, a database of passive bench marks will also be available to public. A comprehensive strategy for incorporating past and future leveling data into a new vertical datum, will be prepared and transformation model will be made available in form of gridded file.

4.3 Development of High Accuracy Geoid Model

Traditionally Geodetic Reference Frames, are accessed through the physical occupation of Geodetic stations/ Reference Marks/Bench Marks. However, with a fusion of Information and Communication technologies with latest Geodetic techniques such as GNSS, access to the Reference Frame can be achieved, without physically occupying the reference station.

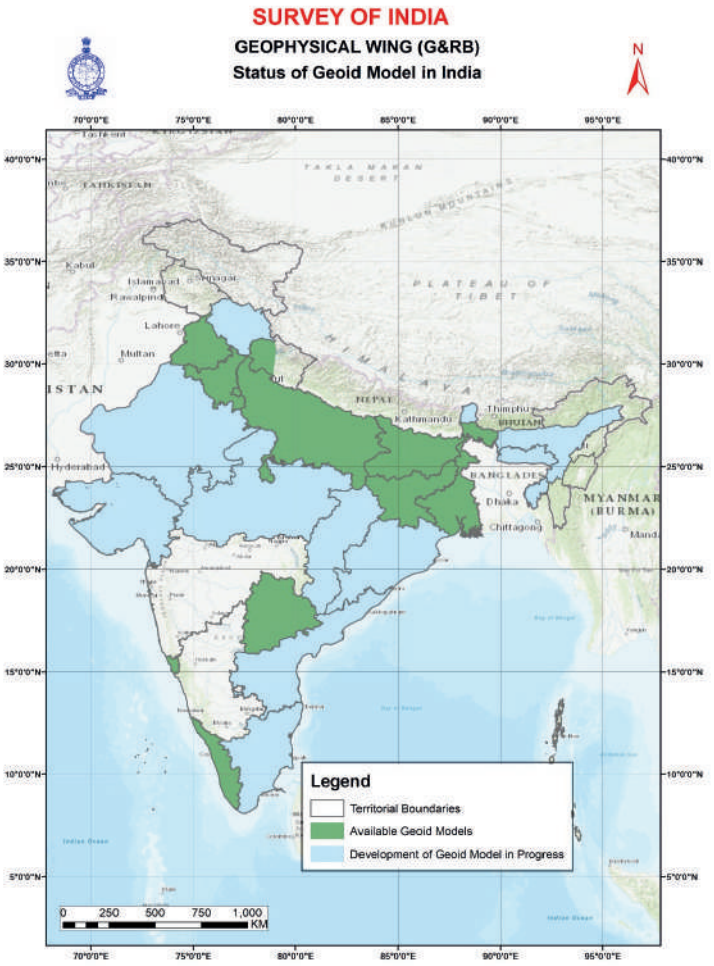

Figure: Geoid Model development status

Continuously Operating Reference Stations (CORS), are equipped with High precision Geodetic Grade GNSS receiver, that collect continuous GNSS data over these permanent stations, which can be shared online with users to provide online access to reference frame for Horizontal position (Position on Reference Surface, i.e. Latitude and Longitude or Easting and Northing) at any time. However, for all Engineering and Scientific applications Vertical position does not just refer to the geometric distance between the user position in space and the reference surface, but to the Potential difference between the user position in space and the reference surface, that relates to water flow (termed as physical height). Traditionally, the physical height/ MSL height of points on the land is determined by geodetic leveling, in which a spirit level is set "level," or tangential to an equipotential surface, and sights are taken on calibrated rods.

Height measured through GNSS observation has only a Geometric component (i.e. Ellipsoidal Height) and in order to access Vertical position through online access, A High accuracy Geoid model is required to convert ellipsoidal height obtained from GNSS to Orthometric height. Geoid model will reduce the rigor and fieldwork needed in various engineering projects and free up resources, from the requirement of physically occupying Benchmarks to access the Vertical Reference Frame. Nowadays many

