# CURRENT TRENDS OF GIS IN INDIA

P.SASIKUMAR

# INDEX

- Government Agencies
- Open Sources
- NSDI
- Navic
- Indian Geo Spatial Market
- Smart City

# GOVERNMENT AGENCIES

# Indian Earth Observation Programme

Vibrant Space Segment ↔ Strong Ground Mechanisms → Diversity of Applications

## LAND & WATER

RESOURCESAT-2

RISAT-1

## HIGH RESOLUTION

CARTOSAT-2; 2A; 2B

RISAT-2

CARTOSAT-1

## OCEAN

OCEANSAT-2

SARAL

## WEATHER; CLIMATE

INSAT-3A

KALPANA

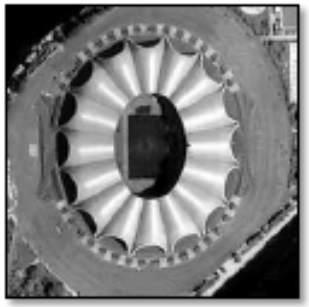
MEGHA-TROPIQUES

INSAT-3D

1 km ← IMAGING CAPABILITY → <1 m







# Geospatial Technologies – Building Knowledge

- **Earth Observation (EO) Systems (space-borne & airborne)**
  - Sensors with various SPATIAL, TEMPORAL resolutions, EM regions

- **GIS**
  - VISUALISE & ANALYSE all geo-linked data
  - Integrate Ground Data (Non-spatial Databases, Ground sensors, Crowdsourced data, etc.

- **GNSS**
  - Locations, Mobile Mapping

- **APPLICATION**
  - Decision Making with Knowledge

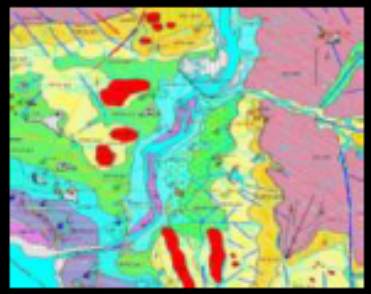

# Applications of GST: A Few Examples

## Agriculture

**Area & Production estimation for 8 major crops**

- In-season multiple forecast
- Satellite data + Agro-meteorology + Land based observations

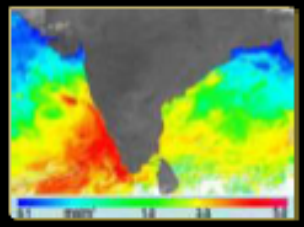
## Drinking Water



**Groundwater Prospects Zones & Recharge Sites**

- Improved success rate for Bore wells
- Improved water level

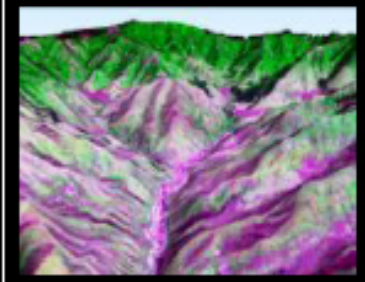
## Fisheries



**Potential Fisheries Zone (PFZ) Forecast**

- Fish catch doubled
- Reduced search time by 60% & fuel cost by abut 30%

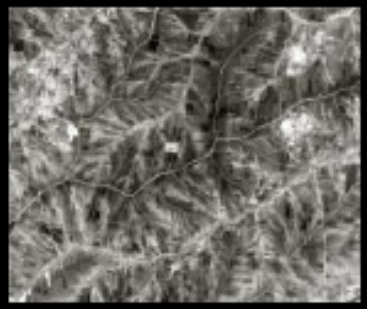
## Watershed Development



**Better productivity potential & improved livelihood**

- Soil & Water Conservation
- Enhanced crop yield
- Decrease in fallow lands

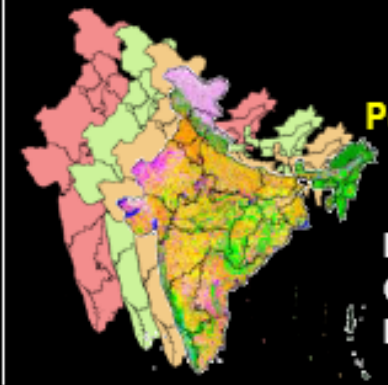
## Monitoring Irrigation Infrastructure



**Inventory & Mapping of Irrigation Infrastructure**

- Assessment of gaps in irrigation potential created and its utilization at the ground level

