AEGIST: Applications of Enterprise GIS in Transportation
TRB-2025

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January 2025

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Disclaimer: Information in this deck is subject to change during the AEGIST Project (2019 – 2024)

About AEGIST

Transportation Pooled Fund (TPF) program

- FHWA Office of Planning and Safety
- States DOTs Participating: 18; Engaged 5
  - » Completed Implementation Projects: 6 States
  - » Active Implementation Projects: 7 States
- Local Agencies and NG911 Stakeholders in California, Pennsylvania
- National Programs: EDC-6 Digital As-Builts, BIM for Infrastructure (TPF5-480)
- Standard Development Organizations: buildingSMART and OGC
- Industry Consultants
- Software Vendors

Legend
PFS State
Engaged State
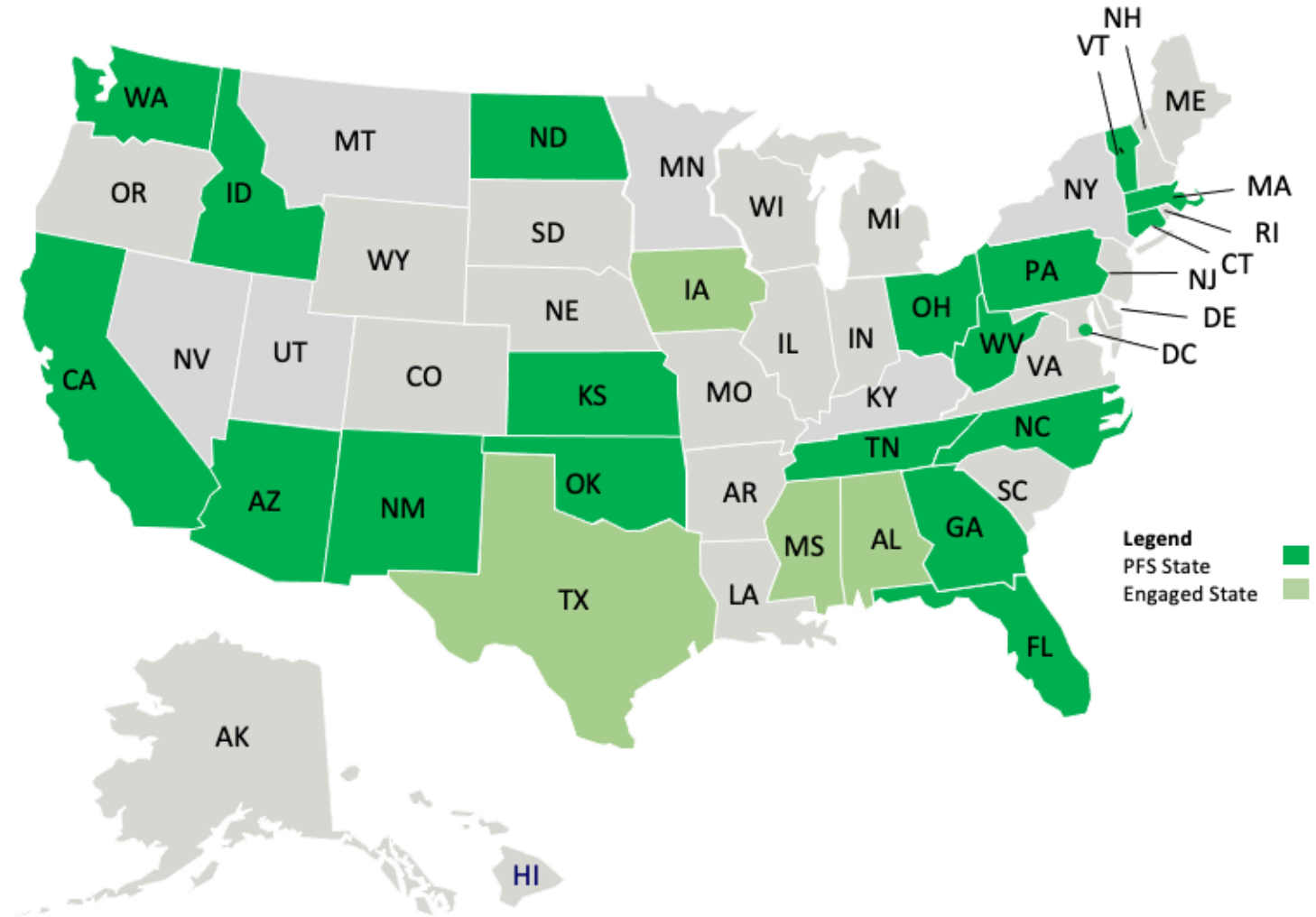
Why AEGIST?