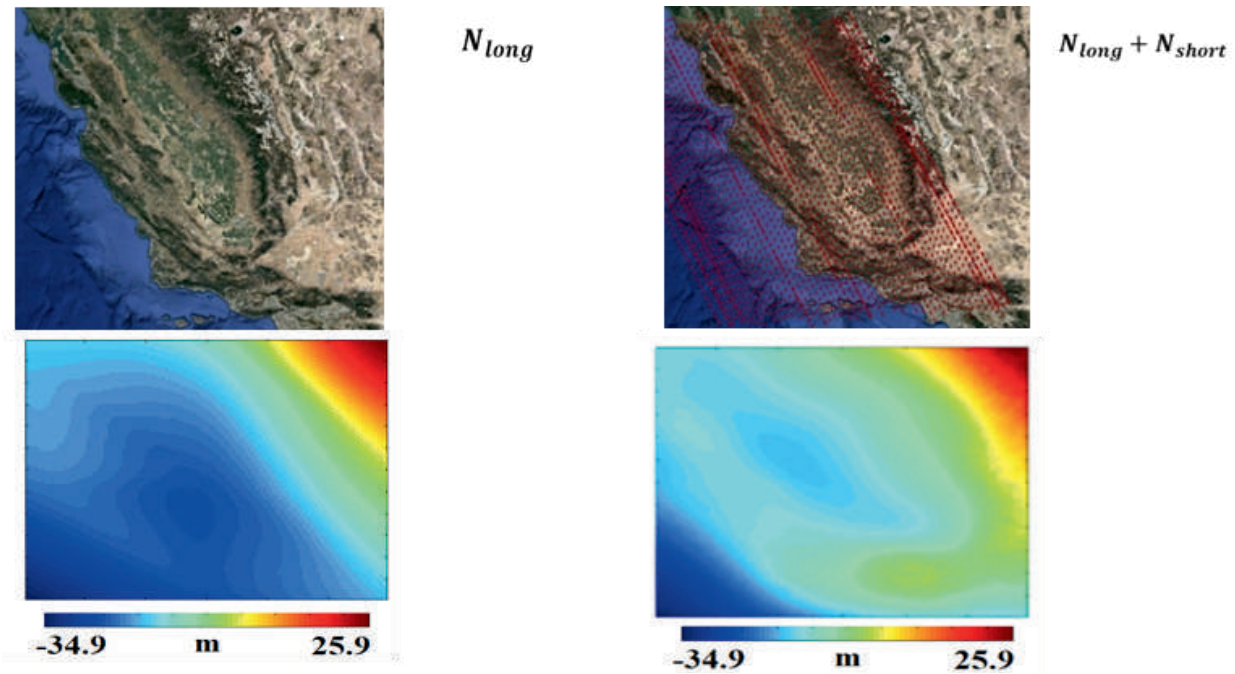

Figure: Geoid model development (long + short) component

Satellite based Gravity mission data like GRACE mission, are available which can be used to yield a continental scale geoid model accurate to centimeter level over wavelengths longer than 200 Kms. However, considering Indian topography and Elevation data requirement (25 cm for plain, 1-3 meter for hilly and mountainous areas), a much finer resolution Geoid Model will be required, which can be possible by integrating short and medium wavelength gravity data (i.e. Surface/Airborne Gravity data) along with Satellite Gravity data and processing using Spherical Harmonic Model.

SoI has been studying Geoidal Undulation since the 20th Century. However, the focus of such studies was to calculate the Deflection of Vertical correction for Geodetic observations. After the advent of GPS technologies, attempts to create mathematical models between GPS-based ellipsoidal heights and MSL heights i.e. Geoid Model have been made in some pockets. However, these attempts were concentrated over a small region and had been made for academic purposes only. In 2017-18, Survey of India, has undertaken the generation of High-resolution DEM work under various projects for which the need of preparation of High-Resolution Geoid Model has been felt. Under said Project works Geoid Models of the states of Uttar Pradesh, Bihar, Jharkhand, West Bengal, Haryana, Punjab, Goa, Telangana, parts of Uttarakhand and Kerala have been prepared. Similar accuracy Geoid Models are being developed in the remaining subcontinental and coastal regions of country while for Islands and Himalayan Areas, 50 to 100 cm accuracy Geoid models will be prepared.

5. Benefits of GRF

- Geodetic Reference Frame (GRF) serves as the basic building block, needed for the meaningful development of any GIS product/ service. It not only provides, accurate and efficient means for positioning land information, but also provides an uniform & effective language for interpreting and disseminating it.
- Standardized Geodetic Reference Frame, will reduce discrepancies in geospatial data interpretation and analysis. This promotes uniformity in mapping, surveying, and geospatial infrastructure development projects. It ensures consistency and compatibility of geospatial data collected by different organizations, facilitating joint research initiatives and projects.
- A robust geodetic reference frame is essential for long-term monitoring of Earth's surface, atmosphere, and oceans. They enable researchers to detect subtle changes over time, such as tectonic movement, seismology, meteorology, climate change, sea level rise, subsidence, and glacial movements.
- Positioning and Navigation Timing (PNT) services plays a crucial role in various socio-economic sectors, by enabling decision makers to make informed decisions, optimize resource use, and improve productivity and sustainability. It allows them to precisely monitor and manage their equipment and resources.
- A well defined and consistent GRF allows surveyors and other users to accurately determine and express locations on the Earth and to quantify the changes in space and time.
- Urban and Regional Planning: a unified GRF will allow urban planners Seamless Integration of Multi-Source Data, and save resources by allowing different organizations working in sync with other organizations. It will reduce need for duplication and unnecessary translations.
- Infrastructure Development: Engineers and developers benefit from GRF for designing infrastructure projects, such as roads, bridges, and utility networks. GRF will assist Minimizing errors in alignment, especially for large-scale or cross-regional projects where small misalignments can lead to significant issues. GRF aids in optimizing the use of materials and resources during construction by enabling machine control and auto navigation for construction equipment.
- Modernization of Land Records: GRF will assist in consistent mapping of land assets, linking them with electronic markers and digitalization thereafter in order to generate a true Geographical Information System and Electronic Document Management System which helps in accurate land accounting, monitoring, transaction and utilization. It benefits land owners, planners, decision-makers, and land administrators.

