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WELCOME

U.S. Department of Transportation

Office of the Assistant Secretary for Research and Technology

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Federal Transit Administration

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ITS Transit Standards
Professional Capacity Building Program

Module 2:
Transit Management Standards, Part 1 of 2

Instructor

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Target Audience

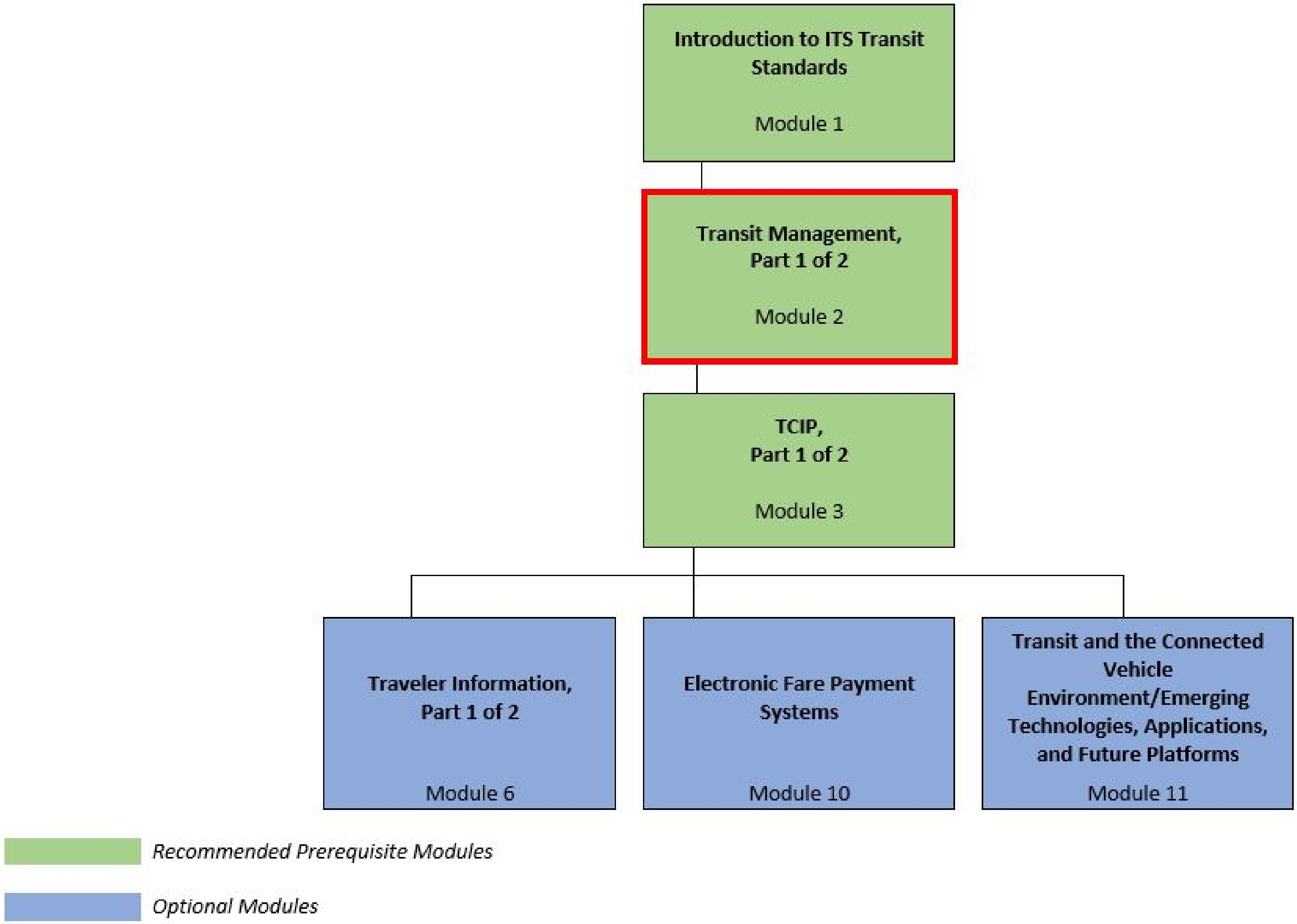
- Transit management staff (e.g., department heads and senior management) who are considering introducing or upgrading technology to meet operational and customers' needs;
- Transit agency procurement and grants staff; and
- Transit technology vendors and consultants.

Recommended Prerequisite(s)

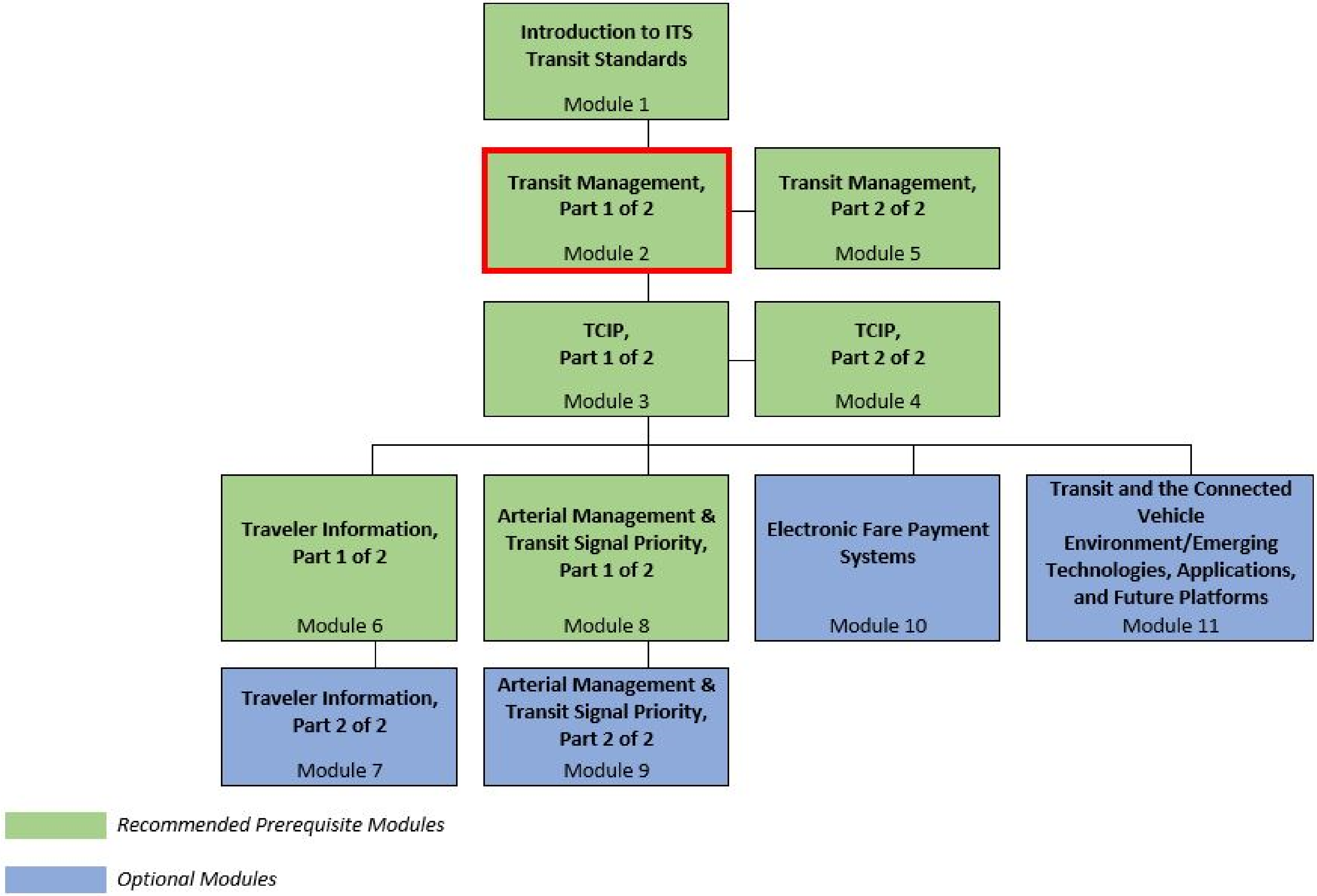
	Decision-Maker	Project Manager	Project Engineer
Module 1: Introduction to ITS Transit Standards	✔	✔	✔

- Recommend prior knowledge includes:
  - General understanding of transit technology used in operations, planning, and maintenance
  - Basic understanding of transit-related portions of the National ITS Architecture

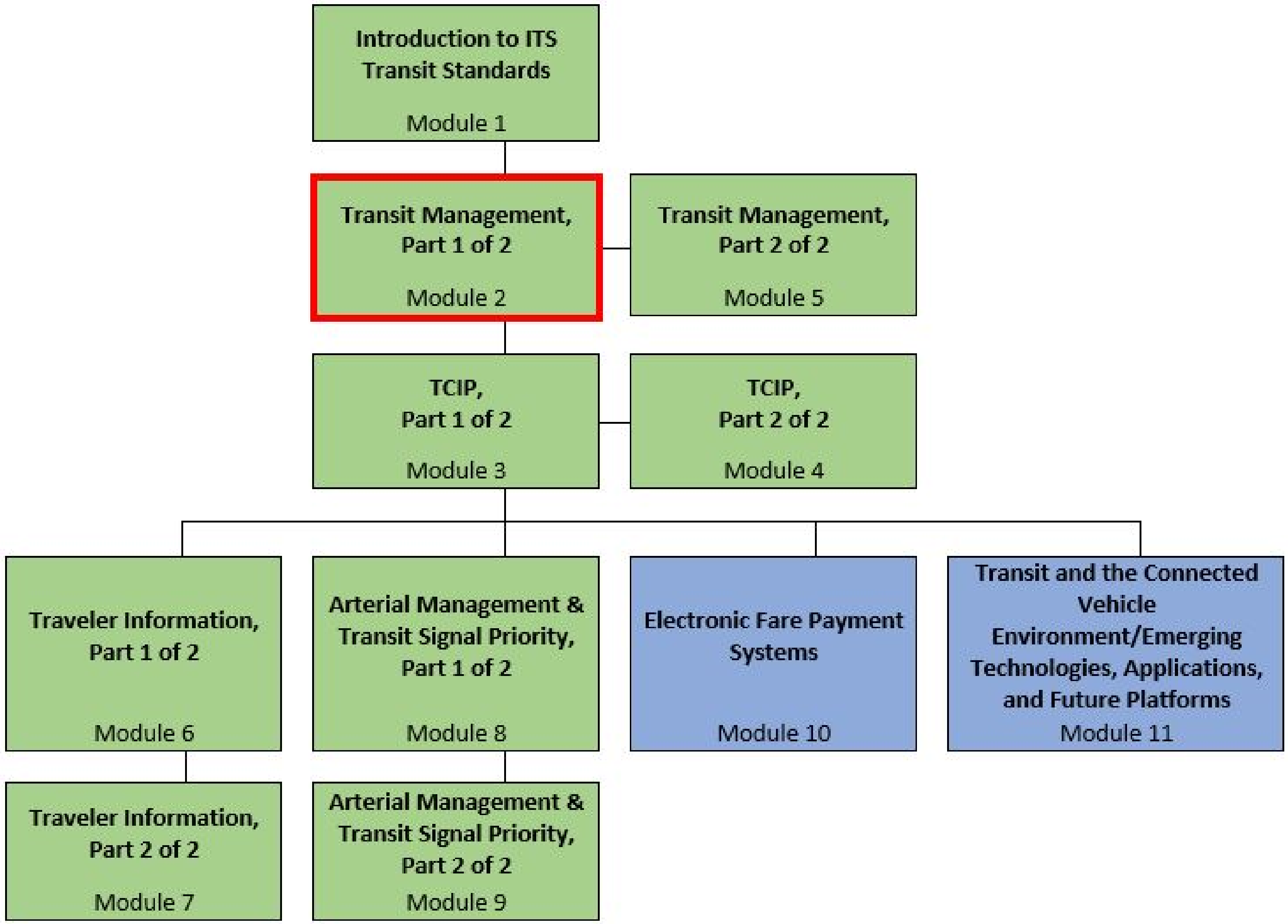
Curriculum Path (Decision-Maker)