Enabling Data Offices/Councils & Geospatial Information System Units at State DOTs to meet Agency Performance Goals and Objectives of Business Units at their Agencies

Project Planning & Programming

Project Selection & Evaluation	Highway Economic Requirements Analysis	Statewide Transportation Improvement Program

Asset Management

(Operations and Maintenance)

Pavement Life Cycle Plan	Bridge Life Cycle Plan	Maintenance Work Management
Emergency Response	Asset Inventory & Routine Inspection Operations	

Data Office, Data Governance Council, Data Analytics Unit
Information Technology (IT) Unit,
Geospatial Information Systems (GIS) Unit

Design & Construction: Digital Delivery

Preliminary Planning & Scoping	Asset Information Models for Preliminary Design, Traffic and Structural Analysis	Construction Management

Traffic and Safety

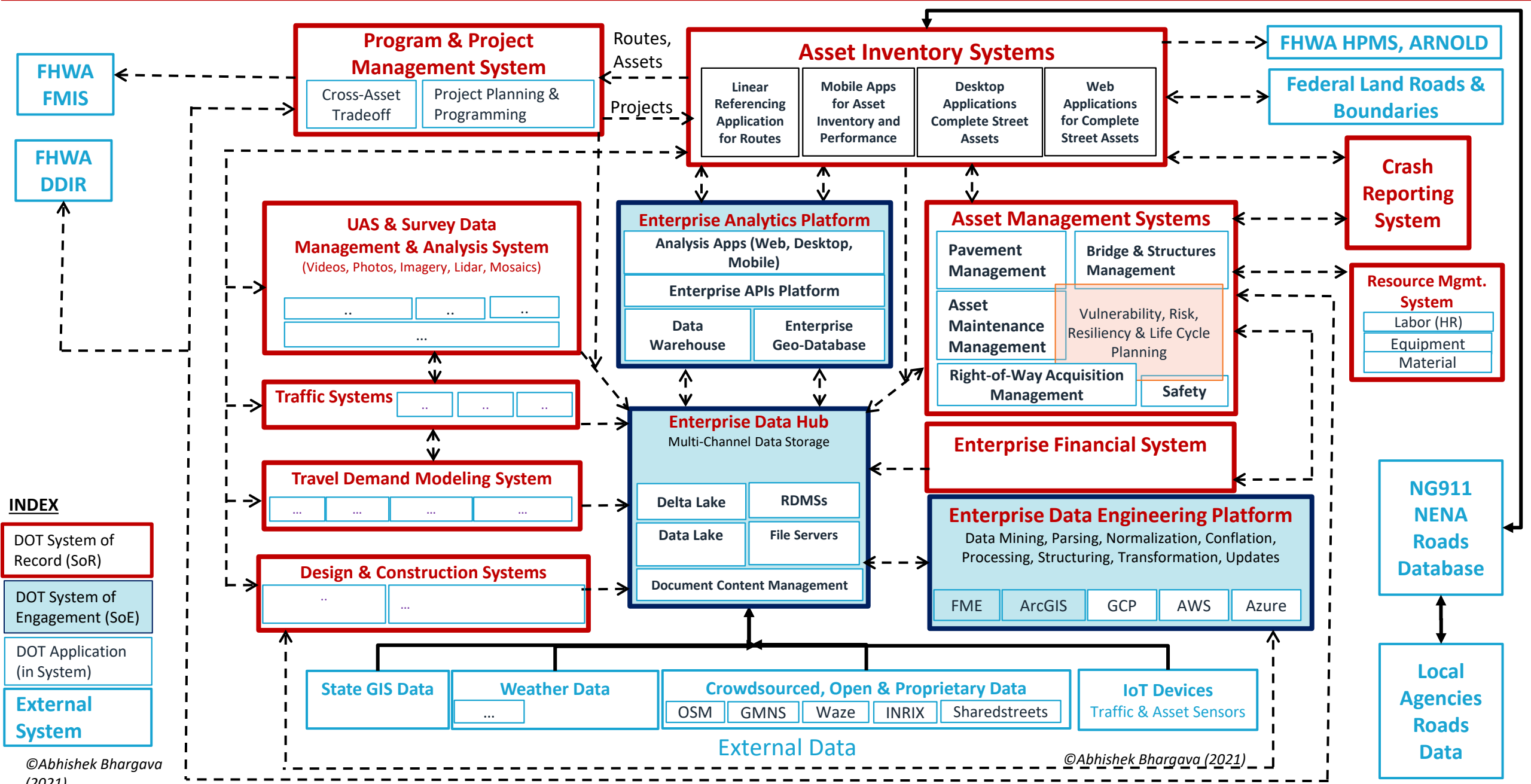|		
Travel Demand Modeling	Highway Safety Analysis	Freight / Truck Routing
Congestion Management	Traffic Systems Operations and Management	