- Transparency: GRF infrastructure enhances transparency by providing access to information, enabling monitoring and accountability, supporting decision-making and policy formulation and improving land administration processes. Transparent use of geospatial data will strengthen governance, fosters public trust, and ensures equitable access to information.
- Improved Beneficiary Service Access: GRF infrastructure will enable effective use of robust geospatial data and technologies in beneficiary service access such as healthcare facilities, water supply systems, and distribution centers etc. Government departments and organizations will be able to serve the needs of beneficiaries in a better way, enhance their quality of life, and promote inclusive and sustainable development.

India's vision of “Viksit Bharat" by 2047, aims to transform the country into a fully developed nation by its centenary year of independence. This vision encompasses wide-ranging developmental goals including economic prosperity, technological advancements, robust infrastructure, and improved standards of living for all citizens. The focus is on inclusive growth that ensures equitable access to healthcare, education, and employment opportunities across all segments of society. Environmental sustainability and effective governance are also pivotal, aligning with global goals and national priorities to create a sustainable and resilient future for India. GRF infrastructure, plays a crucial role in the development of India as a nation and arrive at the forefront of Viksit Bharat. Its importance spans various sectors and aspects of development, including urban planning, agriculture, disaster management, and infrastructure development, which will in return, can significantly enhance the everyday lives of citizens through:

- Improved Public Services: Geospatial data can help in efficient routing of public transportation, better management of utilities, and more responsive public health services.
- Enhanced Safety and Security: Accurate geospatial data aids in disaster management and enhances national security by providing detailed landscapes for strategic planning.
- Economic Opportunities: By fostering a geospatial industry, new jobs in technology and analysis will emerge, boosting economic growth and innovation.
- Informed Decision-Making: Citizens gain from transparent and informed decision-making in government projects that directly impact their communities and environments.
- Environmental Sustainability: Geospatial data assists in monitoring and managing environmental resources, ensuring sustainable development practices that benefit future generations.

6. Stakeholder Engagement

Advanced geospatial technologies are constantly empowering governments and private organizations to build a geospatial infrastructure that helps them plan policies and programs, automate operations and improve execution. The geospatial industry can create a huge economic impact via employment generation, increased operational efficiencies, improved transparency and resource efficiency, better decision-making and cost savings. Although Geospatial sector will have impact on every sector of economy, some of these sectors, as given below, will see major disruption in coming decades and will be critical in India's vision to become a 30 trillion-dollar economy by 2047.

i. Land administration and management
ii. Environmental protection
iii. Planning and land use
iv. Agriculture
v. Water management
vi. Defense and national security
vii. Forest management

viii. Disaster management
ix. Infrastructure development
x. Statistics and demographics
xi. Marine information
xii. Address management
xiii. Telecommunications
xiv. Urban planning

Figure: Applications of Geodetic Reference Frame

The National Geospatial Policy 2022 by the Government of India has a comprehensive mandate to harness the full potential of geospatial technologies for sustainable development, efficient governance, and national security. Geodetic Reference Frame will able to provide an integrated platform to assimilate data generated by various departments and organizations working in these sectors. However, in order to ensure long term sustenance of value and benefits accrued by Geospatial products, stakeholders will be required to engage at various levels.

6.1 Training and Capacity development

Capacity refers to ability of workforce to deliver results, capacity building means enhancing their performance, competency and abilities. It would be very important to have the requisite available capacity within government as well as in the industry in India to achieve targets mandated in NGP 2022.

While there is a growing demand for geospatial professionals, there's a shortage in quantity and quality. Skilled mid-level and senior professionals are particularly scarce. To meet the necessary capacity building requirement, Training programs and workshops will be organized by the National Institute for Geo-Informatics Science & Technology, Hyderabad.

6.2 Support Mechanism

The Survey of India (SoI) remains committed to supporting its existing stakeholders while actively engaging with potential new partners to extend the applications of geospatial technology into new domains. A key aspect of this effort involves continuously gathering feedback and analyzing user data to inform planning and enhance the societal benefits delivered through its initiatives. The possible uses of the technology are endless; however, to reap benefits from them, awareness and evolution of the technology need to be boosted in the current ecosystem. Under Support Mechanism, following key measures are being taken:

1. Use Case and SoP Development

It will include Identify the specific problem or opportunity the use case addresses, Map out the step-by-step process, Provide a detailed, step-by-step guide for carrying out the activity, Define how the process will be monitored, evaluated, and documented for accountability and Include a mechanism for regular review.

