

High Resolution Data Capture For  
Foundation Data Preparation  
and  
Representation in different Scales

by

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at

New Marrion Hotel, Bhubaneswar  
18<sup>th</sup> December 2018

# Agenda

1. Geospatial Applications.
2. High Resolution Vector Data.
3. Spatial Foundation Data (National/State).
4. Preparing State Level Spatial Foundation data.
5. Design and maintenance of Spatial Data Base.
6. Interoperable Service of Spatial Foundation Data.
7. Infrastructure requirement to maintain Spatial Data life Cycle.
8. Assuring Quality of Data being served to the users/applications.
9. Representation of spatial Data in different scales

# 1. Geospatial Applications

## Who needs the Geo-Spatial Applications ?

- State Government Line Departments.
- State implementing central Schemes like NRDMS District Centers.
- E-Gov/ G-Gov/ M-Gov Schemes.
- General Citizen of India.
- Business Houses.
- Academicians.
- NGOs.
- All other Flagship Projects of current Government.

Awning, BuildingRoof, CurvedRoof, InCompleteBuilding, OnionDome, OnionTop, RoofPoint, RoofRidge, SlopeRoof, Courtyard

3D GIS  
(10)

Boundary  
(29)

State, District, Sub-Division, Urban Body, Locality, Village, Laldora, MCD Zone, MCD Ward, Census Ward, PIN Code, Constituency, and Dept. boundaries

Building  
(92)

Building, Fence & Gates, Commercial, Courts, Education, Facility Centres, Medical Facilities, Heritage & Historical Buildings, Industry, Police, Entertainments, Religious, and Residential

Pencil Point, Pencil Line, Pencil Polygon

Input for  
Updation  
(3)

GPS  
Survey &  
Leveling

Transportation  
(59)

Roads with its Furniture, Airport, Railway and Metro Railway

Map2K, Models, Bench Mark, Ground Control Point

Framework  
(4)

Line  
Depts.  
Inputs

Aerial  
Images

Utility  
(58)

Power, Sewerage, Water Supply, Gas and Oil Services, Communication, and others

**DSSDI  
Data  
Layers  
(357+)**

Ortho-Photos, Colony Layouts, Masavi Maps, Sijra Maps, Landuse Maps,

Image  
(5)

GPR  
Survey

Ground  
Validation

Field  
Property  
Survey

Attribute  
Collection

Landuse  
(38)

Vegetation related areas, Cultivation & Plantation Area, Scrub Area, Marshy, Oxbow lake, Rocky & Mountain features, Sand Area, Barren Land, Fire Line, Quarries, Manmade land covers

Contours (Thick & Thin), Break line, DEM, Depressions, Form line or sub features

Hypsography  
(6)

Hydrography  
(16)

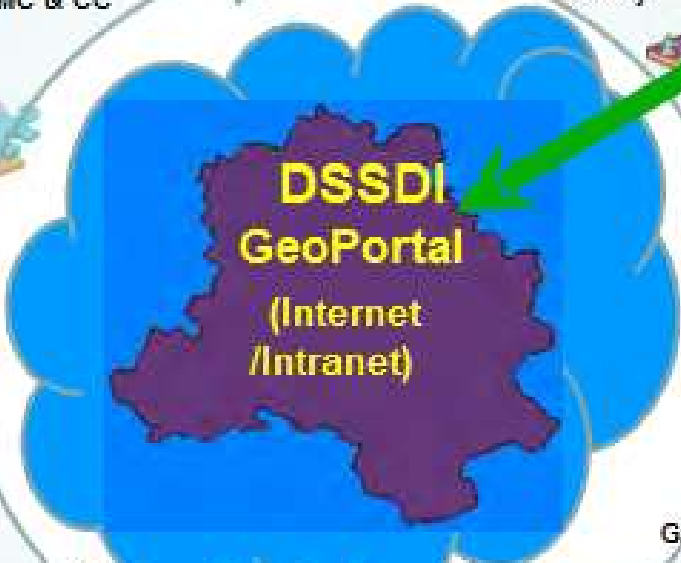
Cadastre  
(15)

Masavi Parcel, Village Boundary, Built-Up, Mixed Built-Up, Transportation, Public Semi-Public, Communication, Forest, Grazing land, waste land, Water bodies, Hill, Boundary Pillars

River, Stream, River Island, Dam, Reservoir, Lake, Pond, Tank, Canal, Water Channel, Water Limit, Swimming Pool

# Delhi Geo-Portal

Line Departments of GNCTD



## Application Development Process in DSSDI



- 1 MCD
- 2 DDA
- 3 NDMC
- 4 Revenue
- 5 DJB
- 6 DTL
- 7 BSES Rajdhani
- 8 BSES Yamuna
- 9 NDPL
- 10 IGL
- 11 PWD
- 12 DTC
- 13 Fire Service
- 14 Delhi Police
- 15 Election Commission
- 16 Education
- 17 Health & Family Welfare
- 18 DPCC
- 19 DTTDC
- 20 Census Dept.
- 21 DSIIDC
- 22 Irrigation & Flood Control
- 23 Dept. of Labour
- 24 Excise & Entertainment & Luxury Tax
- 25 Trade & Taxes
- 26 MTNL
- 27 DIMTS
- 28 DMRC
- 29 Commonwealth Games
- 30 Forests

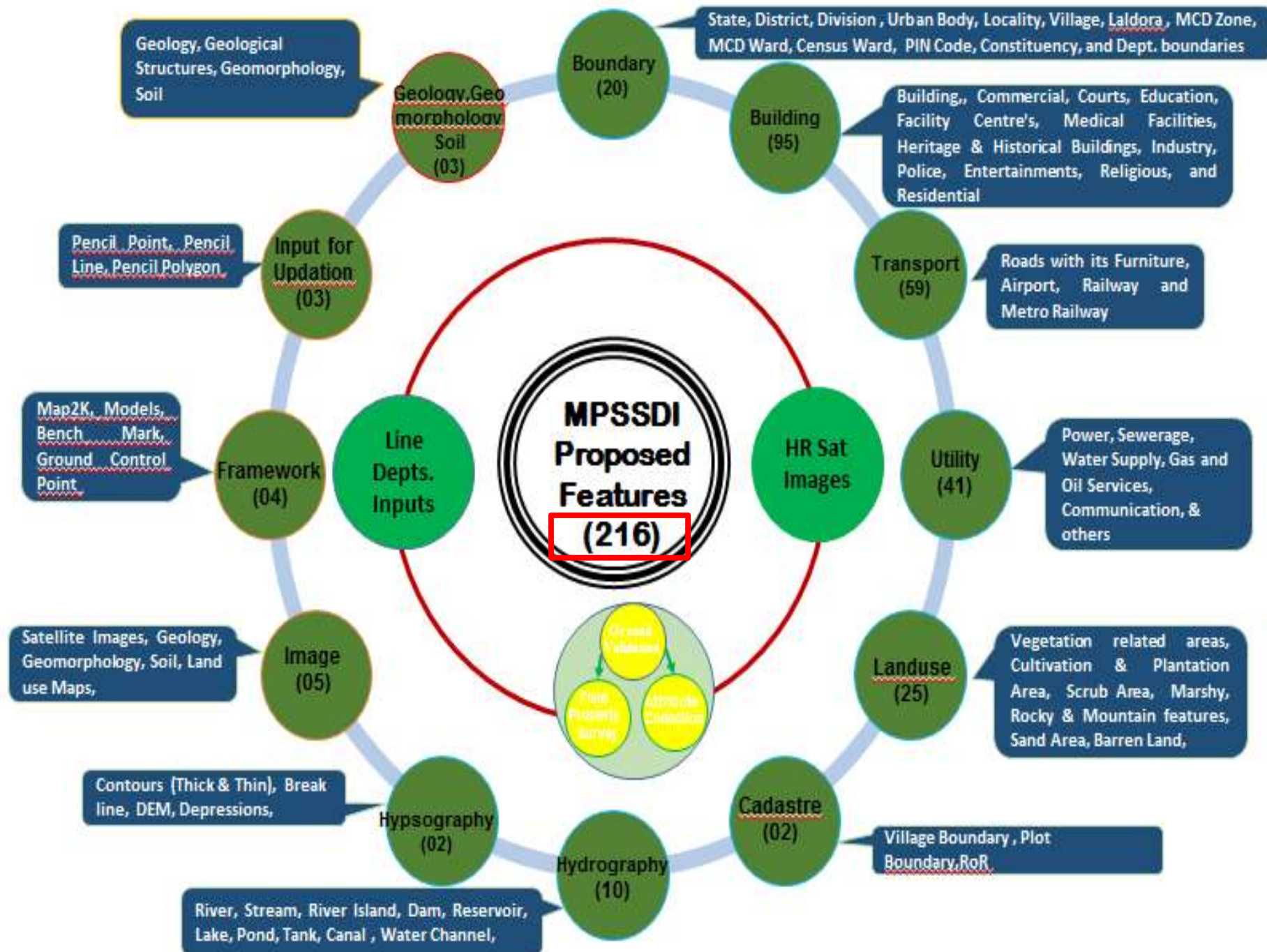
# Applications suggested by **UTTRAKHAND State**

( **OM No. 4876/S.P.A./G.P.S.Cell/2017-18 Dated- 22/01/2018**)

- 1. Police Department**
- 2. Primary Health Centre**
- 3. Public Works Department**
- 4. Tourism Department**
- 5. District electoral Department**
- 6. District Supply Department**
- 7. Uttarakhand Renewable Energy Development Agency**
- 8. Forest Department**
- 9. Child development Department**
- 10. Agriculture Department**
- 11. Irrigation Department.**
- 12. Panch Jal nizam**
- 13. Rural Work Department**
- 14. District industries centre**
- 15. Jila Panchayat Department**
- 16. Abkari Department**