## NR Census

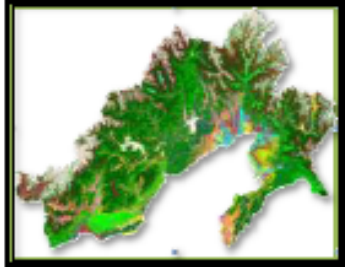


**Periodic Inventory of Natural Resources**

Land use , Wetland, Soil, Snow & Glaciers, Geomorphology, Land degradation, Vegetation

# Applications of GST: A Few Examples contd..

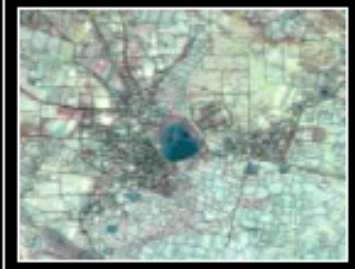
## Forestry



**Assessment of forest cover on a two-year cycle**

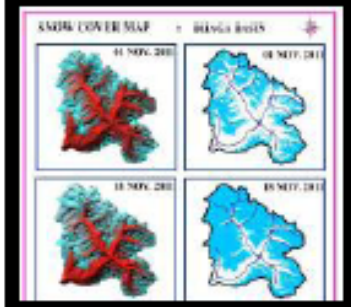
- Plan conservation measures
- Rapid Forest Mapping to identify hot spot areas

## Decentralized Planning at Panchayats



- Geospatial database
- Asset mapping & Activity Planning
- Implementation & Monitoring
- Decision Making at local level

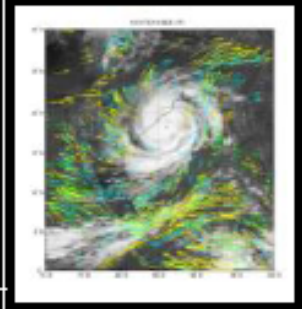
## Snow & Glaciers

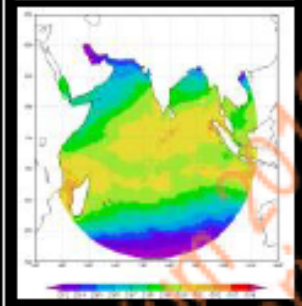


**Monitoring of Glaciers and Snow cover area**

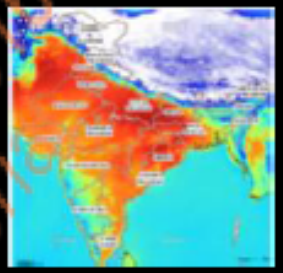
- Glacier Retreat
- Snow-melt Runoff Forecasting
- Input to Climate Change

## Weather & Climate





- Space based Weather parameters & Essential Climate Variables
- Assimilation into model for improved weather prediction
- Ocean State forecast
- Sea Surface Temperature
- Sea Surface Heights
- Prediction of cyclone formation



## National Urban Information System

**Multi-scale (10K, 2K) Urban Geospatial database**

- In support of Urban Planning, Infrastructure development

# Applications of GST: Disaster Management Support

**Institutional Mechanism**
Decision Support Centre (DSC)

**In association with Nodal Agencies**
MHA, MOA, NDMA, State Agencies

## Floods

- Hazard Zonation
- Flood Inundation Maps
- Damage Assessment
- Bank Erosion Studies

## Landslide

- Damage Assessment
- Hazard zonation
- Rainfall induced landslide forecast

## Weather & Cyclone

- Intensity & track prediction
- Damage Assessment
- Heavy Rainfall alerts
- Heat wave alerts

## Forest Fire

- Active Fire Detection
- Damage Assessment

## Drought

- Monthly Agril. Drought Report
- End-of-the-Season Agril. Drought Report
- Carried out by MNCFC