2. Collaborations (National/International):

Government and industry/ industry associations to be encouraged to participate in joint collaborative mechanisms managed and monitored by the SoI. Value addition and service provision shall be the driving force.

6.3 Scientific outreach program

Access to Precision position services supported by GRF infrastructure will not only boost innovation in geospatial and allied sectors but will also require for Study of Earth sciences. GRF infrastructure data will improve our understanding about earth's surface, atmosphere, and water systems. A Better understanding of these earth systems will not only make, the administration better prepared for rescue and rehabilitation operations after the event but will also help in designing resilient infrastructure so that impact to life and economic activities can be minimized during such calamities.

Data acquired via GRF infrastructure will be made available to scientific communities on FAIR data principles (Findable, Accessible, Interoperable, and Reusable) to maximize the value of data across various domains and to ensure that public good data is open as per guidelines given in NGP 2022. To accelerate the adoption of these principles, the following steps will be undertaken:

1. Enhancing Metadata Standards
2. Promoting Open Access Platforms
3. Facilitating Interoperability
4. Encouraging Data Reusability
5. Building Awareness and Capacity
6. Fostering Collaboration

6.4 What we offer to State Governments

- Access: Access to Geodetic Reference Frame (GRF) products and services for state government departments.
- Comprehensive Training: Onsite and structured classroom training on the usage and applications of GRF infrastructure.
- Infrastructure Enhancement: Densification of GRF infrastructure, including Continuously Operating Reference Stations (CORS) and height benchmarks, to meet the infrastructure and developmental needs of the state.
- Technical Advisory Support: Assistance in developing Standard Operating Procedures (SoPs), standards, workflows, and technical specifications.
- Support and Troubleshooting: Continuous technical support through troubleshooting and handholding to ensure seamless integration and utilization of GRF solutions.

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DEPARTMENT OF
SCIENCE & TECHNOLOGY

विकसित भारत अभियान
1947 TO 2047

National Workshop

On Strengthening Of Geospatial Ecosystem

Session-4

Capacity Development: National & International Perspective

25th November 2024

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NATIONAL INSTITUTE FOR GEO-INFORMATICS SCIENCE AND TECHNOLOGY (NIGST)

- Established as CST & MP (Centre for Survey Training & Map Production) on March 6, 1967 with technical assistance from United Nations Development Programme (UNDP) to develop human resources in the field of Surveying & Mapping Technologies.

- Initially catered to the training needs of the SOI officers & Staff in the field of survey and mapping.

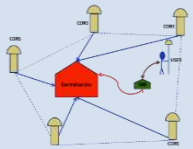
- Gradually broadened horizon to impart professional training to other Centre/State Government Organisations, PSUs, Private Organizations/Individuals and also diverse the training programmes in various aspects of Geo-informatics Science and Technology.

NIGST Curriculum

Geodesy

- Control Provision by GPS

- CORS

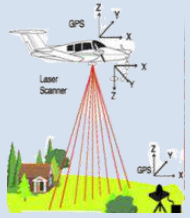


- Gravity and Geoid Modelling
- HP Levelling

- Reference Frame (Geodetic Reference Frame)

Photogrammetry & Remote Sensing

- LiDAR



- DRONE

- Photogrammetry

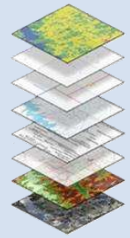
- Remote sensing (ORI, DEM)

Topo. & GIS

- Topographical Survey
- Control Survey
- Cadastral Survey
- Street View Survey
- Office Procedure (Boundary, Toponymy)

- Digital Mapping

- GIS analysis and application (Data Portal, Topographical Data Harmonization)



Geo-ICT

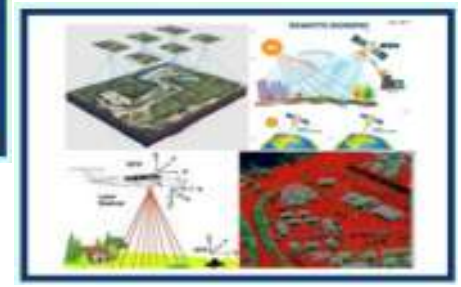
- Geo-ICT infrastructure design, management and operation (UGI, NGDR)

Research & Development Directorate

- Research and Development activities
- Guiding UG/PG / PhD Students for internship / project / Research.

- ✓ Also caters to the Professional needs/technical assistance to several Afro-Asian Countries.