- 17. Dairy Development**
- 18. Electricity Department**
- 19. Swajal Vibhag-**
- 20. District Employment Exchange office**
- 21. District Disaster Management Department**
- 22. District Sports Department**
- 23. D.R.D.A.**
- 24. Jila Yuva Kalyan And Prantiya Rakhshak Dal**
- 25. Minor Saving Department**
- 26. Education Department**
- 27. Fisheries Department**
- 28. Silk Department**
- 29. Jal Sansthan**
- 30. P.M.G.S.Y. Almora**
- 31. Co-operative Department**
- 32. Panch Sthaniya Almora**







# NSDI Demo/Prototype Applications

SDI Interoperable Service - Demo x Projects - NSDI Application x localhost

**nsdi** Projects - NSDI Application admin

## Demo

Montpellier - Transports

Load the map View metadata

## Interoperable Service

NSDI Interoperable Service

Load the map View metadata

## Cadastre

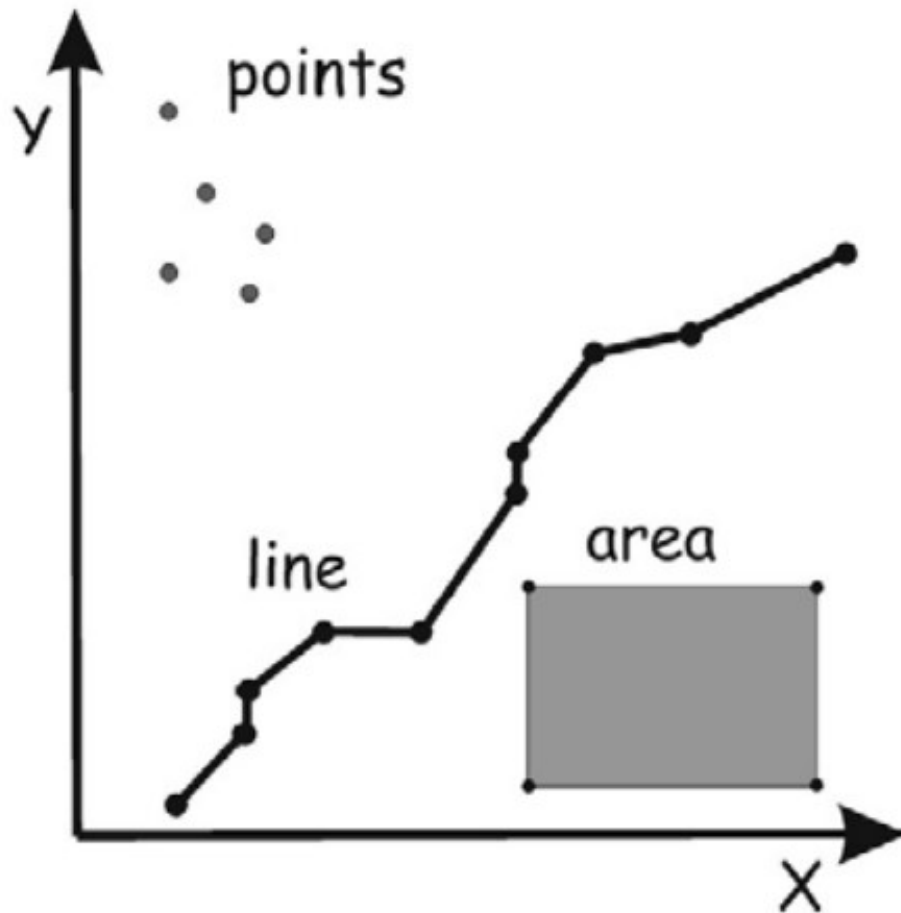
NSDI Cadastre

Load the map View metadata

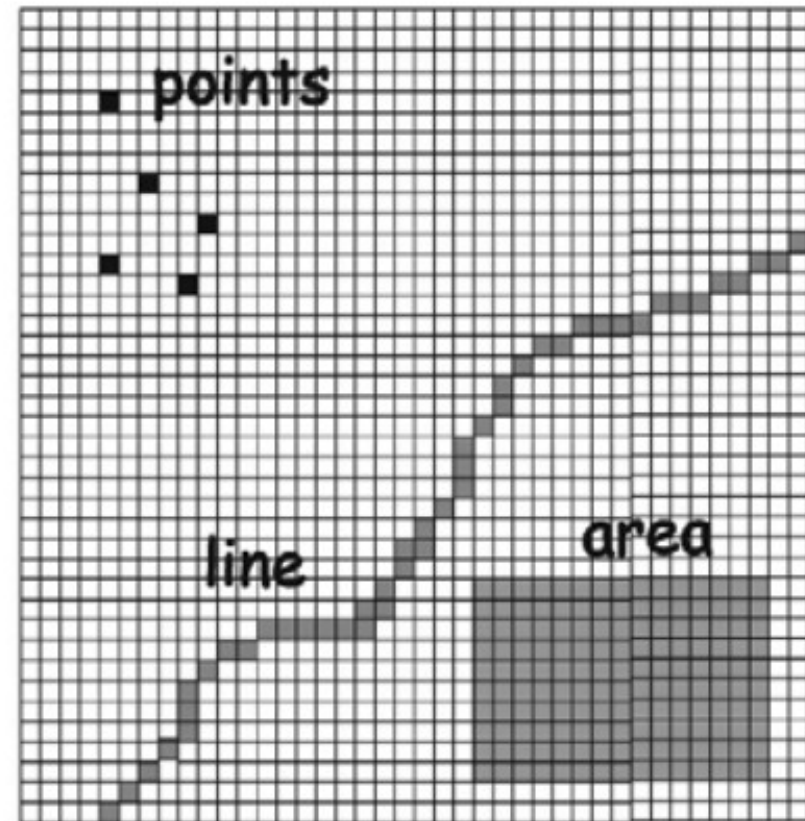
8:45 PM

## 2. High Resolution Vector Data.

## Vector



## Raster



**Vector Data Preferred** : 1. Precise location.  
2. Topology handling better. 3. Data Volume is less



## OSM TOPO MAP - Scales

Scale of the Map	Latitude Extent	Longitude Extent	Approximate area in Sq. Km.
1:1M	4 Degree	6 Degree	184320
1:250K	1 Degree	1 Degree	11520
1:50K	15 Minute	15 Minute	720
1:25K	7 ½ Minute	7 ½ Minute	180
1:10K	3 Minute	3 Minute	27
1:2K	36 Seconds	36 Seconds	1.1

# Map Resolution and Mapable Unit

- Data **resolution** is the smallest difference between adjacent positions that can be recorded. Since a paper **map** is always the same size, its data **resolution** is tied to **map scale**.
- Example on 1:25,000 **scale paper map**, the minimum distance which can be represented (**resolution**) is  $1/4^{\text{th}}$  mm in map scale 6.25 meters.

# Large Scale Vs Small scale Maps

- This is because the area of land being represented by the **map** has been scaled down less, or in other words, the **scale** is **larger**.
- A **large scale map** only shows a **small** area, but it shows it in great detail.
- A **map** depicting a **large** area, such as an entire country, is considered a **small scale map**.
- Generally a scale more than 1:25,000 scale is called high resolution map.
- In this context we will accept 1:4000 scale as village maps and 1:2000 scale 3D as City Maps as decided by Executive Committee of NSDI. Both scales come under High resolution.



### 3. Spatial Foundation Data (National/State)

# Why Foundation Data ?

- It will provide a common reference for the assembly and maintenance of foundation spatial data with national coverage.
- It will deliver best available, latest version, standardized, quality controlled, authoritative single source foundation spatial datasets with easy access over the geographic extent of the country, e.g. an authoritative base map of Roads etc.
- It will facilitate the availability and accessibility of foundation spatial data across all the users from various spheres/domains in the country.
- It will allow for seamless exchange of information and knowledge across organisational , sectoral and jurisdictional boundaries.

# Foundation Data Requirements

Following inter-related elements are required:

- Spatial data themes
- Spatial data sets
- Standards
- Policy
- Governance structures
- Organizations/Stake holders
- Spatial information users/people

## Expected Benefits of the Foundation Data

- Reduction in costs associated with data duplication , storage and access.
- Fast and easy access to basic data for users.
- Reduced complexity for users with single source authoritative data.
- Increased interoperability with the use of common framework national datasets across the spatial information users community including government, industry, academic and research sectors etc.
- Improved decision making with single source authoritative data.
- Greater levels of innovation and competition across all areas of government and industry.

# Topographical data themes

( National Map Policy 2005)

(600+ features Cartographic – 489 features Land Scape )

- Geodetic Reference Framework: SOI GCP network
- Administrative boundaries: Forest, Legislative, National etc.
- Communication: Roads, Railways, Airways, Waterways etc.
- Hydrology : natural and manmade water features etc.
- Habitation: includes settlement and cultural details etc.
- Utilities: Gas/LPG pipelines, Power transmission lines etc.
- Relief/Hypsography/Topography/Bathymetry/Elevation: Contours, Heights, DEM, DTM, Bathymetric data etc.
- Land Cover : includes vegetation, forests etc.

## 4. Preparing State Level Spatial Foundation data.

# Method - 1

- Aerial Photography
- Photography Scale required is 1:15K for 1:10K Mapping.
- Photography Scale required is 1:6K for 1:2K Mapping.
- Mass point collection to be done in stereo mode.
- Ortho photos to be Generated.
- Features to be Collected from Ortho photos.
- GIS Ready Data to be Produced out of this data.
- Field Verification and attribute collection.
- QA/QC of the final data.



# Method - 2

- High Resolution Satellite Imagery
- Cartosat 2 imagery with 0.8 meter GSD for 1:10K Mapping planimetry and spirit leveling for hypsography.
- High resolution imagery 40 cm native GSD or better required for 1:2K Mapping planimetry and Total Station and spirit leveling for hypsography.
- Mass point collection in stereo mode
- Ortho photo creation for hilly terrain or mono digitization for fairly flat terrain type.
- Feature Correction.
- GIS Ready Data Production.
- Field Verification and attribute collection.
- QA/QC

# Method - 3

- Totally use of GPS and total station
- Existing map records to be used for planning and execution of the project.
- Feature Collection.
- Pari-pasu field Verification and attribute collection.
- GIS Ready Data creation.
- QA/QC of the final data.