Curriculum Path (Project Manager)



Curriculum Path (Project Engineer)



Recommended Prerequisite Modules

Optional Modules

Learning Objectives

1. Describe (in overview terms) how transit management functions and systems fit into the National ITS Architecture

2. Describe the core functions and taxonomy of Transit Management systems

3. Briefly describe the functions of systems within the Transit Management taxonomy, and briefly identify the relationships and data exchange among Transit Management systems, Traveler Information, Transit Signal Priority, and Fare Collection systems

4. Explain the role of systems engineering and standards in procurement

Learning Objective #1: Describe (in overview terms) how transit management functions and systems fit into the National ITS Architecture

- Brief review of key concepts of National ITS Architecture (using Module 1 as a reference), including National ITS Architecture layers
- Explain Public Transportation Service Packages
- Explain related Service Packages (e.g., Interactive Traveler Information)

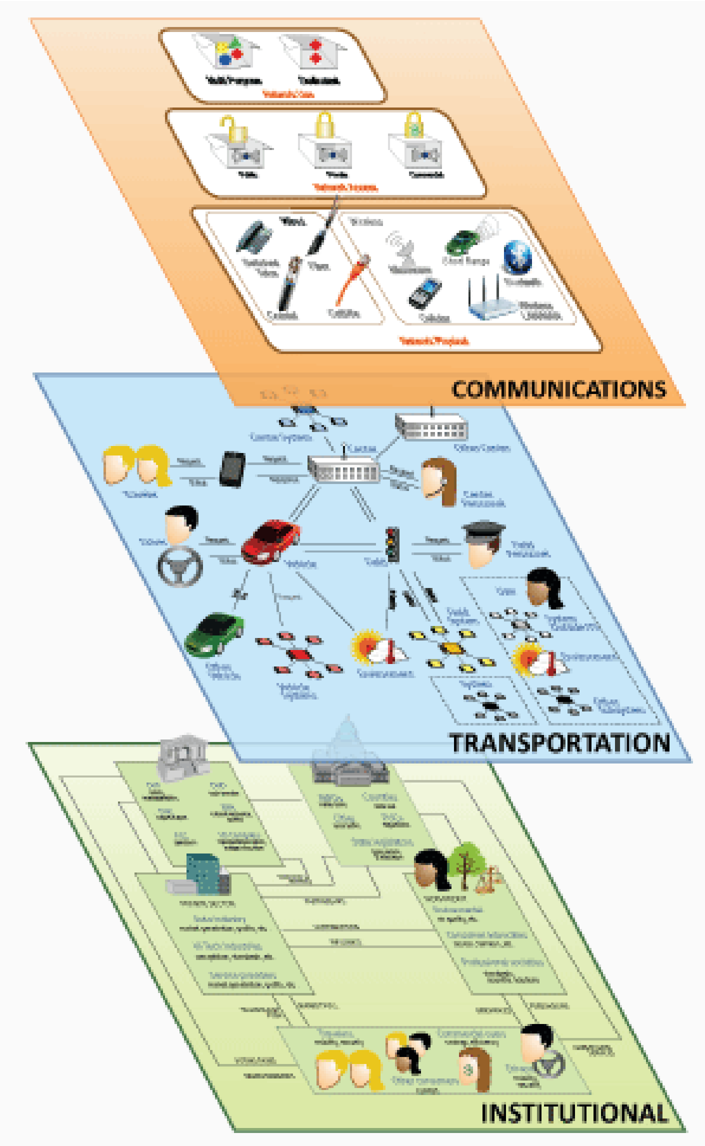
National ITS Architecture

- Provides a common framework for planning, defining, and integrating ITS
- The Architecture defines:
  - The functions that are required for ITS
  - The physical entities or subsystems where these functions reside
  - The information flows that connect these physical subsystems
- Template for the development of Regional ITS Architectures

Architecture Layers

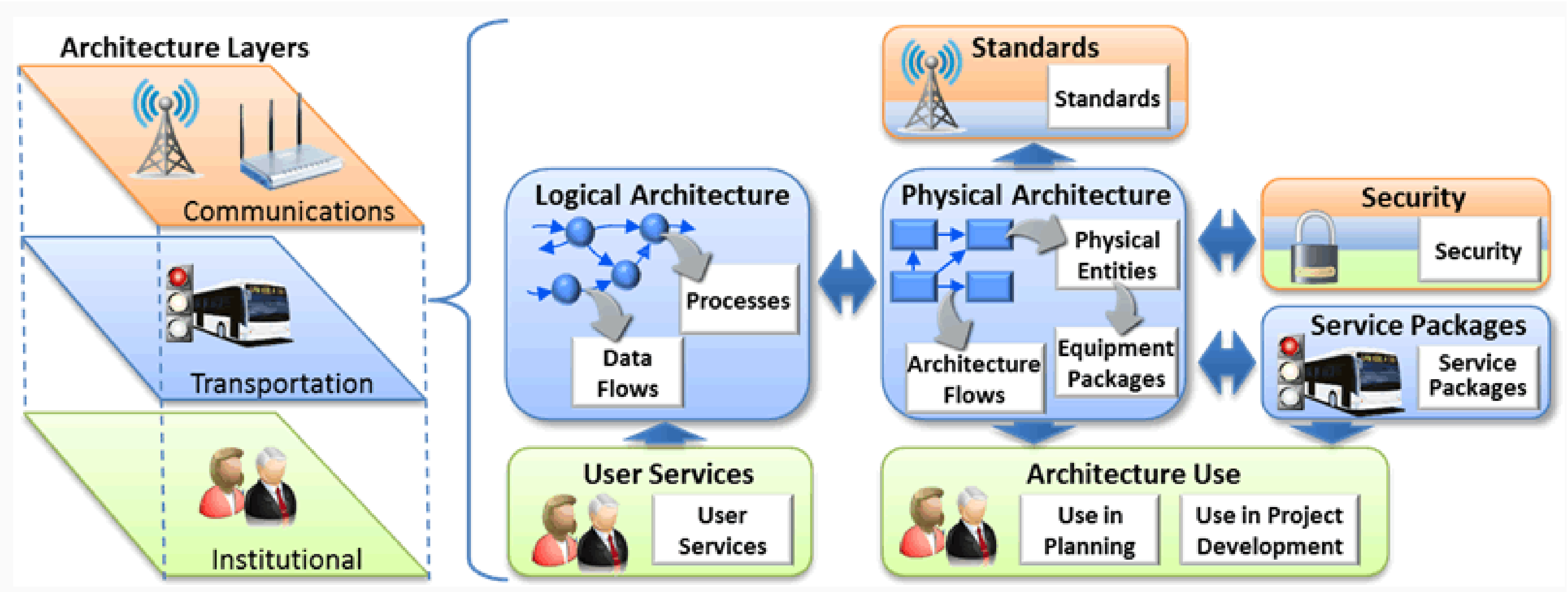
Main Point: *Architecture framework comprised of two technical layers, which must operate in the context of an Institutional Layer.*

- **Institutional Layer** – institutions, policies, funding mechanisms and processes required for effective ITS implementation, operation, and maintenance. Shown as base because solid institutional support and effective decisions are prerequisite to an effective ITS program
- **Transportation Layer** – where transportation solutions defined
- **Communications Layer** provides for accurate and timely exchange of information between systems to support transportation solutions



Architecture View

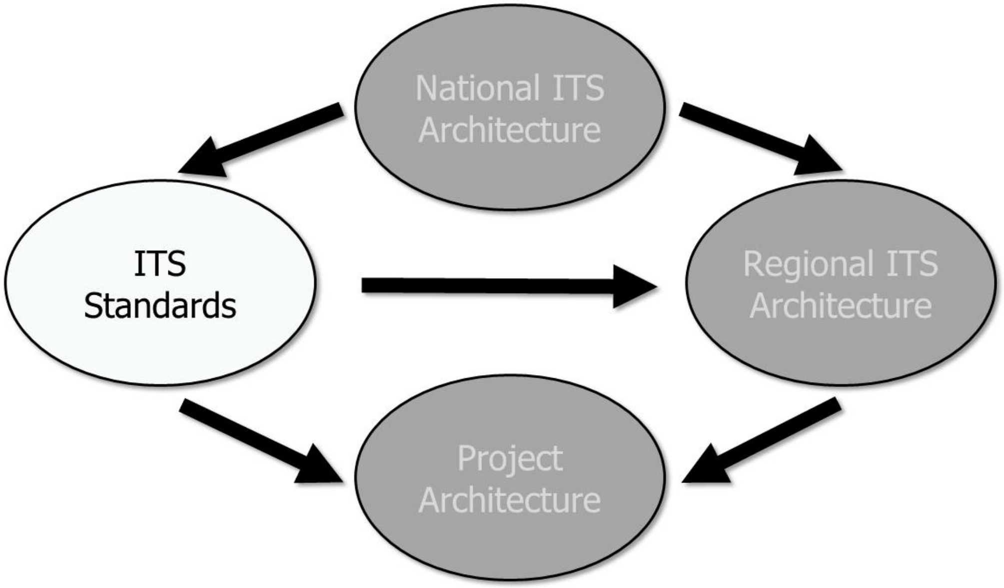
Main Point: *Interconnected presentation of all of the components of the National ITS Architecture*



Purpose of Standards in an Architecture

Main Point: *Standards have a role in the National ITS Architecture as well as Regional ITS Architectures and Project Architecture*

- Fundamental to open ITS environment
- Facilitate deployment of interoperable systems
- This figure shows relationship between ITS standards and architectures



Service Packages (SPs)

- Represent slices of Physical Architecture
- Collects subsystems, equipment packages, and architecture flows that provide desired service
- There are 11 public transportation SPs:
    - Transit Vehicle Tracking
    - Transit Fixed-Route Operations
    - Demand Response Transit Operations
    - Transit Fare Collection Management
    - Transit Security

Service Packages (SPs) (cont.)

