IntelliDrive℠
Data Capture and Management Program

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U. S. Department of Transportation
Research and Innovative Technology Administration

Outline

- Program Vision and Objectives
- Key Concepts
- Current Projects and Products
- Upcoming Activities
- Issues
- Question and Answer

IntelliDrive Mobility

Real-time Data Capture and Management

Mobility and Environmental Applications

Real-Time Data Capture and Management

Vision

- Active acquisition and systematic provision of integrated, multi-source data to enhance current operational practices and transform future surface transportation systems management

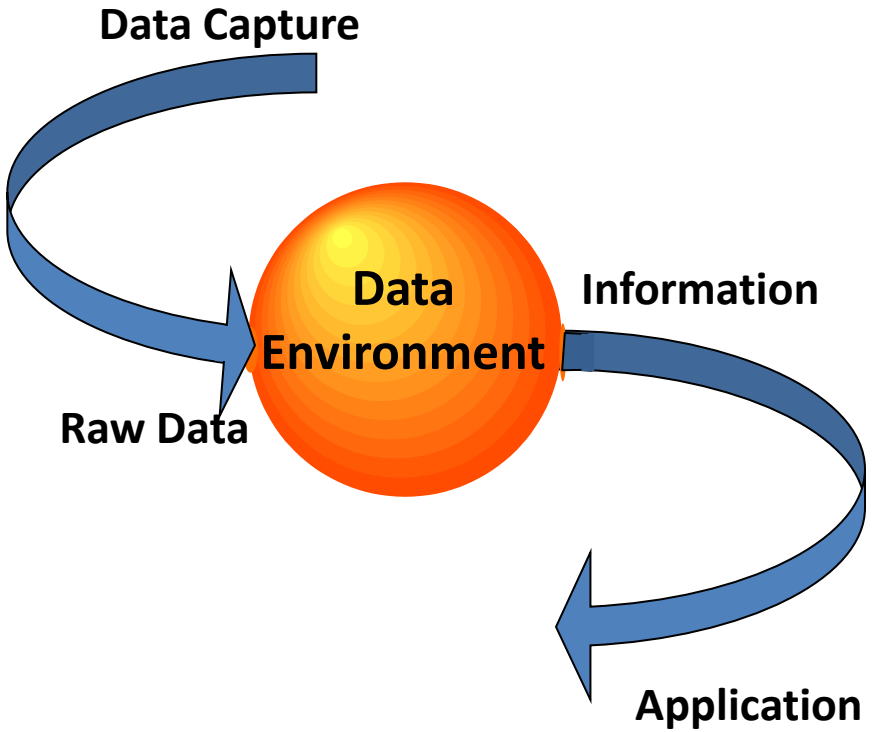
Objectives

- Enable systematic data capture from connected vehicles (automobiles, transit, trucks), mobile devices, and infrastructure
- Develop data environments that enable integration of data from multiple sources for use in transportation management and performance measurement
- Reduce costs of data management and eliminate technical and institutional barriers to the capture, management, and sharing of data

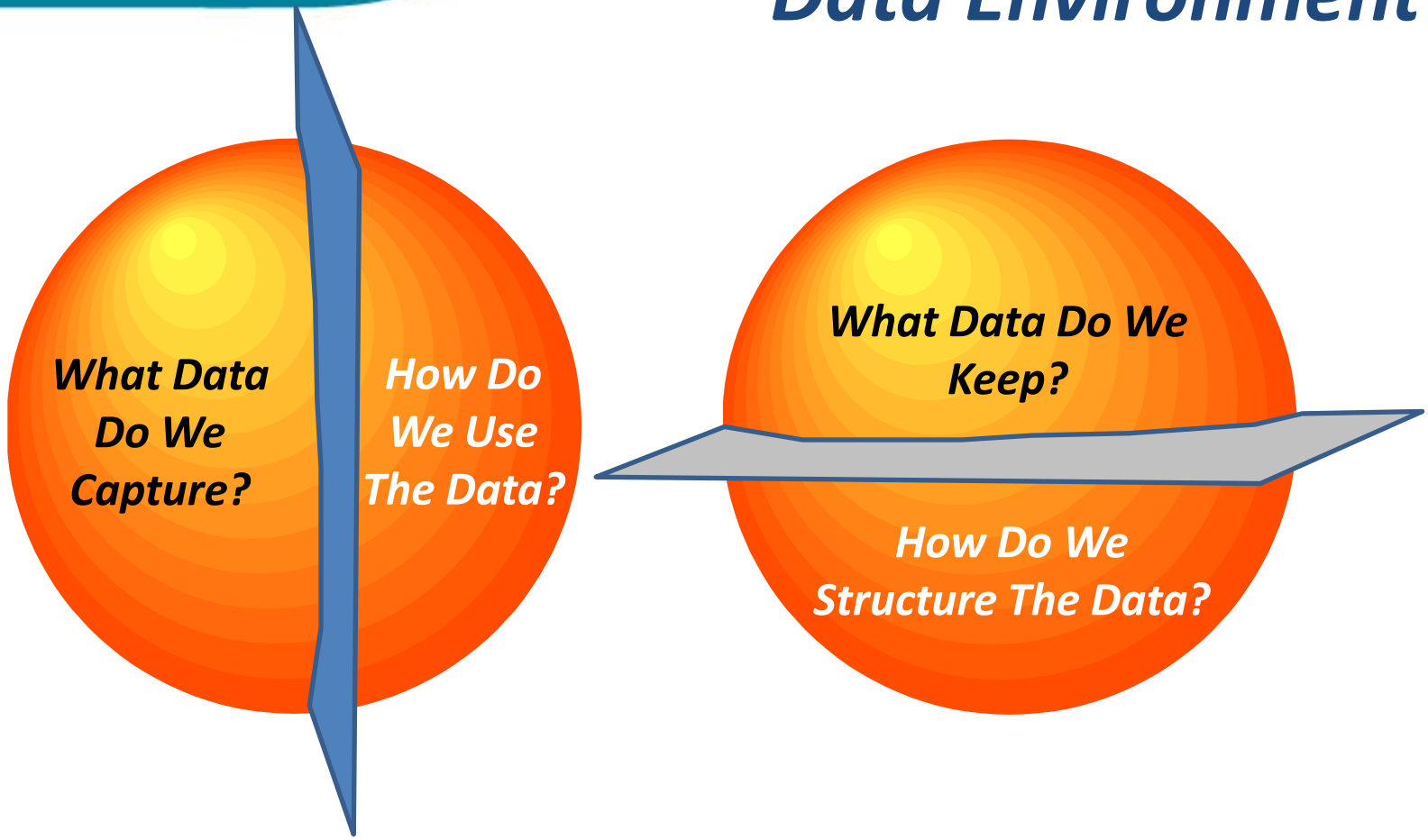
Data Environment Concept

Data environment:

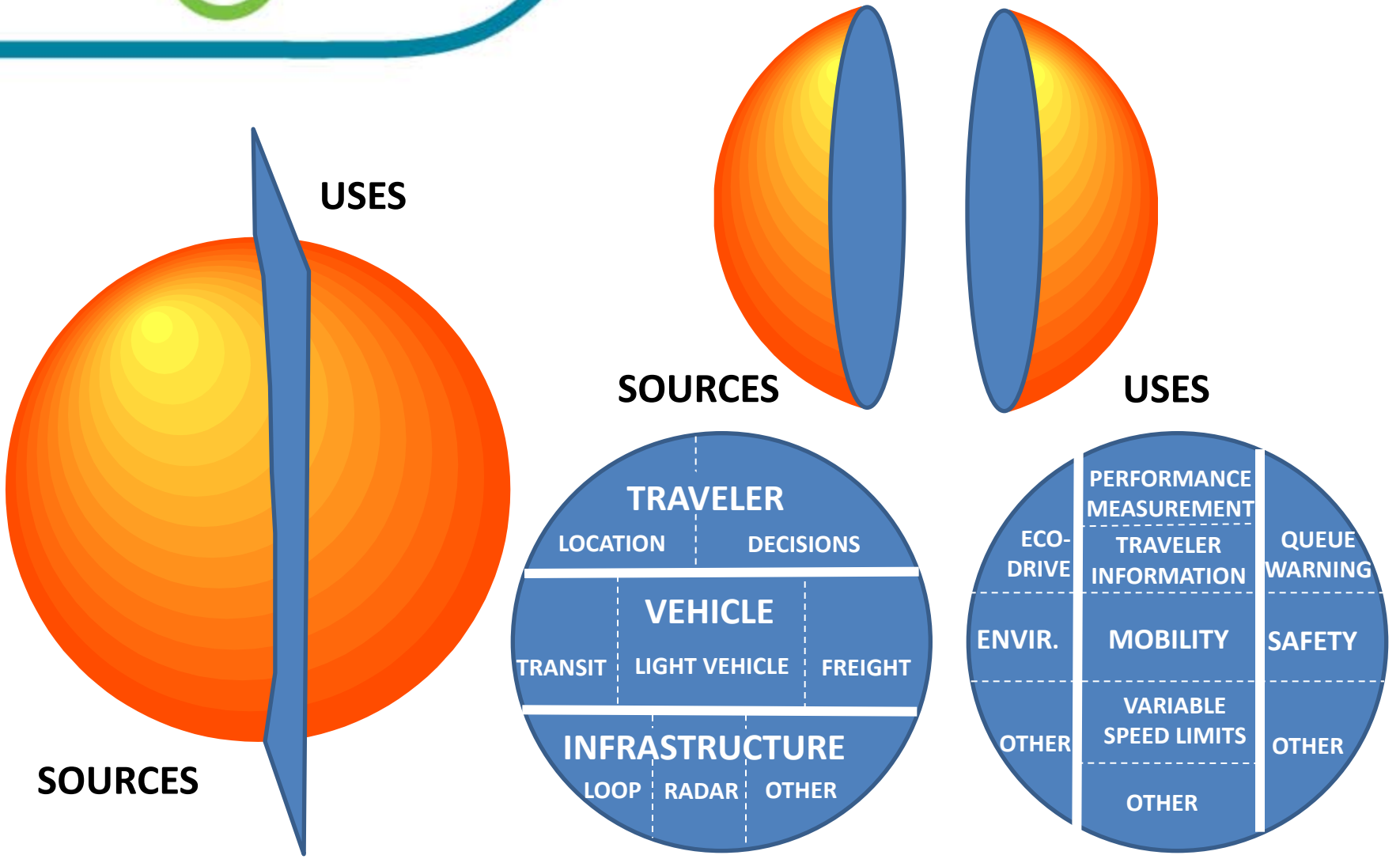
- well-organized collection of data of specific type and quality
- captured and stored at regular intervals from one or more sources
- systematically shared in support of one or more applications



