AEGIST: Applications of Enterprise GIS in Transportation
TRB AED-40: Geospatial Information Science Update

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

AEGIST Activities Update

- FHWA Office of Planning and Safety

- States DOTs Participating: 18; Engaged 5

- Local Agencies and NG911 Stakeholders in California, Pennsylvania.

- Federal Lands Management Agency

Legend
PFS State
Engaged State
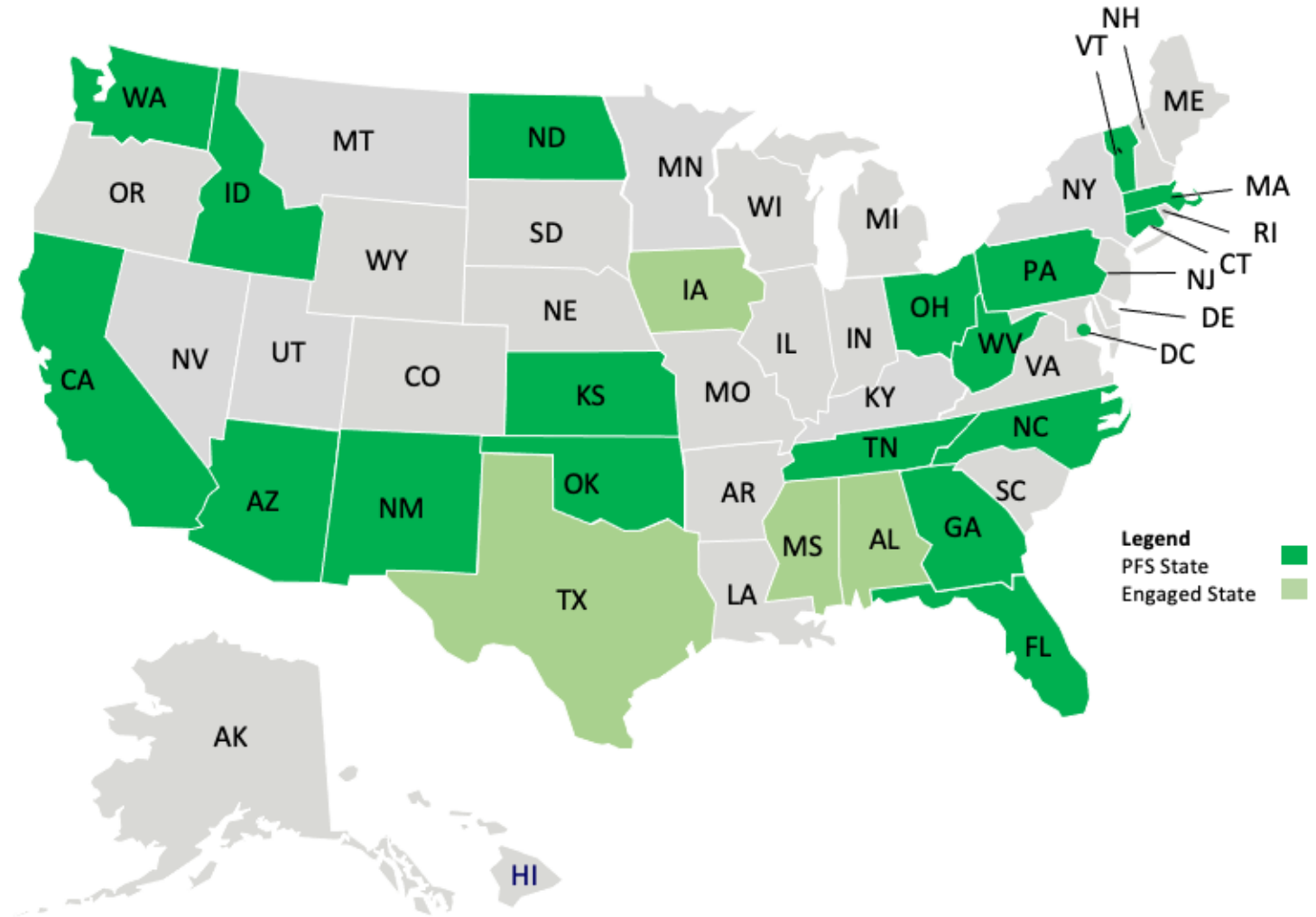
AEGIST Activities Update

- One Road Centerline – State DOT Linear Referencing, Local and Federal Lands

- HPMS 9 and National Road Network (NRN)

- Open Standards Compliant, Machine Readable, Topological Road Network Data Model

- Complete Streets Design and Decision Support to enable Transportation Equity

- Building Information Modeling & Geospatial Information Systems, Digital Twins

- Spatial Data Engineering & Analytics: Spatial Econometric and AI/ML Models

- Enterprise Data Governance (Spatial and associated Non-Spatial Data)

AEGIST Publication Data Model Influencing HPMS/ARNOLD and NRN; PFS States to Review & Comment on the AEGIST Model
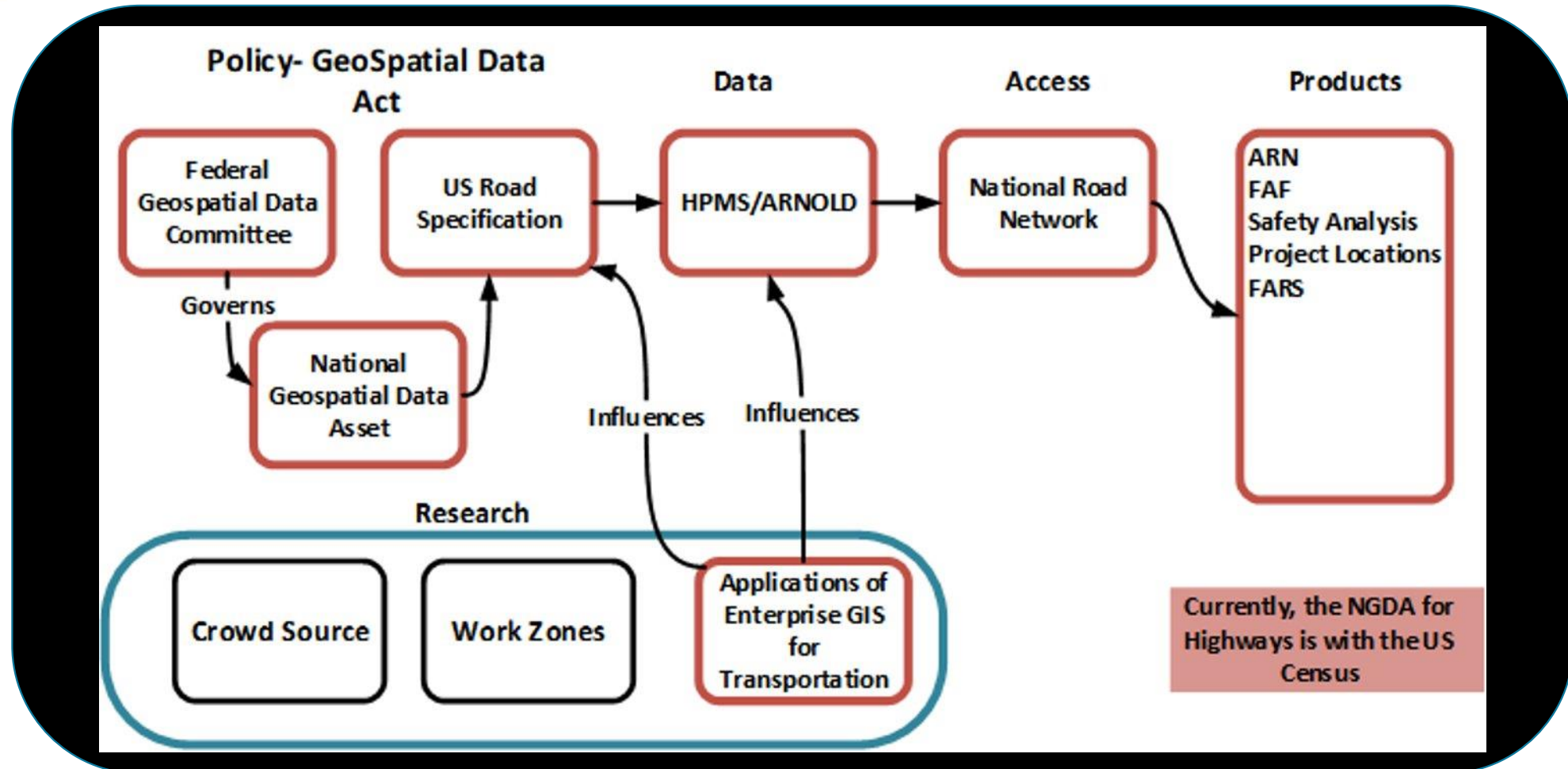
Data Modeling Standards

