New Space Economy

Session : Space & Geospatial: Force Multipliers For A Better Tomorrow

Space & Geospatial empowered

Cloud Native & FAIR

Geospatial Knowledge Infrastructure

Vinod M Bothale

Ex-Associate Director, NRSC/ISRO

Advisor, Geospatial & Space, Suhora

Advisor, Technology, Gridbots Robotics

Synergy :Space & geospatial

- Space and Geospatial are closely intertwined, with **space providing the overarching infrastructure** and data sources.

- The **synergy of space and geospatial** technologies allows us to **collect, process, and analyze** vast amounts of data to better understand our planet.

- **Geospatial technologies** have a wide range of powerful applications in diverse sectors and **can provide near-real time solutions to the real world problems** that are far complex and having complicated workflows.

- Space is one of the important enabler in whole Geospatial ecosystem.

Space & geospatial : Complementary to each other

1. **Data Sources:** Space-based assets are fundamental data sources for synoptic and frequent coverage.
   (Globally 1000s of satellites are planned by plethora of space-techs)
1. **Global Coverage:** Space-based assets offer a global perspective, ensuring that data is not limited by regional or national boundaries. This global coverage is essential for applications like international disaster response and climate monitoring and also makes business model, viable.
2. **Monitoring and Surveillance:** Space assets enable continuous monitoring and surveillance of the Earth's surface, which is crucial for applications like disaster management, environmental monitoring, and precision agriculture.
3. **Navigation and Positioning:** GPS and other space-based navigation systems are integral to positioning, enabling accurate location-based services.
4. **Complemented by *other*** Geospatial Assets (Maps, data, information , attributes) and analytics

Multi-tier imaging platforms

- **Satellites**
- **Aircrafts**
- **Drones**
- **Terresterial Surveys**

Each is going to stay and does not replace other

Solutions to problems : Fusion of Space & Geospatial

- **SPACE DATA / IMAGES**

- **DRONE IMAGES**

- **HUMAN INTERPRETED / AI POWERED MAPS FROM SPACE DATA**

- **CROWD-SOURCING FOR IN-SITU DATA & INFORMATION FEED**

- **IOT SENSOR FEEDS**

- **LIDAR SURVEYS**

- **STREET VIEWS**

- **DATA COLLECTED FROM CAR NAVIGATION**

So far …. So Near

High resolution SAR : Dwell Mode

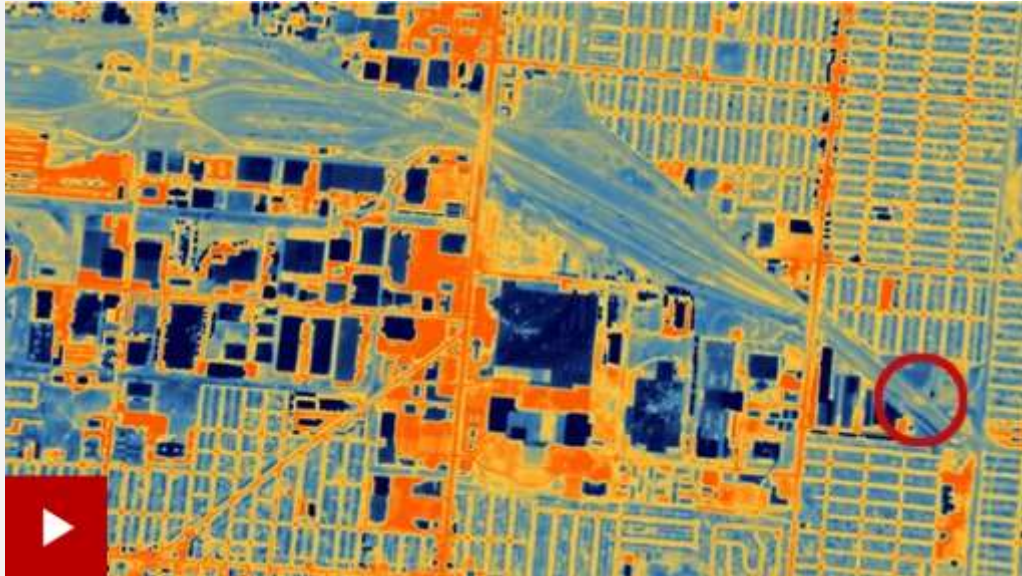Source: Iceye

High resolution & High frequency SAR

Source: Iceye

Source : Capella Space

High Resolution Thermal imagery

Source : SatVU

Hotsat-1

3.5 m resolution
from Space

INDIAN STARTUPS
SAR-Optical Hyperspectral

… And Many More

Space & geospatial: Key Opportunities

- **Forewarning / early warning – disaster, agriculture.**

- **Application as a service mode –Urban , Water and many domains**

- **On demand information generation , anywhere anytime**

- Enhanced use of space assets by using Deep learning models – Imaging same latitude at different times but compensating for time gaps

- Enhancing Trust - Data and service sharing among private entities using blockchain .