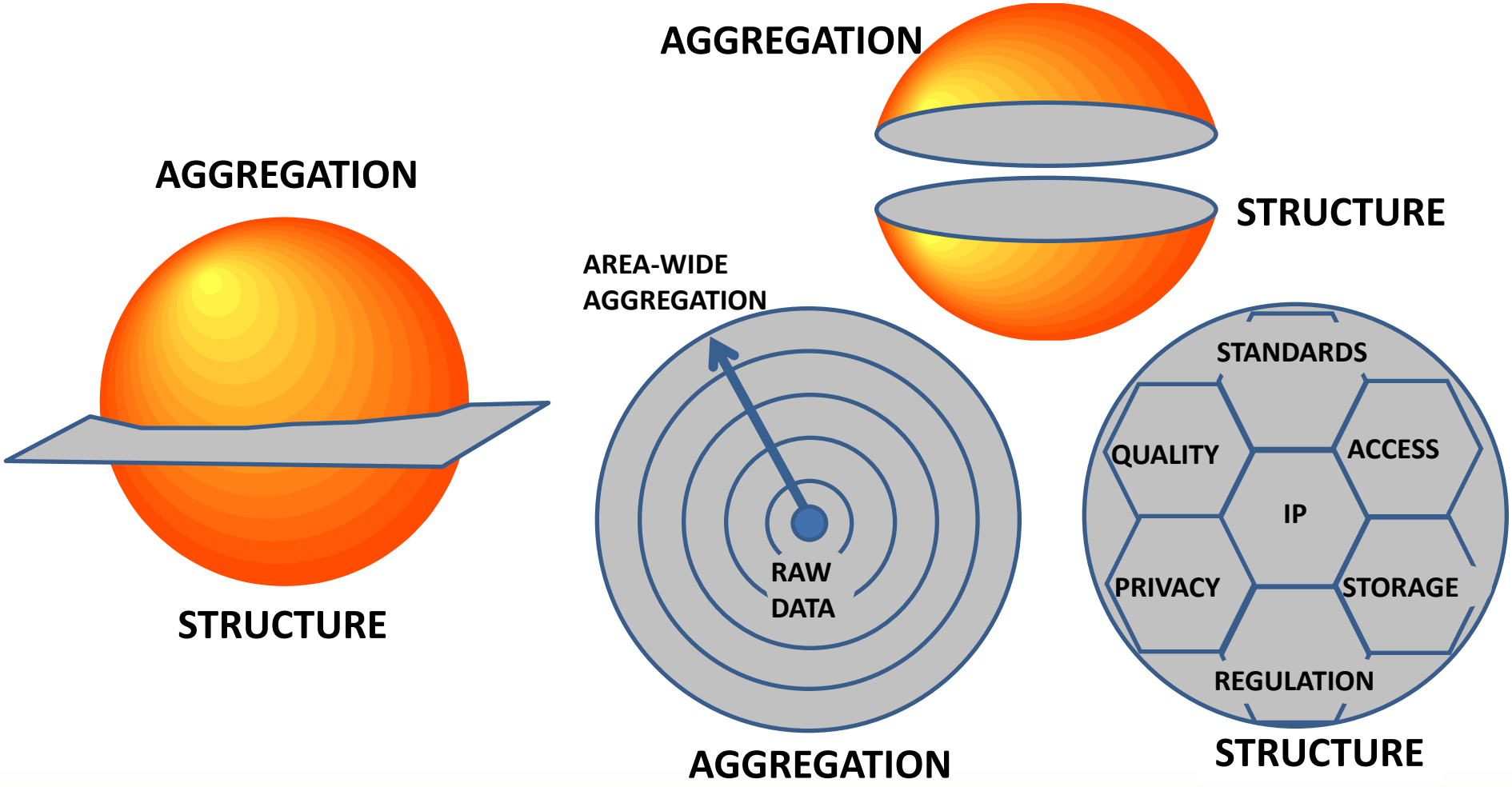
Key Issues in Defining A Data Environment