- All Roads Network of Linearly Referenced Roads (ARNOLD)
- Highway Performance Monitoring System (HPMS), especially HPMS 9.0 Reassessment
- United States Road Specifications (USRS) and US Army Corp of Engineers (USACE) Road Lines
- United States Census Bureau's Road TIGER/Line files
- Model Inventory of Roadway Elements (MIRE)
- Geographic Data Format (GDF) from Open Geospatial Consortium (OGC)
- CityGML from Open Geospatial Consortium (OGC)
- General Modeling Network Specification (GMNS)
- Industry Foundation Classes (IFC) from buildingSMART
- Open Street Maps (OSM) and Shared Streets
- Proprietary standards: Esri Roads & Highways ALRS, Bentley AssetWise LRS (AWLRS), Geomedia, Transcend Intersection Manager, TranCAD, Cube, Emme
- National Bridge Inventory (NBI); Bridge Management Elements (BME); National Bridge Elements (NBE)

AEGIST Incorporating GMNS Standard for Modeling Multimodal, MIRE-Compliant Signalized Intersection from ARNOLD and NG911 Roads
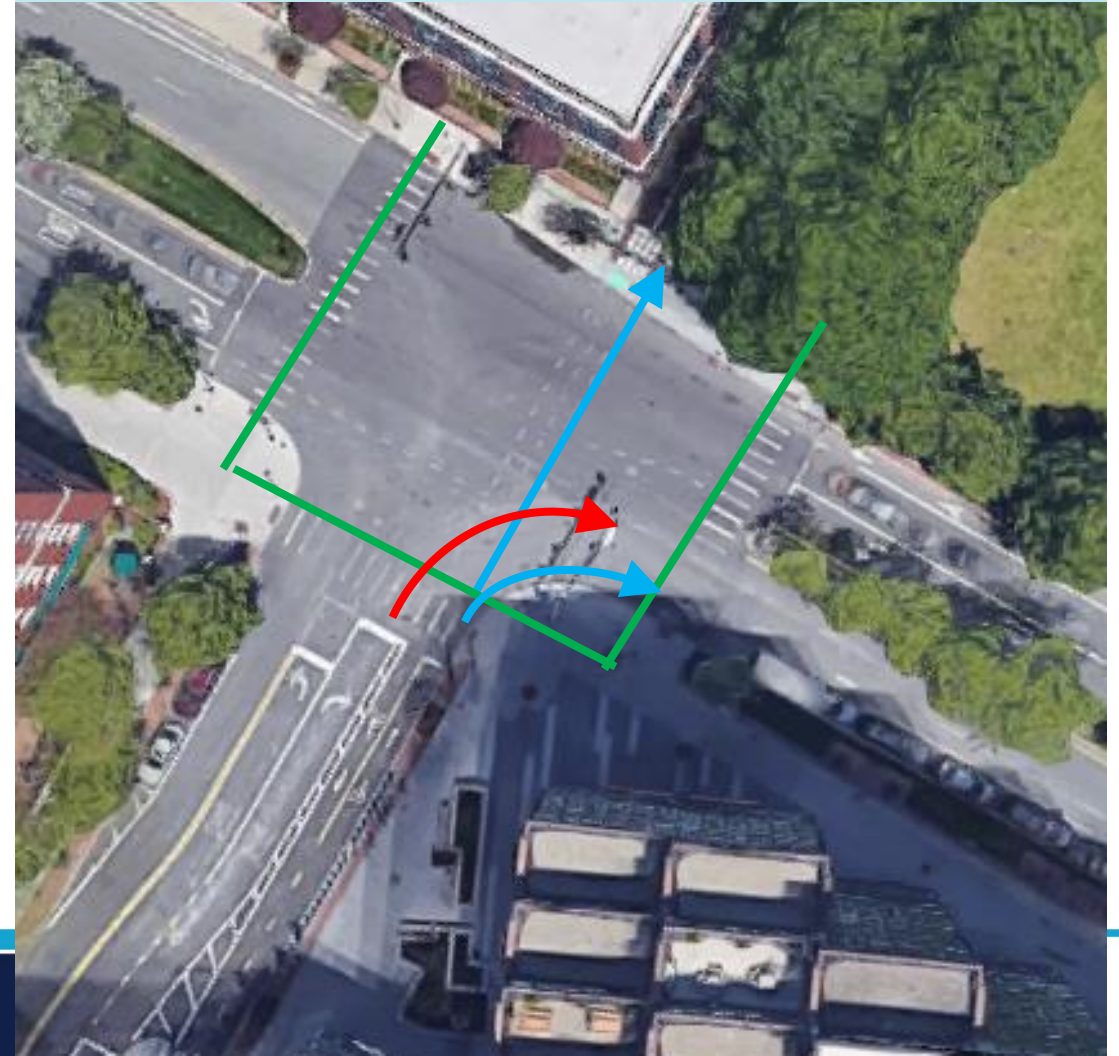

Selected Movements from Ames St.
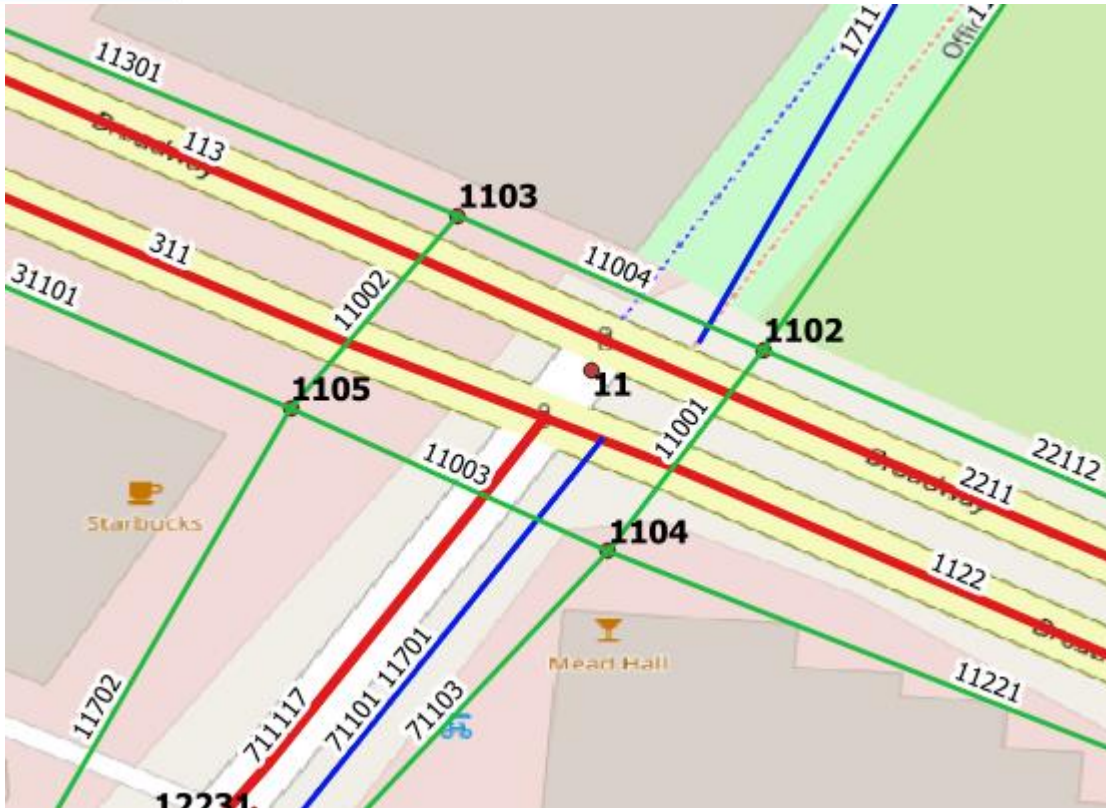
Red: **Vehicle links and movements**
Blue: **Cycle track links and movements**
Green: **Pedestrian links and crosswalks**

with GMNS Multiresolution Representation
- Link level
- Lane level

Basic Network:
Nodes
Directed links
(no explicit representation of sidewalks)

Basic Network:
Nodes
Directed links
Undirected links
(explicit representation of sidewalks)