U.S. Department of Transportation
Federal Highway Administration

AEGIST Geospatial Data Management Systems and Applications

Program & Project Management System
- Cross-Asset Tradeoff
- Project Planning & Programming

Routes, Assets

Projects

FHWA FMIS

FHWA DDIR

Asset Inventory Systems
- Linear Referencing Application for Routes
- Mobile Apps for Asset Inventory and Performance
- Desktop Applications Complete Street Assets
- Web Applications for Complete Street Assets

FHWA HPMS, ARNOLD

Federal Land Roads & Boundaries

Crash Reporting System

UAS & Survey Data Management & Analysis System
(Videos, Photos, Imagery, Lidar, Mosaics)
- .. .. ..
- ...

Enterprise Analytics Platform
- Analysis Apps (Web, Desktop, Mobile)
- Enterprise APIs Platform
- Data Warehouse
- Enterprise Geo-Database

Asset Management Systems
- Pavement Management
- Bridge & Structures Management
- Asset Maintenance Management
- Vulnerability, Risk, Resiliency & Life Cycle Planning
- Right-of-Way Acquisition Management
- Safety

Resource Mgmt. System
- Labor (HR)
- Equipment
- Material

Traffic Systems
- .. .. ..

Enterprise Data Hub
Multi-Channel Data Storage
- Delta Lake
- RDMSs
- Data Lake
- File Servers
- Document Content Management

Enterprise Financial System

Travel Demand Modeling System
- ... ...

Enterprise Data Engineering Platform
Data Mining, Parsing, Normalization, Conflation, Processing, Structuring, Transformation, Updates
- FME
- ArcGIS
- GCP
- AWS
- Azure

NG911 NENA Roads Database

Design & Construction Systems
- .. ...

INDEX

- DOT System of Record (SoR)
- DOT System of Engagement (SoE)
- DOT Application (in System)
- External System

Local Agencies Roads Data

State GIS Data

Weather Data
- ...

Crowdsourced, Open & Proprietary Data
- OSM
- GMNS
- Waze
- INRIX
- Sharedstreets

IoT Devices
Traffic & Asset Sensors

External Data

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State DOT Technical Services Activities Summary

| Summary of Work Activities		Coordination Efforts
Connecticut DOT	(1) Road Network Data Quality Report Generation using FME (including HPMS Data) (2) Asset Information Requirements and Design to GIS Data Handoff from Digital As-Builts	
Idaho Transportation Department	(1) Spatial **Data Governance** Platform (Data Portfolio/Catalog; Data Engineering and Data Analytics) (2) DOT LRS Roads and Federal Land Roads Data Conflation Tool (Python-Based) (3) Strategic Roadmap for Geospatial Data Management	**FHWA BIM Projects:** BIM National Strategic Roadmap; Data Governance
Tennessee DOT	(1) Strategic Roadmap for Spatial Data Management and Governance at Enterprise Level (2) BIM-GIS Integration – Roadway Characteristics Data from Design/BIM Models to Geospatial Information Systems using Digital Twins and Building Information Modeling Tools-Techniques	**FHWA BIM Projects:** BIM National Strategic Roadmap; Data Governance
Caltrans	**(1) California Roads Sharing (CaRS):** Caltrans, CalOES, Local Agencies (NG-911, ARNOLD-HPMS Data)	**e911/NG-911, HPMS 9.0 MIRE, National Roads Pilot**
Pennsylvania	(1) Traffic Count Site Selection Using GIS (2) Geocoding Data Workflow Automation using Python-Based Geoprocessing Tool (3) Speed Limit Data Quality Review using Routes, Signs, Vertical-Horizontal Curves GIS Data **(4) Local Agency and DOT Roads Integration:** NG911 NENA Discussion and Data Exchange with DOT **(5) Data Governance** for PennDOT Assets: Traffic & Safety, Projects, (6) Building Information Modeling: Building Spatial Digital Twins with Data from Multiple Systems	**e911/NG-911, HPMS 9.0 MIRE, National Roads Pilot**