## Earthquake

- Damage Assessment

\+ Emergency Communication Support

Source: NRSC

# Applications of GST: Challenges & Research Opportunities

## Agriculture

- Automated target crop mapping
- Coupling of crop models and geospatial tools for improved crop production forecast and early drought warning
- Climate change impact on agriculture
- Carbon seq. potential of agriculture land-use
- Soil & crop health assessment and early detection of crop diseases
- Retrieval of crop biophysical parameters

## Water Resources

- Develop. of real-time tracking and DSS to provide hydrological outlook
- Assessment of Hydrological Drought
- Specific inputs for Inter-linking of rivers
- Glacial lake hazard zonation and GLOF simulations
- Quantification of ground water recharge
- Effect of climate and land-use/ land-cover change on hydrologic regime of river basins

## Forest & Environment

- Assessment of Afforestation at Early-Growth Stages
- Assessment of Carbon Source and Sinks through Eddy Flux Towers and Upscaling to Regional-Level using RS Data
- Forest Structure and Growth Modeling through Microwave and LiDAR Sensors
- Forest Health Assessment using Hyperspectral Sensors
- Inventory and Assessment of Non-Timber Forest Produce
- Long-term Ecological Studies

## Geology & Mining

- Upgradation of geological database using SAR data and high-resolution topographic information
- Upgrad. & Operationalisation of Mineral & Mining Information System for entire country
- Information extraction from multi-sensor satellite data and geospatial modeling
- Innovative tools and approaches for discovery of new mineral deposits
- Impacts of mining including land subsidence measurement & modeling
- Geodynamics of Himalaya & active tectonics

# Applications of GST: Challenges & Research Opportunities



## Ocean & Atmosphere

- Water quality in coastal and inland lakes
- High-resolution coastal and ocean state forecast
- Polar environment monitoring
- Prediction of high intensity rainfall events, e.g. thunderstorms
- Aerosol and cloud interaction

## Developmental Planning

- Urban growth prediction and LULC change modeling
- 3-D city modeling to assess solar potential
- Effect of climate change on river basin and urban hydrology
- Geotechnical investigations and sub-surface utilities mapping using GPR
- Advanced terrain modeling (using high-resolution stereo satellite/ LiDAR data) for infrastructure projects

## Disaster Management

- Flood forecasting and spatial inundation modeling
- Flood prone area assessment
- Urban Flood modeling
- Modeling of storm surge inundation
- Forest fire danger rating
- Early warning of disasters
- Establishment of National Disaster Management Command Centre (NDMCC)

## Geology & Mining

- Upgrad. of geological database using SAR data and high-resolution topographic info.
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# Promoting Space Applications in Central Ministries/ State Government

Prime Minister urged DOS to pro-actively engage with all stakeholders to maximise the use of space technology in governance and development.

**160** Space Applications across **58** Ministries / Departments

- Majority of these projects (over 110) are related to geospatial applications
- About 30 projects are related to applications of satellite communication and navigation
- About 20 projects require technology development.
- About 55 projects have pan-India coverage.

- Natural Resources Management
- Energy & Infrastructure
- Disaster & Early Warning
- Communication & Navigation
- Geo-spatial Governance
- Societal Services

# OPEN SOURCES

# Geospatial Services through Web Portals



| | |
|---|---|
| bhuvan Gateway to Geospatial World | A geoportal showcasing Indian imaging capabilities and for GIS data creation, visualisation, analysis, GIS products & services in Participatory GIS environ. (http://bhuvan.nrsc.gov.in/) |
| India-WRIS WebGIS Water Resources Information System of India | A portal for comprehensive data & information on India's water resources (http://www.india-wris.nrsc.gov.in/) |
| MOSDAC | A portal for weather forecasting, cyclone prediction and continuous weather & ocean data availability (http://www.mosdac.gov.in/) |
| Biodiversity Information System Indian Space Research Organisation Department of Space, Government of India; IBIN | Portals for providing spatial and species data on biodiversity and bio-resources (http://iirs.gov.in/ and www.ibin.gov.in) |