Parent-child
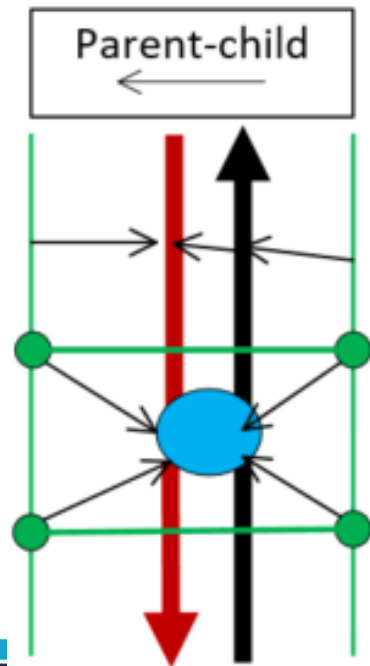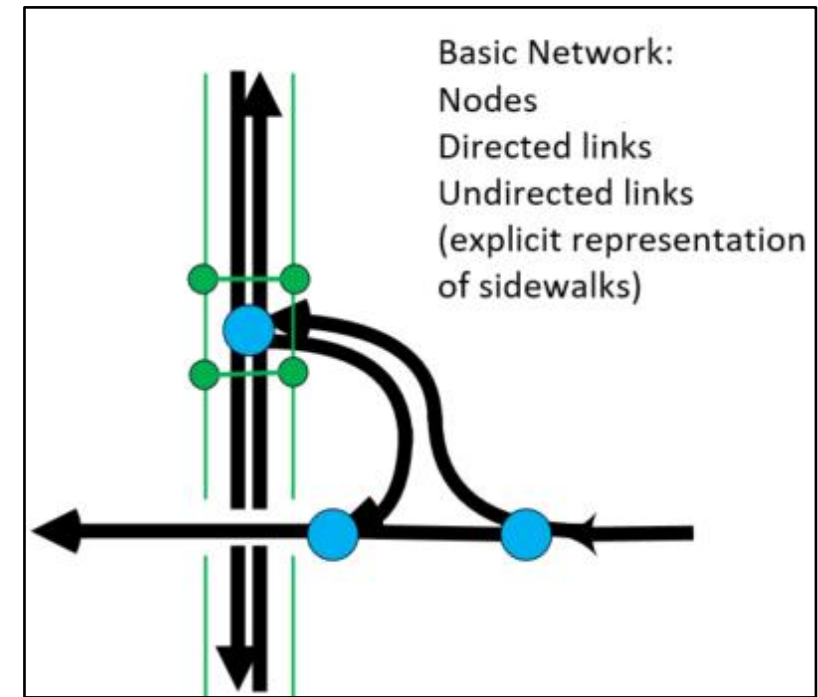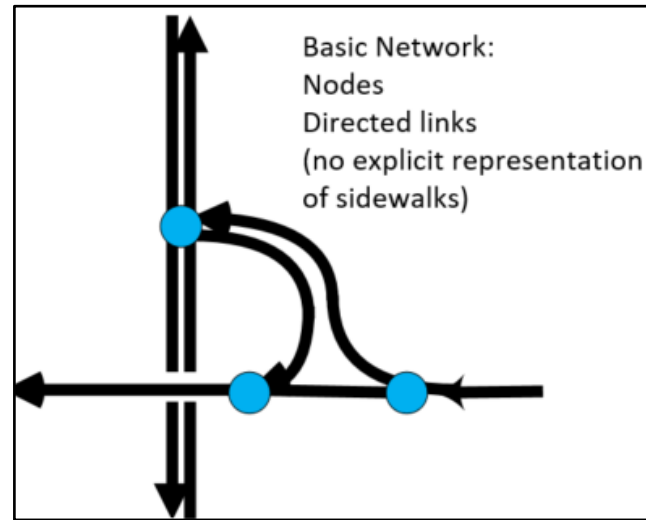
Links may have parent links
- Sidewalks to adjacent roads
- One side of a road to the other (consider the case where the only link with shapepoints is the red link)

Nodes may have parent nodes
-Associate crosswalk entrances with signals

Dynamic Network
Movements
Lanes
Nodes
Undirected links
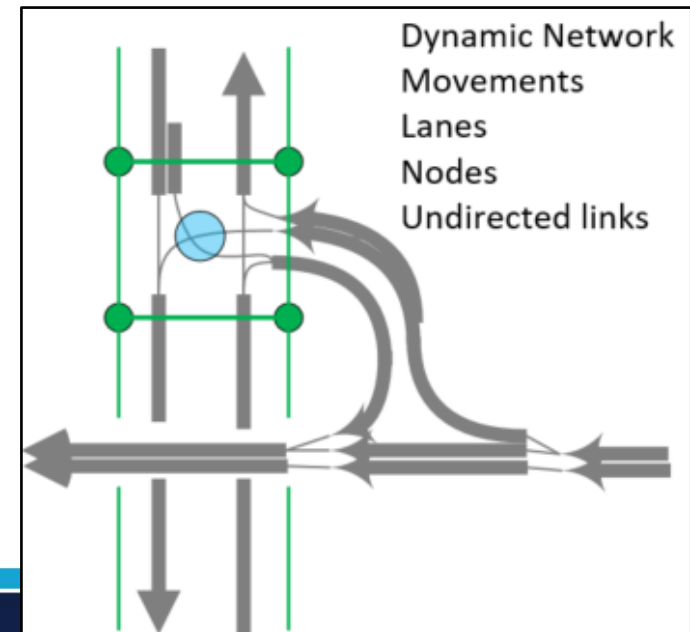
AEGIST Complete Streets Data Modeling

Motorist Routes

Pedestrian Trail Routes

Inventory Routes (HPMS 9: Route Identifications?)

Junctions

Intersections

Road Segments (NG911)

Turn Segments/Lanes

Median Crossovers

Crosswalks

Sidewalks

Signals

Roads and Intersection Modeling
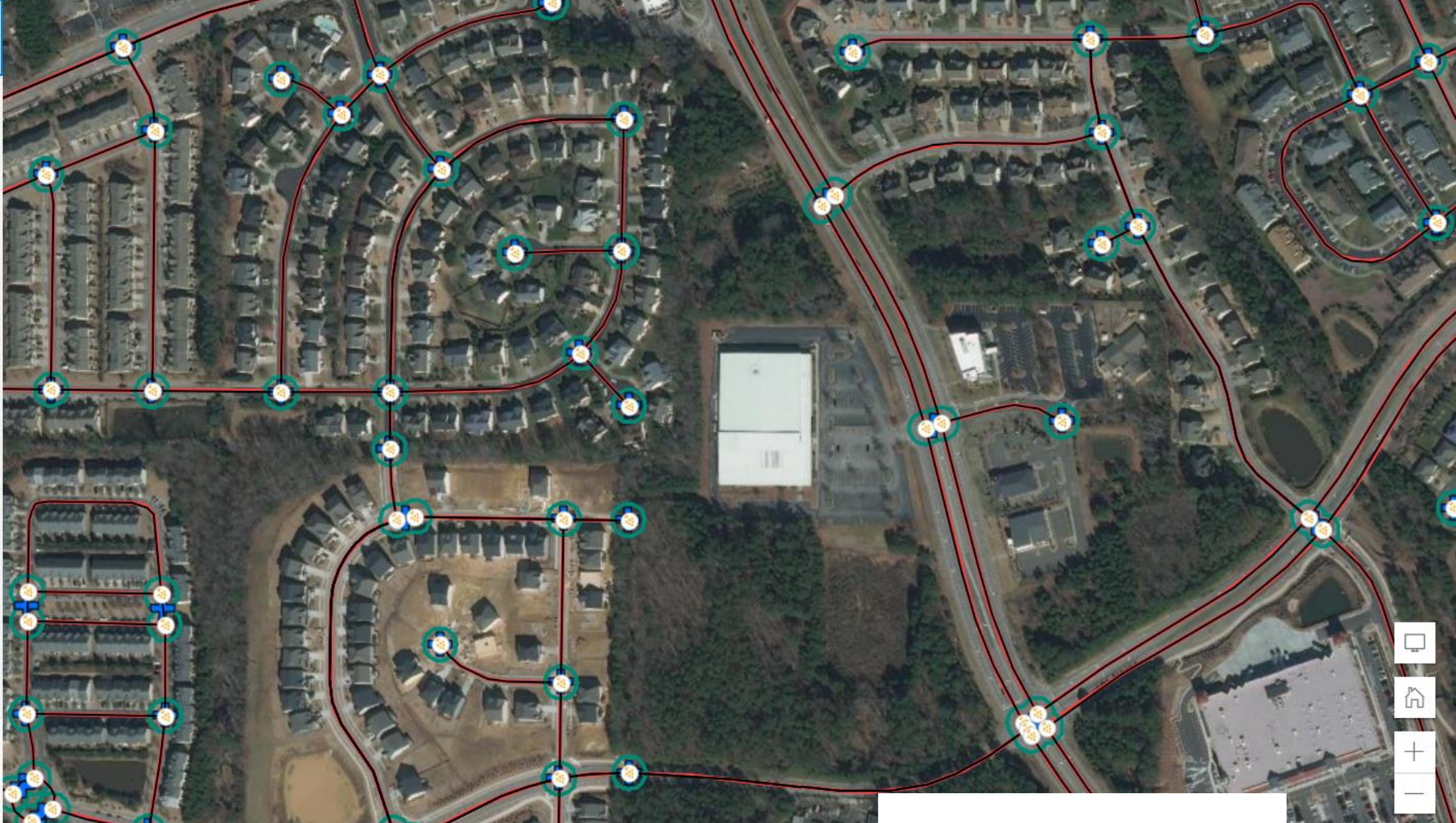
AEGIST Support for Complete Streets & Transportation Equity

