



India **SMART UTILITY** Week 2025

18 - 22 March 2025

New Delhi

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India Smart Grid Forum

ISUW 2025
11th Edition of
India Smart Utility Week,
An International Conference
and Exhibition on
Smart Energy and Smart Mobility

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WORKSHOP ON IMMERSIVE TECHNOLOGIES:
**AR/VR, DIGITAL TWINS, DRONES & ASSISTED REALITY FOR
ENHANCED OPERATIONS & EFFICIENCY**

**Enhancing Power Utility
Management with 3D Digital Twin
based Asset Management and
Inspection**

Dr. Aniruddha Roy
Chief Technology Officer
Genesys International Corporation Ltd
New Delhi

New Delhi | 21 March 2025

Flow of Presentation

- About Genesys
- Power Utility Asset Management Framework
- 3D Digital Twin and Maturity Model
- Usage of Aerial and Terrestrial Systems
- Value Proposition and Benefits

About Genesys



ISO/IEC 27001:2013

Who are we?

- India's largest Geospatial Survey and Mapping company
- Pioneer in Aerial and Terrestrial LiDAR services in India
- India's first company to generate Digital Twin of top 50 cities on licensing Model through "Content program"
- Developed Geospatial Platforms for Enterprise Application
 - (iStreetVision and OysterDT.ai)
- Undertaken major Geospatial Mapping Projects across the Globe - Middle East, Africa, North America, Europe & Asia Pacific.

- MoU signed in 2023 with **Survey of India** (National Mapping agency), Department of Science and Technology, Govt of India for Pan India Digital Twin Mapping for various mission mode projects.



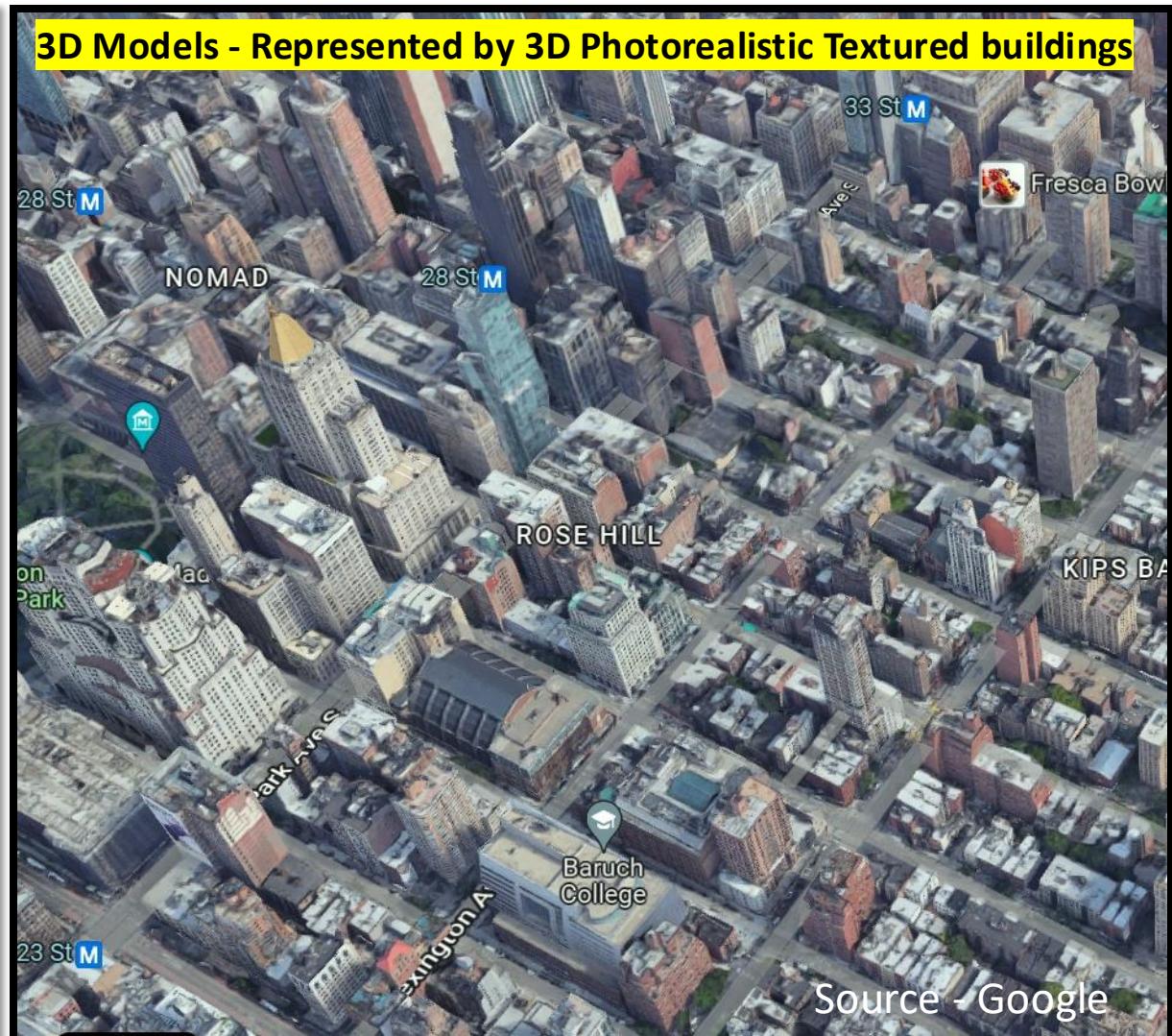
Real world representation

2D Maps Vs 3D Models

2D Maps - Represented by Points, lines and polygons



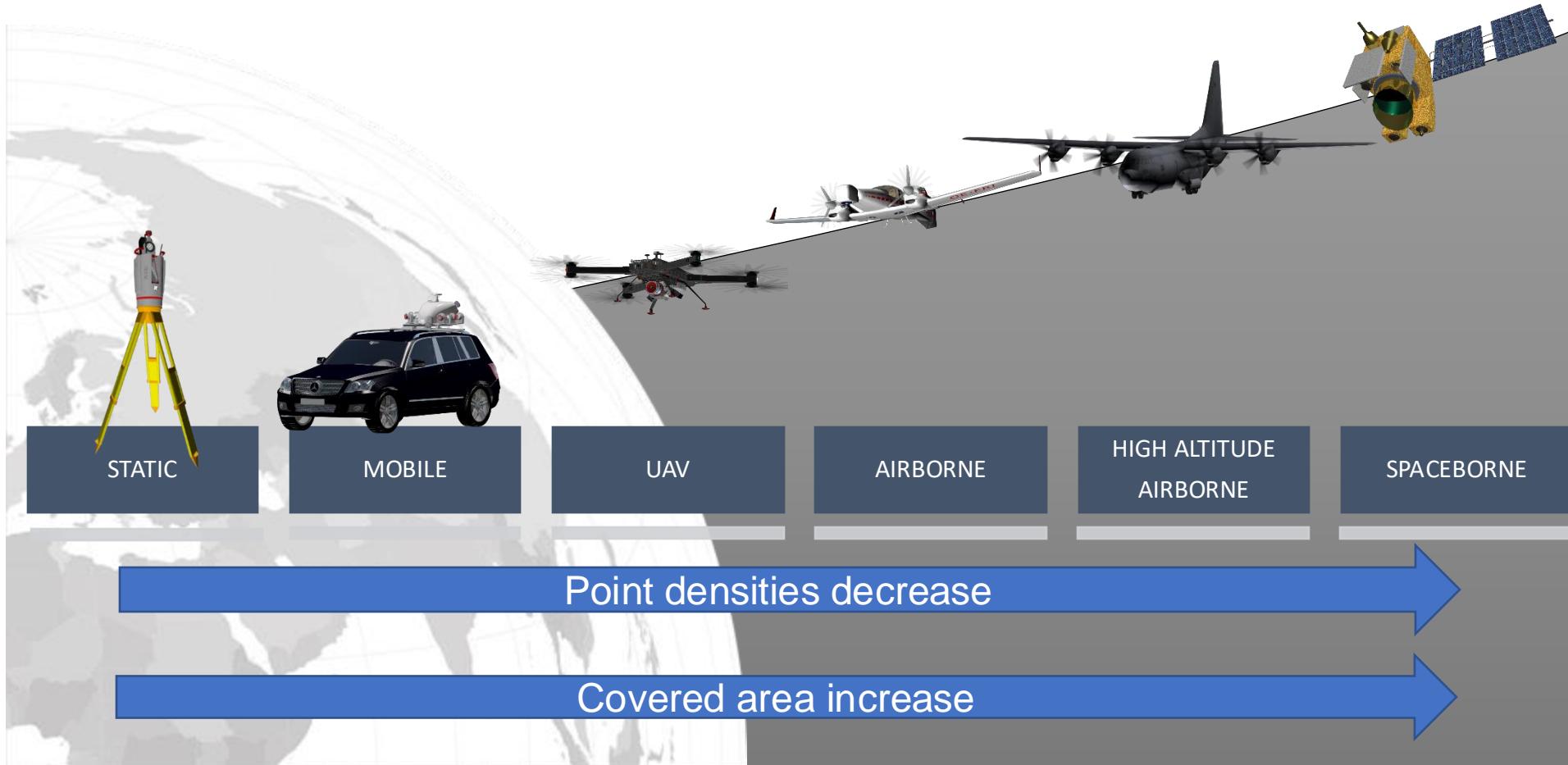
3D Models - Represented by 3D Photorealistic Textured buildings