# NSDI

# NSDI INDIA GEO PORTAL, NATIONAL SPATIAL DATA INFRASTRUCTURE

- OGC compliant Web Map Service (WMS) created by Survey of India from Open Series Map (OSM) Data on 1:50,000 scale and Panchromatic imagery of Bhuvan for Andhra pradesh .
- These rich data sets can be integrated with any other OGC compliant Web Services to make it more meaningful and solve real life problems.
- The whole OSM map data is organised in 8 themes which can be made on /off with the tools provided in layer menu.
- The transparency of the Bhuvan Imagery can be changed by the user as per the requirement using the tool available under layer menu of the India geo-portal.

# NAVIC

# GLOBAL POSITIONING SYSTEM (GPS)

Civilian GPS receivers ("GPS navigation device") in a marine application.

- Global Navigation Satellite System (GNSS)
- GLONASS (Russian)
- BeiDou (BDS) (Chinese)
- Galileo (European)
- Indian Regional Navigation Satellite System (IRNSS) (India)
- Quasi-Zenith Satellite System (QZSS) (Japan)

# NEED FOR NAVIC

- The system was developed partly because access to foreign government-controlled global navigation satellite systems is not guaranteed in hostile situations, as happened to the Indian military in 1999 when it was dependent on the American Global Positioning System (GPS) during the Kargil War.[10] The Indian government approved the project in May 2006.
- The **Indian Regional Navigation Satellite System** (**IRNSS**) with an operational name of **NAVIC** ("sailor" or "navigator" in Sanskrit, Hindi and many other Indian languages, which also stands for **NAV**igation with **I**ndian **C**onstellation[2]) is an autonomous regional satellite navigation system, that provides accurate real-time positioning and timing services. It covers India and a region extending 1,500 km (930 mi) around it, with plans for further extension. The system at-present consist of a constellation of 7 satellites,[1][3] with two additional satellites on ground as stand-by.[4]
- The constellation is already in orbit and system is expected to be operational from early 2018[5][6] after a system check.[7] NAVIC will provide two levels of service, the 'standard positioning service' will be open for civilian use, and a 'restricted service' (an encrypted one) for authorized users (including military).

# Rebuilding India

Samvardhit Bharat - Swavalambi Bharat

Resurgent India - Self-reliant India

**Technology driven India**

## NAVIC

An autonomous regional Satellite Navigation System set up by India

To provide accurate real-time positioning and timing services over India and the region extending to **1,500 kilometers** around India

## Navigation with Indian Constellation (NAVIC)

### Indian Regional Navigation Satellite System (IRNSS)

| | |
|---|---|
| **Country/ies of origin** | India |
| **Operator(s)** | ISRO |
| **Type** | Military, Commercial |
| **Status** | Operational |
| **Coverage** | Regional (up to 1,500 km from borders) |
| **Accuracy** | 10 m (public)<br>0.1 m (encrypted) |

**Constellation size**

| | |
|---|---|
| **Total satellites** | 7 |
| **Satellites in orbit** | 6 (1 redundant) |
| **First launch** | 1 July 2013 |
| **Last launch** | 31 August 2017 19:00 pm IST |
| **Total launches** | 8 (1 Unsuccessful) |

**Orbital characteristics**

| | |
|---|---|
| **Regime(s)** | High Earth |
| **Orbital height** | 36,000 km (22,000 mi)[1] |