Georgia Tech — CREATING THE NEXT

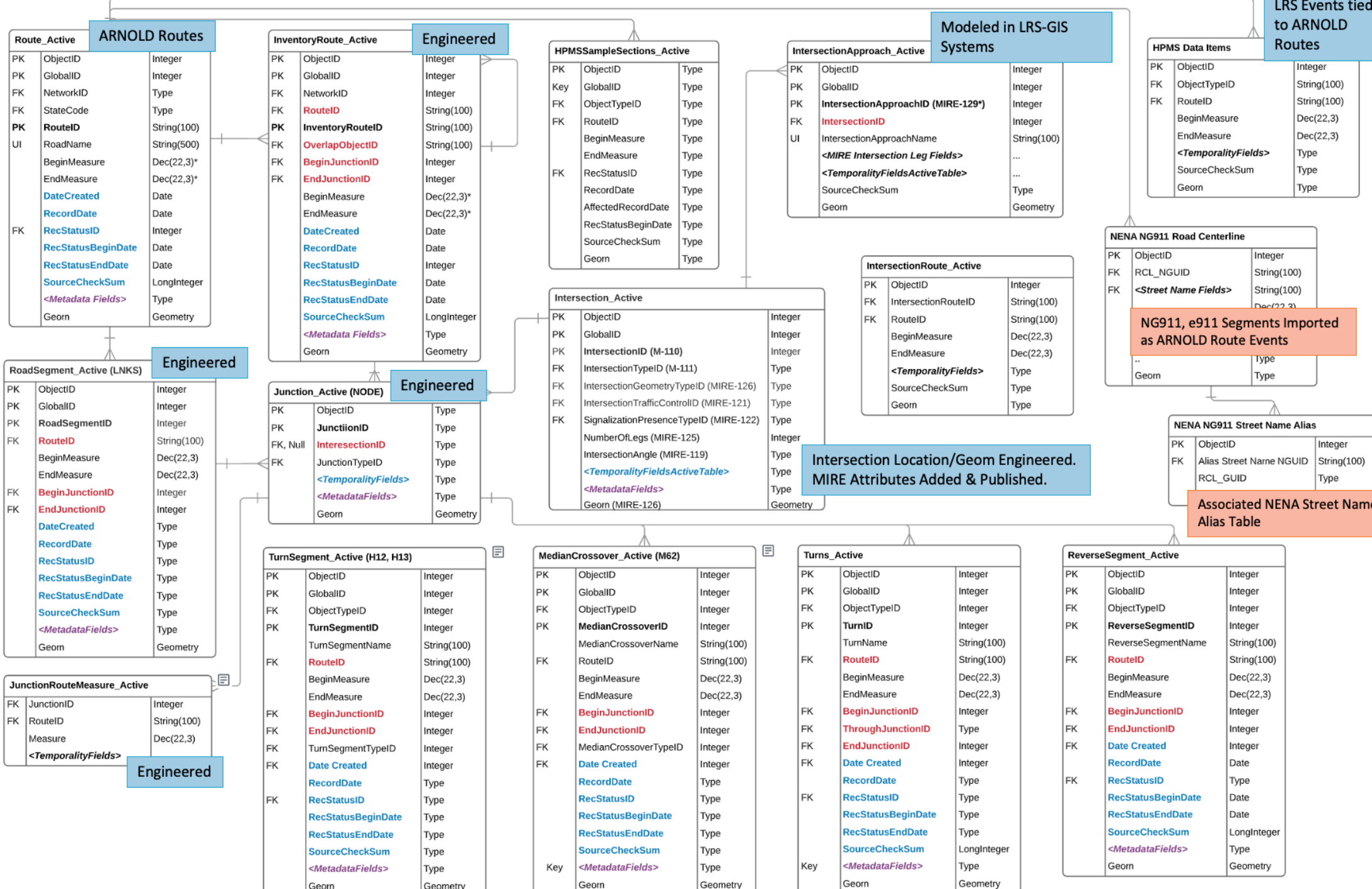**UC PRC** — UNIVERSITY of CALIFORNIA | PAVEMENT RESEARCH CENTER — Davis · Berkeley

Research Roadmap: Inventorying Complete Streets for Asset Management

Vision: Incorporate Complete Streets into asset management systems to cost-effectively take advantage of the societal, economic, and environmental benefits of active transportation

Concept

Scope: Management of assets for long-term performance of active transportation assets as part of a complete streets network

- C1. Technology Review for Inventorying Complete Streets Assets
- C2. Current Practices and Needs Review for Complete Streets
- C3. County/City Review of Practices and Needs

Research

- R1. Inventorying Bike and Pedestrian (and ADA) Facilities
- R2. Condition Evaluation Rating System of Bike and Ped Facilities
- R3. Long Term Performance and Forecasting for CS Assets
- R4. AV/CV for CS data collection
- R5. Crowdsourcing for CS data collection
- R6. Network Level Measurement of Bike/Ped Counts
- R7. LCCA & Value of Complete Streets Improvements
- R8. Safety Impacts of Complete Streets Implementation
- R9. Pilot Testing/ Feasibility of Technologies for Inventorying Complete Streets Assets

Development

- D1. Guidance for Complete Streets Performance Measures, Targets, and Prioritization
- D2. Database Guidance for Complete Streets Assets
- D3. User Interface for Data Input, Analysis, and Presentation
- D4. Optimized Data Collection Methods for Inventorying Complete Streets

Implementation

- I1. Best Practices for Organizational Structures to Support CS
- I2. Best Practices to Encourage Interagency Collaboration for CS
- I3. Training for Complete Streets Condition Evaluation and Prioritization
- I4. National Standards for Complete Streets Targets and Data Collection