# Method - 4

- Use drone ALTM data collection of 40 cm accuracy for planimetric feature collection.
- Existing map records to be used for planning and execution of the project.
- Total Station and Spirit Leveling for GCP and height data collection.
- Paripasu field Verification and attribute collection.
- GIS Ready Data creation.
- QA/QC

# Recommended Use

- Photogrammetry method may be used for hilly terrain like Koraput and Keonjhar of Orissa.
- Satellite imagery method may be used for the area where flying is not viable due to any reason and fairly flat terrain like Gopalpur.
- Drone Technology with Total Station may be used where area of interest is very small and high rise buildings are not there. Also devoid of ALTM obstructions.
- Only Total Station and GPS with spirit leveling may be used for areas like north eastern states or similar area in Orissa.

# Smart City Requirements (Reference Singapore Land Authority)

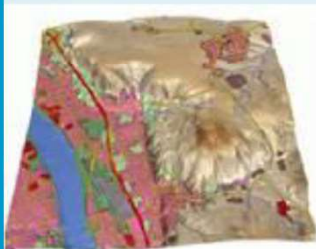
- Upto LoD3/LOd4 City asset Data may be supplemented by Terrestrial Photogrammetry to other methods of Data collection.
- Videography and still photography may also be employed where ever required to capture the desired information.
- Data Base should be suitably designed to include raster data as well with proper scheme of referencing.
- 3D Data service software like Tera Group/Sky Map 3D/Luciad may be used to serve City GML Data for the applications.

# Data Content – to be Very Rich



## 3D Modelling and Data Management

- CityGML represents
  - 3D geometry, 3D topology, semantics, and appearance
  - in 5 discrete scales (Levels of Detail, LOD)