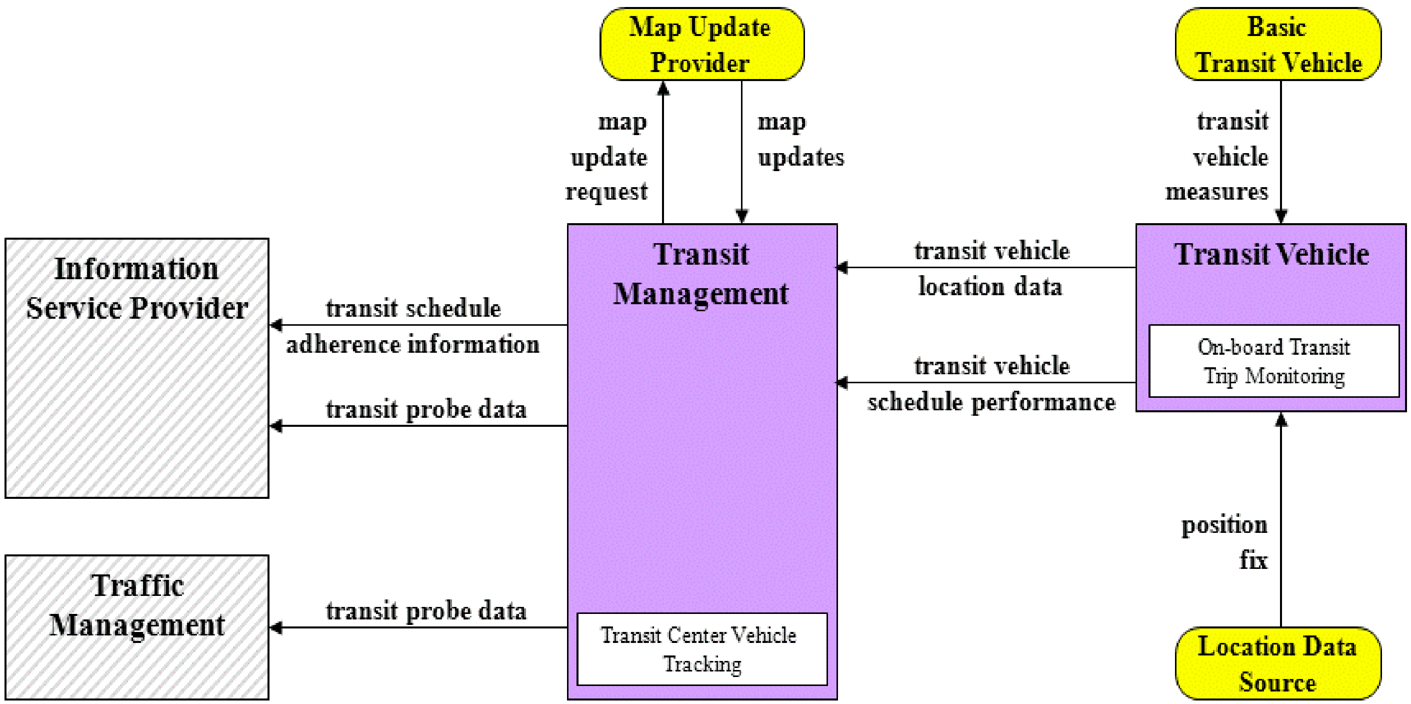
(11 public transportation SPs cont.)

- Transit Fleet Management
- Multi-modal Coordination
- Transit Traveler Information
- Transit Signal Priority
- Transit Passenger Counting
- Multimodal Connection Protection

Transit Management Service Package Example

Main Point: *An example of one transit SP diagram*

APTS01 – Transit Vehicle Tracking



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What is the purpose of ITS standards?

Answer Choices

a) To keep up with technology

b) Interoperability, compatibility, and interchangeability

c) To document data exchange among ITS systems

d) All of the above

Review of Answers

a) To keep up with technology

Incorrect. Standards do not necessarily help agencies keep current with technology.

b) Interoperability, compatibility, and interchangeability

Correct! Standards and protocols provide for interoperability, compatibility and interchangeability.

c) To document data exchange among ITS systems

Incorrect. Standards facilitate data exchange but do not necessarily document the data exchange among ITS systems.

d) All of the above

Incorrect. All of the above do not explain the purpose of ITS standards.

Which of these are not public transportation service packages?

Answer Choices

a) Transit Vehicle Tracking

b) Multimodal Connection Protection

c) Multimodal Coordination

d) Traffic Metering

Review of Answers

a) Transit Vehicle Tracking

Incorrect. This SP is a Public Transportation SP.

b) Multimodal Connection Protection

Incorrect. This SP is a Public Transportation SP.

c) Multimodal Coordination

Incorrect. This SP is a Public Transportation SP.

d) Traffic Metering

Correct! It is not defined as a Public Transportation SP (it is in the Traffic Management group of SPs).

Summary of Learning Objective #1

How Transit Management Functions and Systems Fit into the National ITS Architecture

- Key concepts of National ITS Architecture:
  - Layers: Institutional, Transportation, and Communications
  - User Services (US) – 4 public transit-specific US
  - Logical Architecture
  - Physical Architecture
  - Equipment Packages
  - Service Packages (SPs) – 11 Transit SPs
- Allows tailoring at the local level
- Accommodates changes in technology or institutional arrangements over time

Learning Objective #2: Describe the Core Functions and Taxonomy of Transit Management Systems

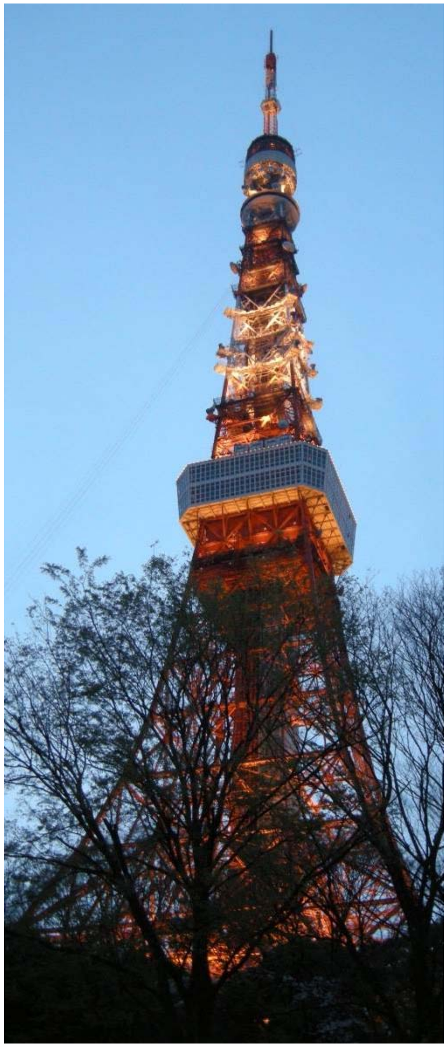
- **Fleet Operations and Management** – facilitate transit operations and provide input to senior management in terms of system performance
- **Safety and Security** – improve safety and security of transit staff and passengers
- **Maintenance** – facilitate maintenance activities such as engine and vehicle component monitoring, tracking of scheduled and unscheduled maintenance activities, inventory systems, and fuel management
- **Data Management** – data management and reporting, technology integration, geographic information system (GIS) application, service coordination facilitated by technology, and open data for third-party application development

Fleet Operations and Management

- Communications technologies
- Automatic vehicle location (AVL)
- Computer-aided dispatch (CAD)
- Automatic passenger counters (APCs)
- Scheduling (fixed-route and paratransit) systems
- Transfer connection protection (TCP)
- Transit signal priority (TSP)
- Yard management
- Intelligent vehicle technologies (e.g., collision warning and precision docking)
- Lane control technologies

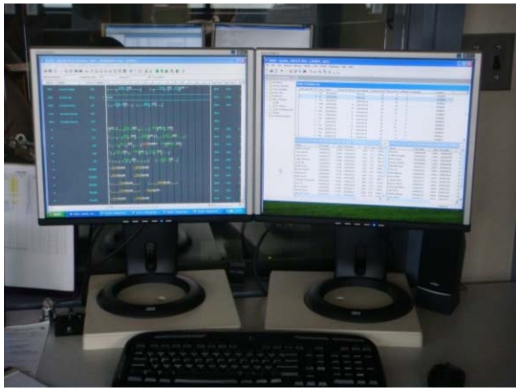
Communications Technologies

- Depend on infrastructure and devices used to transmit voice and data
- Can transmit voice, text, data, and video over radio, cellular, or other wireless networks
- Types of wireless networks:
  - Wide area wireless (WAW)
  - Wireless local area network (WLAN)
  - Dedicated short-range communications (DSRC)
  - Land line and cellular telephone networks
  - Internet and intranet



Automatic Vehicle Location (AVL) and Computer-Aided Dispatch (CAD)

- For operations management – periodically receives real-time updates on vehicle locations and schedule/route status
- Onboard computer with global positioning system (GPS) and mobile data communications
- Provides decisions support tools used by dispatchers and supervisors, allowing proactive management of operations
- Allows for "single point" logon for all onboard systems



Automatic Passenger Counters (APCs)

- Monitors passenger activity by counting number of boarding and alighting passengers
- Data can either be stored for downloading/uploading or transmitted in real-time
- Most common type is infrared technology
- Ability to "stamp" data with exact bus stop location and time of day through integration with AVL
- Real-time information used for conditional TSP
- Can reduce cost of manual data collection and National Transit Database reporting requirements
- Agencies typically deploy APC equipment on either:
  - 12–25% of their vehicles and then rotate the vehicles on different routes as needed; or
  - All vehicles, especially when new buses are purchased