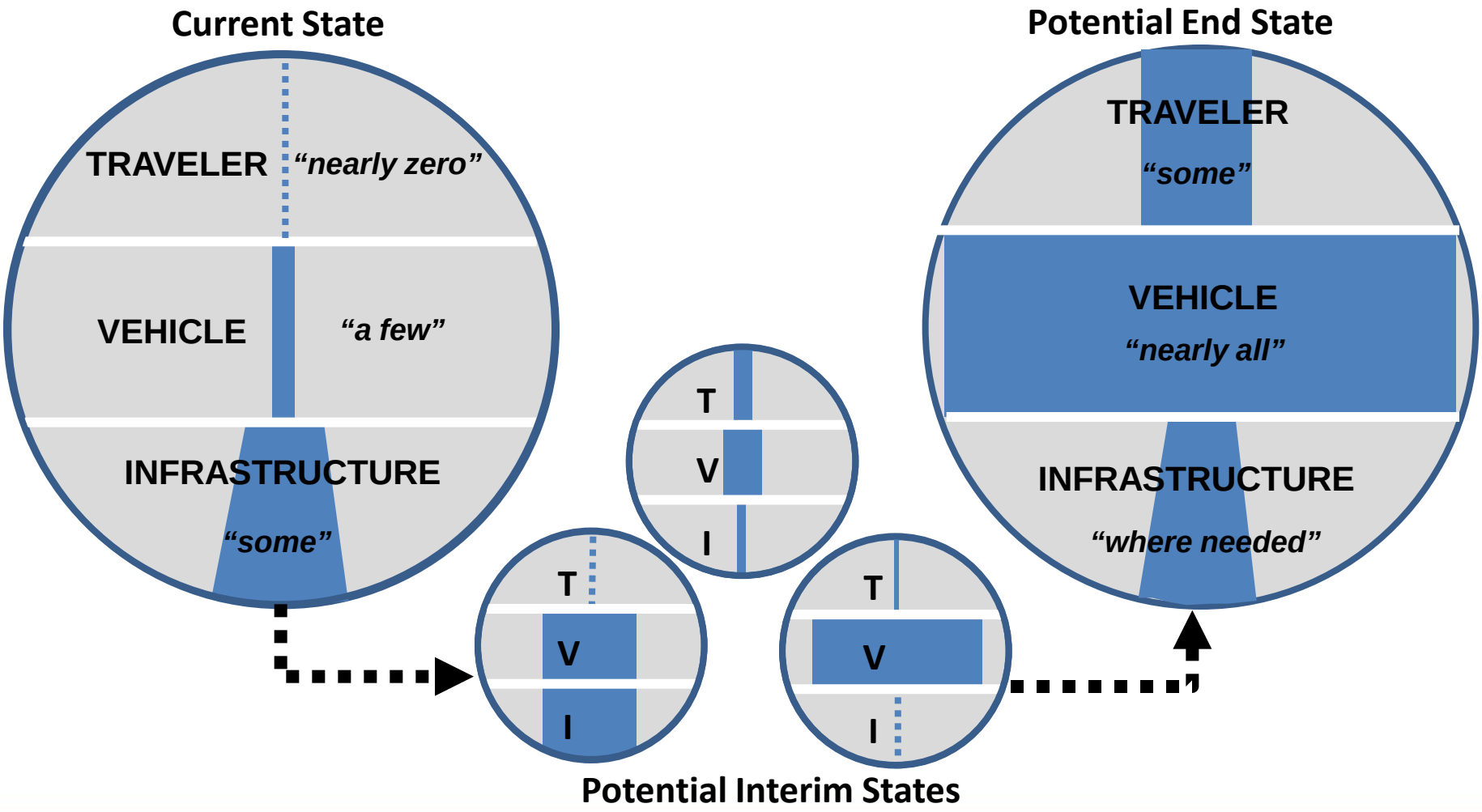
Data Sources and Uses



Data Aggregation and Structure

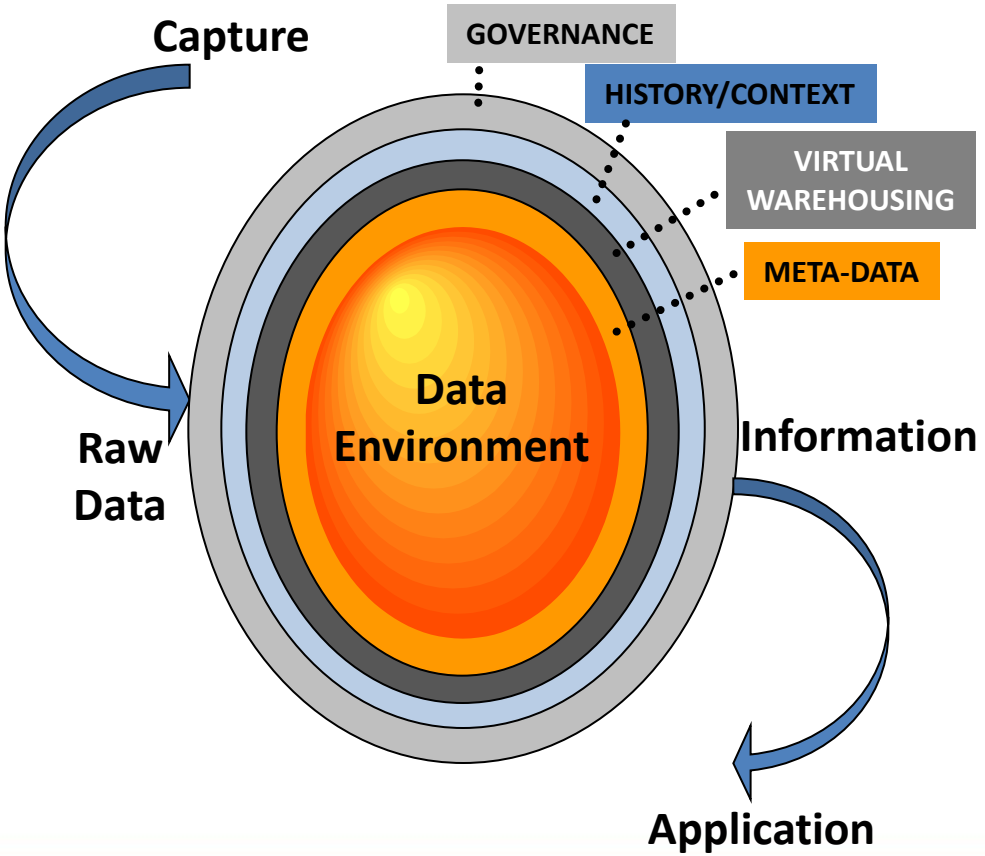


Data Environment Evolution



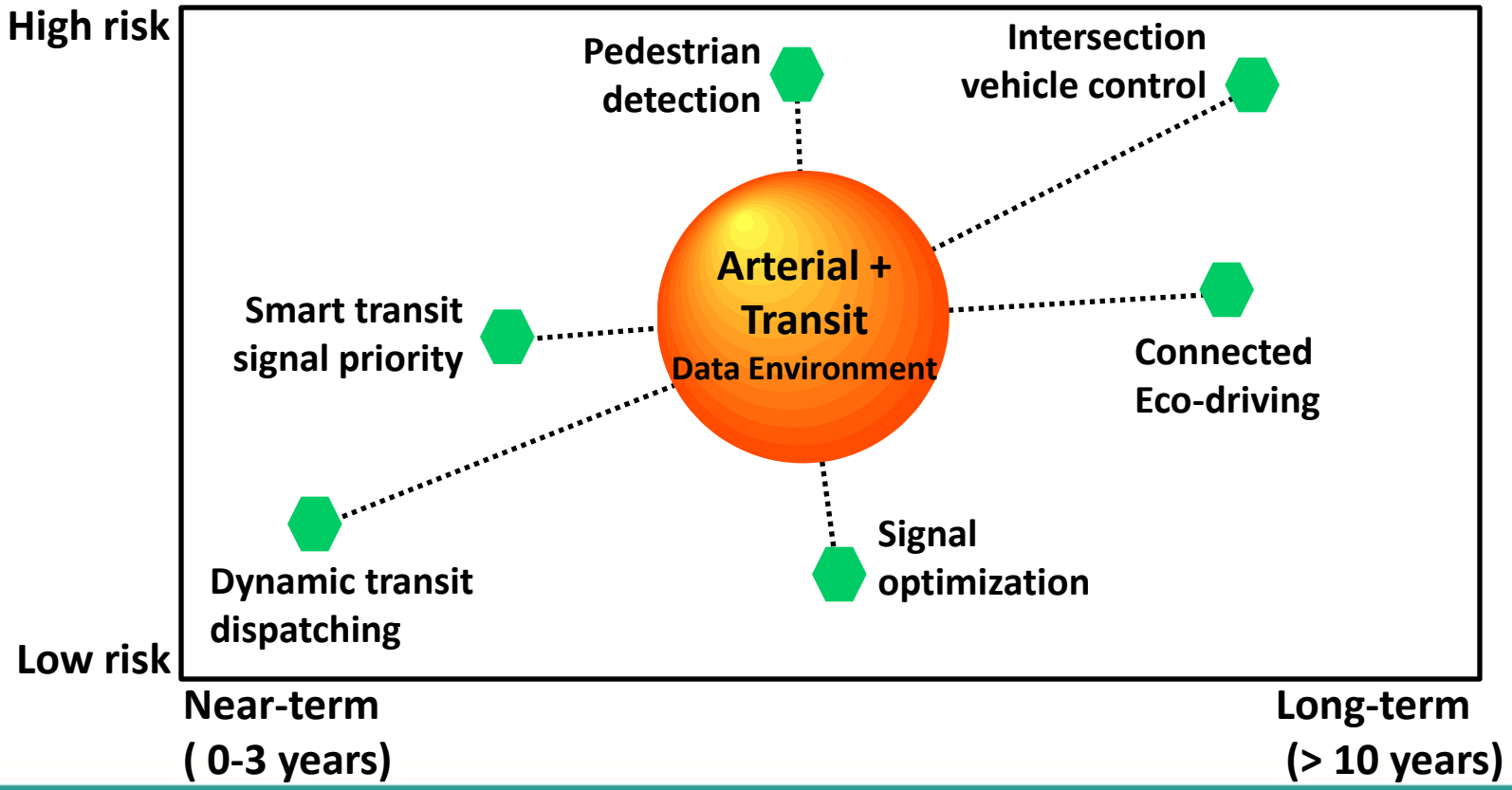
Elements of Data Capture and Management

- **Meta data**:
  - Provision of well-documented data environment
- **Virtual warehousing**:
  - Supports access to data environment and forum for collaboration
- **History/context**:
  - Objectives of data assembly
- **Governance**:
  - Rules under which data environment can be accessed and procedures for resolving disputes