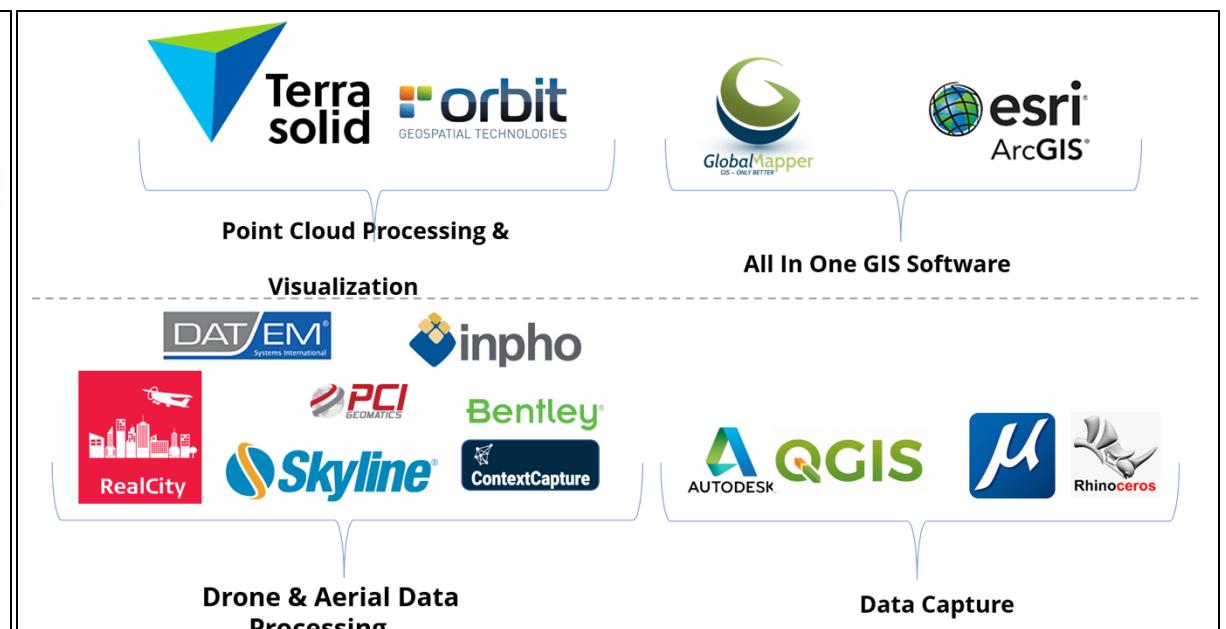
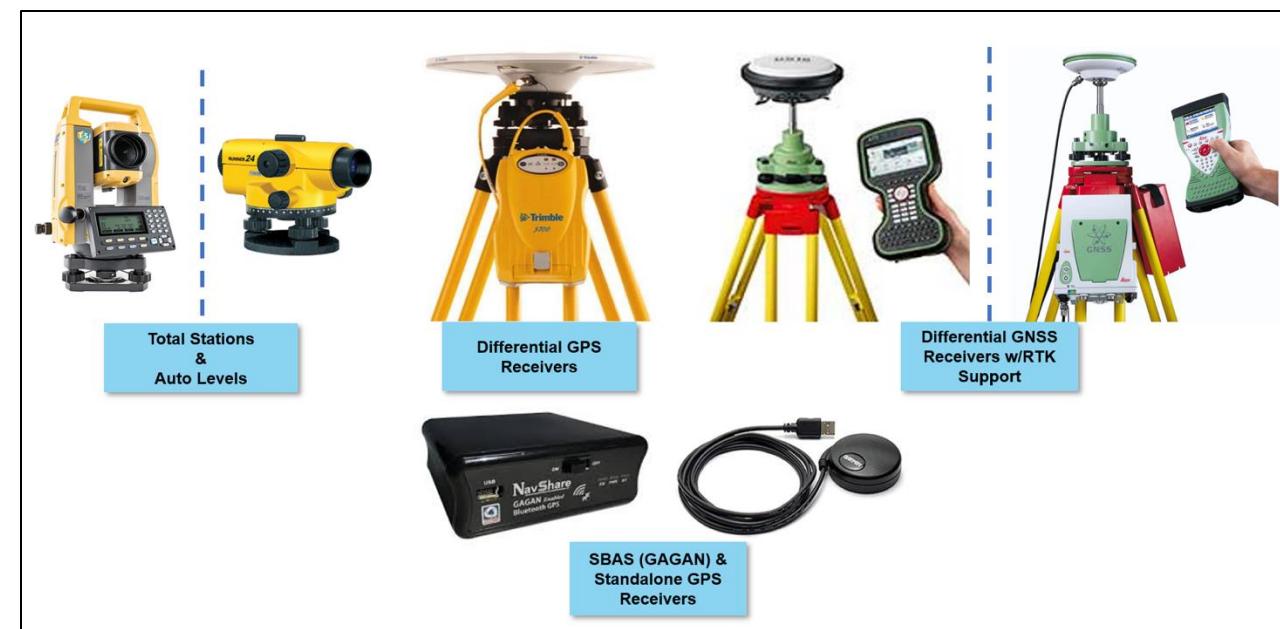
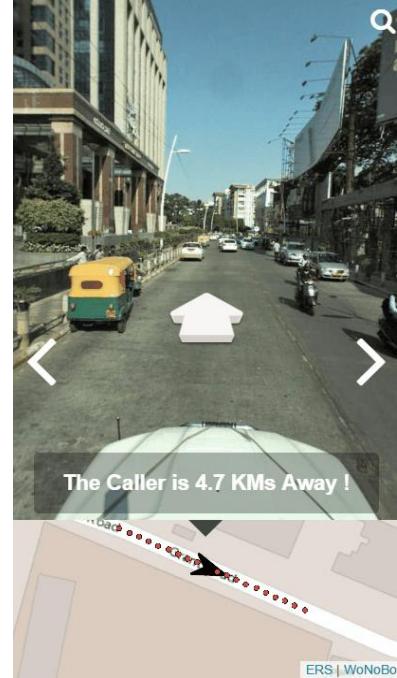
Source - Google

Data Acquisition Platforms

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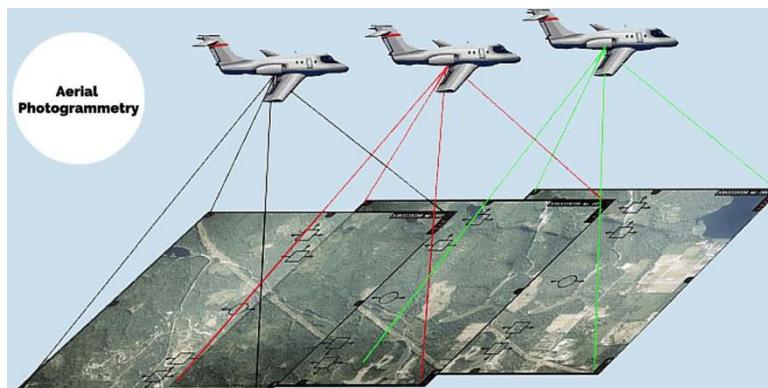
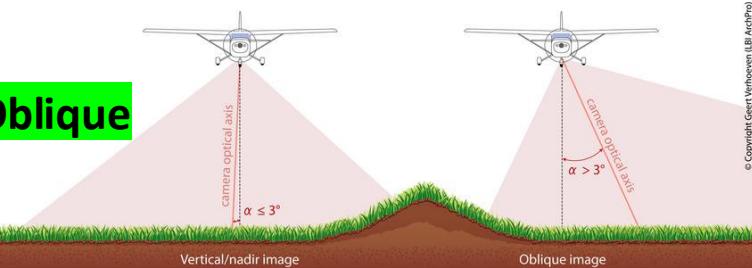
Largest range of aerial,
mobile & terrestrial sensors
in India



Data Acquisition | LiDAR & Optical Sensors |

Top View

Vertical and Oblique



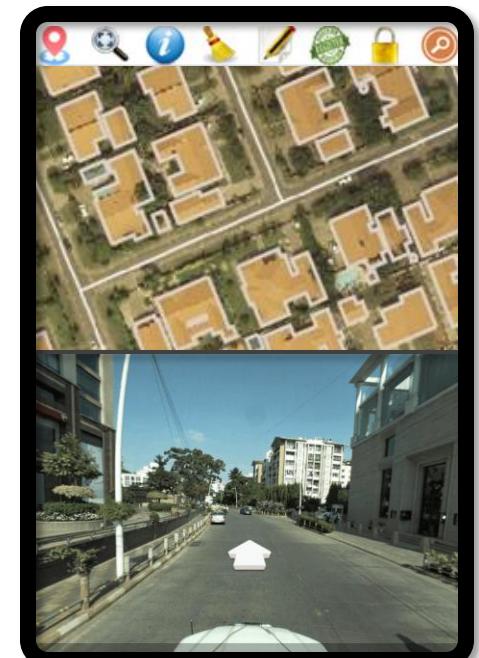
Ground View



Narrow lanes



Motorable roads



Power Utility Asset Management Framework

Genesys' Utilities Asset Management Framework

GENESYS

Who we serve



TRANSMISSION UTILITIES



DISTRIBUTION UTILITIES

Asset Service



Asset Inspection
(Survey & Data Capture)



Asset Modelling
(Vector Models)



Asset Health
(Fault Detection & Prediction)



Vegetation ,
Encroachment, ROW
Management



GIS Updates
(Conflation and As-built Updates)

Assets we cater



Transmission
Towers



Transmission
Lines



Distribution
Poles



Distribution
Lines



Transformers



Substations



Wind Turbines



Solar Farms

Our E2E Services

Survey

Data Processing

Reporting

AI & ML Solution

Managed Services



Pre-Construction Phase

ROW & Line Planning

- Accurate Terrain Mapping
- Tree Height, clearance, Density Mapping, Canopy Analysis
- Obstacle Detection and Clearance
- Helpful in Design – Compatible to PLS CAD
- Efficient Route Planning
- Quantifying Material
- Enhanced Safety and Risk Assessment
- Improved Cost Estimation
- Reduces the need for on-site surveys



Construction Phase

As-Built Inspection

- Optimal Placement of Towers or Poles
- Compliance with Safety Regulations and Mitigates the Risk of Contact between Power Lines
- Visualizing as-built conditions
- Vegetation management



Operations and Maintenance

Asset Inspection & Condition Monitoring

- Drone based Patrols
- Visual Inspection
- Thermal & LiDAR based data collection and analysis.
- Asset Health Condition assessment
- Vegetation & Encroachment management
- Line clearance and outage prevention
- Data-driven asset management
- Enhanced worker safety

Tower

- Frame Inspection
- Tower foot lose-soil analysis
- Corrosion
- Missing Member
- Missing Nut-bolts
- Lattice Crack
- Nests
- Tower Base Inspection
- Earth Wire Junction
- Oxidation Analysis
- Salt Deposits

Jumpers & Insulators

- Insulator clamp inspection
- Lose Jumper Inspection
- Jumper Joints
- Grading Rings
- Cracks and polluted insulators
- Insulation Chipping
- Insulation Indentation