Ohio DOT	(1) Strategic Roadmap for Roads Data Administration using LRS: 10 Areas Identified, such as:
	   • Road Network Data Model for Travel Demand Modeling & Safety using DOT & Local Data
	   • **Complete Streets:** Bike Routes and Pedestrian Network
	   • HPMS 9.0-ARNOLD Rules Compliance, LRS-GIS Database Administration, Data Quality
	   • Open Standards Compliant, Machine Readable, Topological Road Network Data Model
		e911/NG-911, HPMS 9.0 MIRE, National Roads Pilot

State DOT Technical Services Activities Summary

| Summary of Work Activities		Coordination Efforts
Georgia DOT	(1) Road Network Data Supply Chain – Roadway Characteristics Data Collection with Local Agencies	**e911/NG-911, HPMS 9.0 MIRE, National Roads Pilot**
Massachusetts DOT	(1) Automated Intersection and Interchange Data Model for MIRE using LRS Routes and Structures	**ARNOLD, HPMS 9.0 MIRE, National Roads Pilot**
New Mexico DOT	(1) ALRS Review and Comparison with AEGIST Data Model (National Road Network- NRN Data Model) (2) Intersection Features Data Engineering and Modeling with Topology and Connectivity using Lidar and Open Street Maps (OSM) data.	**e911/NG-911, HPMS 9.0 MIRE, National Roads Pilot**
Washington State DOT	(1) Road Network Data Modeling in Linear Referencing Systems for Enterprise Use (2) Geospatial Database Modernization and Cloud-based Geospatial Data Management	**HPMS 9.0, MIRE, National Roads Network**
Florida DOT	(1) Intersection Features Data Engineering and Modeling with Topology and Connectivity: Open Standards Compliant, Machine Readable, Topological Road Network Data Model	**HPMS 9.0, MIRE, National Roads Network**
North Carolina DOT	(1) Linear Referencing System and Road Network Data Governance	**HPMS 9.0 National Roads Network**
Kansas DOT	(1) Intersection Features Data Engineering and Modeling with Topology and Connectivity (2) Lidar Data Integration into LRS-GIS System and Publication for use by Enterprise Systems.	**e911/NG-911, HPMS 9.0 MIRE, National Roads Network**
North Dakota	(1) Using Artificial Intelligence (AI) to process Lidar Data and extract Road Information	
Arizona DOT	(1) Intelligent Route Identifier Architecture for Enterprise Use	