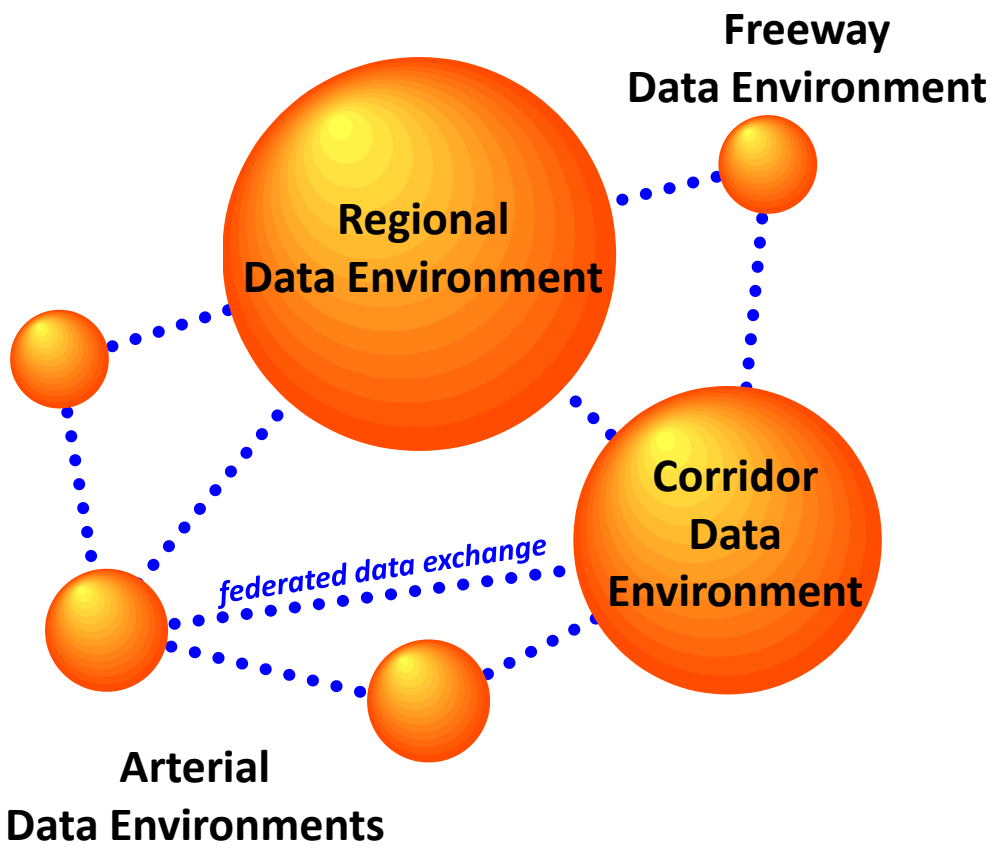


Each Data Environment Supports Multiple Apps

Overlapping data needs and synergy between application concepts

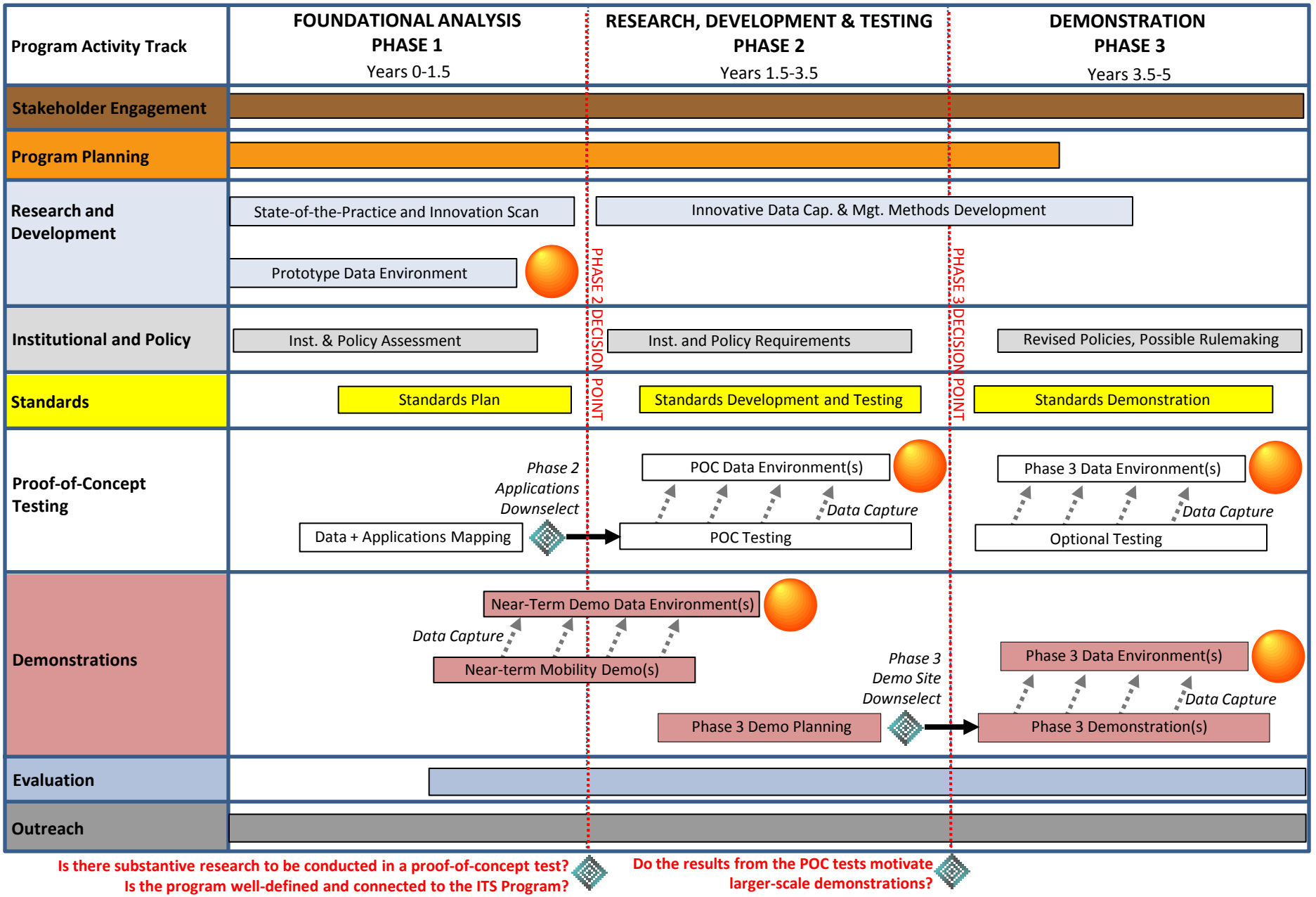


Federated Data Environments



- **Federated Data Systems**
  - Decentralized
  - Virtual
  - Independent
  - Heterogeneous
  - Systematic data exchange among federated environments
- **Each data environment supports a specific level of system control/decision**
  - For example, geographic (figure)
  - Might also be functional or jurisdictional, other

IntelliDrive℠ Data Capture and Management Program: High-Level Roadmap



High-Level Roadmap v1.0 (4/5/2010)

LEGEND: Decision point; Data Environment; Program Activity

Projected Program Outcomes

- Establish a system of IntelliDrive federated data environments
- Broad collaboration supporting data environment utilization
  - Leverage data to support high-priority application development
  - Encourage technical exchange between researchers
- Implementation of data management processes representing best practices

Current Projects and Program Products

- Current Projects
  - Technical State-of-the-Practice/Innovation Scan
    - USDOT Lead: Mohammed Yousuf (FHWA R&D)
    - Principal Investigator: Dick Mudge (Delcan)
  - Policy Assessment*
    - USDOT Lead: Walter During (FHWA Office of Operations)
    - Lead Researcher: Suzanne Sloan (Volpe Center)
  - Standards Assessment*
    - USDOT Lead: Tom Stout (FHWA)
    - Principal Investigator: Nu Rosenbohm (SAIC)
  - Data Environment Evaluation Framework
    - USDOT Lead: Walter During (FHWA)
    - Principal Investigator: Anita Vandervalk (Cambridge Systematics)
- Available Program Products
  - Program vision, other documents on IntelliDrive website
  - Prototype Data Environment

*Joint activity with Data Capture and Management Program

Data Capture Prototype Data Environment

- https://datacapture.noblis.org/