Overhead Lines

- Conductor Strand Inspection
- Wire surface damage
- Spacer Inspection
- Conductor Clearance
- Vegetation Management
- Encroachment
- Sag & Sway

Inspection Technologies

Visual

Thermal

LiDAR

Operations & Maintenance: Overhead Lines and Asset Inspection Services

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Tower Frame



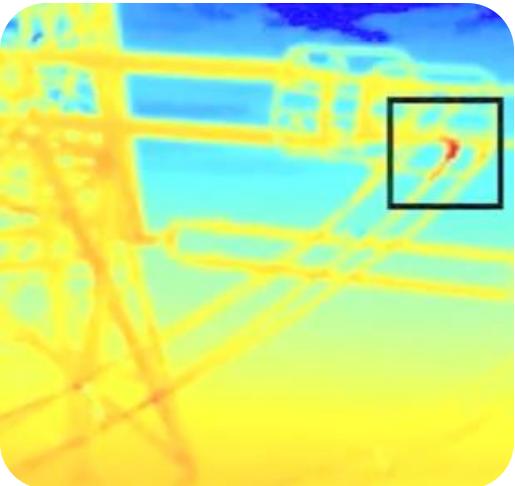
Insulator Cracks



Missing Nut-bolt



High Res Close Inspection



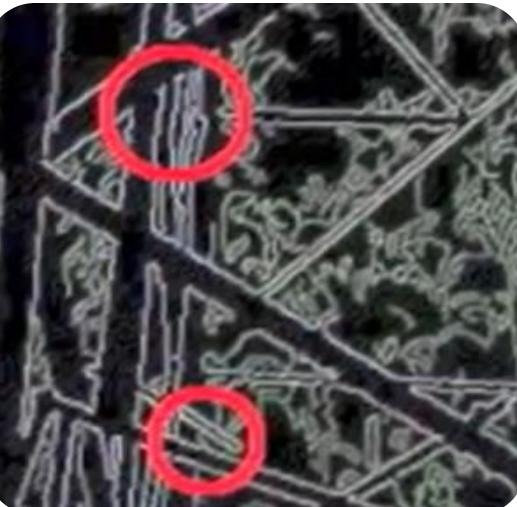
Thermal Abnormality



Broken Insulator



Conductor Strand



Lattice Crack

3D Digital Twin and Maturity Models

DIGITAL TWIN

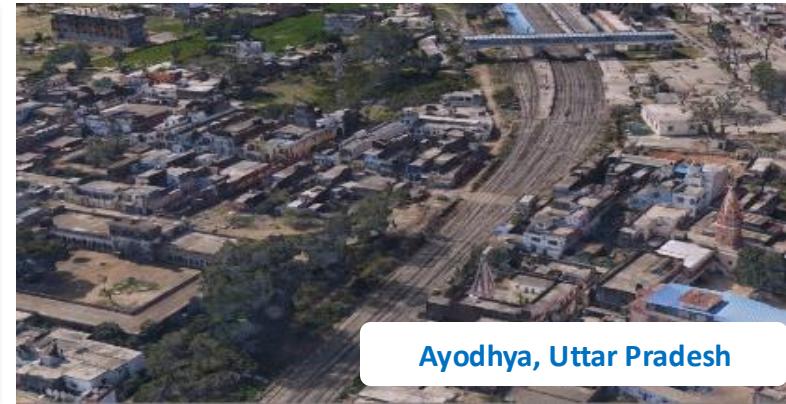
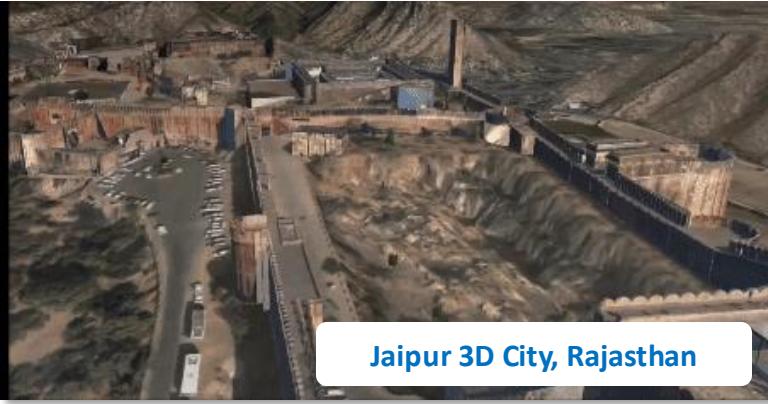
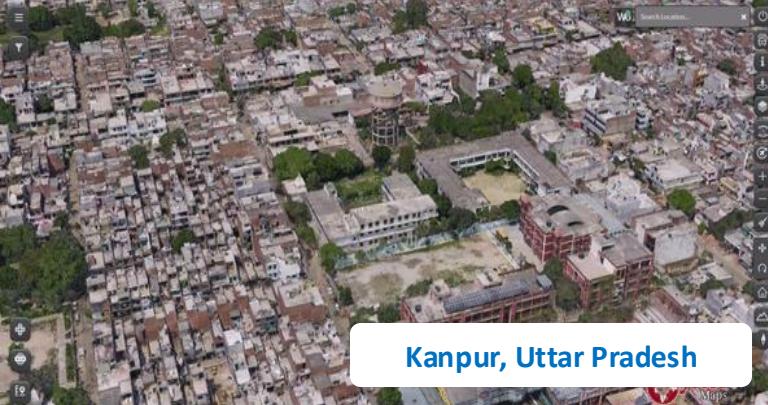
A Digital Twin is a **Virtual Accurate Geometric Representation** of the real world, including physical objects, processes, relationships, and behaviours

3D GIS

ADDS DEPTH & DIMENSION

Genesys Digital Twin Experience

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Digital Twins

Maturity Model

Real-Time and
Predictive
Digital Twins

05



PREDICTIVE TWIN

04



AUTONOMOUS TWIN

03



INTERACTIVE TWIN

02



INFORMATIVE TWIN

01



GEOMETRIC TWIN

Virtual Asset
Digital Twins



Digital Twins
Maturity Model

Real-Time and
Predictive
Digital Twins

05



PREDICTIVE TWIN

- Physics-Based Modelling
- Real-Time 'What-If' Scenario
- Predictive Analysis
- Recommended Actions

04



AUTONOMOUS TWIN

- Artificial Intelligence for:
 - Data Analytics
 - Change Detection (Temporal Analysis)

03



INTERACTIVE TWIN

- Sensors and IoT (CCTV, AWS, Smart Pole etc.)
- Data Modification at Asset Level
- AR/VR/MR
- Connect Data Using API Microservices

02



INFORMATIVE TWIN

- Attribute Linking/ Joining
- Document and Media Integration
- Search and Query Tools

01



GEOMETRIC TWIN

- Real World Visual Replica
- Accurate 3D Geometrical Model
- Platform Agnostic Datasets
- (Unreal Engine and NVIDIA Omniverse
ESRI, Bentley, AutoDesk, Cesium, Open Source, etc.)