Scheduling Software

INPUTS	<u>Service Configurations</u> • Route Structure • Span of Service • Service Frequencies • Time Points • Terminal Points	<u>Work Rules concerning:</u> • Layover Recovery Time • Interlining • Deadhead Time	<u>Work Rules concerning:</u> • Min & Max Platform Hours • Report & Turn in Allowances • Spread Time and Penalty • Relief Points & Allowance • Make-up Allowance • Run Type Percentages	<u>Work Rules concerning:</u> • Type: Agency Developed vs. Cafeteria Style • Min Work Hours/Week • Max Work Hours/Day • Days Off/Week • Extra Board Procedures • Seniority Lists
OUTPUTS	**Trip Building** <u>Time Tables that consider:</u> • Cycle Times • No, of Vehicles required • Running Times • Timed Transfers • Layover/Recovery Time • Layover Locations • Interlining	**Blocking** <u>Blocking Sheets that include:</u> • Block Numbers • Pull-out Pull-in Times • Trip Numbers • Terminal Departure and Arrival Times • Layover/Recovery Time <u>Block Summary Recap</u> • Platform Hours <u>Blocking Graphs</u>	**Runcutting** <u>Run Guide that includes:</u> • Block Assignments • Pull-out/Pull-in Times • Time On and Off Bus • Platform Hours • Total Spread Time • Report Allowance • Turn-in Allowance • Relief Allowance • Make-up Allowance • Work Hours • Overtime • Spread Penalty • Pay Hours	**Rostering** <u>Operator Schedule that includes:</u> • Run Number • Daily and Weekly Pay Hours • Days Off • Weekday, Saturday, and Sunday Schedules

Transfer Connection Protection (TCP)

- Triggered when vehicle operator of incoming vehicle makes transfer request using on-board mobile data terminal (MDT) to enter outgoing route
- Central system determines whether outgoing vehicle can and should be held based on estimated arrival time of incoming vehicle
- Central system will notify:
  - Incoming vehicle's operator whether outgoing vehicle will be held
  - Outgoing vehicle's operator if it is to hold, until what time, and for what route
- Dispatcher reviews current pending transfers
- Will have expanded functionality within an application of Integrated Dynamic Transit Operations (IDTO) bundle of applications within USDOT Connected Vehicle Program

Transit Signal Priority (TSP)

- Give authorized transit vehicles ability to automatically change the timing of traffic signals using these strategies:
  - Passive Priority
  - Active Priority
  - Operating in Real-Time
- Can be limited to extending green cycle, but can result in red cycle truncation and phase insertion
- May be done “conditionally” based on passenger load, type of service (Bus Rapid Transit (BRT) vs. local) and schedule adherence

Transit Signal Priority (TSP) (cont.)

- Interaction of four major elements:
  - Transit vehicle
  - Transit fleet management
  - Traffic control
  - Traffic control management
- Enhanced with four functional applications of vehicle detection, priority request generation (PRG), priority request server (PRS), and TSP control

Yard Management

- Automatically locates vehicles within certain distance accuracy inside yard
- Allows yard attendants to adjust vehicle locations manually on a yard map
- Provides interface with CAD/AVL system to record pull-in and pull-out time, and assigned vehicle operators
- Can be interfaced with fixed-route scheduling software to access vehicle operator information in real-time

Intelligent Vehicle Technologies

- Rear Impact Collision Warning System
- Side Collision Warning/Object Detection System (aka Lane Change and Merge Collision Avoidance)
- Frontal Collision Warning System
- Intersection Conflict Warning System
- Lane Change/Merge Warning System
- Pedestrian Collision Warning

Intelligent Vehicle Technologies (cont.)

- Vehicle Assist and Automation (VAA):
  - Lateral Guidance (aka lane keeping for operating on narrow rights-of-way, such as freeway shoulders)
  - Vehicle Platooning
  - Precision Docking
  - Automated Operations

Lane Control Technologies

- Bus shoulder riding
- Intermittent bus lane (IBL)/moving bus lane (MBL)
  - Restricted lane for short time intended to be activated only when flow of general traffic is operating below speed that inhibits bus transit speeds
  - When traffic conditions are not expected to cause delays to bus, intermittent bus lanes are not activated
  - AVL required to establish bus location ties into variable message signs (VMS) to inform drivers of lane restriction and integration into real-time ITS traffic monitoring systems

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Which one of these technologies are included in the fleet operations and management category?

Answer Choices

a) On-board automated voice announcements

b) Scheduling software

c) Data management and reporting

d) All of the above

Review of Answers

a) On-board automated voice announcements

Incorrect. This technology is not included in any of the four categories in the taxonomy.

b) Scheduling software

Correct! This technology is included in the Fleet Operations and Management category.

c) Data management and reporting

Incorrect. This technology is included in the Data Management category.

d) All of the above

Incorrect. These technologies are included in multiple categories in the taxonomy.

Safety and Security

- Mobile (On Board and Exterior) and Fixed Video Surveillance
- Covert Emergency Alarm and Covert Live Audio Monitoring
- On-board Digital Video Recorders (DVRs)
- G-force Monitoring

Mobile (onboard and exterior) and Fixed Video Surveillance

- Review recorded images
- Potential crime prevention
- Identify criminal activity and perpetrator(s)
- Identify improper passenger and driver behavior
- Incident/insurance investigation

Covert Emergency Alarm and Covert Live Audio Monitoring

- Allows dispatchers to listen in on what is happening inside vehicle while an incident is taking place
- Covert microphones are one-way communications in order not to alert person responsible for incident that dispatcher/police are listening in
- Driver in distress presses a covert switch that activates the covert microphone and monitor in dispatcher's office automatically displays the information for that vehicle and map display zooms in on that vehicle

Onboard Digital Video Recorders (DVRs)

- Connected to onboard cameras to record images from cameras
- Equipped with removable recording drive to allow playback of recorded video on centrally located playback system
- Able to store specific number of days of video, beyond which, previously recorded video will be overwritten
- May have capability to use Wi-Fi to upload video once vehicle enters yard or garage

G-Force Monitoring

- System includes g-force sensor and electronic data logger to capture and provide information about unusual movement of transit vehicles and capture events such as vehicle turns, hard braking, and fast acceleration or deceleration
- G-force data can:
    - Assist in accident reconstruction and analysis
    - Protect transit agencies from litigation
    - Reduce cost of insurance
    - Analyze operator actions
    - Identify maintenance issues

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Which of these technologies are in the safety and security category?

Answer Choices

a) G-force monitoring

b) Data management

c) Geographic information systems

d) Traveler information

Review of Answers

a) G-force monitoring

Correct! This technology is included in the Safety and Security category.

b) Data management

Incorrect. This is one of the categories and not included in the Safety and Security category.

c) Geographic information systems

Incorrect. This is included in the Data Management category.

d) Traveler information

Incorrect. This is not included in any of the four categories in the taxonomy.

Maintenance

- Engine and drivetrain systems monitoring
- Maintenance software to schedule and track scheduled and unscheduled maintenance activities, and manage parts inventory
- Fuel management system

Engine and Drivetrain Systems Monitoring (a.k.a. vehicle component monitoring)

- Sensors that monitor various components of vehicle and report back on components performance
- Maintenance supervisors can use this information to perform preventive maintenance intervention before a minor problem becomes major and costly one
- Monitoring performed in real-time and problems are reported instantly

Maintenance Software

- Facilitates the scheduling of maintenance activities
- Tracks maintenance actions
- Manages parts inventory
- Assists with:
  - Work order management
  - Tire management
  - Driver reporting
  - Mechanic/ technician tracking
  - Purchase order generation
  - Customer/ departmental billing
  - Use of bar coding and handheld data for parts management and inspections

Fuel Management System

- Measure and manage use of fuel
- Employ various methods and technologies to monitor and track:
  - Fuel inventories
  - Fuel purchases
  - Fuel dispensed
- Information stored and reports generated with data to inform management practices
- Online fuel management provided through use of web portals to provide detailed fueling data, enabling:
  - Consumption control
  - Cost analysis
  - Tax accounting for fuel purchases

Data Management

- Data management and reporting
- Technology integration
- Geographic information system (GIS) application
- Service coordination facilitated by technology
- Open data for third-party application development

Data Management and Reporting

- Data generated by public transit ITS components installed in vehicles at central locations or at other locations
- Data typically collected and archived in individual databases
- Once data is archived, used for “after-the-fact” analyses and reporting by different business units within a public transport organization (e.g., planning, operations, customer service)
- Utilize true potential of data by consolidating in central repository to make process of data management, analysis, and reporting more efficient

Technology Integration

- Opportunities for technologies to be integrated with systems that are external to transit agency, such as a regional traffic management center or an information services provider
- Integration, when implemented from enterprise-wide perspective and regional perspective when appropriate, improves overall usability of technology environment made up of products from different vendors on multiple platforms and data from different systems
- Facilitates “system” of interconnected ITS applications that collectively produce services and advantages far greater than ITS applications could achieve individually and independently

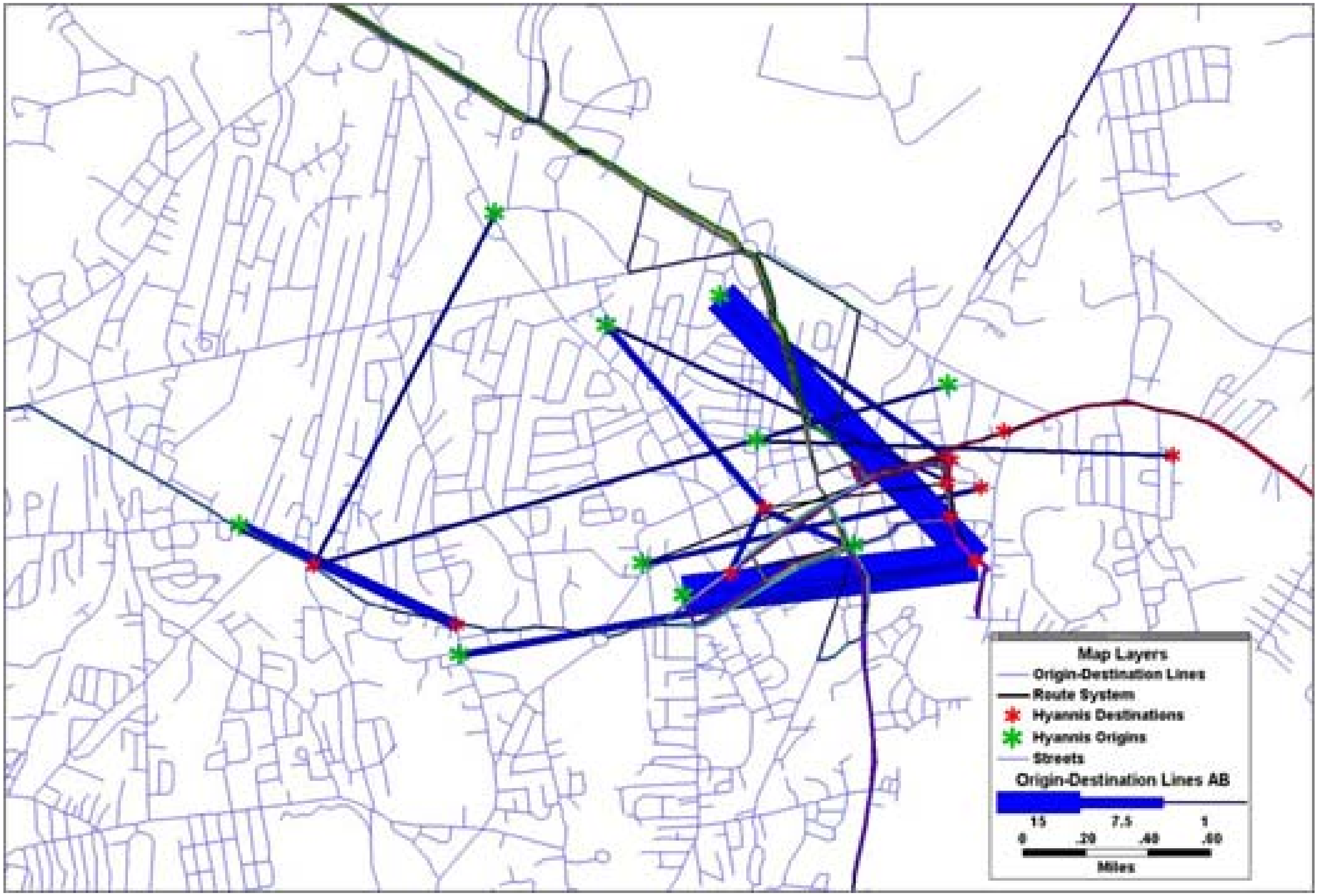
Geographic Information System (GIS) Application