**Other details**

| | |
|---|---|
| **Cost** | 212 million |


ONLY 5 COUNTRIES HAVE THIS TECHNOLOGY
USA
EU
RUSSIA
CHINA
INDIA

# INDIAN GEO SPATIAL MARKET

# HOW BIG IS THE INDIAN GEOSPATIAL MARKET?

## FACTS - GEOSPATIAL MARKET

### India

**12 - 15%**
growth at a cumulative annual rate

**$4 bn**
market

**$3 bn**
The annual budget of government agencies for GIS services is estimated to be

**$20 bn**
Market - expected to be by 2025

# FUTURE

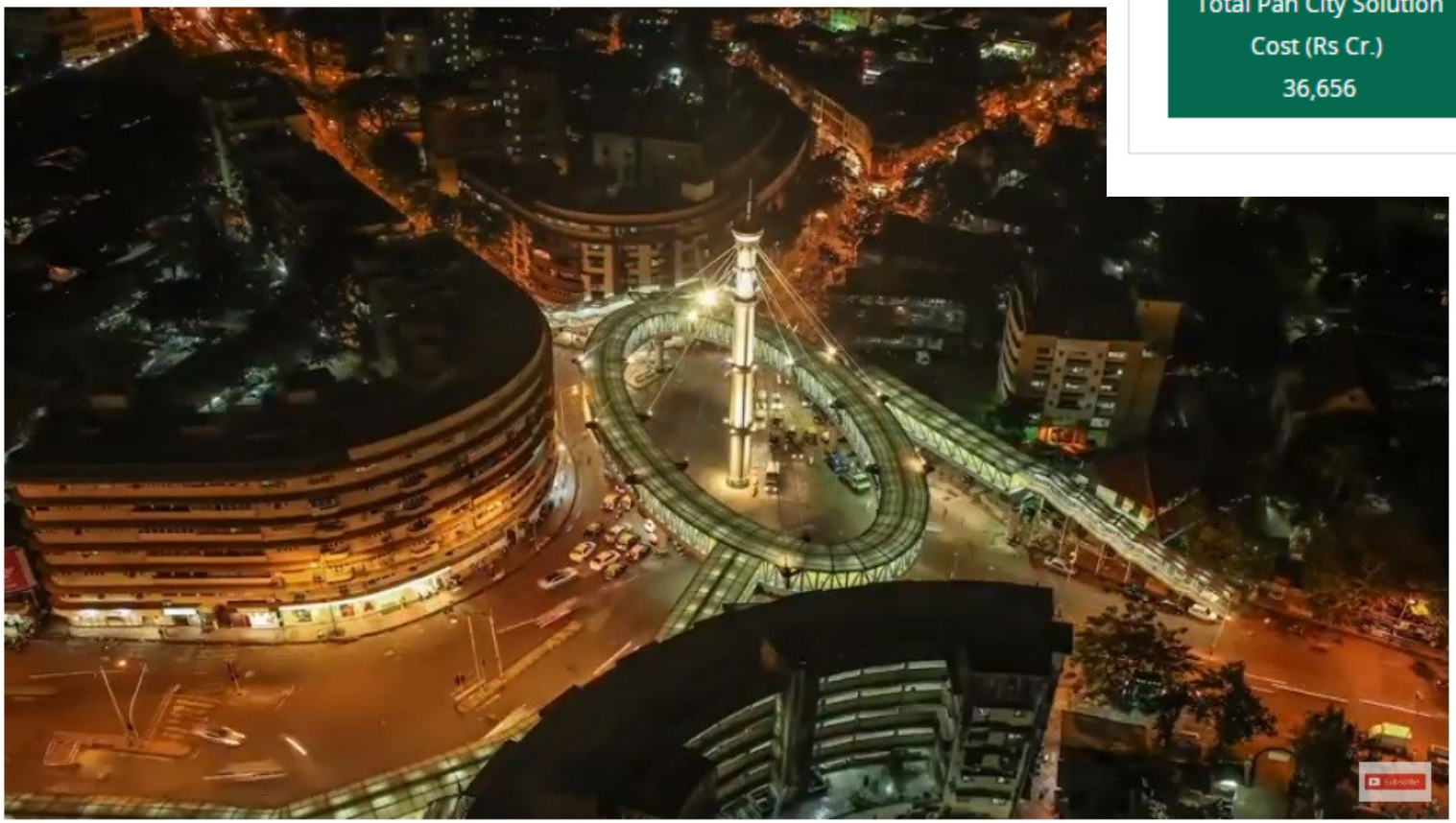
- All flagship programs be it smart cities, skill development, Digital India, Start-Up India, Make in India, the Clean Ganga project, or the push to infrastructure, industrial development, energy, or smart agriculture have substantial geospatial component.
- “The $4 billion Indian geospatial industry in India is expected to become a $20 billion market by 2025, growing at a cumulative annual rate of 12 to 15 per cent. In addition, the estimated annual budget of government agencies for GIS services currently stands at $3 billion. This is expected to further increase with the government’s push for leveraging space and location technologies for development and governance” as stated by Union Minister of Urban Development, Housing and Urban Poverty Alleviation and Information and Broadcasting M. Venkaiah Naidu, the Geospatial industry is sure to revolutionise Indian Governance.