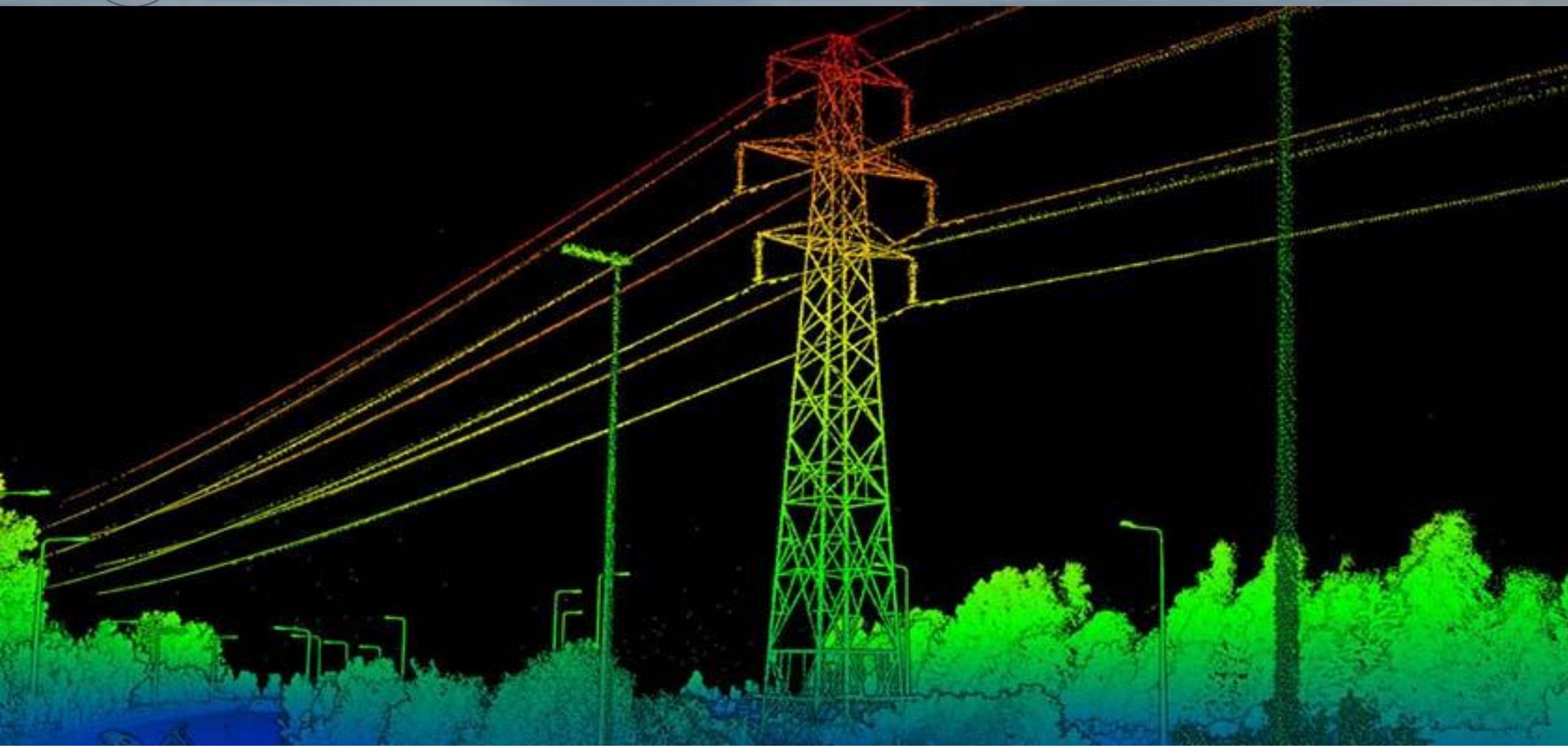
Virtual Asset
Digital Twins



01

GEOMETRIC TWIN

GENESYS



02

INFORMATIVE TWIN

Contents



Drawing Order

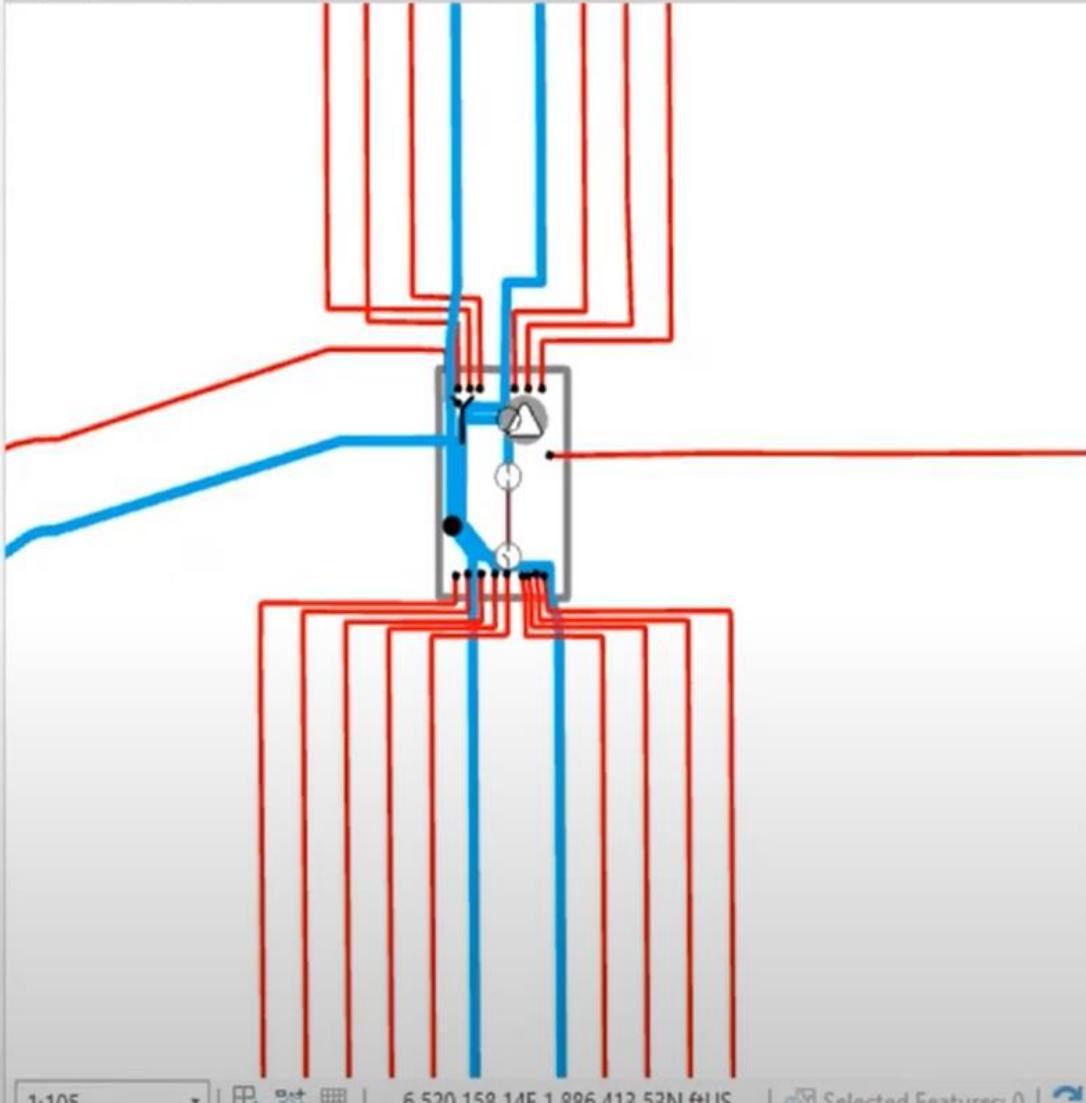
3D Layers

3D_AOI

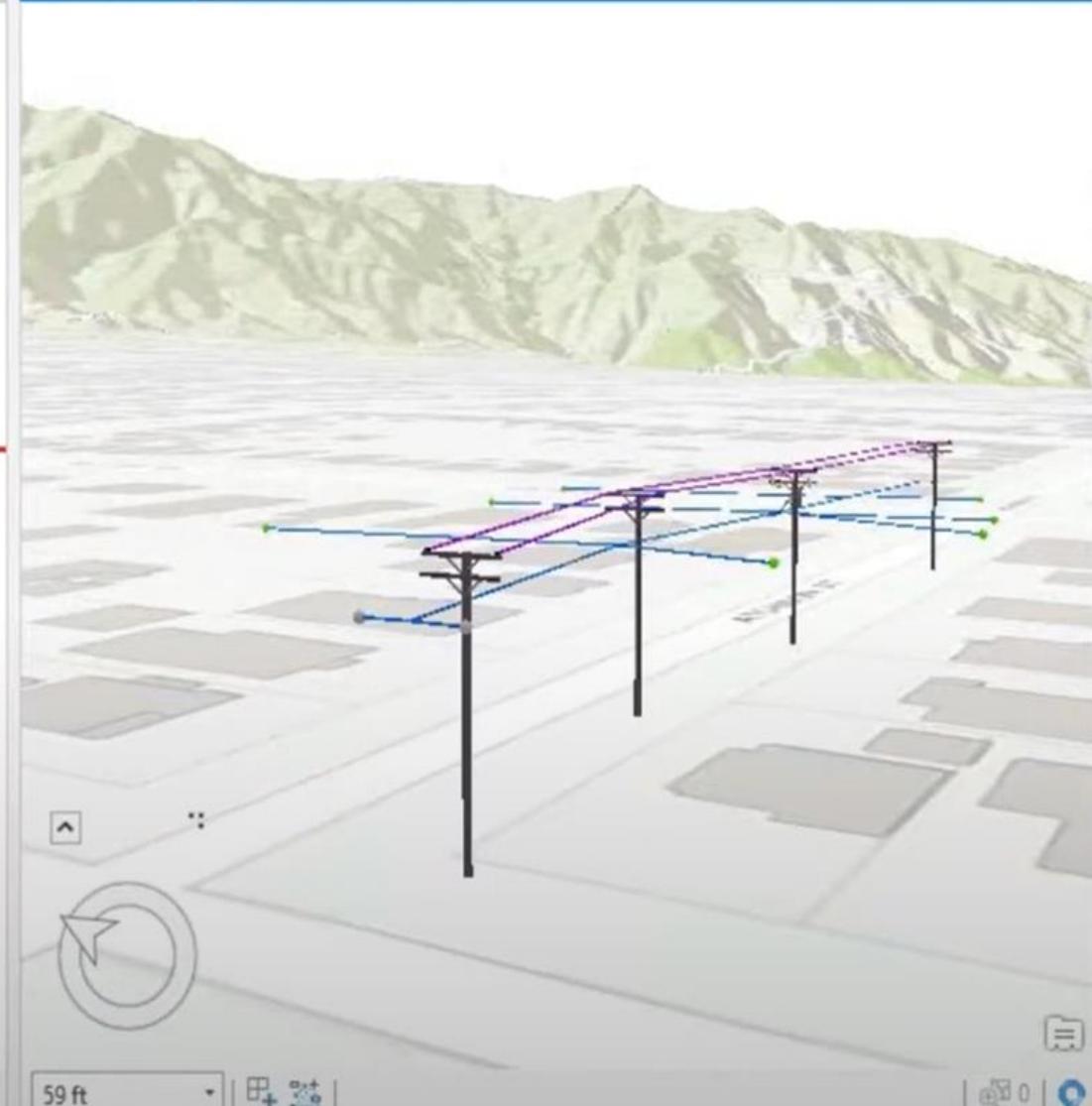
- ElectricLine - OH
- ElectricDevice - Fuse
- ElectricDevice - Trans
- Pole
- Vault
- Conduit Section
- ElectricLine - UG
- ElectricJunction
- StructureJunction
- ElectricAssembly
- StructureLine
- StructureBoundary
- AOI_Rest