- Data (and meta-data) from the Michigan IntelliDrive Test Bed
  - Documented probe data samples from recent tests (POC/NCAR)
  - Open source analytical tools
  - Simulated 100% market penetration data for the test bed contributed by the University of Michigan Transportation Research Institute (UMTRI)
  - Forums for researchers to register projects, flag erroneous data, contribute analyses and data views

- Prototype objectives
  - Refine the Data Environment concept
  - Test key hypotheses about governance and user collaboration

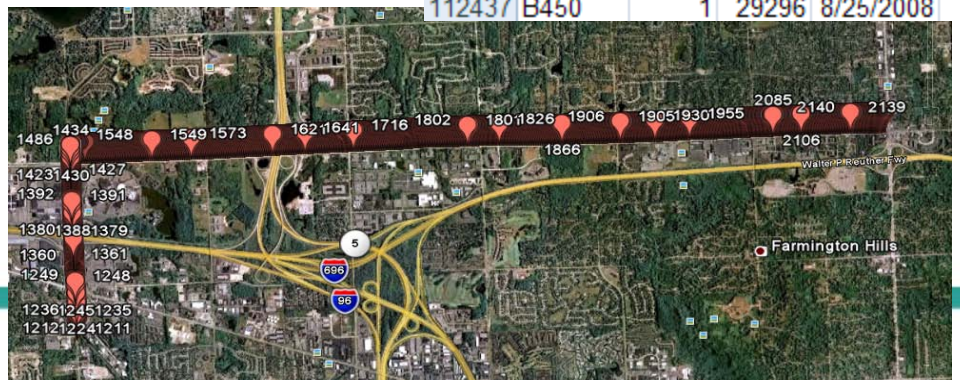
Log Files from Onboard Equipment (OBE)

```
1219244661807   Wed, 20 Aug 2008 15:04:21 GMT   B420    CommManagerOBE#1.14.2#34        34
1219244661807   Wed, 20 Aug 2008 15:04:21 GMT   B420    CommManagerOBE#1.14.2#34        34
1219244661820   Wed, 20 Aug 2008 15:04:21 GMT   B420    CommManagerOBE#1.14.2#34        34
1219244661820   Wed, 20 Aug 2008 15:04:21 GMT   B420    CommManagerOBE#1.14.2#34        34
1219244661826   Wed, 20 Aug 2008 15:04:21 GMT   B420    com.vii.delphi.probedata#4.6.2  45
1219244661827   Wed, 20 Aug 2008 15:04:21 GMT   B420    CommManagerOBE#1.14.2#34        34
1219244661835   Wed, 20 Aug 2008 15:04:21 GMT   B420    com.vii.delphi.probedata#4.6.2  45
1219244661842   Wed, 20 Aug 2008 15:04:21 GMT   B420    com.vii.delphi.probedata#4.6.2  45
1219244661898   Wed, 20 Aug 2008 15:04:21 GMT   B420    CommManagerOBE#1.14.2#34        34
1219244661944   Wed, 20 Aug 2008 15:04:21 GMT   B420    com.vii.delphi.probedata#4.6.2  45
1219244661965   Wed, 20 Aug 2008 15:04:21 GMT   B420    com.vii.delphi.probedata#4.6.2  45
,27,"Periodic",1219244648265,1219244661697,0,1219244661847,"2001:1890:110e:ba27:0000:0000:00
  thePosition {
    utcTime {
      year 2008,
      month 8,
      day 20,
      hour 15,
      minute 4,
      second 8
    },
    longitude -667487552,
    lat 339555236,
    elevation 3605,
    heading 55897,
    speed 1800,
    timeConfidence notEquipped
```