Current Project
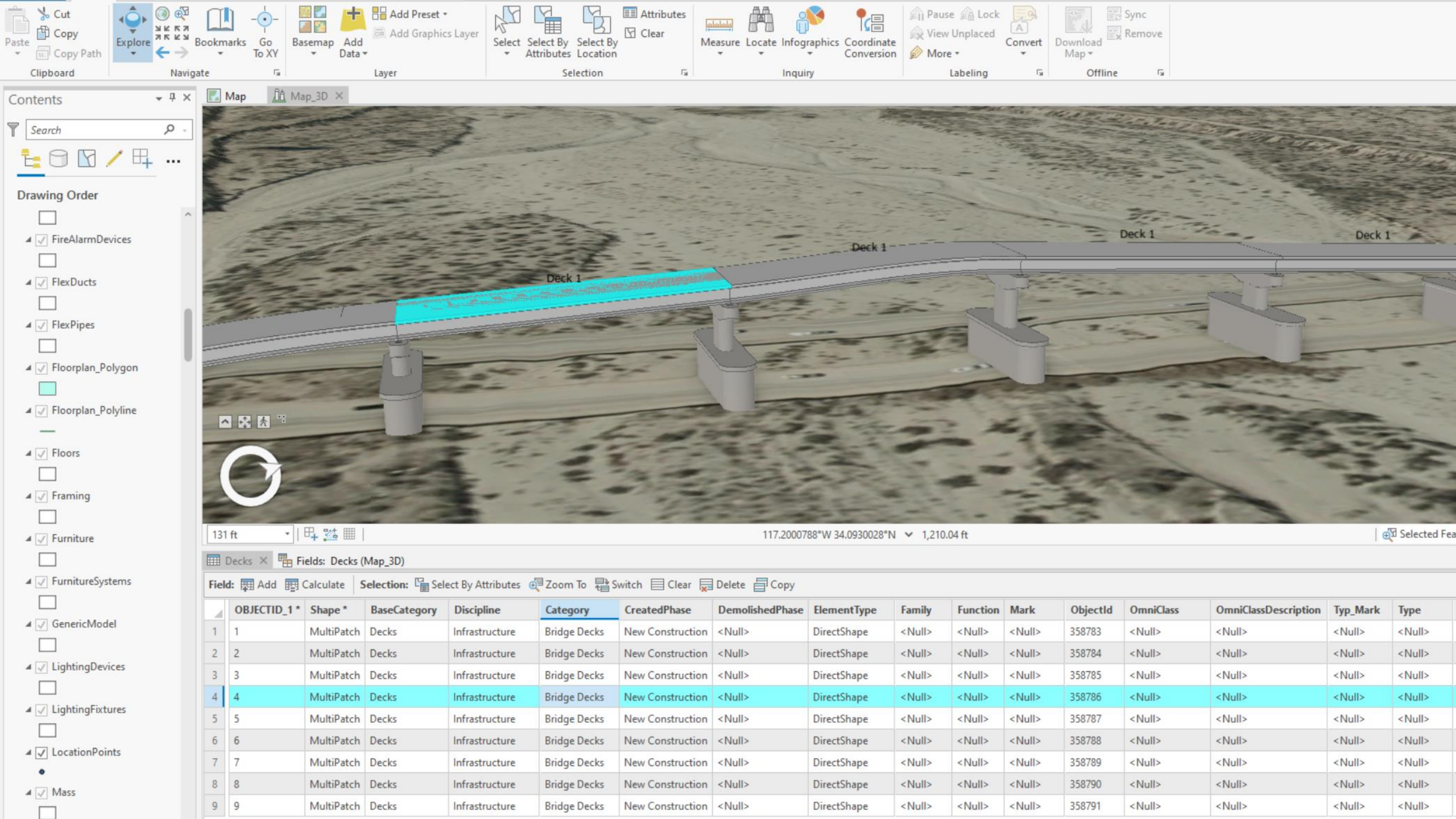
Governing Data Using Spatial & Linear Referencing Systems

Spatial Data Modeling in
Transactional Systems of Records (SoRs)
and **Spatial Data Engineering** for Publication to
Enterprise Data Warehouses, Databases to support
Spatial Data Analytics and Reporting
Via the Systems of Engagement (SoE)

Ensuring Transportation Equity by Preparing
Spatial Transportation Data for Decision Makers
across All Asset Life Cycle Phases & Processes
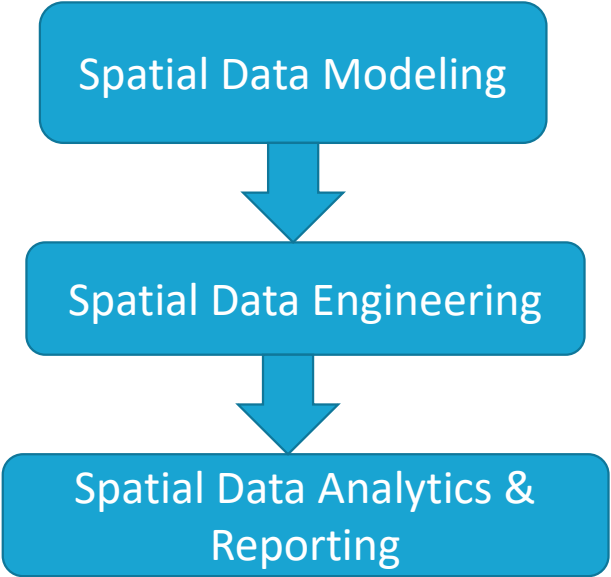
Spatial Data Modeling

⬇

Spatial Data Engineering

⬇

Spatial Data Analytics & Reporting

AEGIST Implementation Activities at PFS States

	CA	CT	FL	ID	TN	PA	OH	KS	NM	NC
Spatial Data Governance, Management *Strategy, Roadmap, Metadata, Data Portfolio & Library, Workshops*				✅	✅	✅	✅			✅
Spatial Data Modeling										
Roads Data Modeling & Business Rules *DOT, Federal, Local: HPMS, ARNOLD, NG911, MIRE, Intersection*	✅		✅			✅	✅	✅	✅	✅
Intersections Data Model *HPMS 9.0, MIRE, GDF, IFC Roads Based*			✅				✅	✅	✅	✅
Data Quality Automation *HPMS, MIRE & Assets*	✅	✅		✅						
Spatial Data Integration and Engineering										
Roads Data Integration, Authoritative Data Mgmt. *DOT, Federal, Local Roads Data Sharing & Federation*	✅		✅					✅	✅	
Road Network and Events Data Publication/Sharing *Data Model for Data Warehouses. Data Models & Engineering in Data Hubs*		✅		✅		✅	✅			
Spatial Data Analytics										
Spatial Statistics, Econometrics, AI/ML, Optimization *Descriptive, Diagnostics, Predictive and Prescriptive Analytics; Image Analysis*		✅	✅			✅		✅		✅

State DOT Technical Services Activities Summary

Base Period States (Oct 2019 – May 2022)		Coordination Efforts
Connecticut DOT	(1) Road Network Data Quality Report Generation using FME (including HPMS Data) (2) CTDOT LRS-GIS Data Migration to AEGIST Data Model (formerly NRBM) for Publication & APIs	
Idaho Transportation Department	(1) Spatial Data Governance Platform (Data Portfolio/Catalog; Data Engineering and Data Analytics) (2) DOT LRS Routes, FLMA Routes and Local Agency Routes Conflation Tool (Python-Based)	**FHWA BIM Projects:** BIM National Strategic Roadmap; Data Governance
Tennessee DOT	(1) Strategic Roadmap for Spatial Data Management and Governance at Enterprise Level (2) Data Governance Pilot (TENTATIVE): Establishing Enterprise Data Integration, Engineering & Analytics Platforms for Spatial Data Governance. Goal: Eliminate Redundancies in Data Mgmt.	**FHWA BIM Projects:** BIM National Strategic Roadmap; Data Governance
Caltrans	(1) Data Sharing Agreement between Caltrans, CalOES, Counties (NG-911, ARNOLD-HPMS Data) (2) CTDOT LRS-GIS Data Migration to AEGIST Data Model (formerly NRBM) for Publication & APIs	**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) 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) Spatial Data Management and Governance Roadmap: 10 Areas Identified, such as:
	    • Routable Network Development for Travel Demand Modeling using DOT & Local Data
	    • HPMS 9.0-ARNOLD Rules Compliance, LRS-GIS Database Administration, Data Quality
		e911/NG-911, HPMS 9.0
		MIRE, National Roads Pilot

State DOT Technical Services Activities Summary

Period of Performance 1 States (July 2021 – Feb 2023)		Coordination Efforts
New Mexico DOT	(1) ALRS Review and Comparison with AEGIST Data Model (National Road Network- NRN Data Model) (2) Generating Routes with Z-values using Lidar data (3) Intersection Features Data Engineering and Modeling with Topology and Connectivity using Lidar and Open Street Maps (OSM) data. Pilot Implementation: Limited Study Area. (Semi-Automated Data Engineering/Modeling). Statewide Implementation (Investigating Automation with Lidar Data)	**e911/NG-911, HPMS 9.0 MIRE, National Roads Pilot**
Washington State DOT	**To be determined** **Considering:** (1) Guidance on how and why to implement dual carriageway option (2) Strategies for local agencies to collect and report all public roads updates and MIRE FDE (3) GIS Applications and Data/System Integration Architecture (4) Strategies for transforming from Mainframe LRS to GIS-Based LRS	**HPMS 9.0, MIRE, National Roads Pilot**
Florida DOT	(1) Intersection Features Data Engineering and Modeling with Topology and Connectivity (2) Dual-Carriageways Data Modeling	**HPMS 9.0, MIRE, National Roads Pilot**
North Carolina DOT	(1) Intersection Features Data Engineering and Modeling with Topology and Connectivity (2) Spatial Data Governance	**HPMS 9.0 National Roads Pilot**
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. *Mobile* *Lidar Project Tasks: Routes with Z-values from Lidar Data, Creating HSM Road Segments & Calibrating Safety Performance Functions*	**e911/NG-911, HPMS 9.0 MIRE, National Roads Pilot**