- ✓ With over 35,000 alumni including 600 trainees from Afro-Asian countries in 57 years of its existence, NIGST has proven itself as premier institute of training in the field of Geospatial Science and Technology.



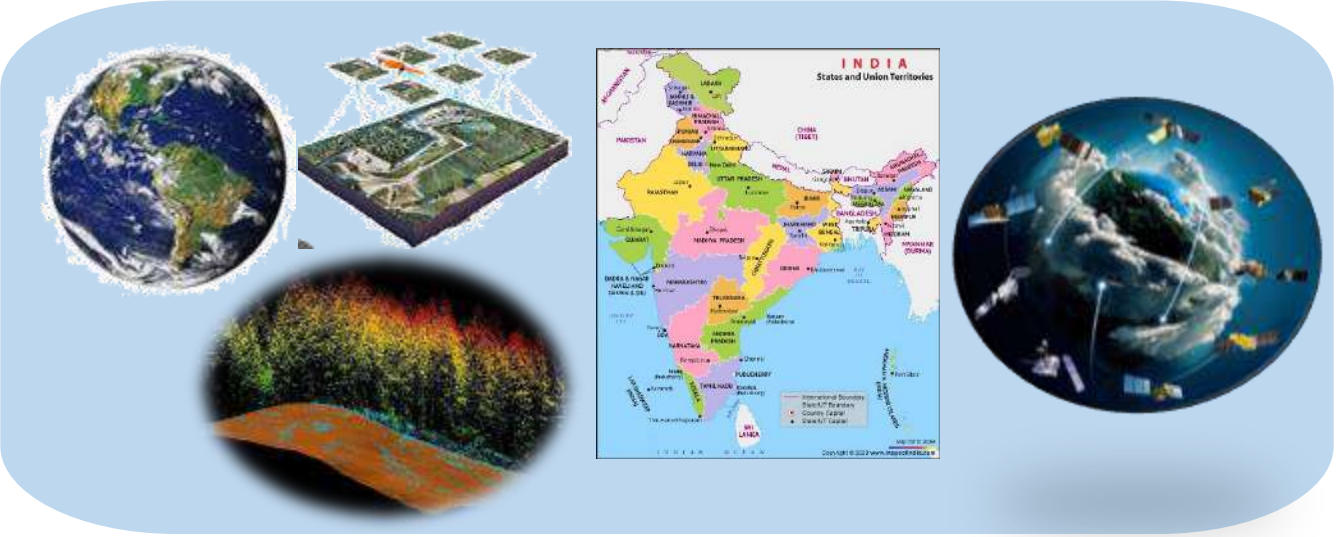
- ✓ NIGST provides training in the disciplines of Geodesy, Cartography, Digital Mapping, Photogrammetry, Remote Sensing, Topographical Surveys & Mapping, Drone Surveys & Mapping, LIDAR, GIS, Land Information System and GEO-ICT.

- ✓ NIGST offers professional training with excellent blend of field exercises, laboratory practices and intensive theoretical lectures by experienced faculty members and field surveyors using state of the art equipment.

TRAININGS CONDUCTED FOR ITS OWN QUALIFICATIONS

✓ NIGST has already conducted 83 batches of Surveying Engineer course for the directly recruited Group 'A' officers (UPSC-IES) and 95 batches of Surveying Supervisor course for the directly recruited Surveyors.

✓ NIGST has conducted 72 batches of Advanced courses in the field of Geodesy, Photogrammetry, Remote Sensing, Digital Mapping, LiDAR technologies.



✓ In addition to the above, NIGST regularly conducts customised courses for the requirements of various Organizations.

Periodical Up-dation of Syllabus:

- Advancements in knowledge to adopt new discoveries and researches to necessitate changes in the curriculum to keep trainees informed about latest developments in the respective field of study as per the demand of the market.
- Course structure and syllabus are revised as detailed by Board of Studies. A template with aspects like objective, eligibility break up for lecture, Lab and Field hours is prepared in accordance with the changes in syllabus.

LMS (Learning Management System): Management skills involves planning, organizing and controlling resources to achieve goals effectively.

- NIGST has introduced and adopted the systems of interactive learning process by introducing Microsoft teams software with customized online classes.
- Study materials and all other requisite educational materials are shared with trainees.

QUIZEE SOFTWARE

NIGST is acquiring a new software designed to enhance and explore the training opportunities to provide new and innovative methods of teaching resources for a more enriching education experience.

- ✓ **Quizee is a trusted educational based learning platform crafted and aligned with curriculum standards. Quizee facilitates in providing training materials and learning games diving into quizzes for training.**

Rationalization of Basic courses :

NIGST is undertaking a rationalization process for our Basic courses viz., Survey Supervisor (400) from 2 years – 1 year, Surveying Engineer course (500) from 2 years – 1 year to streamline and enhance the learning experience. This process will refine the curriculum, ensuring that each course is aligned with new technology and goals and provides maximum value to the in house officers of Survey of India.