- Provide database management capabilities for display and editing of geographically referenced entities and underlying attribute data
- Provide ability to perform analyses of geographic features such as:
  - Point databases (bus stops, communications transmitters, customer facilities)
  - Lines (streets, bus routes, subway tracks, rights of way)
  - Areas (census tracks, census blocks, traffic analysis zones, zip codes)

Geographic Information System (GIS) Application (cont.)

- Combine ability to accurately map geographically referenced data and to create themes such as employment density by traffic analysis zone or mobility limited persons by block group
- Allow transit agencies to analyze potential effects of adding, removing, or re-routing service
- Used to support trip itinerary planning software, flexible routing and scheduling software required in paratransit industry, and real-time vehicle location components of operations software
- Databases most relevant to transit

GIS (continued)



Service Coordination Facilitated by Technology

- Passengers able to reserve, manage, and track their transportation four local transportation providers
- Customers access center by phone or Internet to make or alter travel plans, then track the vehicles in which they'll be riding
- Partners connected through computer dispatching software, which communicates with every vehicle by onboard computers
- Callers to center able to receive information on health and human services, and general governmental and educational information

Open Data for Third-party Application Development

- Definition:
  - Accessible at no more than cost of reproduction without limitations based on user identity or intent
  - In a digital, machine readable format for interoperation with other data
  - Free of restriction on use or redistribution in its licensing conditions
- As of May 2013, 247 out of 863 U.S. transit agencies have open data

Open ITS Standards

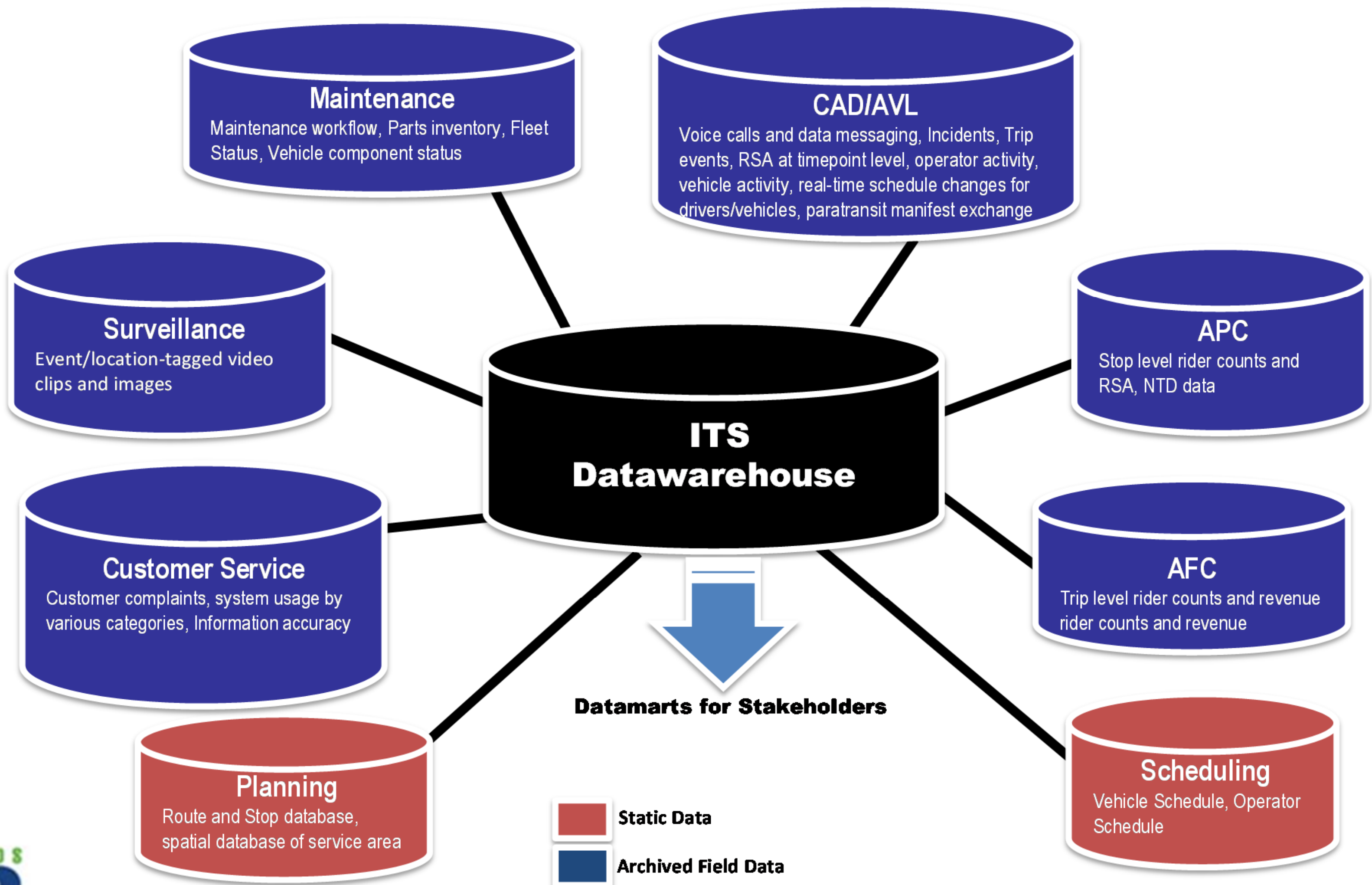
- Standards made available to general public and developed (or approved) and maintained via collaborative and consensus driven process
- Facilitate interoperability and data exchange among different products or services
- Intended for widespread adoption
- Example: OpenStreetMap

4D Approach to Data Structure Development

- **Demand** – the identification and prioritization of stakeholder (various business units within an organization) and external data needs
- **Dimension** – the identification of archived ITS data elements and their characteristics that are of interest to the stakeholders
- **Data** – the identification of data sources and determining processes (e.g., extract, transform, and load [ETL] procedures) to consolidate data into central repositories
- **Delivery** – the design and development of reports, tools, and toolboxes to present data to stakeholders

Typical Datawarehouse and Datamart Configurations

Main Point: *Potential ITS data organization*



Summary of Learning Objective #2

Core Functions and Taxonomy of Transit Management Systems

- **Fleet Operations and Management** – Ten technologies implemented to facilitate transit operations and provide input to senior management
- **Safety and Security** – Four technologies improving the safety and security of transit staff and passengers through on-board and facility technologies
- **Maintenance** – Three technologies facilitate maintenance activities
- **Data Management** – Five technologies necessary to handle automatically ITS-generated data

Learning Objective #3: Identify the Relationships and Data Exchange Among Transit Management Systems, Traveler Information, Transit Signal Priority, and Fare Collection Systems

- **Fleet Operations and Management** – facilitate transit operations and provide input to senior management in terms of system performance
- **Safety and Security** – improve safety and security of transit staff and passengers
- **Maintenance** – facilitate maintenance activities such as engine and vehicle component monitoring, tracking of scheduled and unscheduled maintenance activities, inventory systems, and fuel management
- **Data Management** – data management and reporting, technology integration, geographic information system (GIS) application, service coordination facilitated by technology, and open data for third-party application development