# SMART CITY

## Smart Cities

View More

| | |
|---|---|
| Total Winning Proposals<br>90 | Total Urban Population Impacted<br>95,955,046 |
| Total Cost Of Projects (Rs Cr.)<br>189,256 | Total Area Based Development Cost (Rs Cr.)<br>152,600 |
| Total Pan City Solution Cost (Rs Cr.)<br>36,656 | |




INDIA EXPO CENTRE AND MART
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HEXAGON
STRATEGIC PARTNERS
Mladen Stojic
President, Hexagon Geospatial
RANGING FROM SMART SAFETY TO SMART INFRASTRUCTURE TO SMART PLANNING.

# SMART CITY FEATURES

- Promoting mixed land use in area based developments–planning for ‘unplanned areas’ containing a range of compatible activities and land uses close to one another in order to make land use more efficient. The States will enable some flexibility in land use and building bye-laws to adapt to change;
- Housing and inclusiveness - expand housing opportunities for all;
- Creating walkable localities –reduce congestion, air pollution and resource depletion, boost local economy, promote interactions and ensure security. The road network is created or refurbished not only for vehicles and public transport, but also for pedestrians and cyclists, and necessary administrative services are offered within walking or cycling distance;
- Preserving and developing open spaces - parks, playgrounds, and recreational spaces in order to enhance the quality of life of citizens, reduce the urban heat effects in Areas and generally promote eco-balance;
- Promoting a variety of transport options - Transit Oriented Development (TOD), public transport and last mile para-transport connectivity;
- Making governance citizen-friendly and cost effective - increasingly rely on online services to bring about accountability and transparency, especially using mobiles to reduce cost of services and providing services without having to go to municipal offices. Forming e-groups to listen to people and obtain feedback and use online monitoring of programs and activities with the aid of cyber tour of worksites;
- Giving an identity to the city - based on its main economic activity, such as local cuisine, health, education, arts and craft, culture, sports goods, furniture, hosiery, textile, dairy, etc;
- Applying Smart Solutions to infrastructure and services in area-based development in order to make them better. For example, making Areas less vulnerable to disasters, using fewer resources, and providing cheaper services.

- Landuse Mapping
- Improvement to Road network
- Model Roads
- Non Motorized Transport Corridors
- Rejuvenating the Water Bodies
- E-Schools
- E- Governance
- Revneue Generation
- Solid Waste Management
- Sewage Treatment