**LoD0**  
Terrain Model



**LoD1**  
Block models with  
no roof structures



**LoD2**  
Explicit roof  
structures



**LoD3**  
Detailed  
architectural  
models

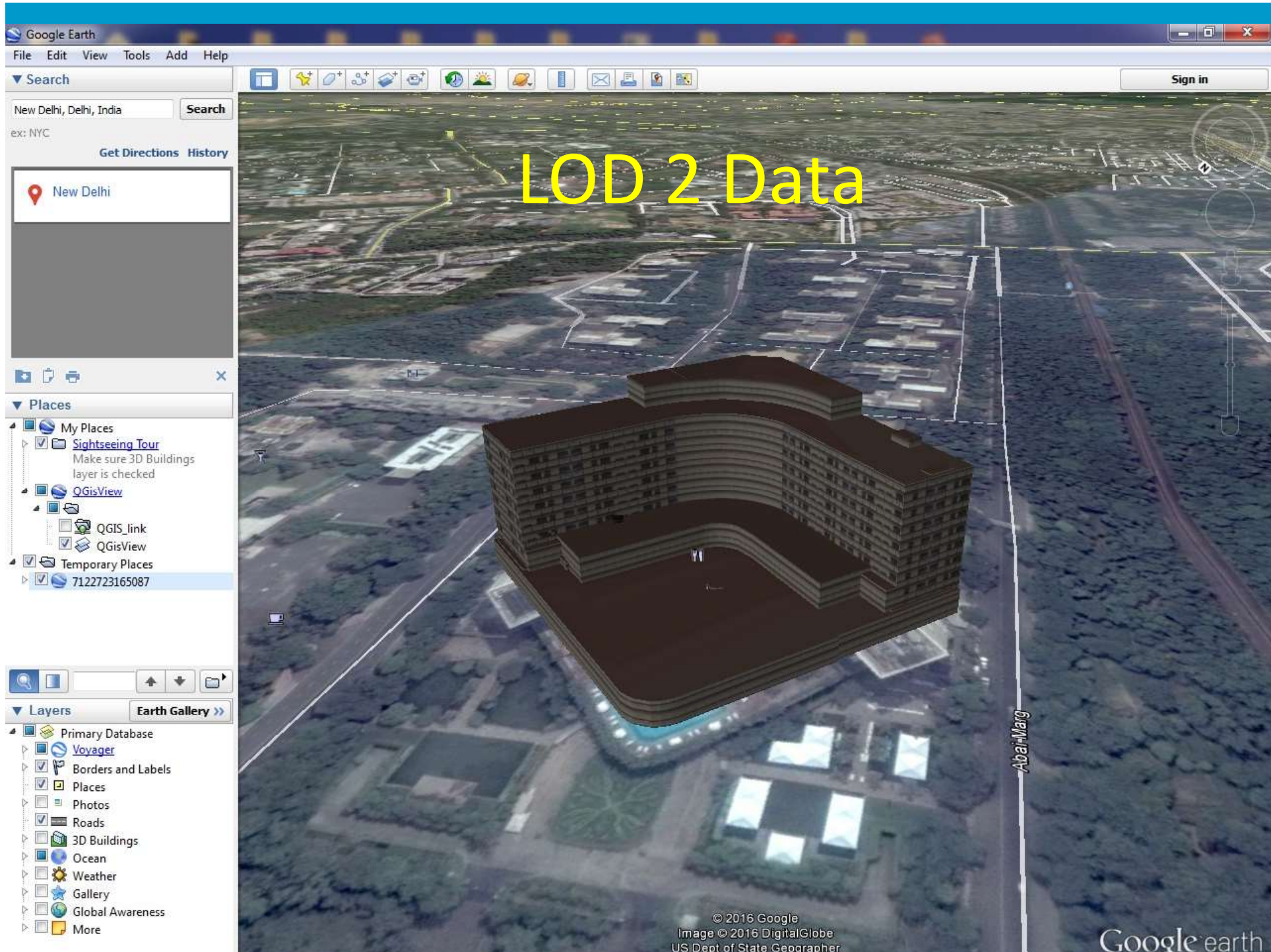


**LoD4**  
Interior  
modelled

# Hotel Taj Palace - Delhi

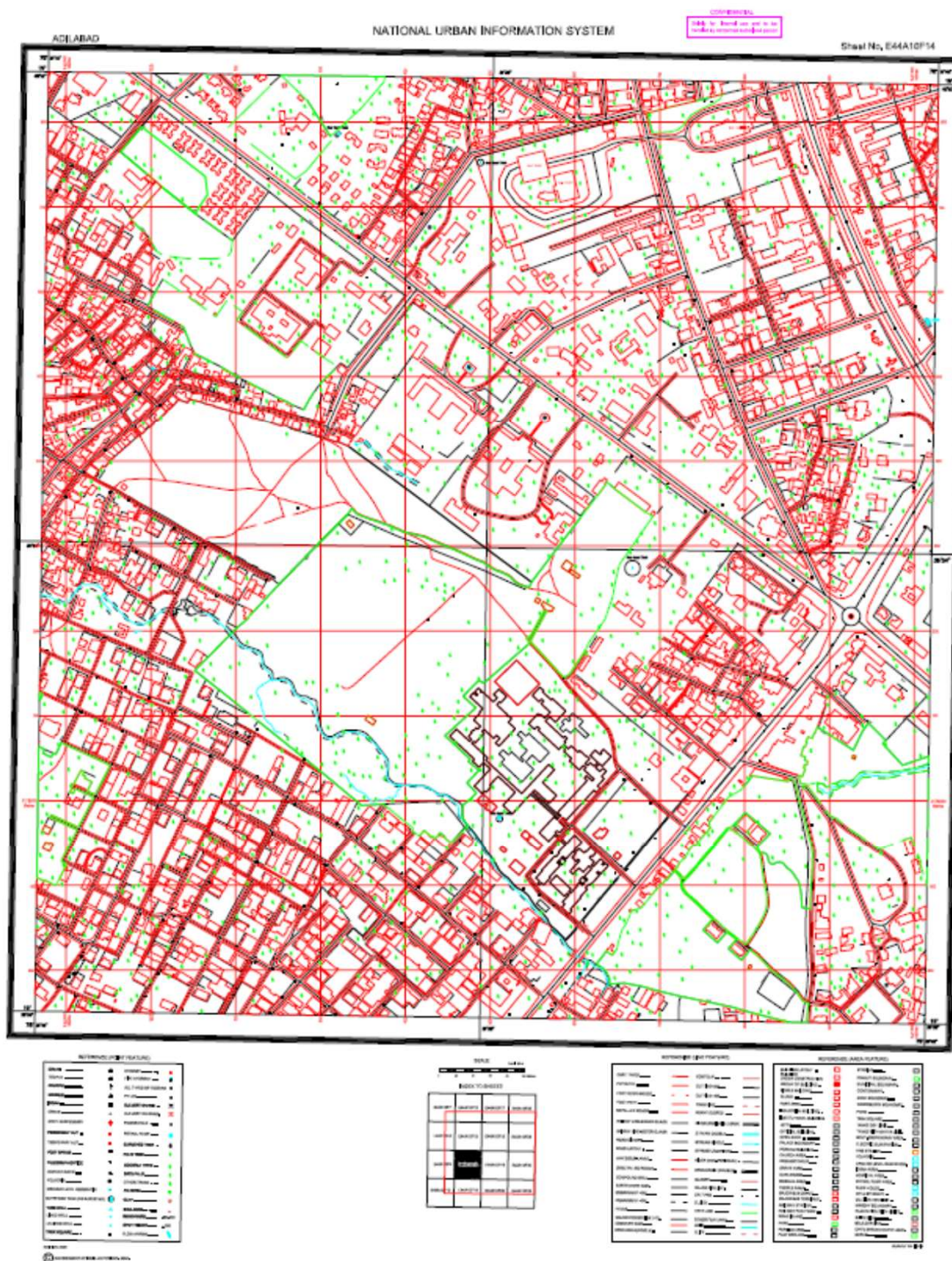






# 5. Design and maintenance of Spatial Data Base.





**1:2000 Scale NUIS Map Sheet – Content is Application Specific**

**Table – 2.2: Urban Network Layer of Line Features**

URBPLCODE	LINE FEATURES	LEVEL – V	REMARKS
00-01-01-00	<b>Transport</b>		
00-01-01-01		Metalled road - edges	Edges
00-01-01-02		Bridge	Both edges
00-01-01-03		Bridge on Rail	Both edges
00-01-01-04		Cart Track	Centre line
00-01-01-05		Fly Over	Edges
00-01-01-06		Foot Over Bridge	Centre line
00-01-01-07		Foot Path	Centre line
00-01-01-08		Metalled road - centre line (for feature 00-01-01-01)	Centre line (where divider is not existing)
00-01-01-09		Pack Track	Centre line
00-01-01-10		Railway Crossing	Manned, line across road on both side minimum 6mm
00-01-01-11		Railway Line – Broad gauge	Each line to be surveyed separately
00-01-01-12		Railway Line – Meter gauge	Each line to be surveyed separately
00-01-01-13		Road Divider, metalled road	Where existing
00-01-01-14		Road Layout	Extreme edge of road (to be surveyed if 2m away from metalled road or 3m away from centre line of unmetalled road)
00-01-01-15		Road width is less than 3m, where both the edges are not visible	Lanes / Sub-lanes
00-01-01-16		Unmetalled road	Edges
00-01-01-17		Unmetalled road	Centre line
00-01-02-00	<b>Infrastructure</b>		
00-01-02-01		Aqueduct	
00-01-02-02		Canal	
00-01-02-03		Compound Wall	
00-01-02-04		Earthwork Dam	
00-01-02-05		Embankment upto 3m ht.	Above ground
00-01-02-06		Embankment-Above 3m ht.	Above ground
00-01-02-07		Fence	

## NUIS Data Model

(About 25 percent features of OSM)

Source: Tender Document



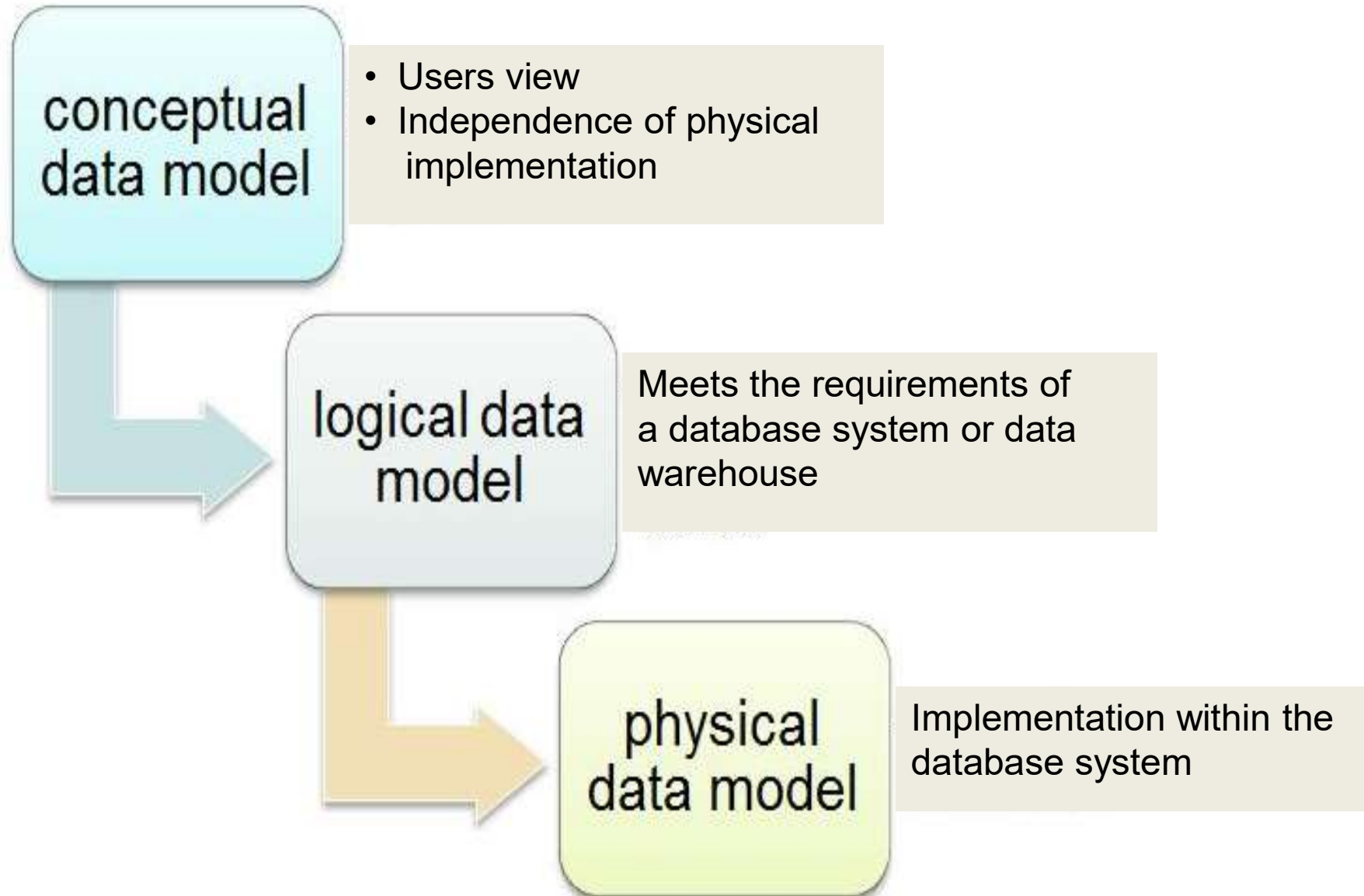