Speed Limit Data Extraction from Permits PDF Using Computer Vision (Optical Character Recognition)

Speed Limit Permits
(Authoritative Source)

Scripts and/or models to automate analysis

Process to extract data from PDF, Excel or other static documents

Create tools or processes to sync data among sources or notify when changes occur

TC -31
12/86

ORIGINAL

COMMONWEALTH OF PENNSYLVANIA
Department of Transportation
Engineering District 8-0

County: Lancaster
SR: 0741 (Entire SR)
Speed Limit

As a result of an engineering and traffic study, a speed limit(s) on the following section(s) of the subject State-designated highway is hereby established:

From Segment	Offset	To Segment	Offset	MPH	Side	Posting Responsibility
0010	0000	0040	0000	Turnback		
0040	0000	0050	1247	35	Both	PennDOT
0050	1247	0090	0977	45	Both	PennDOT
0090	0977	0130	1938	35	Both	East Hempfield
0130	1938	0190	0000	35	Both	Manor Twp.
0190	0000	0210	0306	40	Both	PennDOT
0210	0306	0250	0150	45	Both	PennDOT
0250	0150	0250	2912	40	Both	PennDOT
0250	2912	0260	0000	Null With SR 0324		
0260	0000	0284	0000	45	Both	PennDOT
0285	0000	0285	1265	45	Descending	PennDOT
0284	0000	0284	1265	45	Ascending	PennDOT
0284	1265	0290	0000	Null With SR 0222		
0290	0000	0300	0345	40	Both	PennDOT
0300	0345	0320	0804	35	Both	West Lampeter Twp.
0320	0804	0350	2003	40	Both	PennDOT
0350	2003	0390	0000	25	Both	Strasburg Boro.
0390	0000	0400	2233	25	Both	Strasburg Twp.
0400	2233	0530	0870	50	Both	PennDOT
0530	0870	0540	3008	35	Both	PennDOT

(End SR)

```python
def MCRegDF(Page1DataSplit, year):
    DF = pd.DataFrame()
    for LineNo in range(3,len(Page1DataSplit)):
        #Regular expression being used to extract a list of tuples by including multiple () extraction brackets
        #Look for A-Z 0 or more times
        #IF you encounter one space, keep looking for A-Z 0 or more times
        #Stop extracting if you encounter space one or more times - But this should only happen after you have ignored
        #space one time. Extract all of these spaces as second value in the tuple
        #Third value in the tuple should include 0-9, encountered 0 or more times AFTER having encountered a series of spaces
        LineContentList = re.findall('([A-Z]*\s[A-Z]*)(\s+)([0-9,]*)',Page1DataSplit[LineNo])
        for item in LineContentList:
            if item[0] != ' ':
                s1 = item[0].strip()
                s2 = item[2].strip()
                s3 = ''
                for i in s2.split(","):
                    s3 = s3 + i
                DF = DF.append({'COUNTY':s1, 'MCReg_'+str(year):s3}, ignore_index=True)
    DF = DF.set_index(['COUNTY'])
    return DF


MCReg2013DF = MCRegDF(MCReg2013Page1DataSplit, 2013)
MCReg2014DF = MCRegDF(MCReg2014Page1DataSplit, 2014)
```

California Road Sharing (CaRS)

California Road Sharing (CaRS)

Road to Governed California Centerlines

California's road system is managed by various authoritative roads data management government agencies. These include the Caltrans State Department of Transportation (DOT), 58 counties and 482 municipalities using multiple data systems.

Vision: The **California Road Sharing (CaRS) Program** will establish the **Road to Governed California Centerlines**. Road data modeling, management and exchange practices will be coordinated across Caltrans, Cal OES and Local agencies. A Statewide Roads Data, Applications and Technology Architecture will be created for management of road centerline geometry and road information. Pilot projects will be done with stakeholders in California and workshops will be held as part of the ongoing FHWA-led AEGIST program involving 18 States, in the U.S. to gather information for successful deployment of an integrated and federated data management system with data modeling, governance, sharing and QA/QC rules..

Benefits to Stakeholders

- Public safety enhancement through data-driven emergency management, preparedness and incident response
- Transportation planning, traffic studies, safety assessments and geo-locating address information (geocoding)
- Linear referencing of infrastructure asset inventory and condition assessment data in Asset Management Systems
- Capital and Maintenance project work data management (linear/spatial referencing)
- Topologically connected routable network development for map-based vehicle routing and analysis of driving directions, distances, roadway mileage.
- Deployment of Statewide Roads Data Governance Framework through establishment of National standards-based roads data modeling and QA/QC rules across government agencies
- Development of Digital Twin and AI/ML Applications for Infrastructure Management, CV/AV & Unmanned Aerial Systems
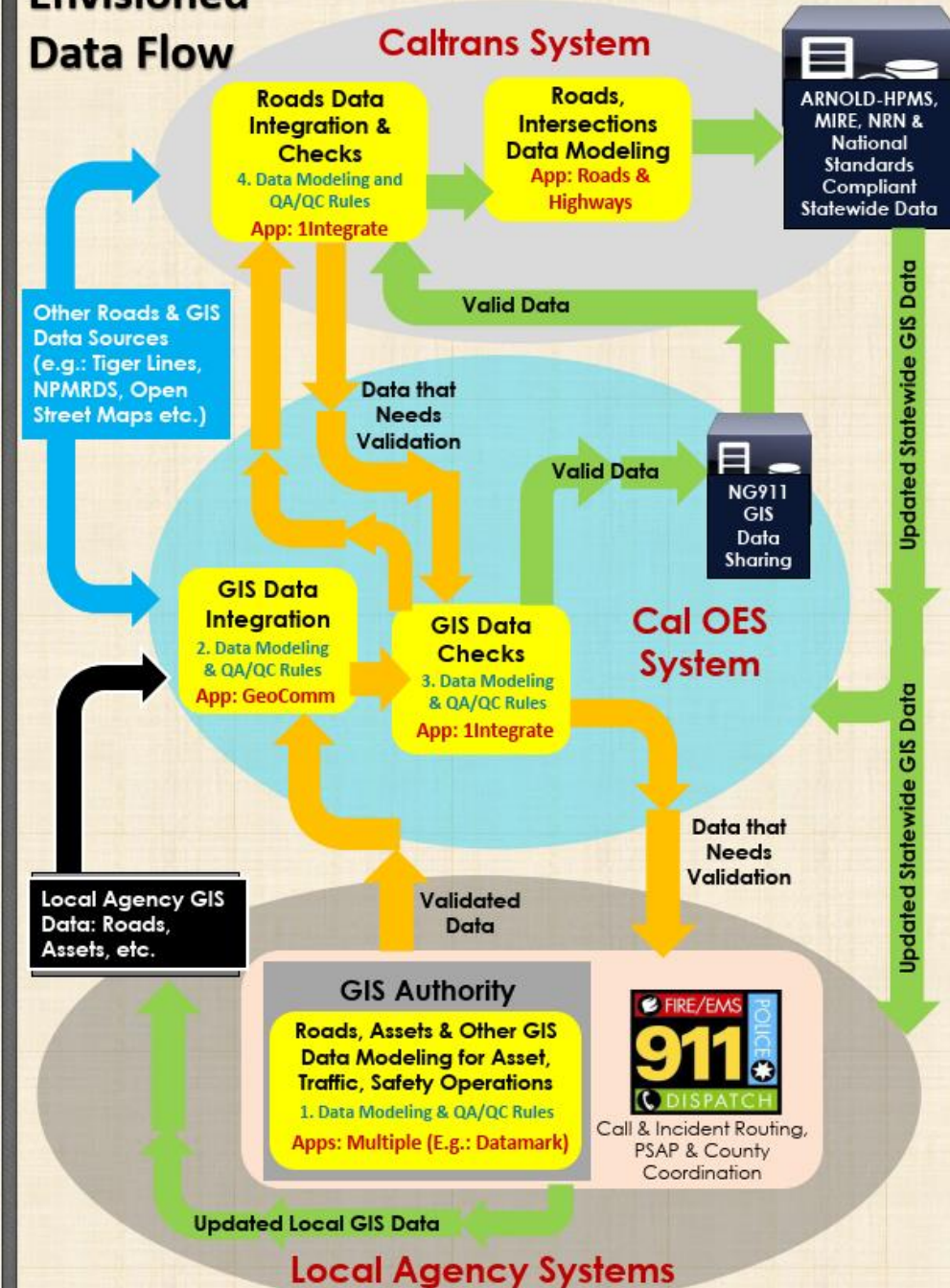
Roads Data Modeling & QA/QC Rules

- Null and Multi-Part Geometry
- Duplicate Vertices
- Centerline Alignment
- Digitization Direction
- Centerline Accuracy, Source
- Self-Intersecting Geometry
- Start/End Nodes Alignment
- Overshoots/Undershoots
- Kickbacks
- Bifurcations
- Turn Lanes & Ramps Centerlines
- Emergency Crossovers
- Railroad Crossings
- Administrative Boundary Junctions
- Overlap/Concurrent Roads
- Dual-Geometry (Divided/Undivided)
- Roundabouts & Traffic Circles
- Road Identification Information (ID, Name, Class etc.)