Fleet Operations and Management

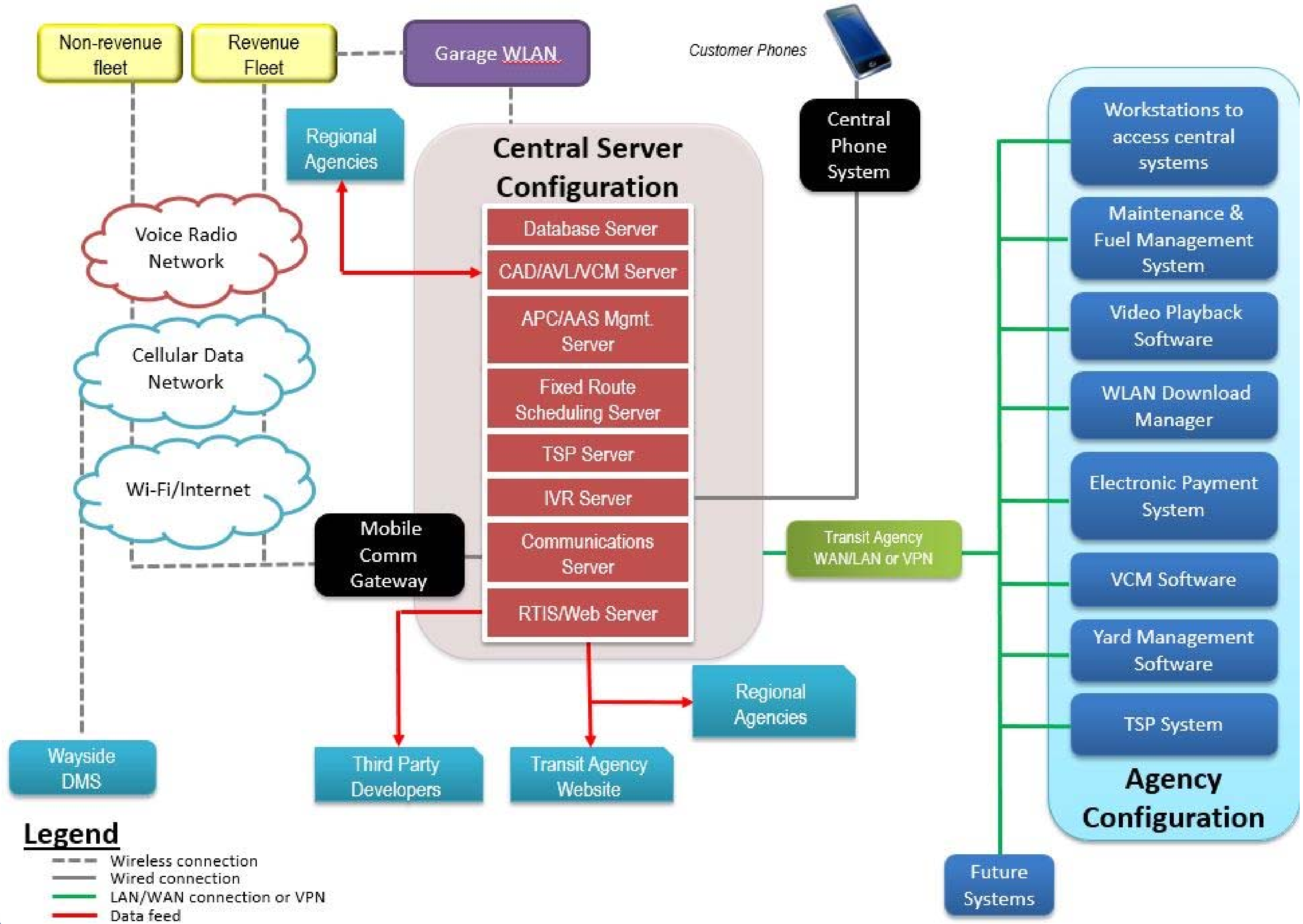
Category	System/Technology	Dependent on
Fleet Operations and Management	Communications technologies	Public/private voice and data communication backbones
	Computer-aided dispatch (CAD)	• Voice and data communications technologies • Automatic vehicle location (AVL) system • Route and vehicle schedule data
	Automatic vehicle location (AVL)	• Data communications technologies • Global positioning system (GPS) or other location enabling technologies, such as WiFi
	Automatic passenger counters (APCs)	• AVL system • Route and vehicle schedule data
	Scheduling (fixed-route and paratransit) systems	Stop database (contains data such as stop name, location, routes that stop at this stop, direction of travel from this stop, list of amenities available at this stop)

Fleet Operations and Management (cont.)

Category	System/Technology	Dependent on
Fleet Operations and Management	Transfer connection protection (TCP)	• AVL system • CAD system
	Transit signal priority (TSP)	• AVL system • CAD system (when TSP used based on schedule adherence status) • Roadside signal infrastructure
	Yard management	Indoor positioning systems (e.g., radio frequency identification [RFID]-based, WiFi-based)
	Intelligent vehicle technologies (e.g., collision warning and precision docking)	Varies by technology application and deployment
	Lane control technologies	• AVL system • CAD • Virtual mirror • Lane guidance systems • Roadside signal infrastructure

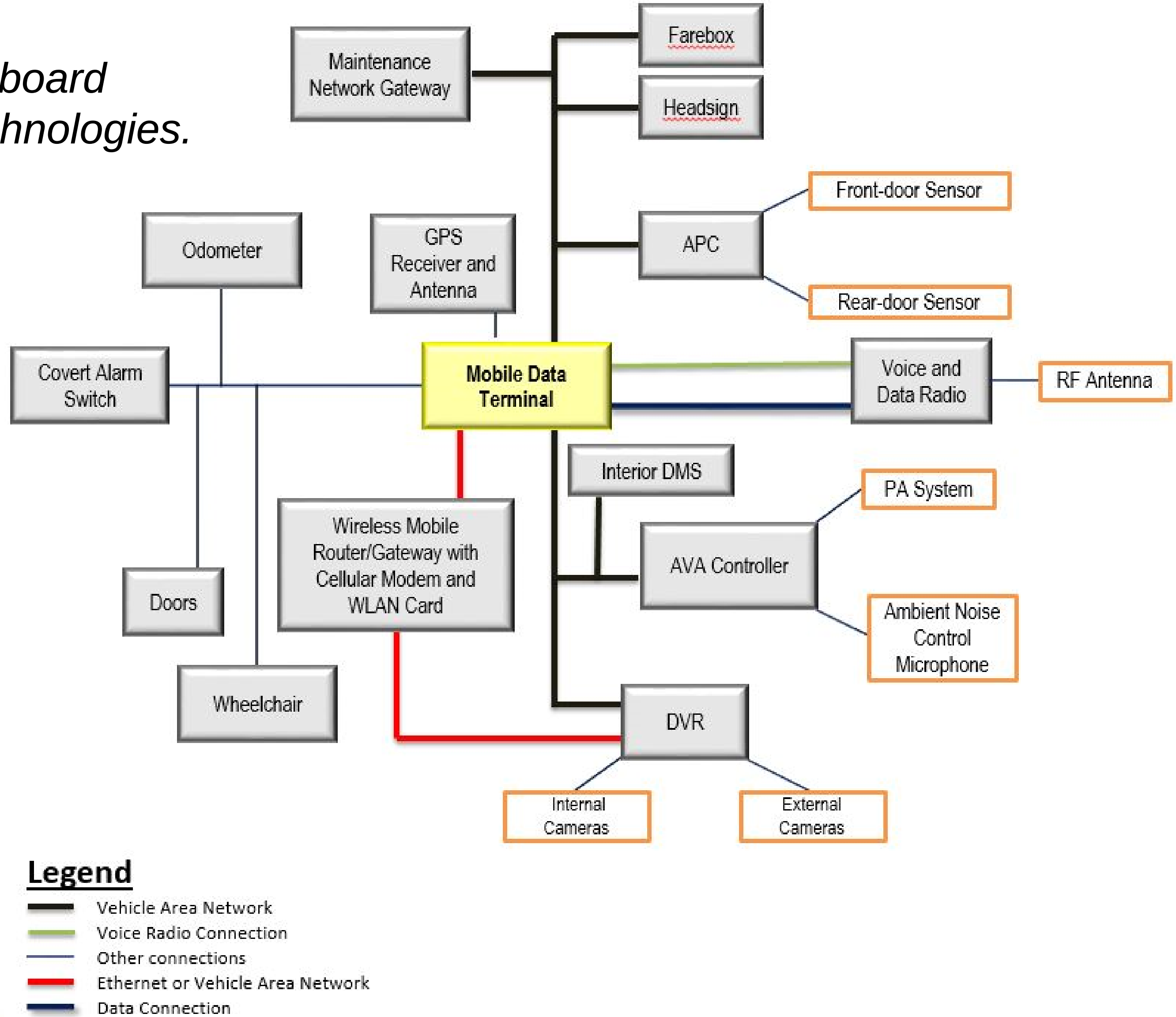
Example of Central System Technology Relationships

Main Point: *Shows the relationships among central Transit Management and other transit ITS technologies.*



Example of Onboard Technology Relationships

Main Point: *Shows the relationships among on-board Transit Management technologies.*



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Computer-aided dispatch (CAD) is dependent upon which one of these technologies?

Answer Choices

a) Voice and data communications technologies

b) Automatic vehicle location (AVL) system

c) Route and vehicle schedule data

d) All of the above

Review of Answers

a) Voice and data communications technologies

Incorrect. CAD is dependent on voice and data communications.

b) Automatic vehicle location (AVL) system

Incorrect. CAD is dependent on AVL.

c) Route and vehicle schedule data

Incorrect. CAD is dependent on route and vehicle schedule data.

d) All of these

Correct! CAD is dependent on all of these.

Safety and Security

Category	System/Technology	Dependent on
Safety and Security	Fixed video surveillance	Data communications technologies
	Covert emergency alarm and covert live audio monitoring	• Voice and data communication technologies • CAD system • AVL system
	On-board digital video surveillance	No dependence on other systems
	G-force monitoring	AVL system

Maintenance

Category	System/Technology	Dependent on
Maintenance	Engine and drivetrain systems monitoring	OBD-II or Society of Automotive Engineers (SAE) J1708/J1939 compatibility of on-board computers within engine and drivetrain
	Maintenance software to schedule and track scheduled and unscheduled maintenance activities, and manage parts inventory	No dependence on other systems
	Fuel Management System	No dependence on other systems

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Within the maintenance category, is fuel management dependent on another technology?

Answer Choices

a) Yes

b) No

Review of Answers

a) Yes

Incorrect. Fuel Management is not dependent on another technology.

b) No

Correct! Fuel Management is not dependent on another technology.

Data Management

Category	System/Technology	Dependent on
Other	Enterprise database/ datawarehouse and reporting	• Open databases • Data dictionary
	Technology integration	Multiple dependencies
	Geographic information system (GIS) application	Spatial data recording and management systems
	Service coordination facilitated by technology	• CAD/AVL systems shared across participants • Voice and data communications technologies
	Open data for third-party application development	Standard format for data such as General Transit Feed Specification (GTFS) and GTFS-real time

Summary of Learning Objective #3

Identify the Relationships and Data Exchange Among Transit Management Systems and Other Systems

Examples of dependencies for each Transit Management category:

Category	System/Technology	Dependent on
Fleet Operations and Management	Communications technologies	Public/private voice and data communication backbones
	Automatic vehicle location (AVL)	• Data communications technologies • Global positioning system (GPS) or other location enabling technologies, such as WiFi
	Automatic passenger counters (APCs)	• AVL system • Route and vehicle schedule data
Safety and Security	Fixed video surveillance	Data communications technologies
Maintenance	Engine and drivetrain systems monitoring	OBD-II or Society of Automotive Engineers (SAE) J1708/J1939 compatibility of on-board computers within engine and drivetrain
Data Management	Enterprise database/ datawarehouse and reporting	• Open databases • Data dictionary
	Open data for third-party application development	Standard format for data such as General Transit Feed Specification (GTFS) and GTFS-real time

Learning Objective #4: Explain the Role of Systems Engineering and Standards in Procurement

- Extend case studies to explain the underlying SE process used and why it was used
- Describe Transit Management functions with standards and those without standards
- Discuss impact and importance of using SEP in procurement