# Geo-Spatial Data modeling-Data Base Design

Data model is a description of the features represented by a computer system together with their properties and relationship.

For effective sharing of geo-databases among various departments, it is necessary to model the respective databases in standard form, namely, UML(Unified Modeling Language).

Modeling own database in UML for each department will enhance the interoperability of data within various organizations.

# Conceptual Data Base Design to Physical Data Storage



# Fostering Software Level Interoperability (OGC-DST Plugfest – 2017)

The OGC-DST Plugfest-2017 brings to the fore a valuable perspective on the utility of the standards and the readiness of the Indian business community to offer services and solutions to address common scenarios associated with development and management of Smart Cities.

Participants of the OGC-DST Plugfest-2017 Sprint #2 held at NSDI, New Delhi on 21 June 2017



## Plugfest Main Recommendations

### WFS

Remove ambiguity in a future version WFS to clarify exact GML structure required.

### WMS/WFS/WMTS

WFS and WMS have reached maturity in the marketplace such that interoperability of data amongst software platforms can be consistently realized. There is a need to raise awareness in use of WMTS.

### WPS

Include and promote WPS in a future Plug fest.

# Broad Contents of NTDB

## A. Real World Objects

- Communications
- Habitation
- Hydrography
- Hypsography
- Land cover
- Utilities
- Adm. Boundaries
- Vital Installations

## B. Cartographic Objects

- Map frame and text



# Real World Objects – Roads

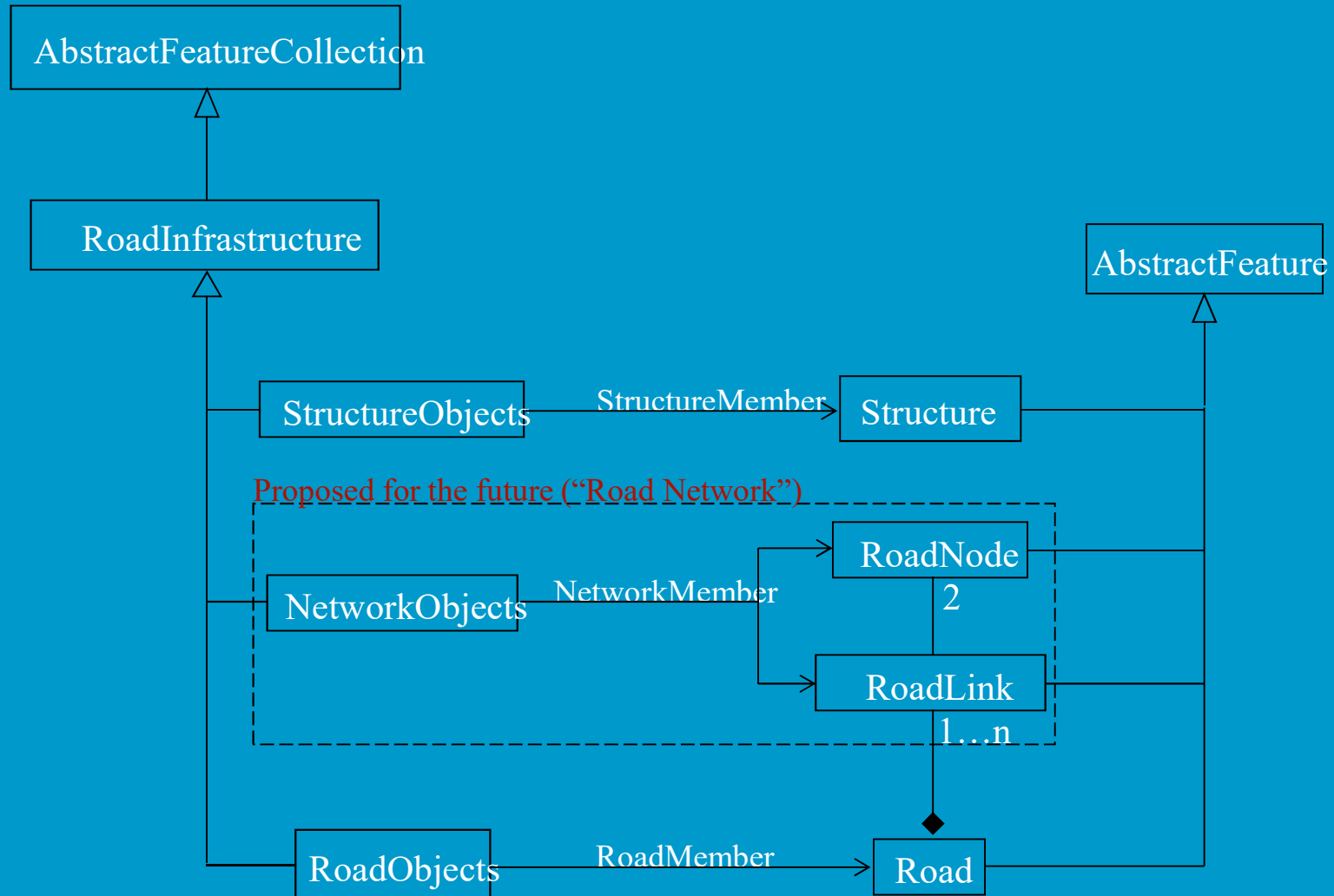
Feature name	Abbr. Name	Feature Code	Geometry	DVD code	
				Major	minor
Road metalled 1 <sup>st</sup> importance	RDMT_1	3101	Line string	11	1100
Road metalled U/C 1 <sup>st</sup> importance	RDMUC1	3102	Line string	15	1000
Road U/M 1 <sup>st</sup> Importance	RDUM_1	3103	Line string	11	5100
Road 1 <sup>st</sup> importance Distance stone tick	RDSTK1	3104	Cell/symbol	13	2100
Road 1 <sup>st</sup> importance Distance stone Number	RDSTN1	3105	P/Text	11	8610