2D Layers

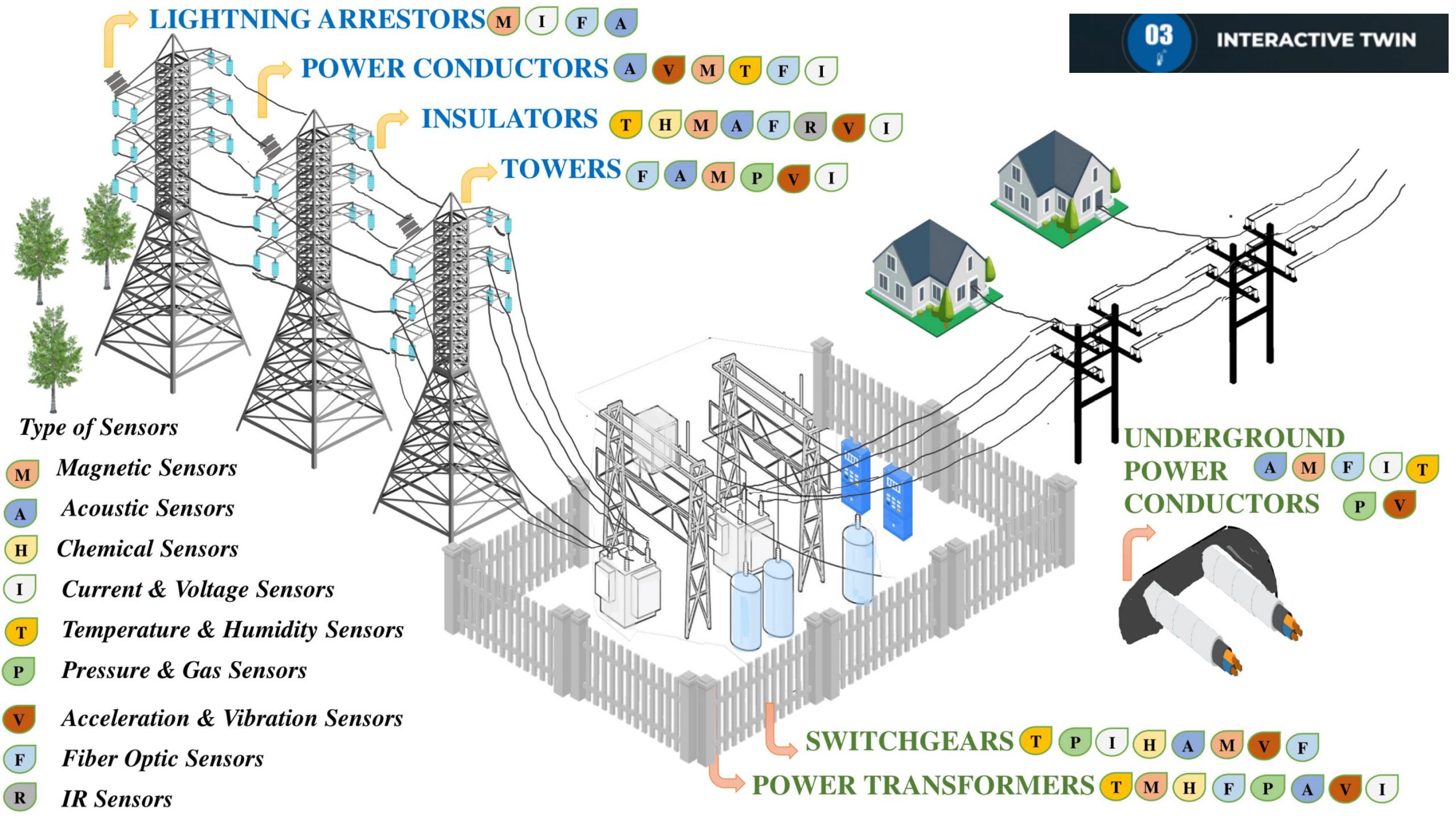
Map 2D X



Map 3D X



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04

AUTONOMOUS TWIN



above encroachment site 2

Source - AAM

05

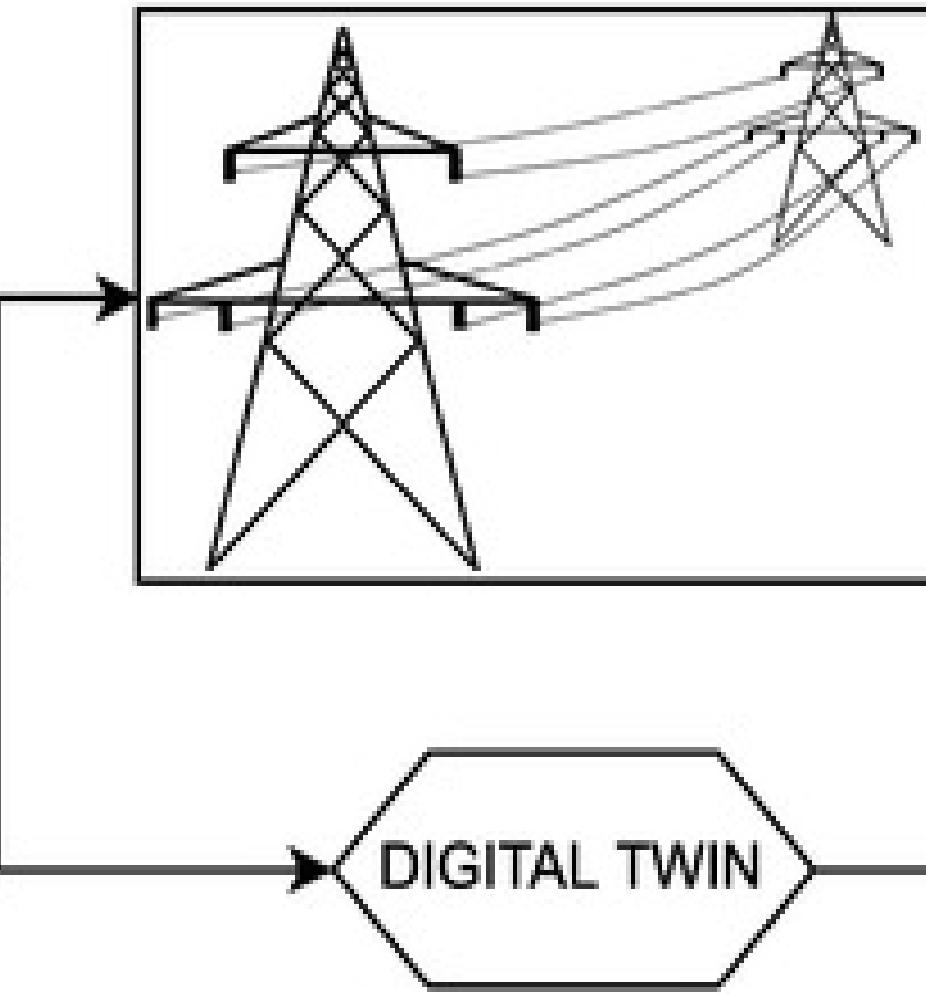
PREDICTIVE TWIN

GENESYS

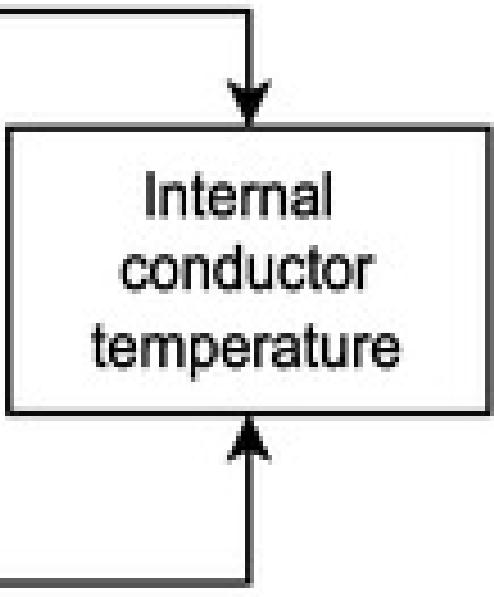
Computational Fluid Dynamics
CFD 3D based Dispersion Model

INPUTS

Air temperature
Sun irradiance
Wind direction
Line current
...