- Minimising re-investments and focussing on target business without loosing the power of data already available in market.

2.1.3. To enable easy availability of valuable Geospatial data collected utilizing public funds, to businesses and general public.

2.2.9. Develop a Geospatial Knowledge Infrastructure (GKI) underpinned by Integrated Data and Information Framework.

5.1.3. **Unified Geospatial Interface (UGI),** an electronic data querying and processing service, will be operationalized for provision of consumer-oriented products, applications, services and solutions using the Geospatial data and metadata contained in the NGDR and utilizing the data supply chains from the Central and State Level Partnering Agency Data Nodes………The UGI will include access to all open Geospatial data directly or indirectly collected by the Central and State Level Partnering Agencies on terms to be determined by GDPDC. ….. The UGI will eliminate duplicity of efforts among national agencies like Survey of India, National Remote Sensing Centre (NRSC), Forest Survey of India (FSI), Geological Survey of India (GSI), National Bureau of Soil Survey and Land Use Planning, etc that create Geospatial Data using public funds and various other agencies.
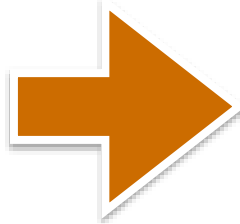
Action :

Design and Realise Cloud Native and FAIR Geospatial Knowledge Infrastructure

India – Leading with national level SDIs

- National level Geo-Platforms are not so common
- India has "Bhuvan"
- Bharat maps also powering national level applications
- Platform have grown and providing excellent support to National initiative, flagships programs on

- Mostly popular in usage by government department and ministries
- Visual Map Analytics, Charting, Crowd Sourcing, Asset Mapping, Inventory, Analysis, Support for Planning and Development, Natural Resources Maps and satellite images.
- Bhuvan - Open Source, OGC Compliant services
- Scalability & High-Availability with traditional approach.

FAIR

Paradigm Shift from SDI to Cloud Native GKI

Geospatial Knowledge Infrastructure (GKI). Data — Information – Knowledge

- Cloud Native : **Distributed, Scalable, Resilient, Manageable, Observable, Automated,Highly Available, Agile**
- and **FAIR** is desired
- GKI be designed with Cloud native architecture
- Applications to be designed to optimally leverage the benefits of the cloud computing delivery model.

- Containers
- Service meshes,
- Microservices,
- Immutable infrastructure, and
- Declarative APIs

▸ These techniques enable loosely coupled systems that are resilient, manageable, and observable. Combined with robust automation, they allow engineers to make high-impact changes frequently and predictably with minimal toil.

Cloud Enabled	**Cloud Ready**	**Cloud Native**
GIS Platform Applications	Database APIs Toolkits Applications	Serverless Model Allowing developers to build and run applications without having to manage servers
• VMs instead of Dedicated Physical Servers • Known predefined time • Storage and CPU • BS/FS/OS-Storages	• Containers, but still predefined time • Full-ON Storage , CPU Limited Scalability • Database Partitioning or Duplication for handling higher load / load balancing	• Serverless Model Services . • Scale Storage/CPU for required time period • Massive Scalability as per App demand Multi-Cloud Elastic

Design of Cloud Native GKI : <u>Promising Tech</u>

- Raster Data Format : Cloud Optimised GeoTiff **(COG)**
- Vector Data Format : With Spatial Indexing , Schema like Flatgeobuf , **Geoparquet**
- Image Converter to COG
- Image Tiler : TTiler
- **Dynamic Tile Serving of COG**
- Data Publisher : Geoserver
- GUI Viewer, Validator , Creator
- GUI : Openlayers, Leafmap
- Metadata Server
- Database - Very Common to many IT applications

- Image Rendering in WebGL
- **Raster Analysis : Geoblaze**
- **Spatial Temporal and Asset Catalogs (STAC)**
- 3D tiles
- Devops: Entire Workflow components from Designing to Publishing including testing
- Jupiter STAC UI
- **Cloud native Webservers**

Space & Geospatial synergy and service through Cloud native GKI would foster the geospatial application growth in the country boosting the economy.

An early action to initiate this by GDPDC is welcome.

Thanks

vinod.bothale@gmail.com