PROGRAM GOALS

✓ Create a governed state-wide road centerline dataset to meet ARNOLD and NG911 roads data requirements

✓ Provide mutual benefits to State and Local jurisdictions, especially the business users involved in highway project planning, survey, design, construction, safety, traffic and asset management operations

✓ Coordinate roadway cartographic and data model recommendations

✓ Support Transportation for the Nation (TFTN), which promotes a publically available, high quality road centerline that is coordinated across all levels of government

✓ Building Information Modeling (BIM) for Roads and Assets using Standards for supporting AI/ML Applications, CV/AV and UAS.

Envisioned Data Flow

Caltrans System

- Roads Data Integration & Checks — 4. Data Modeling and QA/QC Rules — App: 1Integrate
- Roads, Intersections Data Modeling — App: Roads & Highways
- ARNOLD-HPMS, MIRE, NRN & National Standards Compliant Statewide Data
- Valid Data

Other Roads & GIS Data Sources (e.g.: Tiger Lines, NPMRDS, Open Street Maps etc.)

Data that Needs Validation

Valid Data

NG911 GIS Data Sharing

Updated Statewide GIS Data

Cal OES System

- GIS Data Integration — 2. Data Modeling & QA/QC Rules — App: GeoComm
- GIS Data Checks — 3. Data Modeling & QA/QC Rules — App: 1Integrate

Data that Needs Validation

Local Agency GIS Data: Roads, Assets, etc.

Validated Data

Local Agency Systems

- GIS Authority — Roads, Assets & Other GIS Data Modeling for Asset, Traffic, Safety Operations — 1. Data Modeling & QA/QC Rules — Apps: Multiple (E.g.: Datamark)
- 911 DISPATCH — FIRE/EMS, POLICE — Call & Incident Routing, PSAP & County Coordination

Updated Local GIS Data

California Road Sharing Initiative

Idaho Geoprocessing Tool for DOT and Federal Lands Roads Data Conflation

Idaho Data Portfolio ▼

Data Assets ▼ | Object Type Library (OTL) | Data Dictionary | Data Applications | ➕

⊞ Grid view 👥 ▼ | </> 1 hidden field | ⧩ Filter | ▦ Grouped by 1 field | ↕ Sort | 🎨 Color | ▤ | ⤴ Share view

TOGAF 9.2 Standard Compliant

	Asset ID	Description	Owners	Stewards	Performance Goal	Business Domain	Priority
PERFORMANCE GOAL **Infrastructure Health**		Count 11					
28 ①	Bridge	As part of national requirements for our bridge inve...	DOT Bridge Department	Program Info Coordinato...	Infrastructure Health	Asset Management	High
29	Culvert		DOT Asset Management	ITD Districts	Infrastructure Health		
30	Horizontal Curve (Alignment)		HPMS Coordinator Doro...	HPMS Coordinator Doro...	Infrastructure Health		
31	HPMS 0.1 Mile Segments		HPMS Coordinator Doro...	HPMS Coordinator Doro...	Infrastructure Health		
32	HPMS Sample Sections		HPMS Coordinator Doro...	HPMS Coordinator Doro...	Infrastructure Health		
33	Maintenance Work Orders		DOT Asset Management	Maintenance Manager S...	Infrastructure Health	Asset Management	Medium
34	Pavement (Road) Surface	Road Surface is maintained on state routes by ITD a...	DOT Asset Management	HPMS Coordinator Doro...	Infrastructure Health	Asset Management	High
35	Pavement Distress				Infrastructure Health	Asset Management	High
36	Pavement Roughness (IRI)	Pavement ratings gathered from longitudinal road p...	DOT Roadway	Pavement Data Manager...	Infrastructure Health	Asset Management	High
37	Pavement Structure				Infrastructure Health	Asset Management	High
38	Snow Plow Data	Data generated from snowplow pings process as pa...	DOT Maintenance Supp...	Maintenance Manager S...	Infrastructure Health	Fleet & Equipment	High
➕							
PERFORMANCE GOAL **Infrastructure Health** **Traffic Safety** **Mobility**		Count 3					
PERFORMANCE GOAL **Infrastructure Health** **Mobility**		Count 3					
PERFORMANCE GOAL **Traffic Safety**		Count 4					
45	Crash Data	Records of crashes with vehicle and severity inform...	Office of Highway Safet...	Office of Highway Safet...	Traffic Safety	Management	High
46	Intersection Influence Area	A spatial polygon feature that represents the shape ...	DOT Asset Management	Not Currently Managed	Traffic Safety	Management	Low
47	Intersection Routes		Not Currently Managed	Not Currently Managed	Traffic Safety	Management	Low
48	Traffic Counts	Raw Traffic data from counters	DOT Traffic Data	Traffic Data Manager Ma...	Traffic Safety	Travel Demand Modeling	High

ITD Data Engineering & Governance Dashboard
IPLAN Web Maps & Layers

Number of Webmaps

840

0   100
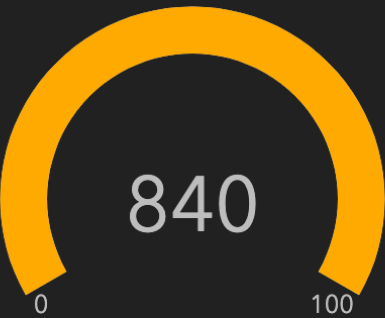
Top 100 Web Maps with Most Layers
Select a Web Map