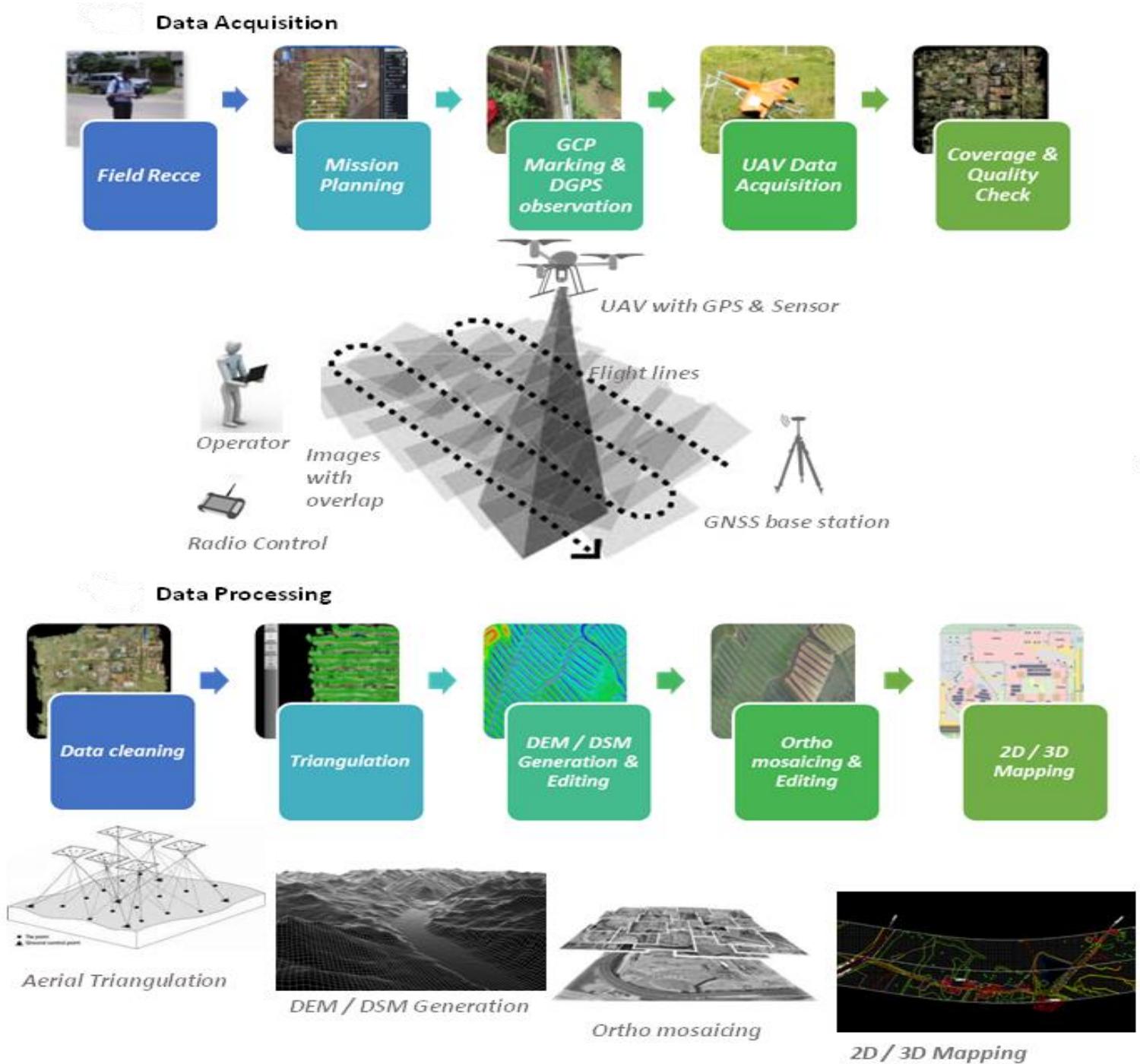
OUTPUTS

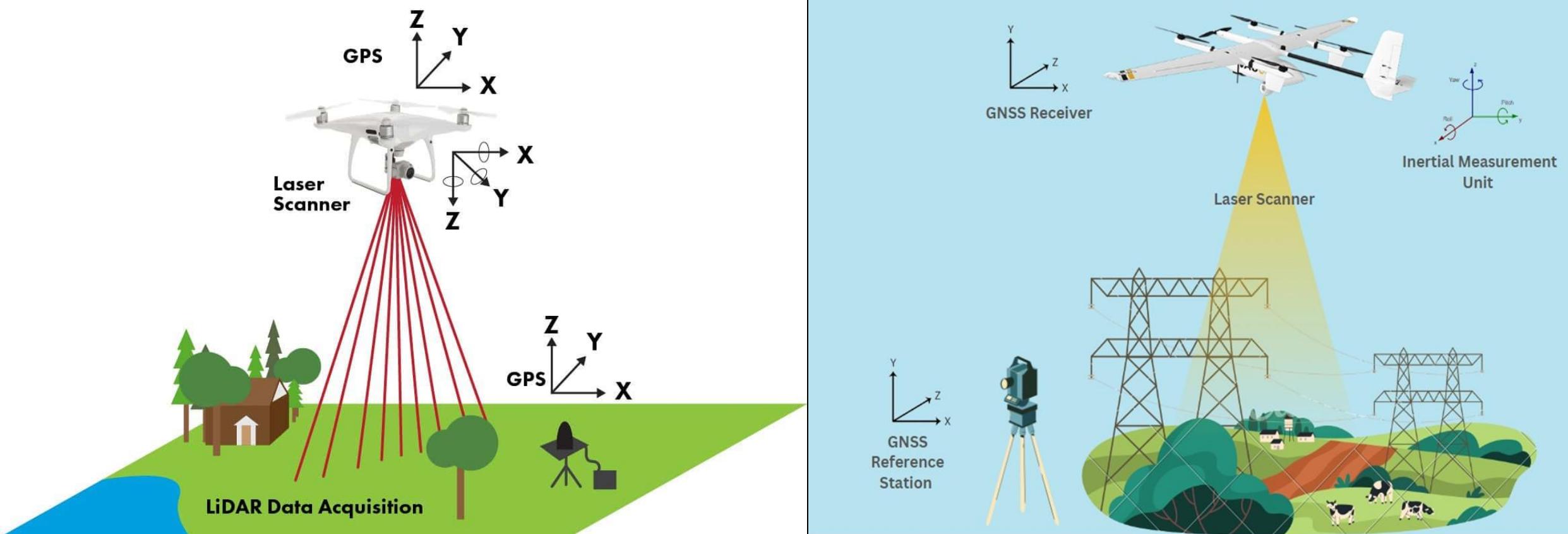


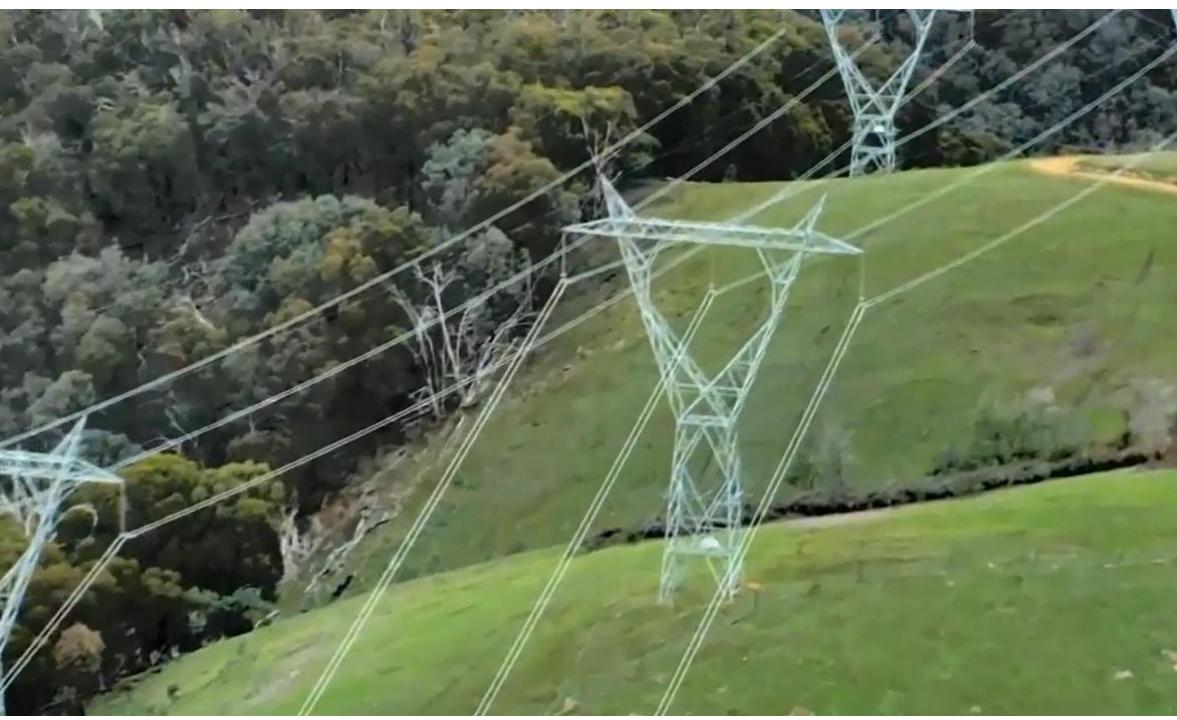
Aerial and Terrestrial Surveys

Aerial/UAV Surveys

- Digital Elevation Model
- 0.5 meter contour
- Topographic Map
- Cross section and long sections as mutually agreed intervals
- 3D View of entire stretch
- Ortho photo