← Raw (Detailed) Log File

Trajectory Extract ↓

1	OBE_ID	logfile	line	date	time	secs	speed	long	lat	x-ft	y-ft
112427	B450	1	29190	8/25/2008	19:05:51	11883	63.3	-83.4321	42.48429	-22529649	15482951
112428	B450	1	29221	8/25/2008	19:05:52	11884	63.1	-83.4322	42.48404	-22529668	15482859
112429	B450	1	29256	8/25/2008	19:05:53	11885	62.9	-83.4322	42.48378	-22529684	15482766
112430	B450	1	29257	8/25/2008	19:05:54	11886	62.9	-83.4322	42.48353	-22529696	15482674
112431	B450	1	29262	8/25/2008	19:05:55	11887	62.6	-83.4322	42.48328	-22529704	15482582
112432	B450	1	29266	8/25/2008	19:05:56	11888	62.6	-83.4322	42.48302	-22529710	15482489
112433	B450	1	29267	8/25/2008	19:05:57	11889	62.6	-83.4322	42.48277	-22529716	15482397
112434	B450	1	29293	8/25/2008	19:05:58	11890	62.6	-83.4322	42.48252	-22529721	15482306
112435	B450	1	29294	8/25/2008	19:05:59	11891	62.4	-83.4321	42.48227	-22529728	15482214
112436	B450	1	29295	8/25/2008	19:06:00	11892	61.1	-83.4321	42.48202	-22529734	15482124
112437	B450	1	29296	8/25/2008	19:06:01	11893	58.4	-83.4321	42.48178	-22529742	15482036



← Trajectory Plot with Google Earth using

Also: extracts of snapshots in log file and RSE interaction events

Snapshots Collected by Roadside Equipment (RSE)

```
<probeVehicleData>
  <msgID><probeVehicleData/></msgID>
  <startVector>
    <utcTime>
      <year>2008</year>
      <month>8</month>
      <day>28</day>
      <hour>14</hour>
      <minute>54</minute>
      <second>50</second>
    </utcTime>
    <longitude>-667453355</longitude>
    <lat>339646020</lat>
```

XML Format (J2735 standard)

Parsed, spreadsheet format

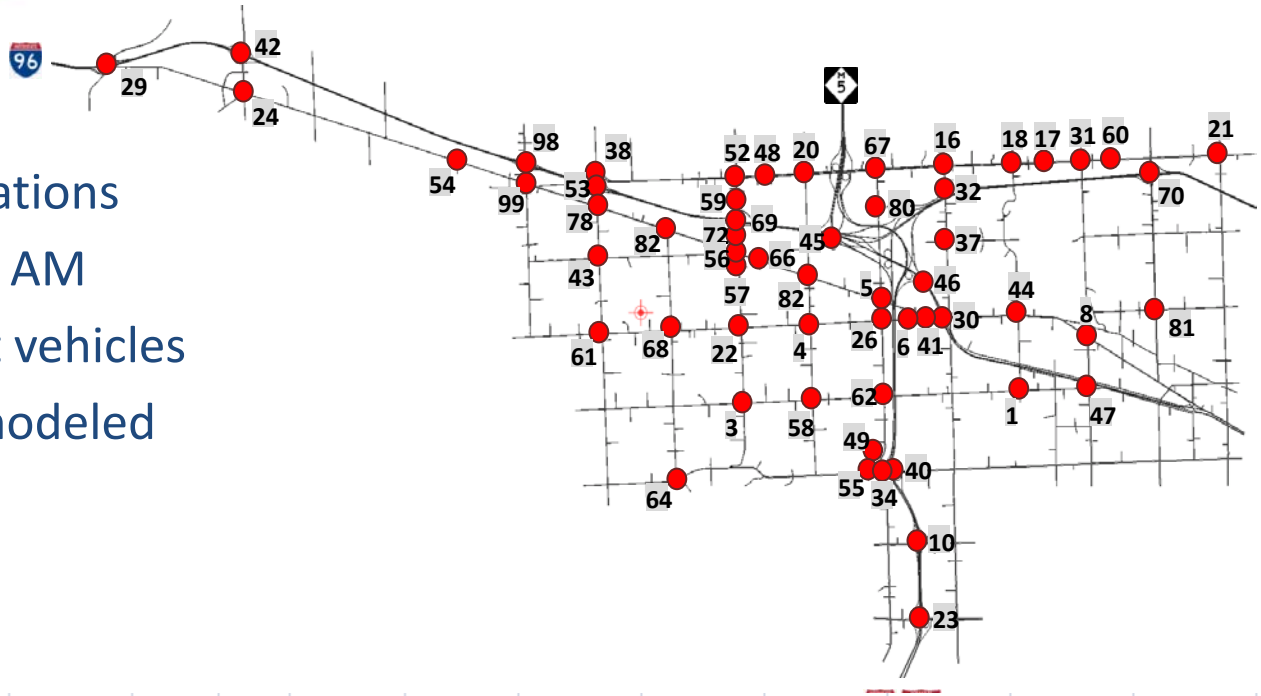
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	RSE#	date	file_name	date	time	SS#	serial#	lat	long	elevation	heading	speed	cntVSDTs	psn	lights	brake_st	brake_boost	abs
172	34	8/21/2008	14.28.28.00	8/21/2008	14:20:51	2	B422	339555826	-667488866	3649	5646	0	15	27337	NULL	NULL	notEquipped	notEquipp
173	34	8/21/2008	14.28.28.00	8/21/2008	14:21:06	1	B422	339555826	-667488866	3649	5646	0	15	27337	NULL	NULL	notEquipped	notEquipp
174	34	8/21/2008	14.28.28.00	8/21/2008	14:28:27	0	B422	339528960	-667484052	102491	38306	0	NULL	NULL	NULL	NULL	NULL	NULL
175	34	8/21/2008	14.28.40.00	8/21/2008	14:28:36	1	B422	339518706	-667489306	3482	34189	0	15	27337	NULL	NULL	notEquipped	notEquipp
176	34	8/21/2008	14.28.40.00	8/21/2008	14:28:37	0	B422	339517732	-667489452	102485	34098	0	NULL	NULL	NULL	NULL	NULL	NULL
177	34	8/21/2008	14.28.56.00	8/21/2008	14:27:35	4	B450	339555898	-667492440	3675	489	0	13	26754	NULL	NULL	notEquipped	on
178	34	8/21/2008	14.28.56.00	8/21/2008	14:27:50	3	B450	339555490	-667492340	3611	63120	82	13	26754	NULL	1111	notEquipped	on
179	34	8/21/2008	14.28.56.00	8/21/2008	14:28:05	2	B450	339557281	-667492733	3617	8160	429	13	26754	NULL	NULL	notEquipped	on
180	34	8/21/2008	14.28.56.00	8/21/2008	14:28:06	1	B450	339557446	-667492360	3614	11550	550	13	26754	NULL	NULL	notEquipped	on
181	34	8/21/2008	14.28.56.00	8/21/2008	14:28:53	0	B450	339534751	-667479633	102457	38455	0	NULL	NULL	NULL	NULL	NULL	NULL
182	34	8/21/2008	14.28.56.00	8/21/2008	14:26:35	4	B450	339555787	-667492510	3593	489	0	13	26754	NULL	NULL	notEquipped	on
183	34	8/21/2008	14.28.56.00	8/21/2008	14:26:50	3	B450	339555992	-667492568	3641	489	0	13	26754	NULL	NULL	notEquipped	on