# Attributes of 'Road' Class

Attribute	Domain	Cardinality	Optionality
Road Name or Number		multiple	mandatory
Road Category	Cart-track plains Cart-track hills/ wooded area/desert Track follows stream-bed/ boundary etc. Road in dry river bed Pack-track hills Pack-track plains Foot-path hills Foot-path plains Motorway Highway	single	mandatory
Road Importance	1 <sup>st</sup> 2 <sup>nd</sup> Others	single	mandatory
Status of construction	Under Construction Complete	single	mandatory
Road condition	Metalled Unmetalled	single	mandatory

# Road Data Model for SoI “Road” theme

(UML Class Diagram – ISO 19109)



# How to Learn the Spatial Data Modeling

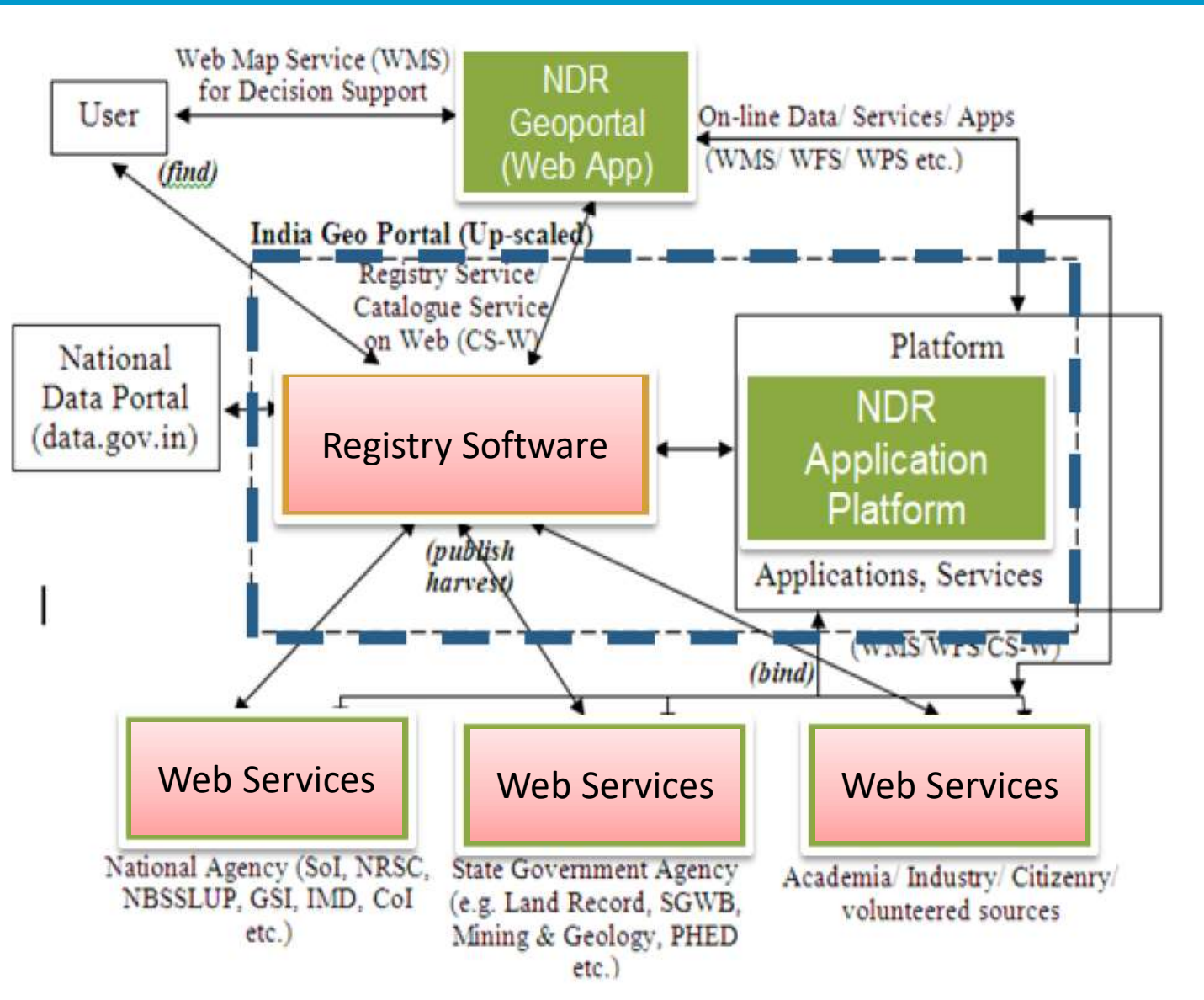


*Workshop on Geospatial Data Modeling*

## Data Modeling with UML

# How to reach to the Spatial Data - National Data Registry – Metadata is the Key

# NDR Architecture



# Registry Requirements

## Organize Information and Data Models

•register / sub registry / items class / items

## Manage Information, Define Roles & Responsibilities

•Submitter / Manager / Control Body / Owner

## Maintain Information

•addition / clarification / retirement / supersession

## Exchange and Transport Information

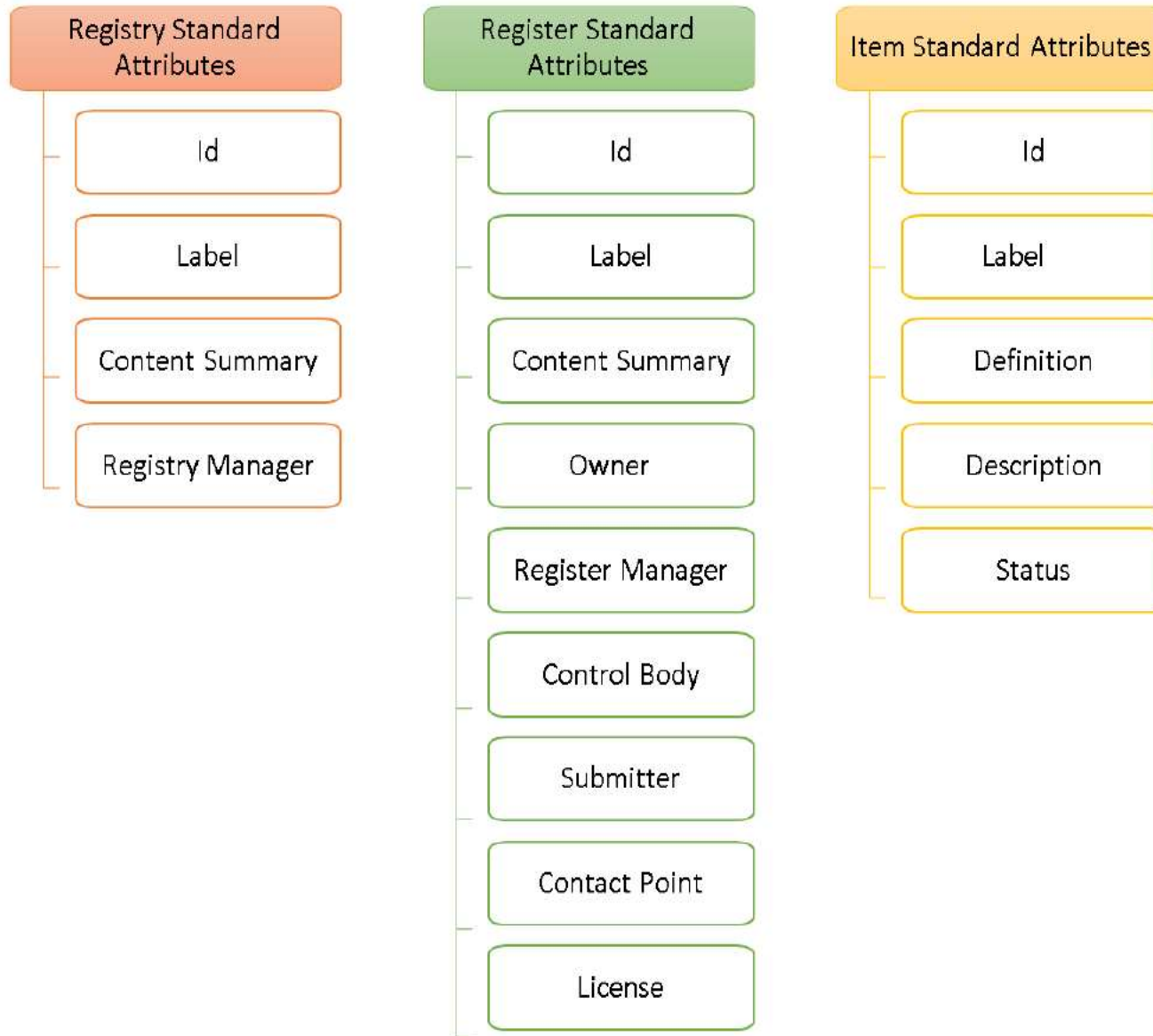
•ISO 19135 XML

Registry shall follow ISO 19135 which specifies procedures for

- establishing,
- maintaining, and
- publishing

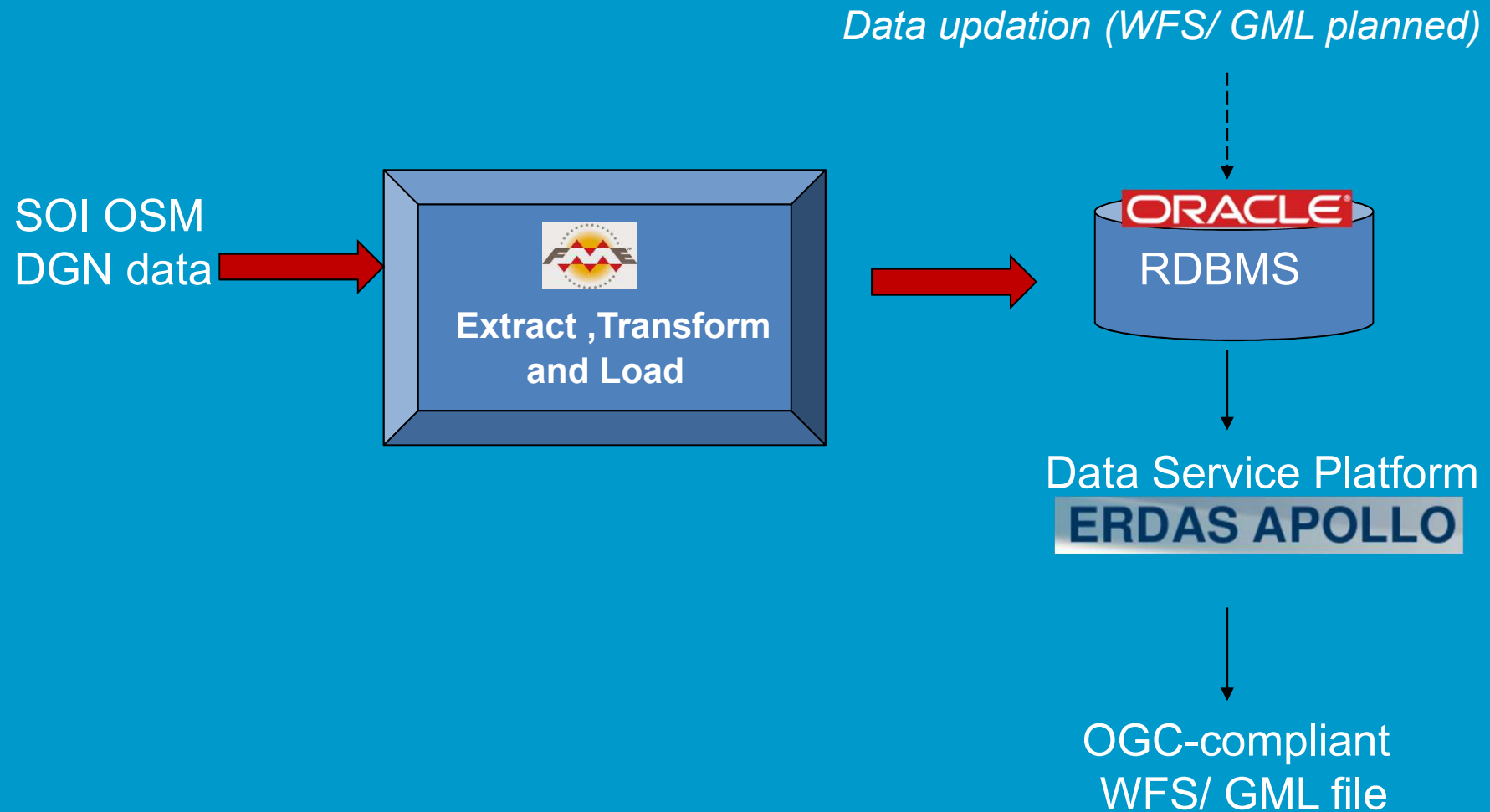
the registers of unique, unambiguous, and permanent identifiers and meanings that are assigned to items of geographic information.

# Content of Registry - ISO 19135 Information Model





# Populate Validated Data to Data Base and Serve – NTDB Example



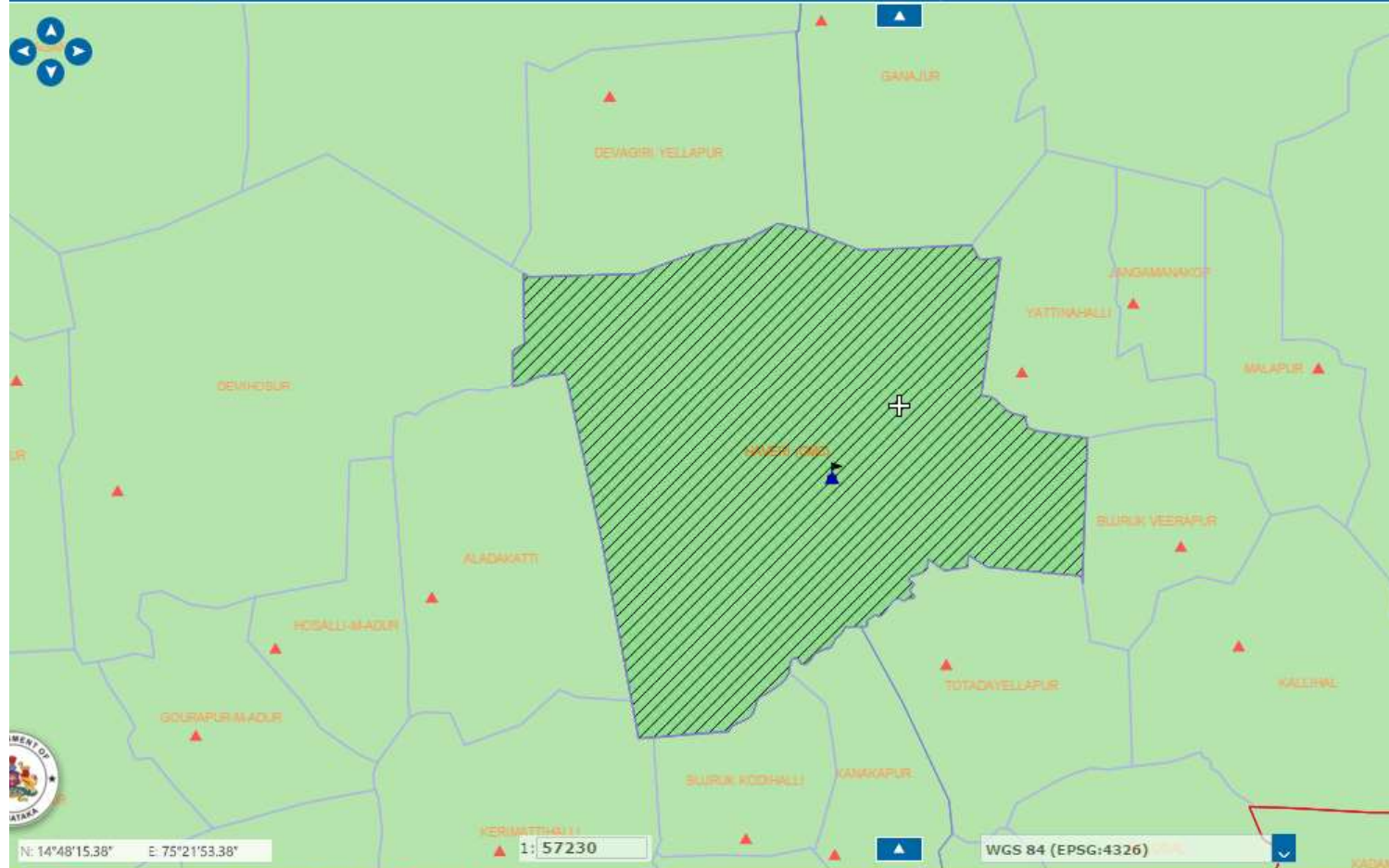
# 6. Interoperable Service of Spatial Foundation Data

The map displays a large green hatched area, likely representing a specific administrative or land use zone. Labels on the map include 'HAYES (2010)', 'TATOHALLI', and 'SULPHUR'. The interface includes a 'Location Search' panel with an 'Enter Location:' field and a 'Layerlist' panel on the right. The layerlist contains the following items:

- Taluk Head Quarters Labels
- Hoblis
- Hoblis Label
- Hobli Head Quarters
- Hobli Head Quarters Labels
- Towns\_Cities
- Towns\_Cities Label
- Villages
- Villages Label
- Village\_Settlements
- Village\_Settlements Label
- PanchayathRajInstitutions
- Electoral Constituencies
- Cadastral
- Geology
- Transportation



# Karnataka Geoportal



## Location Search

Enter Location:  
...