Source - AAM



TREE

Counts and growth predictions

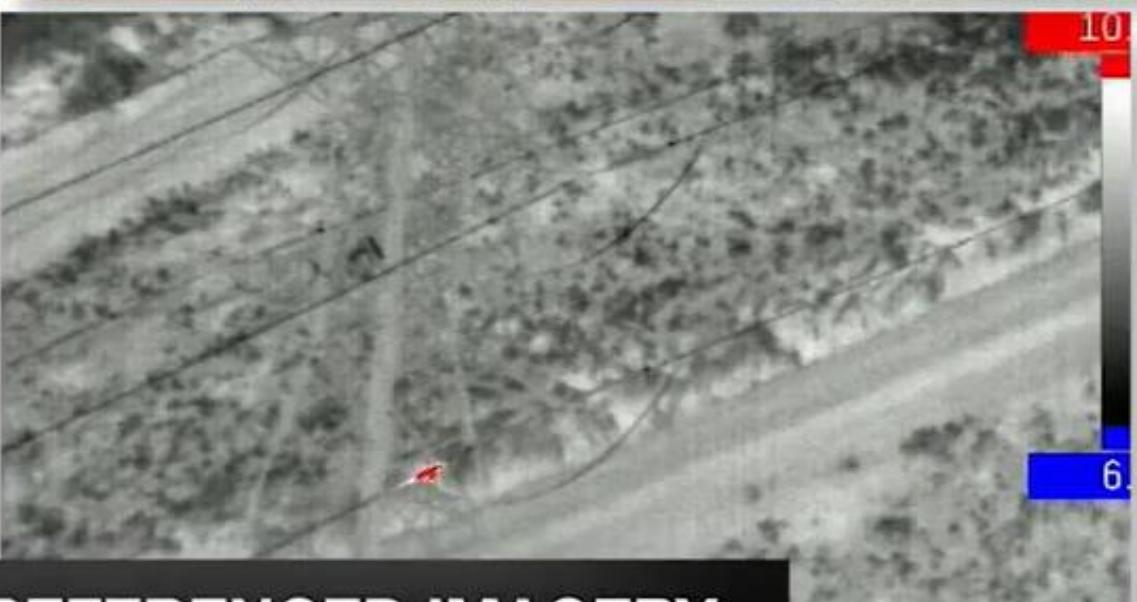
Transmission Lines



LiDAR

point clouds map conductors

Source - AAM



GEOREFERENCED IMAGERY

Video, stills, IR and UV

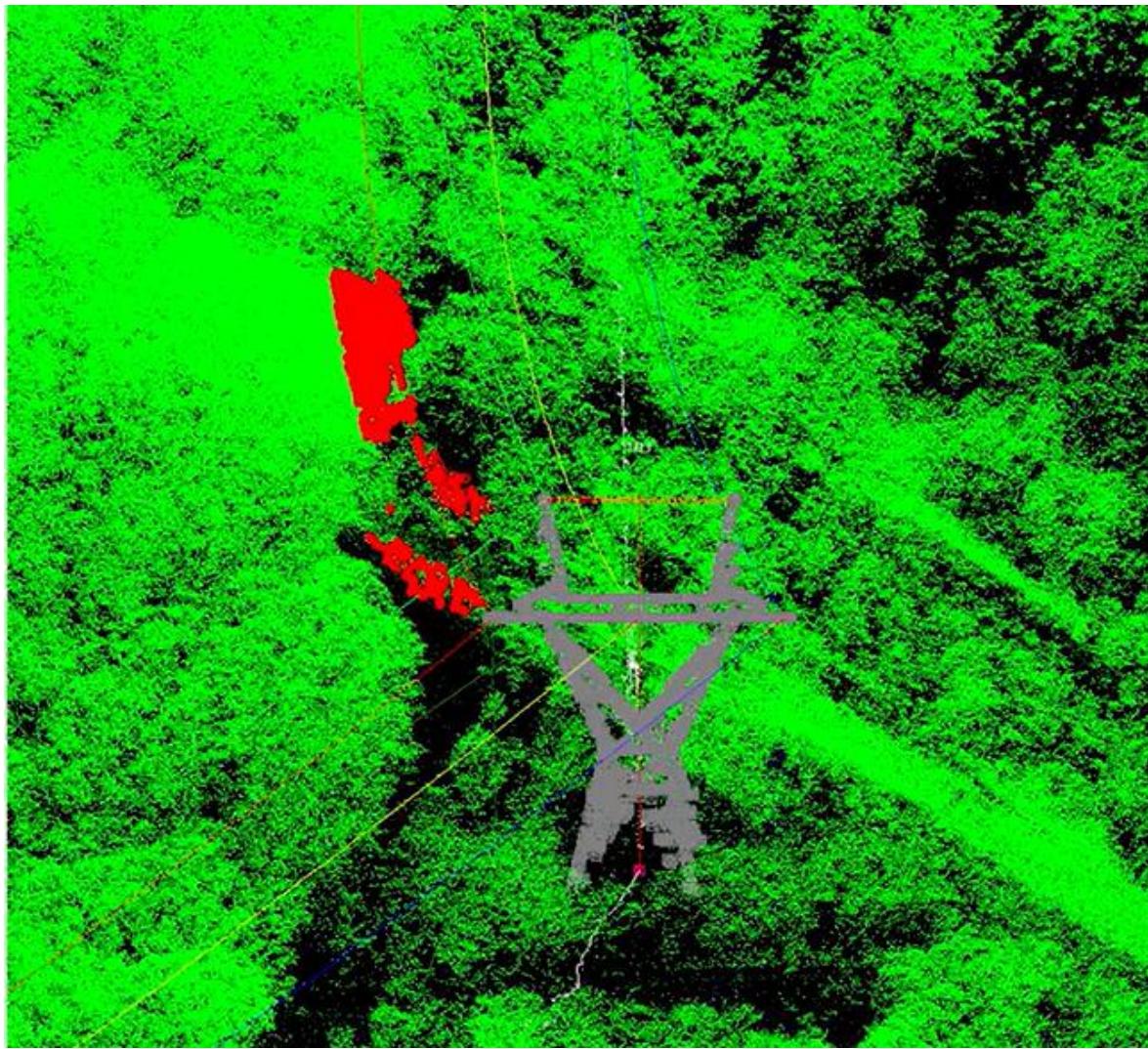
Source - AAM



HIGH DEFINITION

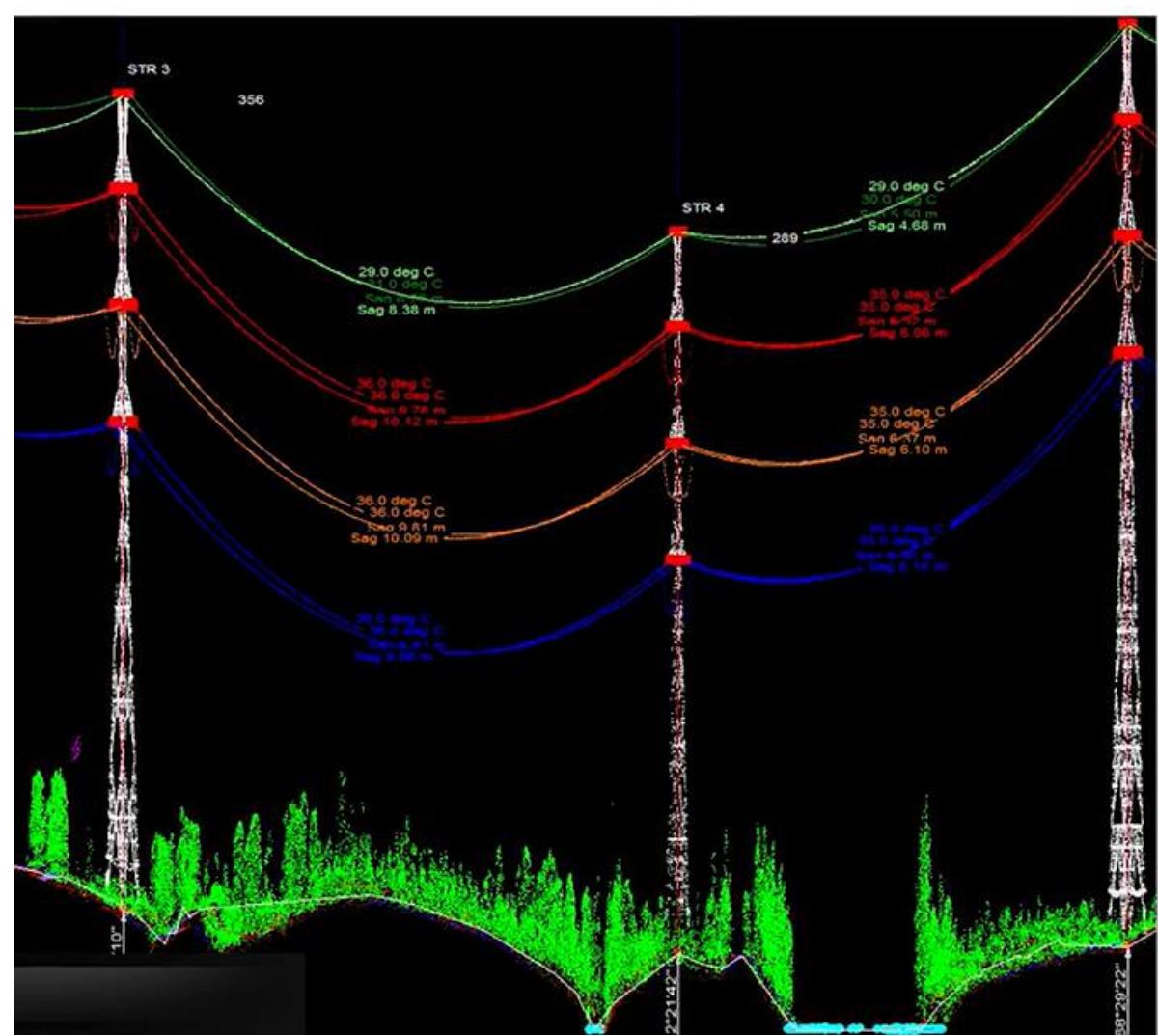
Imagery

Source - AAM



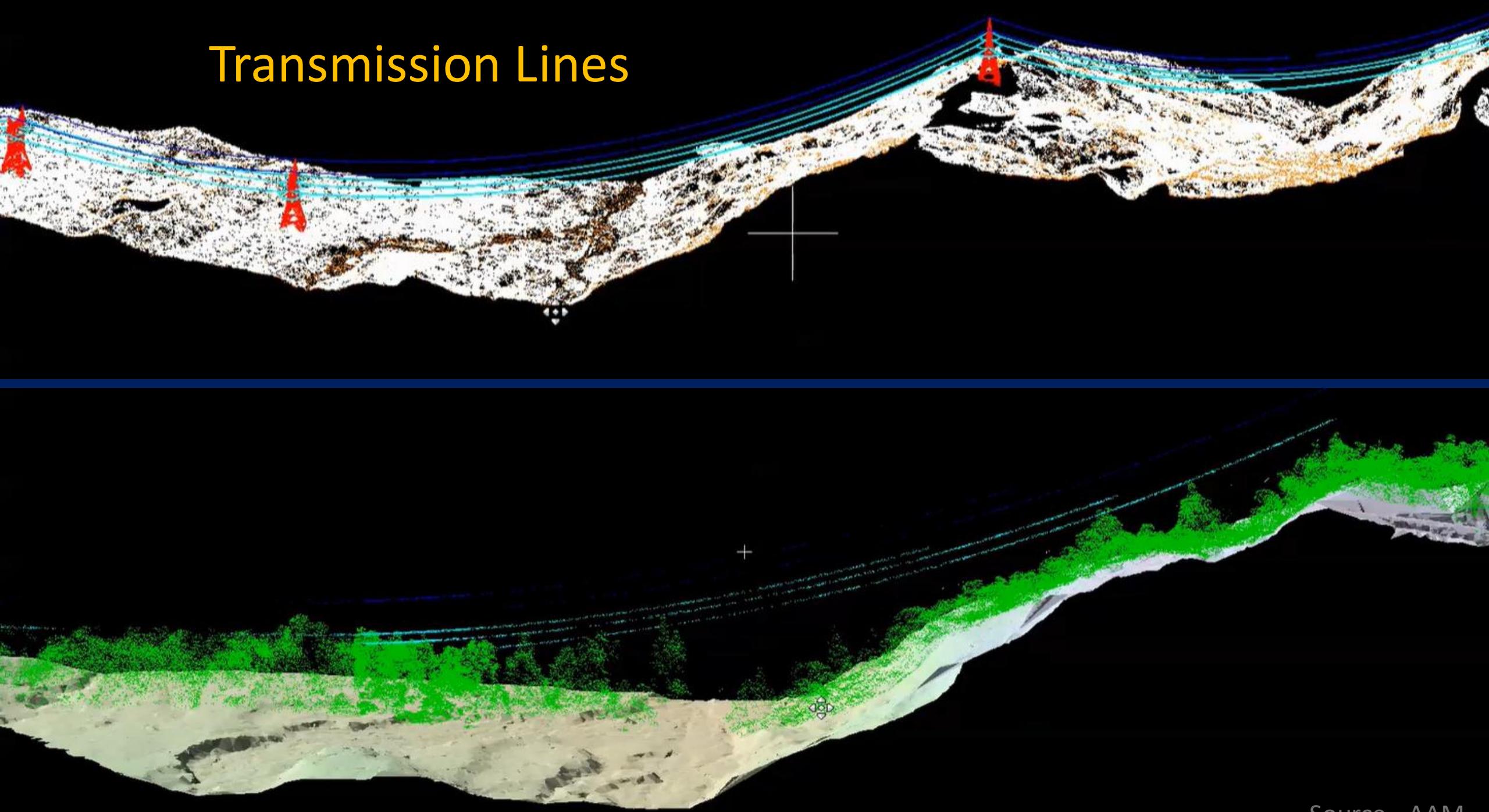
PLS CADD

models



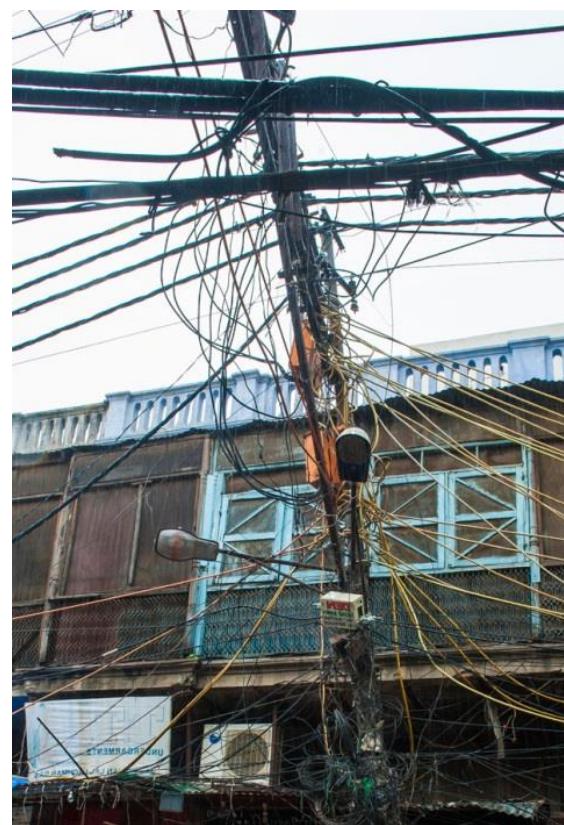
Source - AAM

Transmission Lines



Source - AAM

Distribution Lines - Complex electrical overhead network on ground





Distribution Line Asset Inspection

Mobile LiDAR:

Mobile LiDAR (Light Detection and Ranging) technology is most modern method of scanning and data collection. It is an active remote sensing method that uses a laser to measure ranges (variable distances) to the surrounding environment. When the laser is combined with GPS and Inertial Navigation System (INS) data, a precise dimension, shape and location on Earth is generated in 3D.