NCVET (National Council for Vocational Education & Training)

NIGST is pleased to attain LoI (Letter of Intent) from Pvt Industry to enhance vocational programs and ensure alignment of training with national standards and industry needs to improve the quality of our training and provide learners with the skills required for success in the evolving job market.

NCVET has granted provisional recognition status as Awarding body to NIGST (Dual body Recognition) for Assessment and Awarding of certification as per NSQF (National Skills Qualification Framework) for: Surveyors certification and Drone Licensing.

Geospatial Innovation Hub

NIGST yearns to make this institution an innovation hub to foster the development and application of geospatial technologies and solutions focusing on leveraging Geographic Information Systems (GIS), Remote Sensing, Satellite imageries and other geospatial data .

INFRASTRUCTURE DEVELOPMENT

Library: E Granthalaya - This project is mobilized and completed which is aimed at digitizing library management and improving access to library services through technology adapted from the application developed by National Informatics Centre (NIC) India.

- ✓ A total of 7482 books available in NIGST library have been catalogued in E-Granthalaya app.
- ✓ Member login has to be created to access the books.

Hostel Renovation - Renovation of Everest and Lambton Hostel inside the Survey of India campus has already been completed and Renovation of Mackenzie hostel is underway with 200 capacity for improved functionality, comfort and enhanced living experience.

INFRASTRUCTURE DEVELOPMENT

Sports Complex - A Preliminary Estimate for construction of a sports complex for indoor games and a swimming pool is also acquired from CPWD and is in the pipeline for adoption.

Class rooms are transformed into **Smart Classrooms** to enhance teaching and learning experience with integration of various digital tools such as interactive touch **digital signage boards** with built in PCs, public address system and other multimedia content for presentation of videos and other interactive simulations.

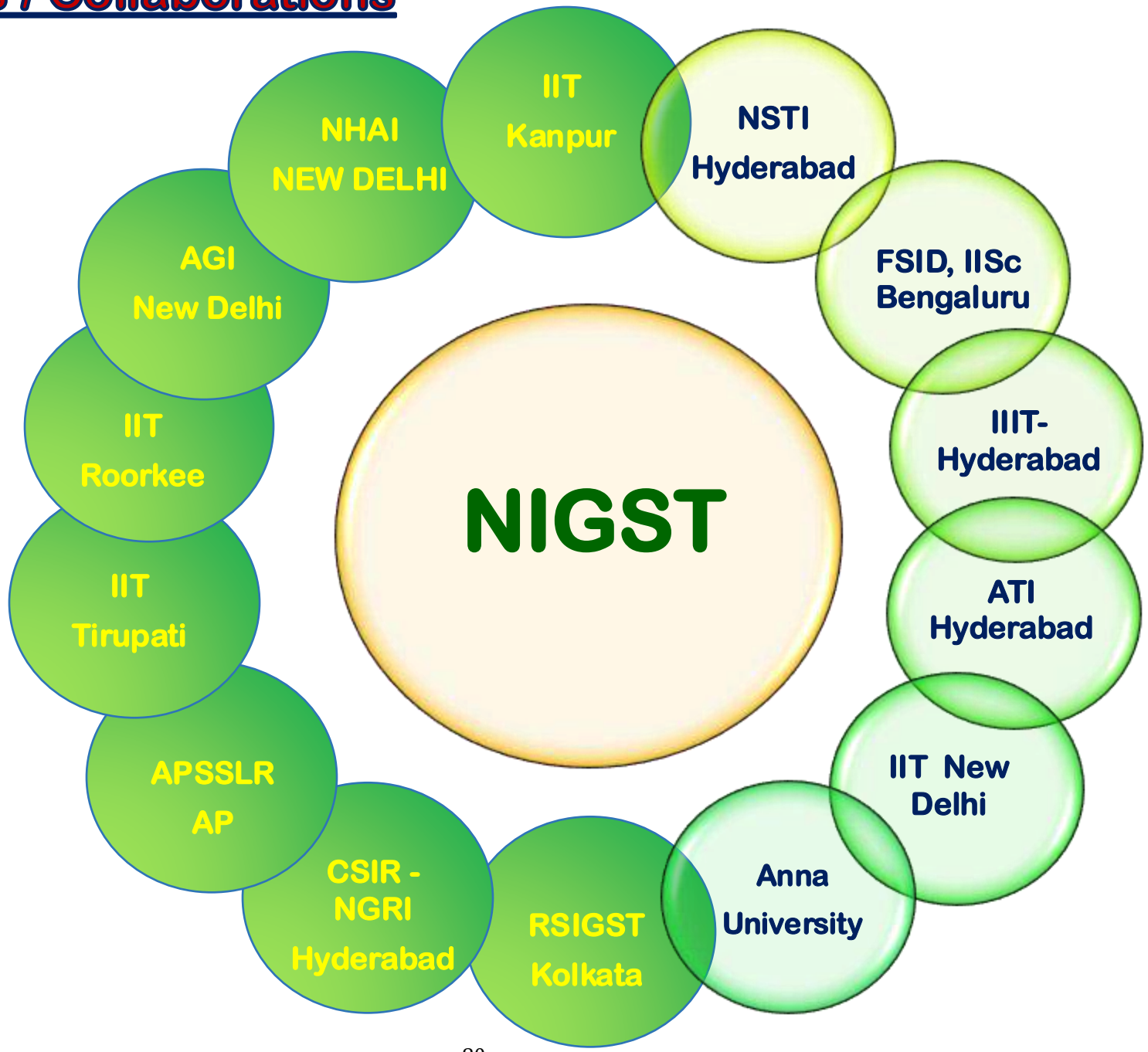
✓ **Trainees are provided with ultra modern state of the art technology instruments to work with.**