Show all
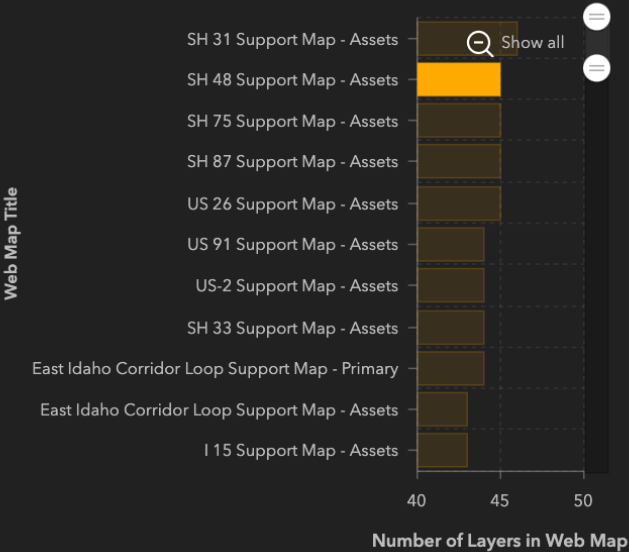
Layers in Selected Web Map
Number of Data Fields in each Layer
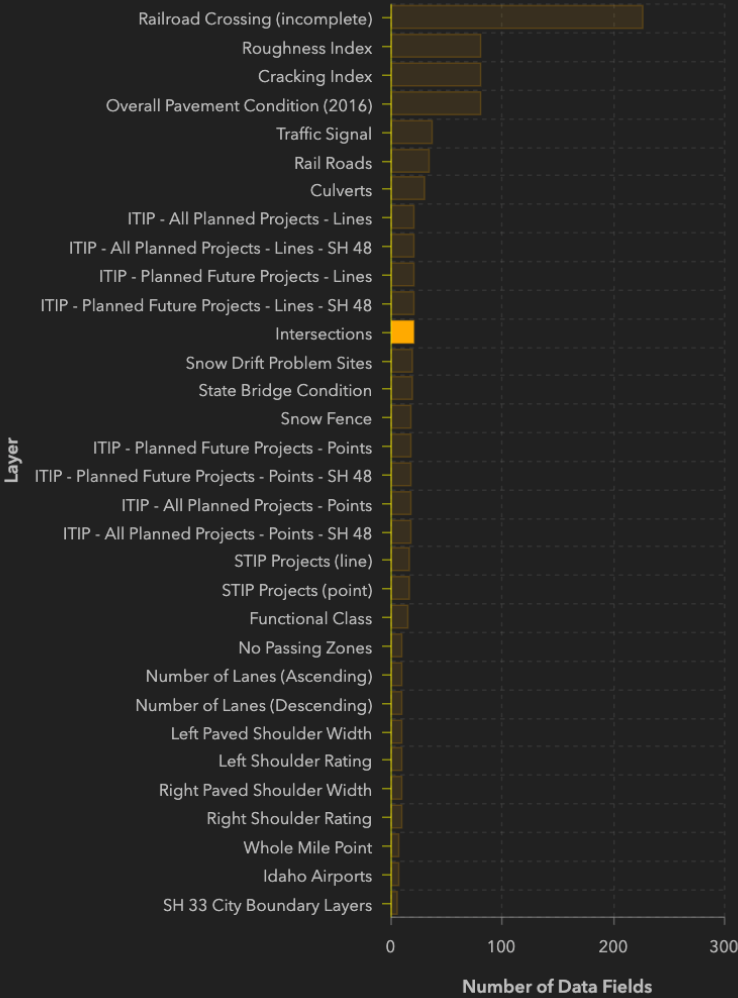
All Web Maps Engineered with Selected Layer
Number of Data Fields associated with Selected Layer by Web Map
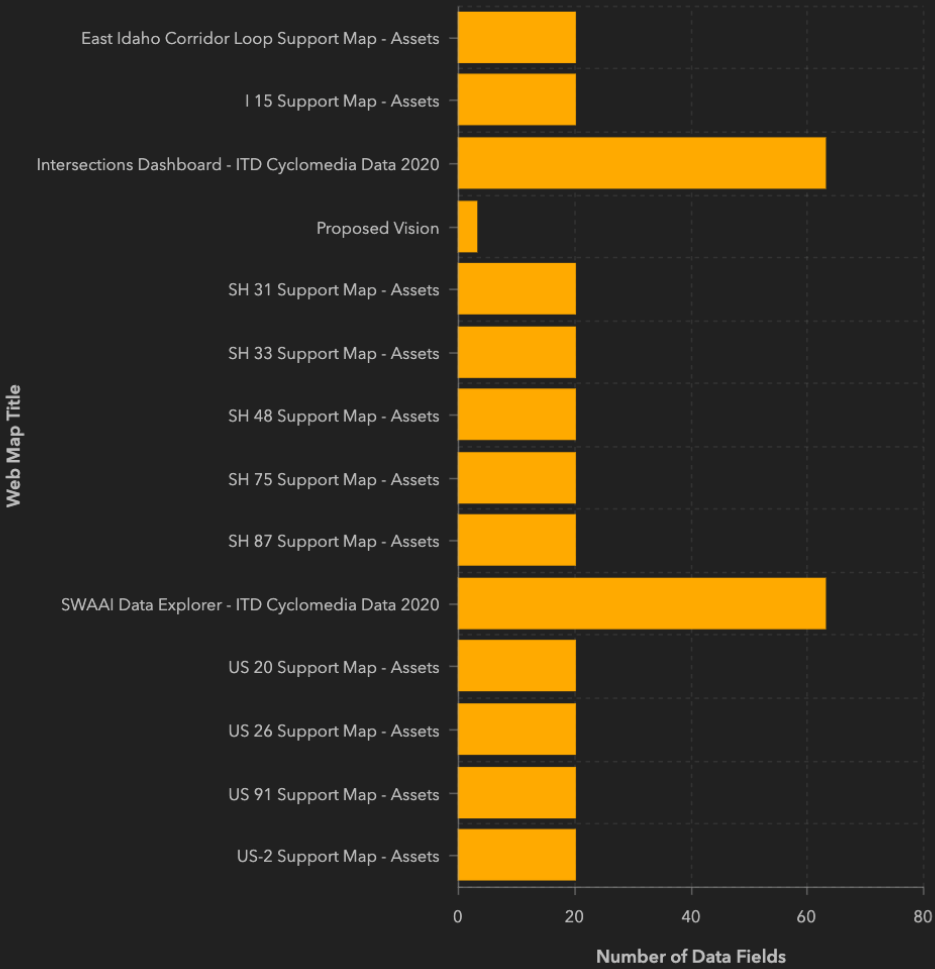
Which Web Maps utilize what data layers?

How many and what data fields are used in each of the Web Map layers?

Who owns the Web Map?

What data assets are the layers associated with?

HPMS Data Quality Rules Automation & Dashboards

1. Portfolio: Inventoried "data assets"

2. Data Models & their objective. Enterprise Data Dictionary, Data Quality Dimensions and rules

3. Automating data processing, integration & quality using Data Science Workbench

4. Data Governance Dashboards

AEGIST Complete Street Activities at PFS States

	PA	TN	OH	CT	ID	CA	NC	KS	FL	NM
R1. Inventorying Bike and Pedestrian Facilities			✓							
R3. Long Term Performance and Forecasting for CS Assets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R5. Crowdsourcing for CS Data Collection			✓				✓	✓	✓	✓
R8. Safety Impacts of Complete Streets Implementation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D1. Guidance for Complete Streets Performance Measures, Targets, Prioritization	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D2. Database Guidance for Complete Street Assets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D4. Optimized Data Collection Methods for Inventorying Complete Streets			✓			✓	✓	✓	✓	✓
I2. Best Practices to Encourage Interagency Collaboration for CS	✓		✓		✓	✓				
I4. National Standards for Complete Streets Targets and Data Collection	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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Asset Inventory and Condition Data Modeling, Integration, Engineering and Analytics using Enterprise GIS

Pavement Management System (PMS)

Application 1: Pavement Analyst

- Distress
- Deterioration Models
- Skid
- IRI
- Pavement Construction History
- Pavement Management Sections
- Work Planning

GIS Application 1: ArcGIS R&Hs LRS (Transactional)

- Tool 1: Pavement Management Sections
- Tool 2: HPMS Sections
- Tool 4: Create Crash Segments
- Tool 5: Crashes Location Referencing
- Tool 6: Assign Crashes to LRS & Segments

Tool 7: Roadway & Geometric Features: Location Referencing
- Lanes
- Guardrails
- Median
- ..
- Shoulders
- AADT
- Intersection, Junction, Leg, Influence Area

Tool 8: Projects Location Referencing, Visualization, Cross-Program Prioritization (Active, Completed, Programmed Projects)
- Pavement
- Bridge
- Safety Projects & Countermeasures

Tool 3: Structures Location Referencing

Safety Management System (SMS)

Application 1: Crash System
- Tool 1: Crashes

Application 2: AW Safety Analyst (Powered by Numetric)

- Tool 1: Reactive Model – Safety Potential via Group Comparison (Crash Segments)
- Tool 3: Proactive Model Scoring (Crash Segments)
- Tool 2: Black Spots ~ Network Screening (using LRS Routes)
- Systemic Safety Analysis
- Tool 4: Project & Treatments Composition, Economic Evaluation
- Tool 5: Network Analysis and Project / Treatment Prioritization using EPFS & Optimization

Bridge Management System (BMS)

- Application 1: AW BrM
- Application 2: InspectTech
- Application 4: AW BrR

Maintenance Management System (MMS)

- Application 2: Work Request, Work Order Operations Apps
- Application 1: Asset Inventory & Performance Assessment Web & Mobile Apps

Enterprise Data Engineering Platform with Data Hub

- eGDB: R&Hs Publication
- Data Warehouse
- Data Lake AI/ML Data Prep
- Application 1: FME
  - Tool 1: FME Desktop

TSMO System

- Application 1: JACKALOPE
- App 2: AWS Lambda
  - Tool 1: AADT Lambda

GIS Application 2: ArcGIS Mobile/Desktop Apps (Transactional)
- Application 1: Maintenance Quality Assessment (MQA)
- Applications Set: Mobile Apps for Asset Inventory and Inspections (e.g. DDIR)

Enterprise Data Analytics Platform

- Application 1: PowerBuilder
- Application 2: ArcGIS Portal
  - Tool 1: Operations Dashboard
  - Tool 2: Web Mapping Application
- App 3: AI/ML Model

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AEGIST Building Information Modeling (BIM) for Asset Inventory (Complete Streets), Performance and Projects Data Management and for Supporting the Performance Forecasting and Asset Life Cycle Analysis

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

INDEX

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

Design & Construction Systems
- ..
- ...

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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