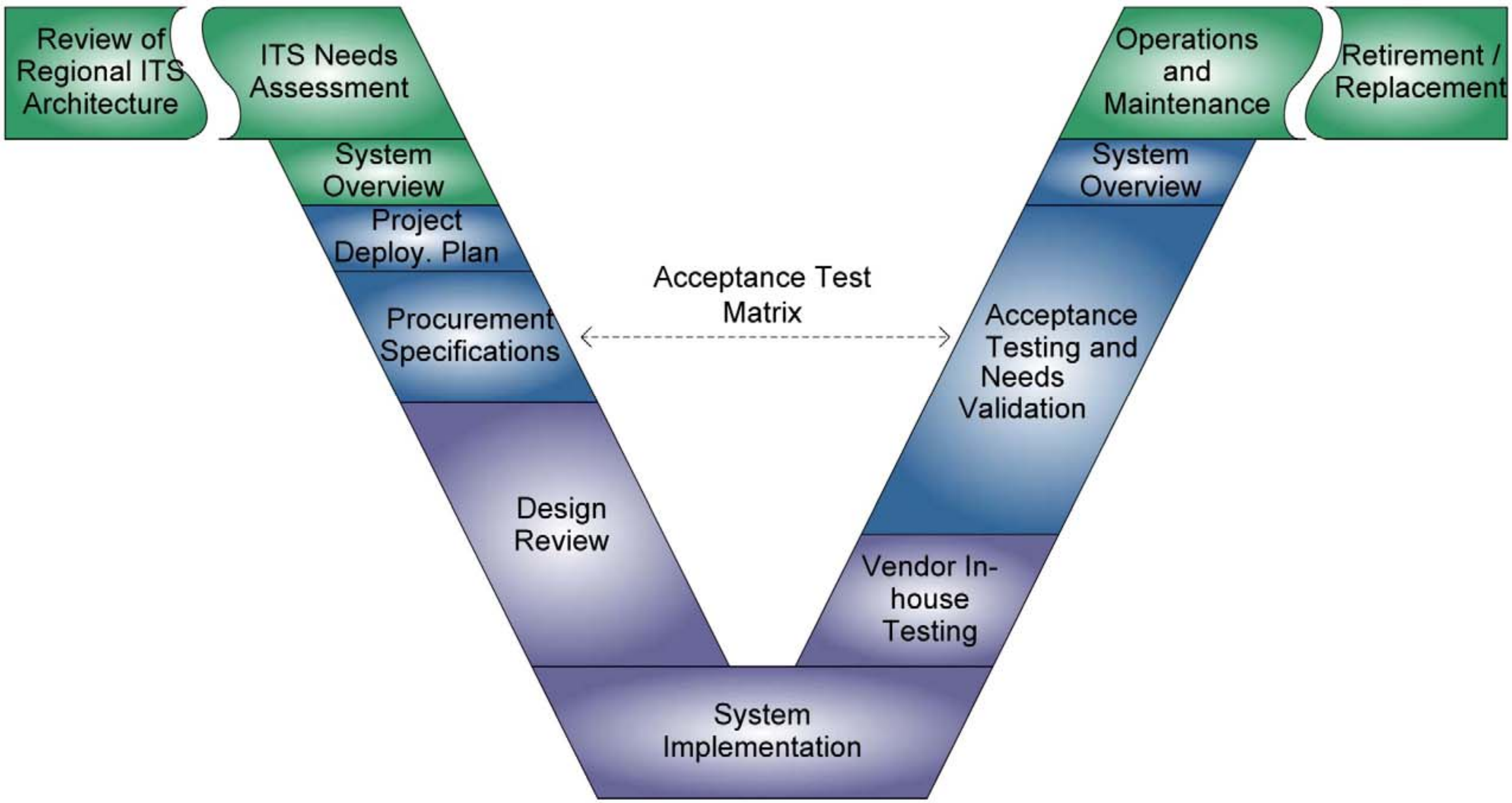
Standards Facilitate Transit Management Relationships

- Standards facilitate relationships among Transit Management functions and among Transit Management and other transit functions
- If standards do not exist, SEP will still facilitate the definition of these relationships
- First several steps of SEP ensure that relationships among transit management components are defined:
  - Concept of Operations
  - System Requirements

Case Studies

Agencies	Project
Chattanooga Area Regional Transportation Authority (CARTA), Chattanooga, TN	▪ SmartBus Project ▪ Generally followed Vee; tailored approach ▪ Better suit scale of organization ▪ Better suit incremental approach (sequence of individual project deployments)
LYNX, Orlando, FL	▪ Model Orlando Regionally Efficient Travel Management Coordination Center (MORETMCC) Project ▪ Used SEP
Efficient Deployment of Advanced Public Transportation Systems (EDAPTS) Program	▪ Tailored the Vee for rural and small transit authority technology projects ▪ Bronco Express example

SEP Vee Model Adapted by CARTA



CARTA's Approach to Applying SEP

- Helped explore and define an overall technology program vision
- Defined ongoing and near-term procurement packages as well as medium- and long-term plans = ConOps
- Developed project deployment plan for each procurement
- Included requirements in procurement as well as acceptance matrix that was basis for later SEP steps
- Vendor completed collaborative design documentation and review process
- Consultant responsible for in-house testing prior to the start of formal acceptance testing
- Testing followed procedures collaboratively planned in advance to verify all acceptance matrix requirements

CARTA’s Keys to Success

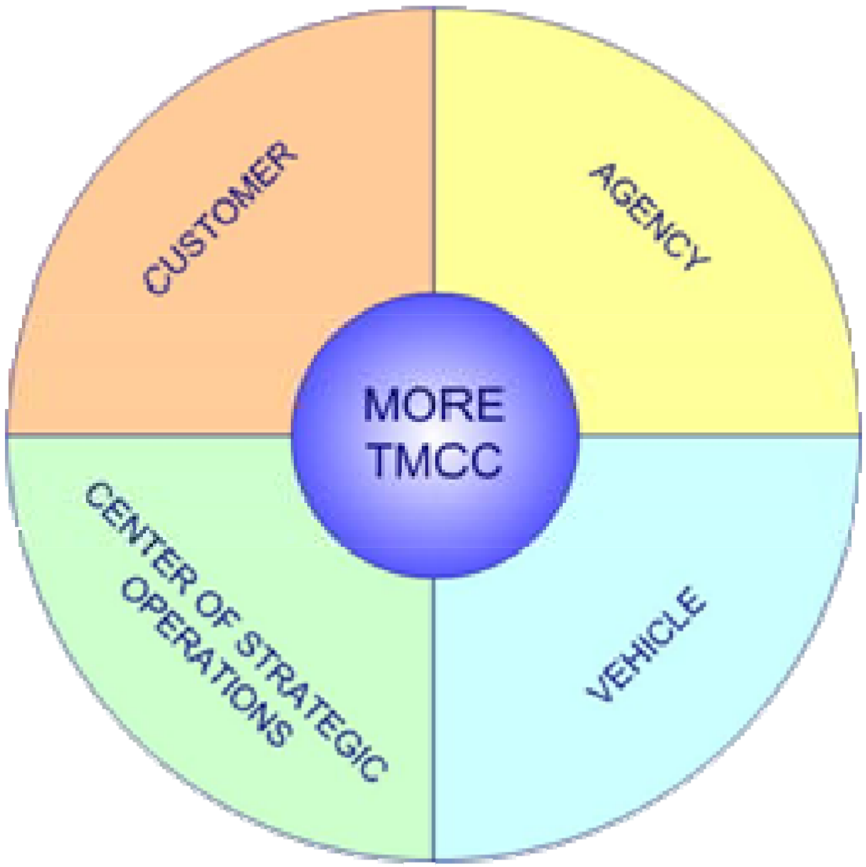
- Using standards in the procurement – SAE J1939 for monitoring common engine, transmission, and braking faults
- Documenting long-term vision for technology
- Avoiding temptation to do too much too fast
- Being willing to accept schedule delays when needed to help manage deployment risks
- Using a data warehouse
- Testing systems thoroughly before introducing them to operations

LYNX Model Orlando Regionally Efficient Travel Management Coordination Center (MORETMCC) SEP

- Problem: What are you trying to solve?
- Concept: How do you think you will solve the problem? Who are the stakeholders?
- Needs: What do the stakeholders need the solution to do?
- Requirements: How must the solution perform to meet the needs?
- Design: Incorporate the problem statement, concept, needs, and requirements.

MORETMCC Vision

Main Point: *The strategic needs of the TMCC look at the overall TMCC vision from the following four touch points: Customer, Agency, Center of Strategic Operations and Vehicle.*



Efficient Deployment of Advanced Public Transportation Systems (EDAPTS)

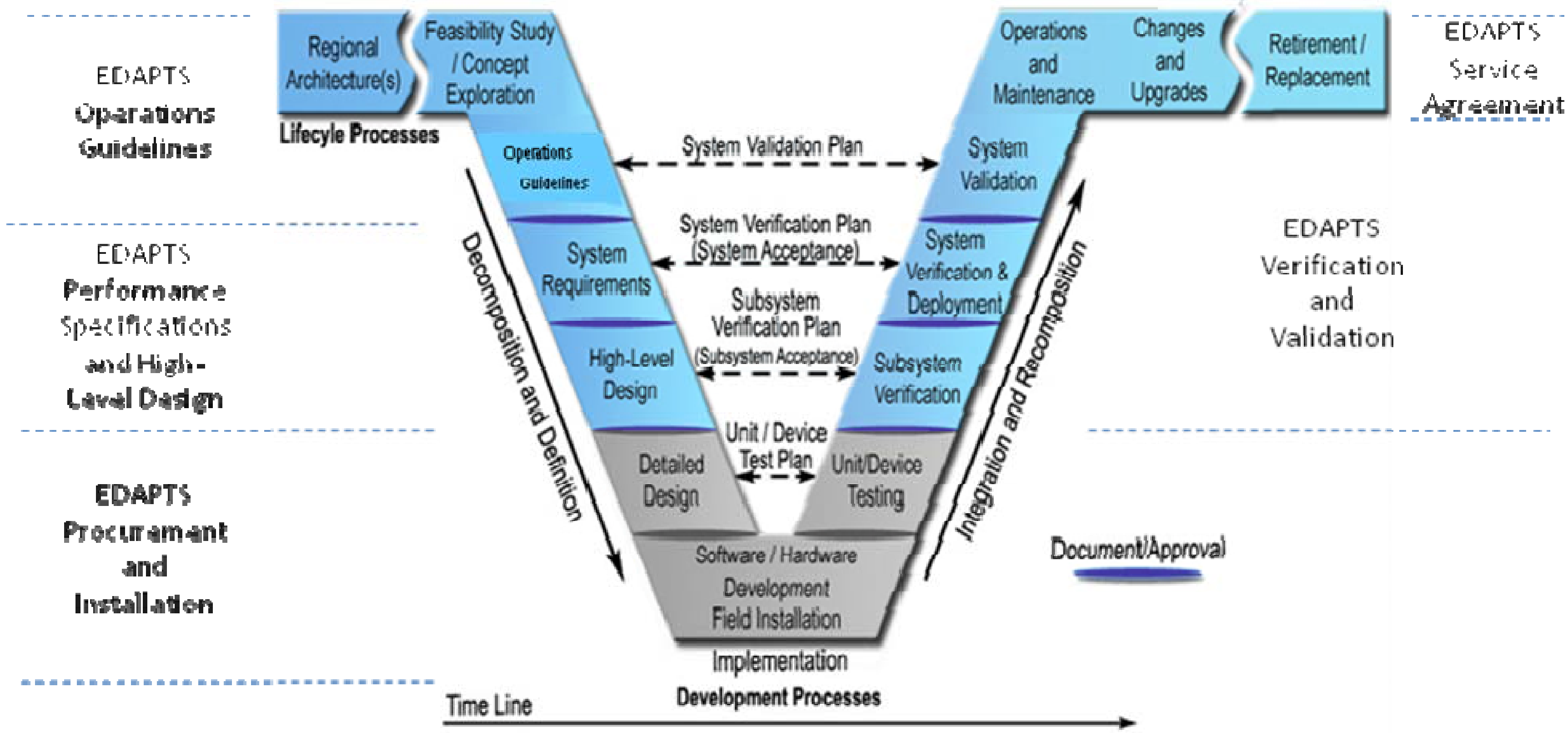
- EDAPTS offers:
  - Simple Systems Engineering Methodology
  - Needs Identification Guidelines
  - Procurement Tools
  - EDAPTS Research Reports
- Simplified Systems Engineering Methodology
  - Assumes Commercial Off-The-Shelf (COTS)
  - Modified FHWA/FTA V-Model
  - Used Transit Communications Interface Profiles (TCIP)
  - Builds On Operations Guidelines
  - Operational Scenarios

Efficient Deployment of Advanced Public Transportation Systems (EDAPTS) (cont.)