## Layerlist

- Administration
- PanchayathRajInstitutions
- Electoral Constituencies
- Cadastral
- Geology
- Transportation
- Water Resources
- Weather Climate
- World Map

N: 14°48'15.38" E: 75°21'53.38" 1: 57230 WGS 84 (EPSG:4326)

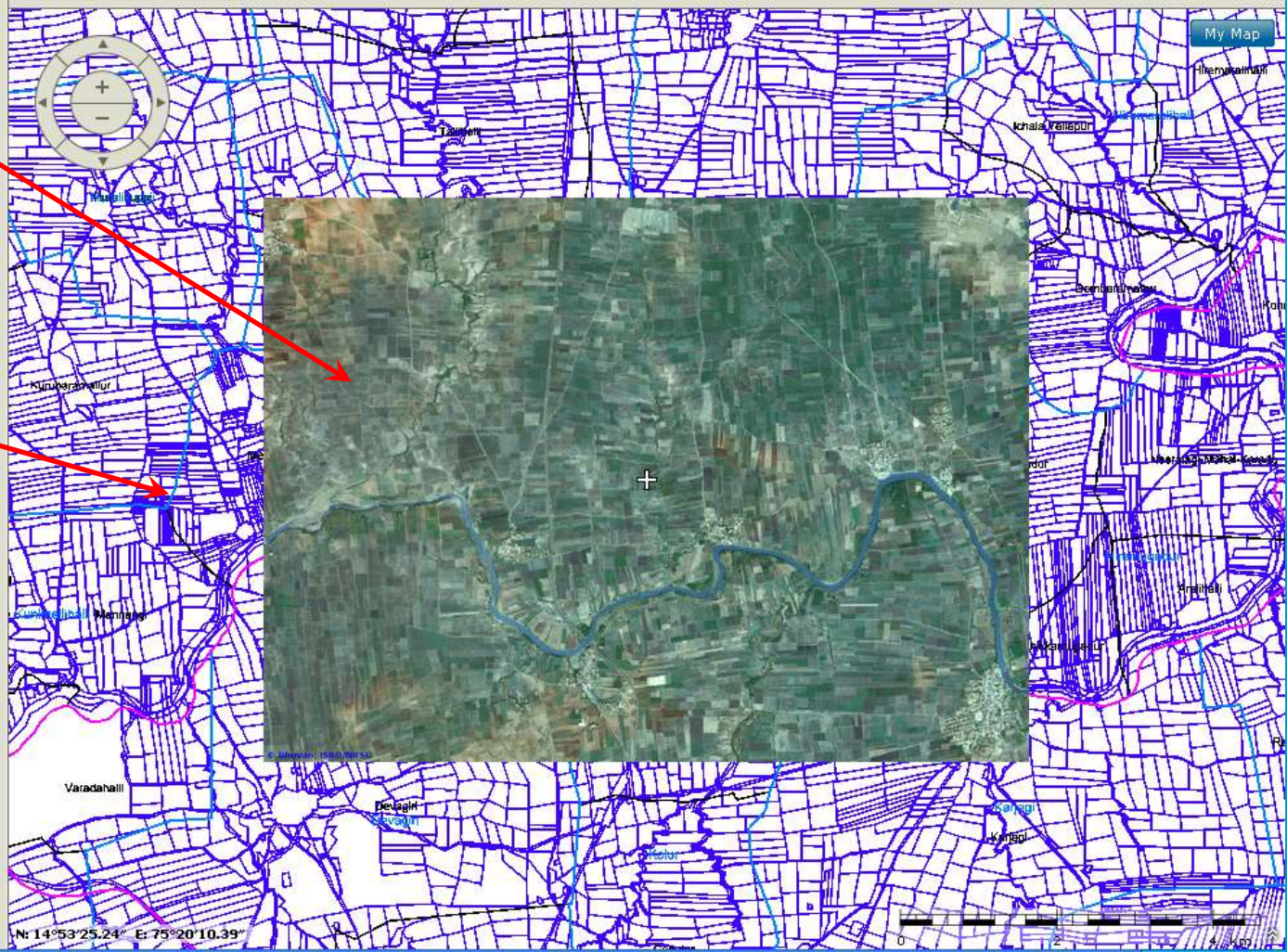




Data Sources Tools Selection Measurements Documentation

Map Content

- Layers
  - BHUVAN-L4
  - copyright
  - Bhuvan
  - STATE LAYERS
    - STATE\_DIVISION
    - STATE\_DISTRICT
    - STATE\_TALUK
    - STATE\_NH
    - STATE\_PC
    - STATE\_LAC
    - STATE\_ZP
    - STATE\_TP
    - STATE\_HOBLI
    - STATE\_GP
    - STATE\_VILLAGE
    - Haveri