Mobile LiDAR Applications:

- ❖ The collected data and point cloud, basic measurements (distance, area, height) can be made with high precision
- ❖ Precise coordinate data can be obtained from points
- ❖ Information on city objects can be extracted
- ❖ All infrastructure elements are shown in coordinates
- ❖ Illegal structures can be detected
- ❖ Objects such as signs, poles, traffic signs on or on the roadside can be measured and their compliance with the standards can be checked.

Case Study - Scope Of Work

GENESYS

The main scope of this study is to perform the below mentioned analysis to identify major impact on electric assets and network by vegetation encroachment, in addition, it will find GIS gap analysis with previous temporal dataset.

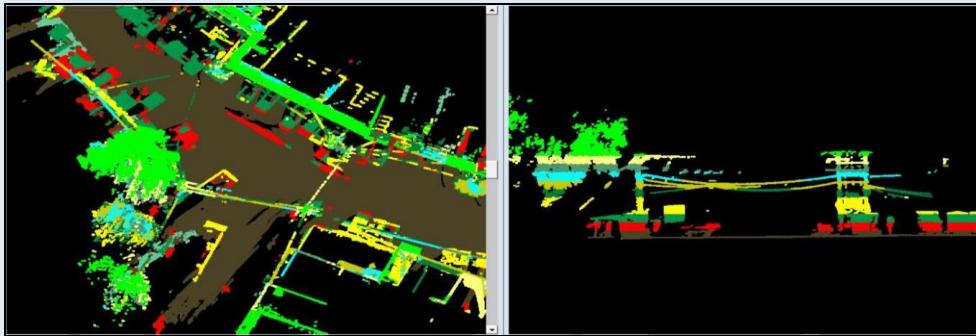
1. Vegetation clearance
2. Ground clearance
3. The vertical clearance from Building
4. Bare or insulated conductor
5. Identification of multiple feeders on a pole
6. Messiness on pole
7. Infrastructure safety
8. Total time consumed
9. Gap in GIS(comparison of existing data with data provided by TATA)

Case Study – Vegetation Management for an Indian Utility

GENESYS



Panoramic 360 View

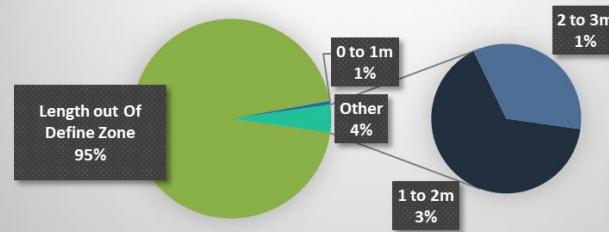


Point Cloud by Elevation View

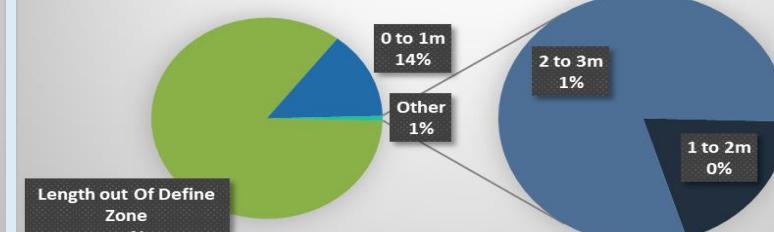


Reports &
Solution
Delivered

Vegetation clearance with reference to Bare Conductor



Vegetation clearance with reference to Insulated Cable



Vegetation clearance with reference to Transformer



Building Clearance



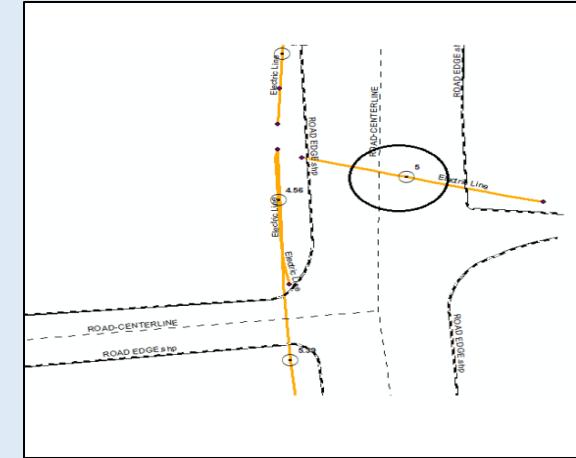
Case Study – Vegetation Management for an Indian Utility

GENESYS



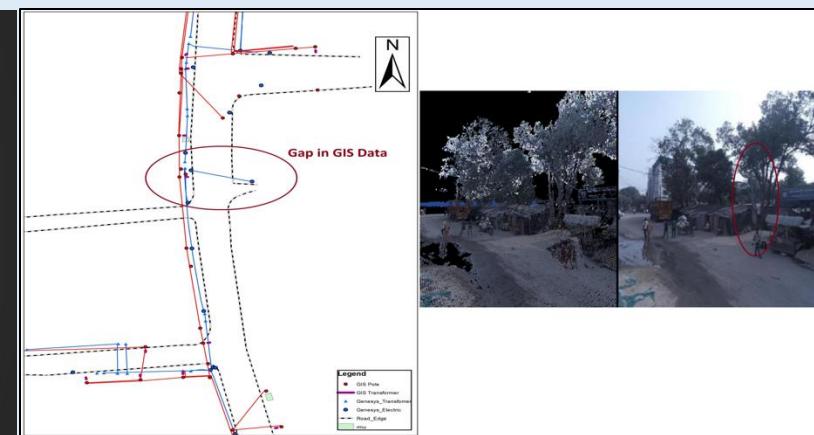
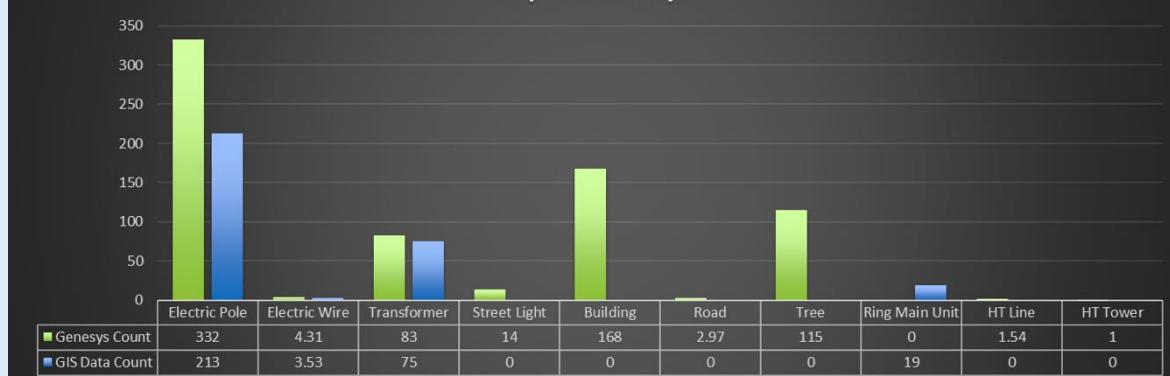
Reports &
Solution
Delivered

Ground Clearance



Temporal Analysis of Electric Network & Assets Data

Temporal Analysis



3D Base Map

GENESYS



- ❖ Electrical Network Base with all required Attribute field with dynamic real time interface was created
- ❖ Generated 2D/3D Models
- ❖ GIS Analysis crucial to find out most critical zones where Vegetation and other unwanted encroachment happened near electric Network

Value Proposition and Benefits

Genesys Value Proposition

Scale

Ability to handle large volume of image processing and hundreds of KMs of LiDAR data processing on daily and weekly basis.

Technology

Ability to ingest Visual/RGB, Thermal and LiDAR data from all industry standard sensors and equipment, Aerial, Drone, Terrestrial etc.

Domain Expertise

Team of experts, with experience on Utilities domain as well as technology platforms.

AI-ML Platform

AI-ML platform has ability to detect various objects and conditions on transmission towers.

System Integration

OGC Compliant APIs to integrate with CRM, SAP, WFM and other systems to automate the processes.

Summary

- For Power Transmission and Distribution lines inspection and Asset management, aerial and Terrestrial surveys helps in acquisition of High accuracy datasets – 2D and 3D
- For 3D Digital Twin generation accurate geometric Models are important with all related attributes
- AI-ML platform has ability to detect various objects and conditions on transmission towers.
- The real time sensor feedback is of paramount important followed by visualisation in AR/ VR environment.
- Genesys has Geometric Twin of 50 cities of India to jump start any related project.

THANK YOU

Genesys International Corporation Limited

73-A, SDF III, SEEPZ – SEZ, Andheri (E), Mumbai 400 096
Maharashtra, India

Ph. No: +91 22 4488 4488 | Fax: +91 22 4488 4499
sales@igenesys.com | www.igenesys.com

Kshemendra Chaturvedi
Sr VP, Utilities,
Genesys International Corp Ltd.
+91 9811976232
Kshemendra.Chaturvedi@igenesys.com

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