Trajectory Conversion Analysis (TCA) Program

- Open Source Python program
- Inputs
  - Vehicle Trajectory Files (Actual or Simulated)
  - RSE locations and range
  - Parameters for snapshot generation & transmission
- Outputs
  - Snapshots generated and transmitted to RSEs
  - Snapshots discarded for buffer overflow or RSE gap
  - Probe segment number changes

UMTRI Paramics Simulation of the Testbed

- 189 Origin/Destinations
- Models 6 AM – 11 AM
- 10,000 concurrent vehicles
- RSE interactions modeled



UMTRI Paramics IntelliDrive Simulator
RSE-specific snapshots output
Simulation executed with Paramics version 6.60

Year	Month	Day	Hour	Min	Sec	Time	RSE_Nam	VehID	Type	PSN	SnapYear	Snaptime	Long	Lat	XPos	YPos	ZPos
-	-	-	h	min	s	s	-	-	-	-	-	s	-	-	m	m	m
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	3932749	2010	21511.5	-83.4308	42.45356	-22304.1	6921.34	260.06
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	3932749	2010	21521.5	-83.4309	42.45504	-22302.2	7084.76	260.23
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	6775253	2010	21543.5	-83.4309	42.45799	-22298.5	7412.9	260.57
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	6775253	2010	21547.5	-83.4309	42.45824	-22298.2	7440.58	260.59
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	6775253	2010	21551.5	-83.4309	42.45851	-22297.9	7469.95	260.62
2010	6	17	6	0	0.6	21600.6	RSE 26	32518	1	6775253	2010	21555.5	-83.4309	42.45885	-22297.5	7507.71	260.66

- Prototype Data Environment: IntelliDrive Michigan Test Bed
  - Sample
  - POC
  - NCAR 2009
  - NCAR 2010
  - All Data
- Submit Project
- Projects
- Forums
- Members
- Website Links
- Create content
- Recent posts
- My account
- Log out

Administrator

- Projects Pending Approval

Search

POC Data Files

The first major set of trials conducted at the DTE was the Proof of Concept (POC)[i] trials during 2008. The POC trials featured fifty-two RSEs within 45 square miles, 27 vehicles configured with OBEs, and a Dedicated Short-Range Communications (DSRC) network. The testing program had three major phases: subsystem test, system integration and test, and public and private applications test. The public application testing portion of the POC trials were conducted during August 2008. RSE data for the public application tests were available for eight days in August 2008. The data in this prototype data environment consists of RSE and OBE data for the middle six of these days. These six days were chosen for inclusion in the data environment because the first and last days had much higher number of duplicate records and questionable data values.

Please select a file type or IntelliDrive type to filter the list.

File Type Processed **IntelliDrive Type** OBE Apply

Data File Group	Type	Download Files
Nodes and Links in Trajectory File	Meta	Description of Nodes and Link used in OBE Trajectory Files Nodes and Link Map
OBE File Documentation	Documentation	Documentation of OBE log files and Three Files Derived from them Documentation of fields in the derived OBE Event files Documentation of fields in the derived OBE Snapshot files Documentation of fields in the derived OBE Trajectory files
OBE ID Information	Meta	OBE IDs used for the POC and NCAR 2009 Trials OBE IDs used for the POC, NCAR 2009 and 2010Trials

Upcoming Activities

- Precise nature, extent and timing are not yet known, however, the program expects to procure assistance in the following areas:
  - Test Data Sets
    - Assemble already collected data sets featuring multi-source data collected using emerging technologies
    - Supports early application research
  - Data Environment Development
    - Develop and make available data environments supporting high-priority applications research and development
  - Federated System Data Manager
    - Connect, foster and manage system of federated data environments

Key Issues

- *Intellectual property rights*
- *Privacy*
- *Governance*
- *Standards and Regulation*
- *Meta-Data*
- *Quality Assurance*
- *Storage*
- *Access and Security*
- *Operations and Maintenance*

Questions?

- *Thank you*