- Needs Identification Guidelines
  - Stakeholders
  - Outcomes
  - Scenarios
  - Priorities
  - Operational Scenarios

EDAPTS SEP and Adaptation of the Vee Model

Main Point: *Shows how EDAPTS used the systems engineering process.*



**Grey Color Blocks Are Done By Vendor Without Direct Purchaser Requirements

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Research and Technology

Does EDAPTS assume Commercial-off-the-Shelf (COTS) using a simplified SEP?

Answer Choices

a) Yes

b) No

Review of Answers

a) Yes

Correct! EDAPTS assumes Commercial-off-the-Shelf (COTS) using a simplified SEP.

b) No

Incorrect. EDAPTS does assume Commercial-off-the-Shelf (COTS) using a simplified SEP.

Transit Management Functions with Standards

- Standards in several Transit Management functions, primarily within:
  - Fleet Operations and Management
  - Data Management
- Serial Control and Communications Heavy Duty Vehicle Network
  - Related Standards:
    - SAE J1708
    - SAE J1939
    - SAE J1587
    - SAE J1944

Transit Management Functions with Standards (cont.)

- Transit Communications Interface Profiles (TCIP) – two modules on this
- General Transit Feed Specification (GTFS)
- General Transit Feed Specification (GTFS)-realtime
- TransXChange

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Research and Technology

Which one of these standards is used for CAD/AVL systems?

Answer Choices

a) GTFS

b) SAE J1939

c) TransXChange

d) All of the above

Review of Answers

a) GTFS

Incorrect. GTFS defines a common format for public transportation schedules and associated geographic information.

b) SAE J1939

Correct! This standard is the vehicle bus used for communication and diagnostics among vehicle components, including CAD/AVL.

c) TransXChange

Incorrect. TransXChange is the UK nationwide standard for exchanging bus schedules and related data.

d) All of the above

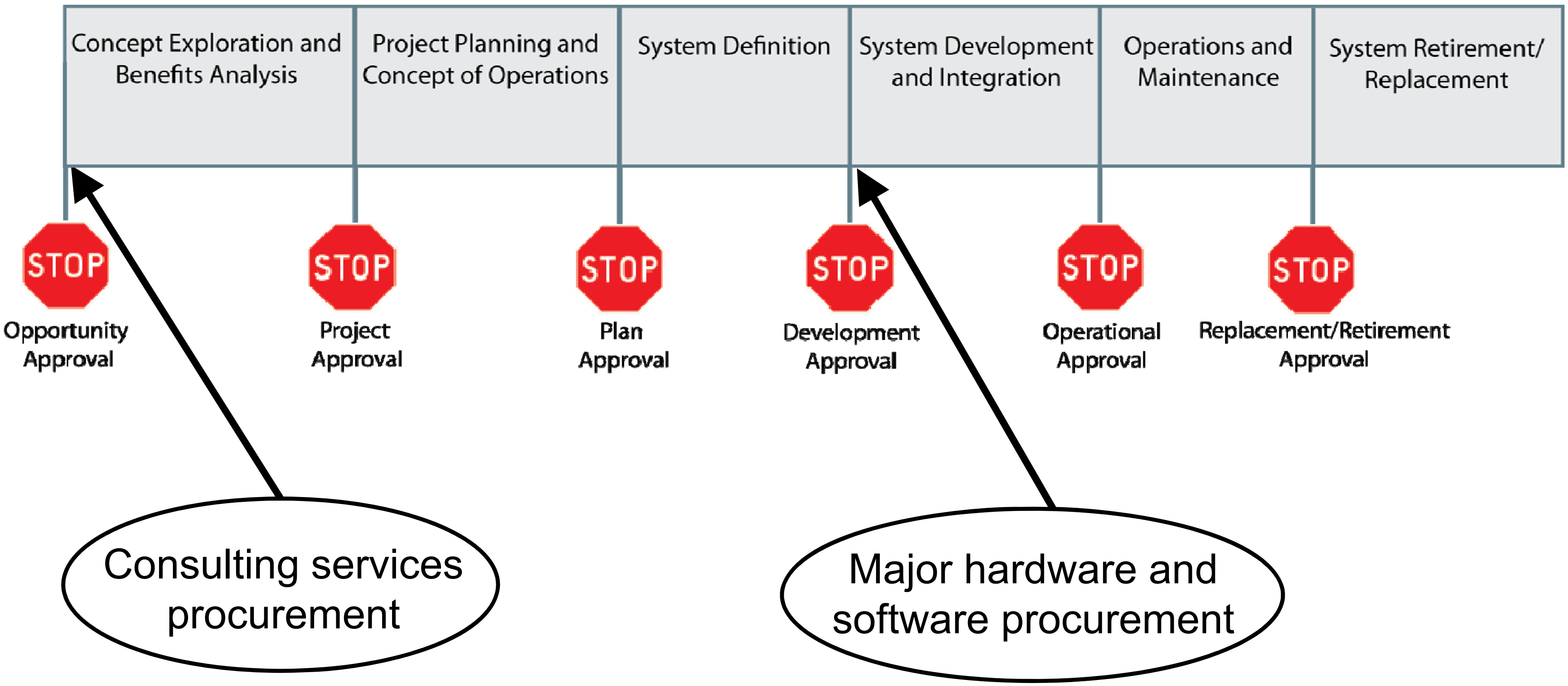
Incorrect. These standards and formats are used for different purposes – not just for CAD/AVL.

Impact and Importance of Using SEP in Procurement

- Allows You To:
  - Define and manage system requirements
  - Identify and minimize risk
  - Integrate system components (physical and organizational)
  - Manage system complexity
  - Enhance communication and system understanding
  - Verify products and services meet customer needs
- Enables Business Planning
- Improves Project Cost Performance

Impact and Importance of Using SEP in Procurement (cont.)

Main Point: *Shows where procurements happen within the SEP.*



Ask Yourself These Questions Before You Begin a Project, and Repeatedly Ask Them Throughout the SE Process

- How well did the system satisfy the needs of the stakeholders?
- Did the project stay within the budgeted cost and schedule?
- What types of challenges occurred during technology implementation?

Summary of Learning Objective #4

Explain the Role of Systems Engineering and Standards in Procurement

- Case studies to explain the underlying SEP used and why it was used:
  - CARTA
  - LYNX
  - EDAPTS
- Transit Management functions with standards:
  - Fleet Operations and Management
  - Data Management

Summary of Learning Objective #4 (cont.)

Explain the Role of Systems Engineering and Standards in Procurement

- Impact and importance of using SEP in procurement:
  - Intended to be integrating mechanism for balanced solutions addressing:
    - Capability needs
    - Design considerations
    - Constraints
  - Intended to address limitations imposed by:
    - Technology
    - Budget
    - Schedule

What We Have Learned

1) The National ITS Architecture allows for __tailoring__ at the local level.
2) User services represent what the system will do from the perspective of the _user_.
3) There are four major categories of Transit Management Technologies in the taxonomy
   a) Fleet Operations and Management
   b) Safety and Security
   c) Maintenance
   d) Data Management
4) APCs are dependent on _AVL___ and _route and vehicle schedule data___.
5) CARTA tailored the __SEP___ approach to better suit the _scale_ of their organization and the _incremental___ approach used to develop the overall technology program.

Resources

- National ITS Architecture 7.0: http://www.iteris.com/itsarch/
- ITS ePrimer Module 7: Public Transportation: http://www.pcb.its.dot.gov/eprimer/module7.aspx
- Systems Engineering for Intelligent Transportation Systems: http://ops.fhwa.dot.gov/publications/seitsguide/section3.htm
- Carol L. Schweiger*and Santosh Mishra, “Utilizing Archived ITS Data: Opportunities for Public Transport,” 19th ITS World Congress, Vienna, Austria, 22/26 October 2012, Paper Number AM-00078
- Haas, E. Perry, and J. Rephlo, *A Case Study on Applying the Systems Engineering Approach: Best Practices and Lessons Learned from the Chattanooga SmartBus Project*, prepared for United States Department of Transportation, Intelligent Transportation Systems Joint Program Office and Federal Transit Administration, submitted by Science Applications International Corporation, November 2009, Contract No.: DTFH61-02-C-00061 Task No.: 61027, http://ntl.bts.gov/lib/32000/32600/32672/61027_se.pdf

Resources (cont.)

- NTI course, Systems Engineering for Technology Projects
- ITS PCB T3 Webinars on ITS Transit Standards, http://www.pcb.its.dot.gov/t3_archives.aspx, which includes 14 archived webinars about Transit Management
- EDAPTS: http://www.dot.ca.gov/research/operations/edapts/
- Doug Jamison and Bill Hearndon, "MORETMCC: Building ITS Capabilities, One Step at a Time," National Rural ITS Conference, Coeur d'Alene, ID, August 31, 2011, http://www.nritsconference.org/downloads/Presentations11/SessionHST_Jamison.pdf

Next Course Module

Module 5:

Transit Management Standards, Part 2 of 2

Thank you for completing this module.

Click here to open the feedback form

OR

Please provide us your feedback:

http://www.pcb.its.dot.gov/stds_training.aspx

(insert exact location for feedback for each module as well as link to Transit ITS Standards – page to be developed as part of standards training site)