Building Geospatial Road Network Model

Planning-Level Road Network Model

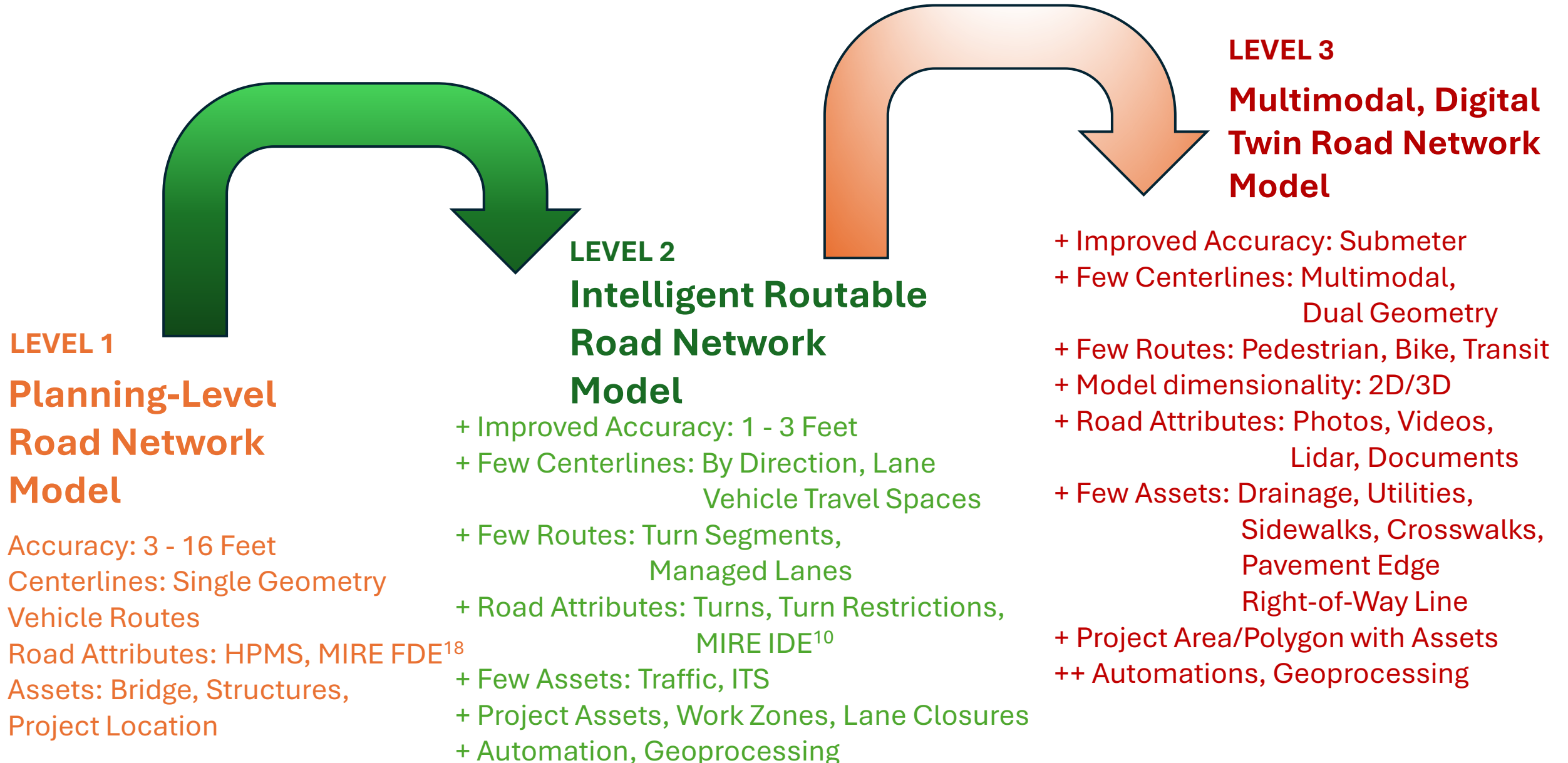**LEVEL 1**
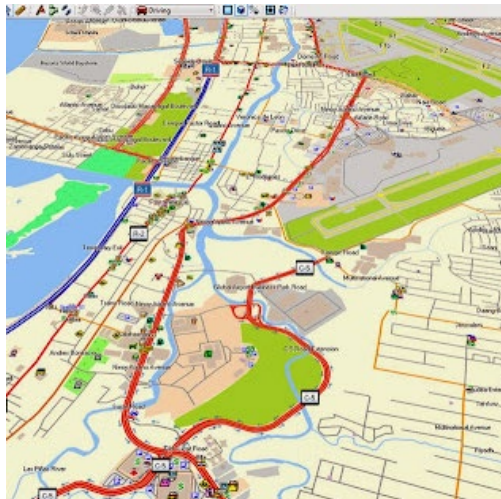
Intelligent Routable Road Network Model

LEVEL 2
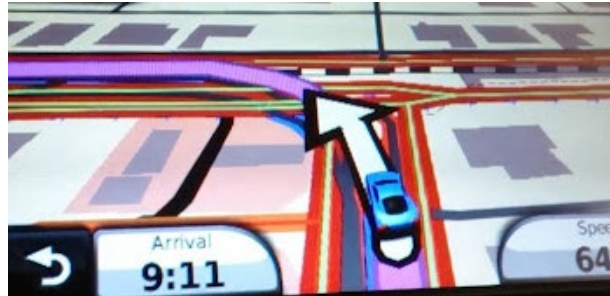
Multi-Dimensional Road Network Model