# CENTRE PLEDGES RS 58,000 CRORE TO 30 SMART CITIES, 4 TAMIL NADU TOWNS, PUDUCHERRY MAKE THE CUT

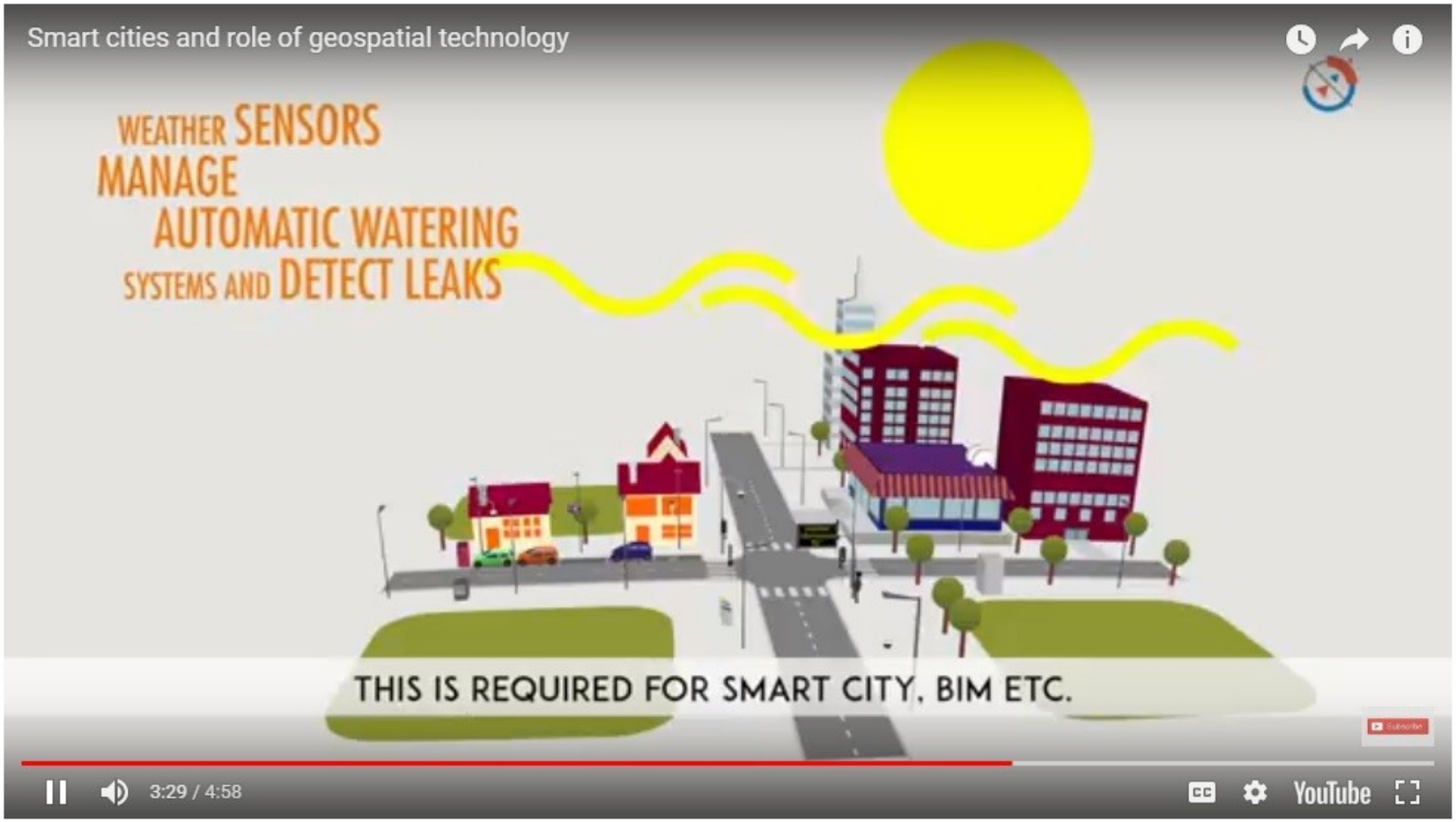
# DRONE

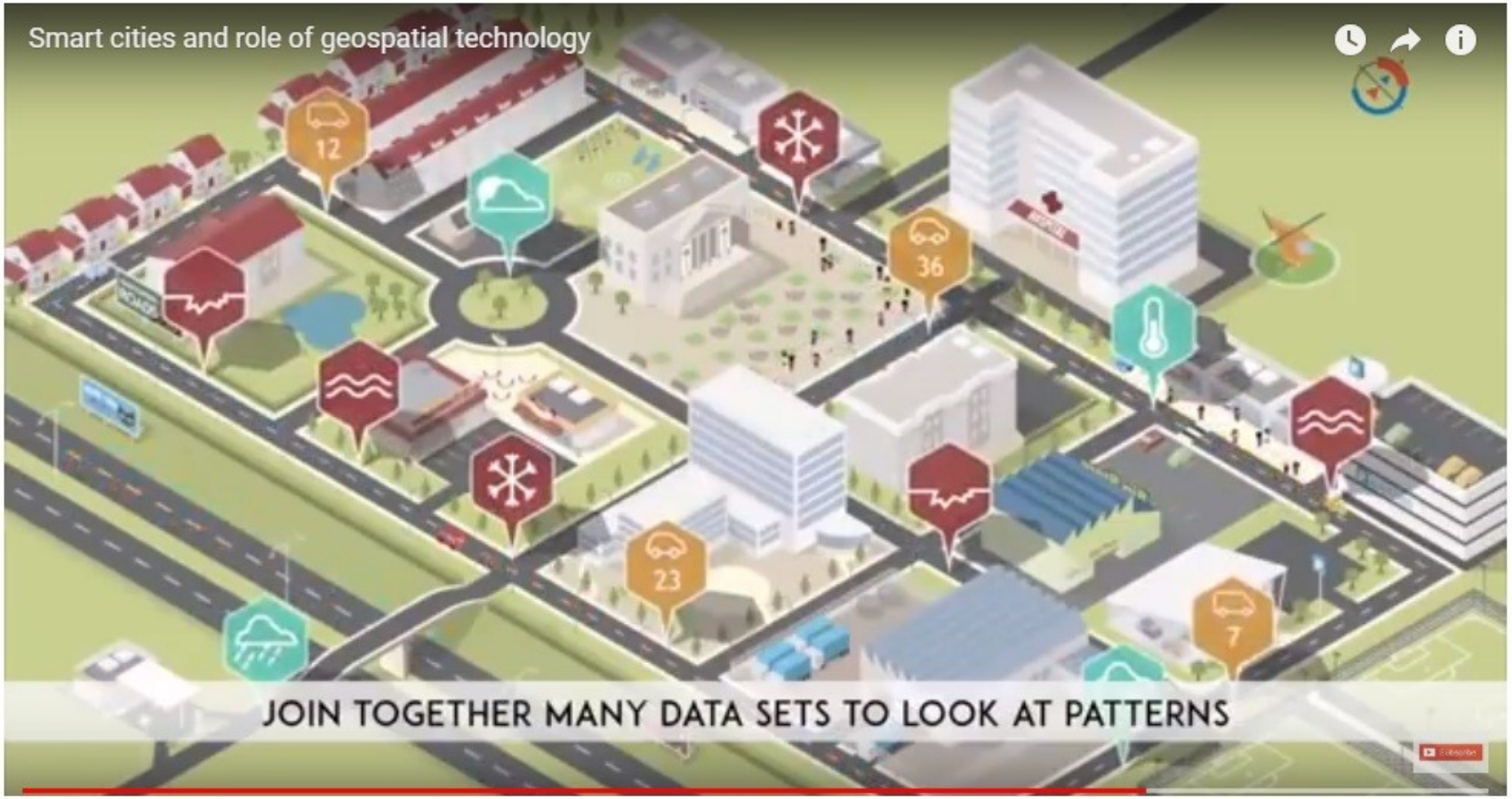
# STREET VIEW


EVERYTHING ON EARTH HAS A LOCATION AND WITH LOCATION


Smart cities and role of geospatial technology
SO FROM A POLICY PERSPECTIVE GEOSPATIAL TECHNOLOGY PROVIDES
2:49 / 4:58
YouTube


Smart cities and role of geospatial technology
LTE MOBILITY NETWORK
BY 2020 THERE ARE GOING TO BE 50 BILLION CONNECTED DEVICES.


Smart cities and role of geospatial technology
WEATHER SENSORS
MANAGE
AUTOMATIC WATERING
SYSTEMS AND DETECT LEAKS
THIS IS REQUIRED FOR SMART CITY, BIM ETC.
3:29 / 4:58
YouTube


Smart cities and role of geospatial technology
12
36
23
7
JOIN TOGETHER MANY DATA SETS TO LOOK AT PATTERNS


Smart cities and role of geospatial technology
WITH ENTERPRISE WORKFLOW AROUND THE GIVEN SOLUTION.
4:13 / 4:58
YouTube


aerial view from northwest
RIVERWORKS DESIGN GROUP

# THANKYOU

# REFERENCES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