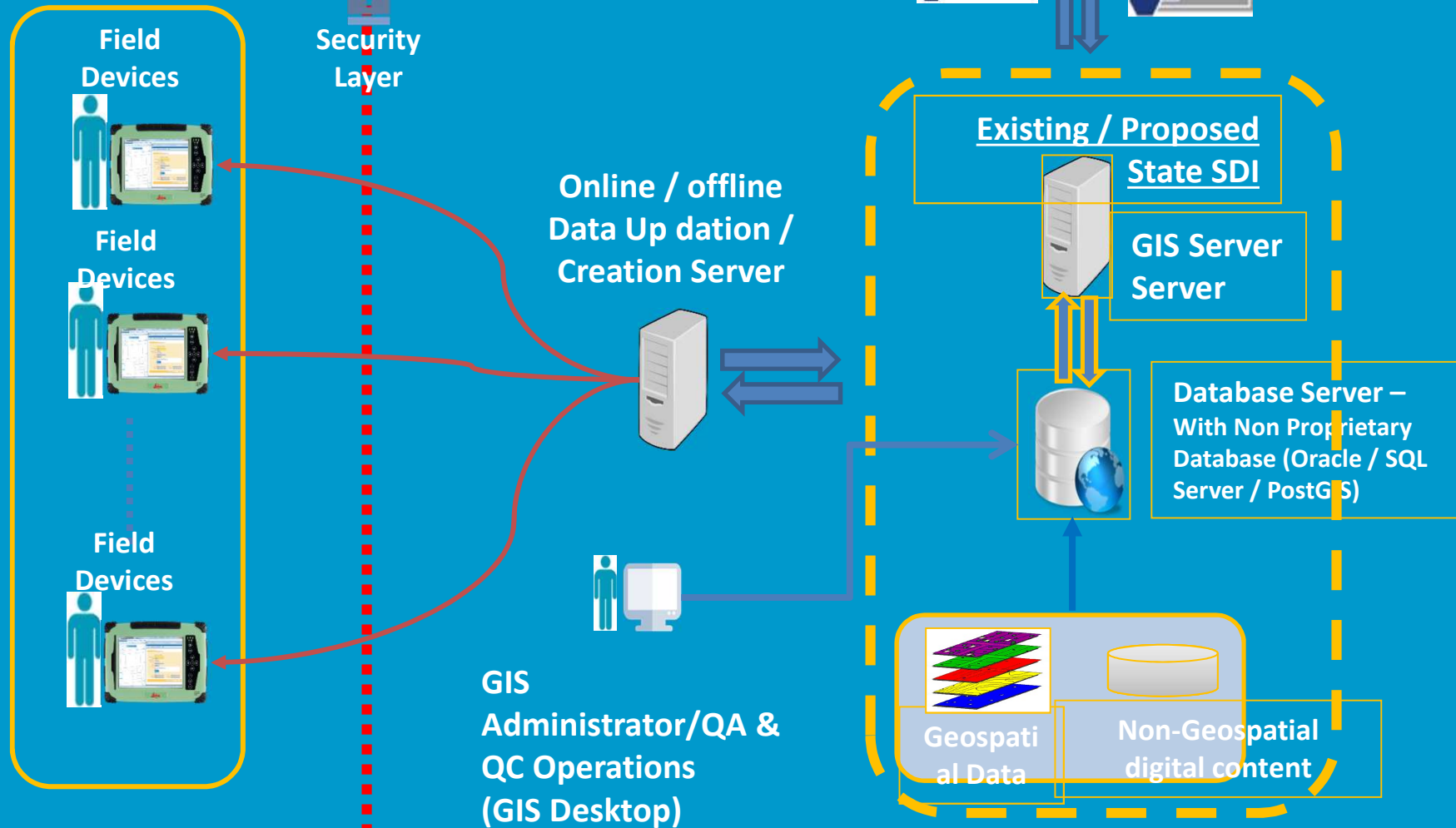
Biogas Report

# 7. Infrastructure requirement to maintain Spatial Data life Cycle

# State Infrastructure

Client System to update / collect field data in online and offline mode

## SDI Application / Clients



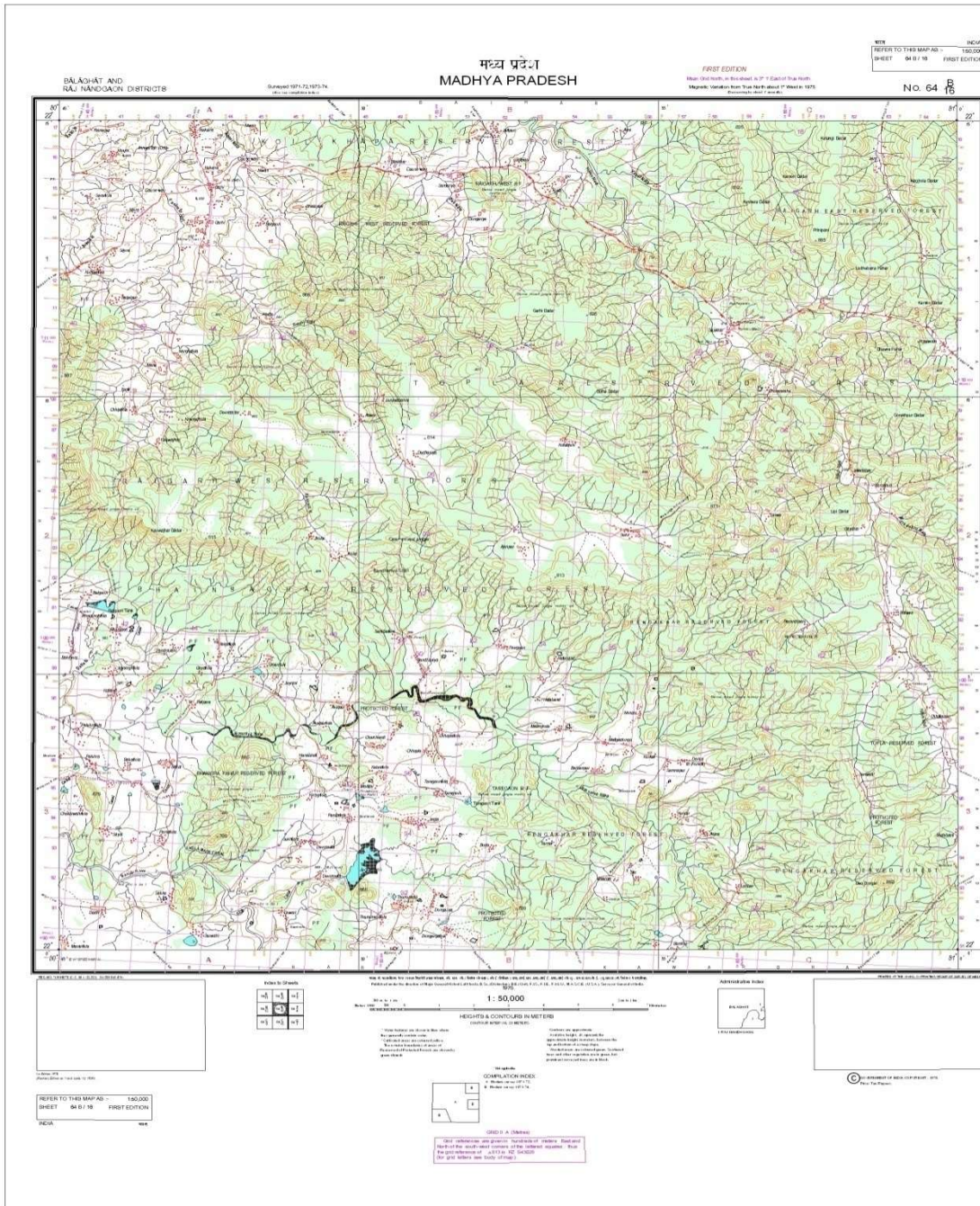
8. Assuring Quality of Data  
being served to the  
users/applications



# Geospatial Quality Control

1. Geospatial professionals must be empanelled for 3<sup>rd</sup> party certification of data quality.
2. There must be different category of professionals registered and maintained in laying with authorized medical attendant.
3. Legal provision and code of conduct of the professionals may be defined and notify by state Govt.
4. Support of different professional bodies like Institution of Engineers/ Institution of Surveyors/ ISG/INCA may be explored.

# 9. Representation of spatial Data in different scales



# Polyconic MAP Scale 1:50,000



# Indian Open Source Map Layout (1:50,000 Scale)

Google Earth Pro

File Edit View Tools Add Help

Search

Search

ext: NYC

Get Directions History

Places

- My Places
  - Sightseeing Tour
    - Make sure 3D Buildings layer is checked
  - SOI\_OSM\_GRID
  - Temporary Places
    - SOI\_OSM\_GRID

Layers

- Primary Database
  - Borders and Labels
  - Places
  - Photos
  - Roads
  - 3D Buildings
  - Ocean
  - Weather
  - Gallery
  - Global Awareness
  - More
  - Terrain

Arabian Sea

Bay of Bengal

Andaman Sea

US Dept of State Geographer  
© 2018 Google  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Image Landsat, Copernicus

Imagery Date: 12/14/2015 18°27'03.33" N 78°29'38.01" E elev 1386 ft eye alt 1995.07 mi

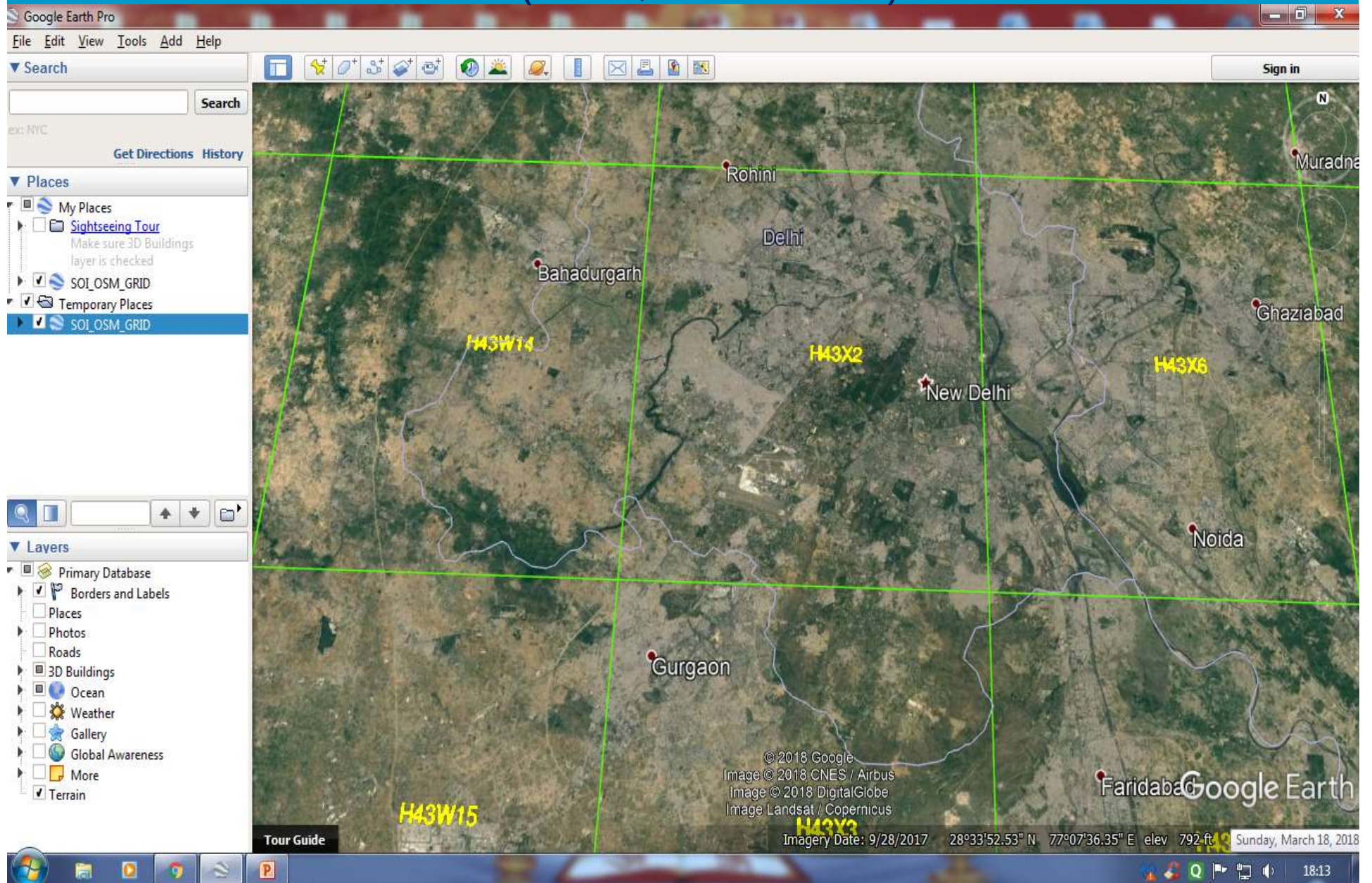
Google Earth

Tour Guide

18:09



# Open Source Maps Around Delhi (1:50,000 Scale)









8 mm

(Centrally) Spz 10R (2.5 mm)

### CONVENTIONAL SYMBOLS

Express Highway with toll with bridge with distance stone . . .			
Roads, metalled according to importance . . . . .			
Roads, double carriageway according to importance . . . . .			
Unmetalled road, Cart-track, Pock-track with pass, Foot path . . . . .			
Streams with back in bed undefined, Canal . . . . .			
Dams; masonry or rock-filled; earthwork, Weir . . . . .			
River: dry with water channel; with island & rocks, Tidal river . . . . .			
Submerged rocks, Shoal, Swamp, Reeds . . . . .			
Wells: lined; unlined, Tube-well, Spring, Tankat permanent; dry . . . . .			
Embankments road or rail; tank, Broken ground . . . . .			
Railways, broad gauge; double; single with station under constrn . . . . .			
Railways, other gauges; double; single with distance stone; do . . . . .			
Mineral line or tramway, Min. Cutting with tunnel . . . . .			
Contours with sub-features, Rocky slopes, Cliffs . . . . .			
Sand features (Tidal) (Sand-hills (permanent), (Sand-dunes) (ring) . . . . .			
Towns or Villages: Inhabited; deserted, Fort . . . . .			
Huts: permanent; temporary, Tower, Antiquities . . . . .			
Temple, Chhatra, Church, Mosque, Gopur, Tomb, Graves . . . . .			
Lighthouse, Lightship, Buoy: lighted; unlighted, Anchorage . . . . .			
Mine, Vine on hills, Grass, Scrub . . . . .			
Palms; palm-yrac; other: Plantain, Coffee, Bamboo, Other trees . . . . .			
Areas cultivated; wooded, Surveyed tree . . . . .			
Boundary, International . . . . .			
- state demarcated; undemarcated . . . . .			
- district; sub-division, taluk or tehsil; forest . . . . .			
- Pillars: surveyed; unlocated; village junction . . . . .			
Height, triangulation station; point approximate . . . . .			
Bench-marks geodetic; tertiary; canal . . . . .			
Post office, Telegraph office, Overhead tank . . . . .			
Rest house or inspection bungalow, Circuit house, Police station . . . . .			
Camping ground, Forests reserved; protected . . . . .			
Spaced names administrative; locality or tribal . . . . .			
Hospital, Dispensary, Veterinary hospital . . . . .			
Aerodrome, Helipad, Tourist site . . . . .			
Power line with pylons surveyed; with poles unsurveyed . . . . .			



**Thank You**