LEVEL 3

Building Geospatial Road Network Model

LEVEL 3

Multimodal, Digital Twin Road Network Model

+ Improved Accuracy: Submeter
+ Few Centerlines: Multimodal,
  Dual Geometry
+ Few Routes: Pedestrian, Bike, Transit
+ Model dimensionality: 2D/3D
+ Road Attributes: Photos, Videos,
  Lidar, Documents
+ Few Assets: Drainage, Utilities,
  Sidewalks, Crosswalks,
  Pavement Edge
  Right-of-Way Line
+ Project Area/Polygon with Assets
++ Automations, Geoprocessing

LEVEL 2

Intelligent Routable Road Network Model

+ Improved Accuracy: 1 - 3 Feet
+ Few Centerlines: By Direction, Lane
  Vehicle Travel Spaces
+ Few Routes: Turn Segments,
  Managed Lanes
+ Road Attributes: Turns, Turn Restrictions,
  MIRE IDE[10]
+ Few Assets: Traffic, ITS
+ Project Assets, Work Zones, Lane Closures
+ Automation, Geoprocessing

LEVEL 1

Planning-Level Road Network Model

Accuracy: 3 - 16 Feet
Centerlines: Single Geometry
Vehicle Routes
Road Attributes: HPMS, MIRE FDE[18]
Assets: Bridge, Structures,
Project Location

Level 1: Planning-Level Road Network Model
Business Processes and Uses

Processes	Use Cases in Category 1
Asset Management	1. Asset Inventory and Inspections Tracking 2. Maintenance work management
Traffic Management & Systems Operations	3. Traffic data mapping 4. Traffic Assets location tracking
Highway Safety Analysis	5. Vehicle Route Network Screening for Hotspot Identification
Project Planning and Programming	6. Capital projects mapping, scoring and prioritization for programming. 7. FMIS project mapping on the federal-aid roads in ARNOLD network. 8. Complete Streets: Assets Mapping & Level-of-Service Analysis
Travel Demand Modeling	9. Macroscopic Travel Demand Modeling 10. Freight Origin-Destination Demand Modeling
Digital Project Delivery	11. Planning, Scoping and Preliminary Engineering 12. Environmental Impact Analysis
Federal Reporting and Guidelines	13. All Public Roads modeled as single geometry with HPMS Road Attributes. FMIS project mapping.

Level 2: Intelligent Routable Road Network Model
Business Processes and Uses

Processes	Use Cases in Category 2
Asset Management	1. Disaster management and routing
Traffic Management & Systems Operations	2. Managed Lanes Operations 3. Congestion Management and Traffic Routing
Highway Safety Analysis	4. Diagnostic Analysis for Identifying Highway Safety Projects
Project Planning and Programming	5. Locating projects and road characteristics by travel direction and lane 6. Disaster recovery projects planning
Travel Demand Modeling	7. Mesoscopic Travel Demand Modeling 8. Freight Undesignated Parking Analysis
Digital Project Delivery	9. Traffic Analysis and Forecasting 10. Structural Analysis
Federal Reporting and Guidelines	11. Roads with physical barrier and curbed median (500 ft, 4 ft) modeled as Dual Carriage-ways with ITS, MIRE FDEs, HPMS attributes

Level 3: Multi-Dimensional Road Network Model

Business Processes and Uses

Processes	Use Cases in Category 3
Asset Management	1. Asset resiliency, Stormwater management and flood impact analysis
Traffic Management & Systems Operations	2. Real-time traffic data ingestion and mapping to road network for development of digital twin
Highway Safety Analysis	3. Intersection Conflicts and Movement Analysis
Project Planning and Programming	4. Integrated Multimodal Transportation Planning 5. Complete Streets with Digital Twin 6. Project assets mapping for scoping. Freight Undesignated Parking Analysis
Travel Demand Modeling	8. Microscopic Travel Demand Modeling 9. Right-of-way and Encroachments
Digital Project Delivery	10. Survey, Photogrammetry Data Integration 11. Construction and Digital As-Builts Data exchange with road inventory systems
Federal Reporting and Guidelines	12. Building Information Modeling and GIS Integration using Digital As-Builts (DABs) to create Enterprise Geospatial Digital Twin & Complete Streets model.

AEGIST Workshop: GIS-T

April 2025

AI-Agent (Chatbot) for:

- Understanding AEGIST Guidelines on Road Network Data Modeling

- Utilizing Artificial Intelligence use for Road Network Data Modeling

- Deploying Data Governance and Management

- Building Level 1, Level 2 and Level 3 Road Model for Enterprise Business Users