3D PLURAVIEW (Stereo Monitor)

Innovative beam-splitter technology for pixel-precise, stereoscopic 3D image displays.

High resolution 4K (UHD) with 8.3 MegaPixel per eye at 10-bit color depth.

MoUs / Collaborations



INITIATIVES

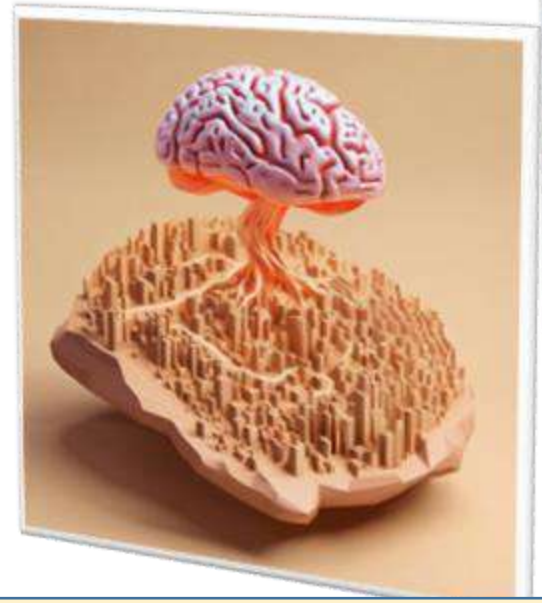
Specific initiatives proposed in the areas of

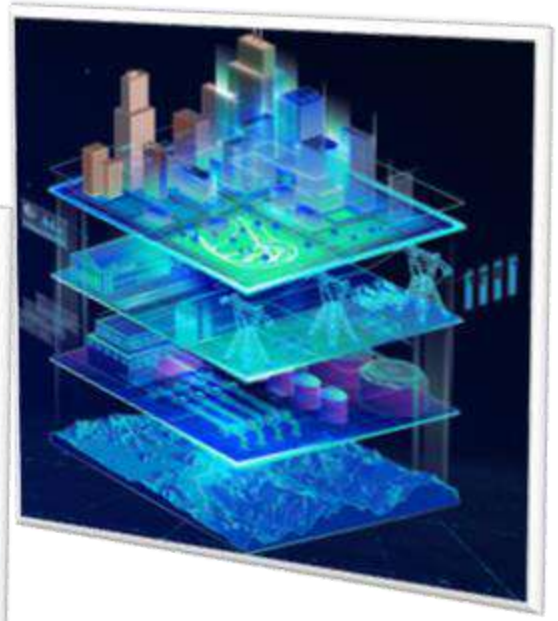
1. Reskilling & Upskilling

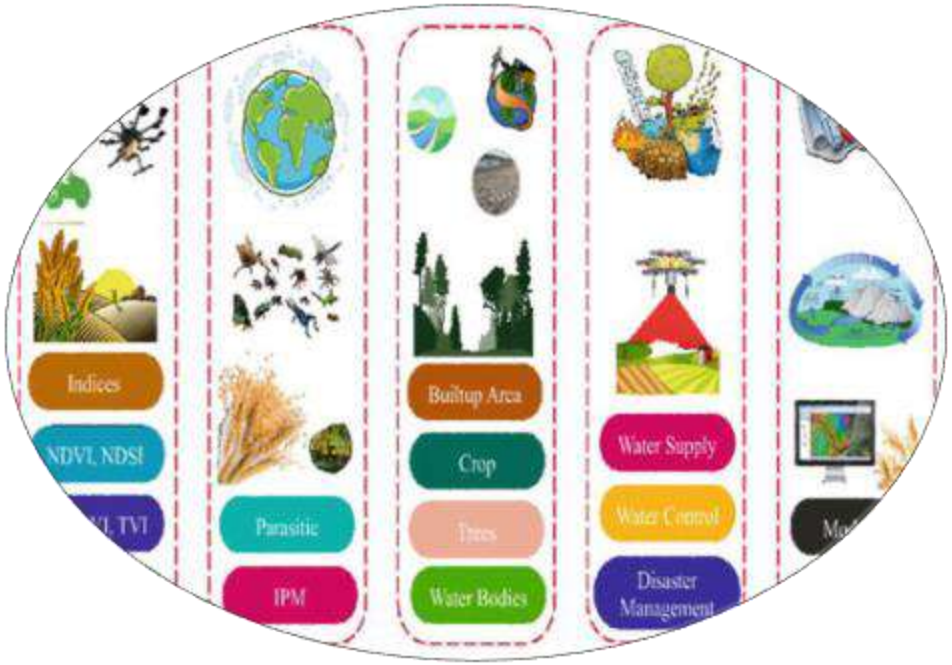
The Trainers of NIGST are regularly attending **Trainers Trainings** for continuous upskilling and reskilling to keep them abreast with the developments in the Geospatial sector.

2. Future skills / Future Jobs

The Geospatial technologies are changing rapidly and soon digital twin, AI / ML will be incorporated in all Geospatial sectors.







3. Research & Development in skilling

An R&D Directorate was set up very recently at NIGST and it will look into the R&D of Geospatial technologies and skilling as well.

Advanced Courses (26 weeks)

Demand driven Customised courses (1-4 weeks)

Basic Courses (52 weeks)

NIGST Training Programmes

Project Based Courses (1-2 weeks)

Short Term Courses (2-4 weeks)

Refresher Courses (3-5 days)

Specialized / Customised Trainings for Extra Departmental organisations in 2024

S No	Organization	Sate Govt. / Ministry	Customized Course	Period
1	District Development Commissioner	Jammu & Kashmir	SVAMITVA	23-05-22 to 27-05-22
2	NHO, NIDEM, DG-Defence Estates, New Delhi	Ministry of Defence	Control Work by GNSS & Network RTK CORS and Special Course on Basics of Surveying, DGPS, CORS, Drone Satellite and GIS for IDES	15-11-21 to 26-04-24
3	APSSLR(Andhra Pradesh Survey Settlement & Land Records)	Andhra Pradesh	Advance Surveying and Mapping Techniques	22-04-24 to 30-08-24
4	Survey Settlement & Land Records, Forest Dept.	Tamil Nadu	DGPS & Total Station	09-09-24 to 13-09-24
5	NATMO	Kolkata, West Bengal	Drone Survey, LiDAR Remote sensing, high Precession Levelling, Street View Survey by 360° Camera, Drone Photogrammetry and Advance GIS.	10-10-22 to 17-03-23
6	IBBD			

Contd…

S No	Organization	Sate Govt. / Ministry	Customized Course	Period
7	Forest Survey of India,	Ministry of Environment & Forests	Modern Trends in Surveying using GNSS & CORS	24-06-24 to 26-06-24
8	Settlement Commissioner & Director, Land Records(SC&DLR)	Maharashtra	Geospatial Information System, Control & Detail Survey an Feature Extraction and Surveying & Mapping with use of GNSS, Drones, Total station and QGIS	30-05-22 to 09-06-23
9	Director of Survey & Land Records	Goa	Advance Hydrography for NIH & SVAMITVA for Land Records	11-08-22 to 25-07-23
10	Salt Commissionerate, Jaipur	Ministry of Home Affairs	Drone Survey	11-07-22 to 15-07-22
11	Trainers Implementing agencies of National Hydrology Project(NHP)	NHP	Use of CORS & Geoid Model	30-10-23 to 13-09-24
12	HRD Power Grid Corporation, Gurugram	Haryana	Surveying & Mapping Techniques and hands on training of Total Station	03-07-23 to 07-07-23

Outreach of NIGST

NIGST has actively reached out to various reputed organizations / institutions like Telangana State Remote Sensing Application Centre, National Institute for Rural Development, Indian School of Business and International Institute of Information Technology for sharing of information, expertise, and resources among individual organizations, as well NIGST fostering a culture of support and knowledge exchange through workshops, conferences and informal interactions.

Teaching Aids

- ✓ Teaching aids are special tools that make learning exciting and understandable. They enhance classroom instruction as well as create motivation.
- ✓ In tactile aids one can touch and feel these objects, like models in an interactive learning method.

What we offer to State Governments

- Necessary training in data acquisition, data processing, GIS & Control Provision.
- Analysis of the training requirement and development of customized courses.
- Development of mandatory courses for the freshly inducted officers.
- Supporting training institutes of the state governments to develop them in to centers of excellence.

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