



W E L C O M E



U.S. Department of Transportation
Office of the Assistant Secretary for
Research and Technology

Mac Lister

A screenshot of the website for the ITS Professional Capacity Building Program. The header includes the United States Department of Transportation logo and navigation links. The main content area features a navigation menu, a 'Welcome to ITS Professional Capacity Building' section with a blue background, a 'FREE TRAINING' section with a list of courses, and a 'WHAT'S NEW' section with several news items.

United States Department of Transportation
OFFICE OF THE ASSISTANT SECRETARY FOR RESEARCH AND TECHNOLOGY
Intelligent Transportation Systems
Joint Program Office

ITS Professional Capacity Building Program / Advancing ITS Education

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Welcome to ITS Professional Capacity Building
The ITS PCB Program is the U.S. Department of Transportation's leading program for delivering ITS training and learning resources to the nation's ITS workforce.

FREE TRAINING
The ITS PCB Program and partners offer many free ITS training courses.

- Web and Blended Courses from CITE
- ITS Standards Training
- Upcoming T3 Webinars

WHAT'S NEW

New Web-Based Training from ITS Joint Program Office

- Connected Vehicle Reference Implementation Architecture Training now available

New NHI Course

- Systems Engineering for Signal Systems Including Adaptive Control (NHI-133123)

New ITS Case Study Available

- National ITS Architecture

Added to T3 Archive

- Learn from the Experts: Open Data Policy Guidelines for Transit - Maximizing Real Time and Schedule Data-Legalities, Evolutions, Customer Perspectives, Challenges, and Economic Opportunities - Part II Presented on August 7, 2014
- Saving Lives and Keeping Traffic Moving: Quantifying the Outcomes of Traffic Incident Management (TIM) Programs Presented on July 31, 2014

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Jeffrey Spencer



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ITS Transit Standards Professional Capacity Building Program

Module 3: Transit Communications Interface Profiles (TCIP), Part 1 of 2: Introduction to the Standard and Transit Architectures

Acknowledgments

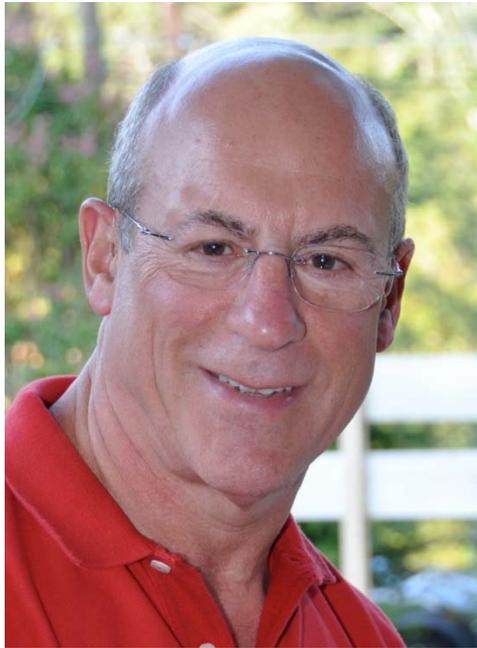
- **Ayers Electronic Systems, LLC**
- **Critical Link, LLC**
- **National Transit Institute**

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Instructor



Jerome M. Lutin, Ph.D., P.E., AICP
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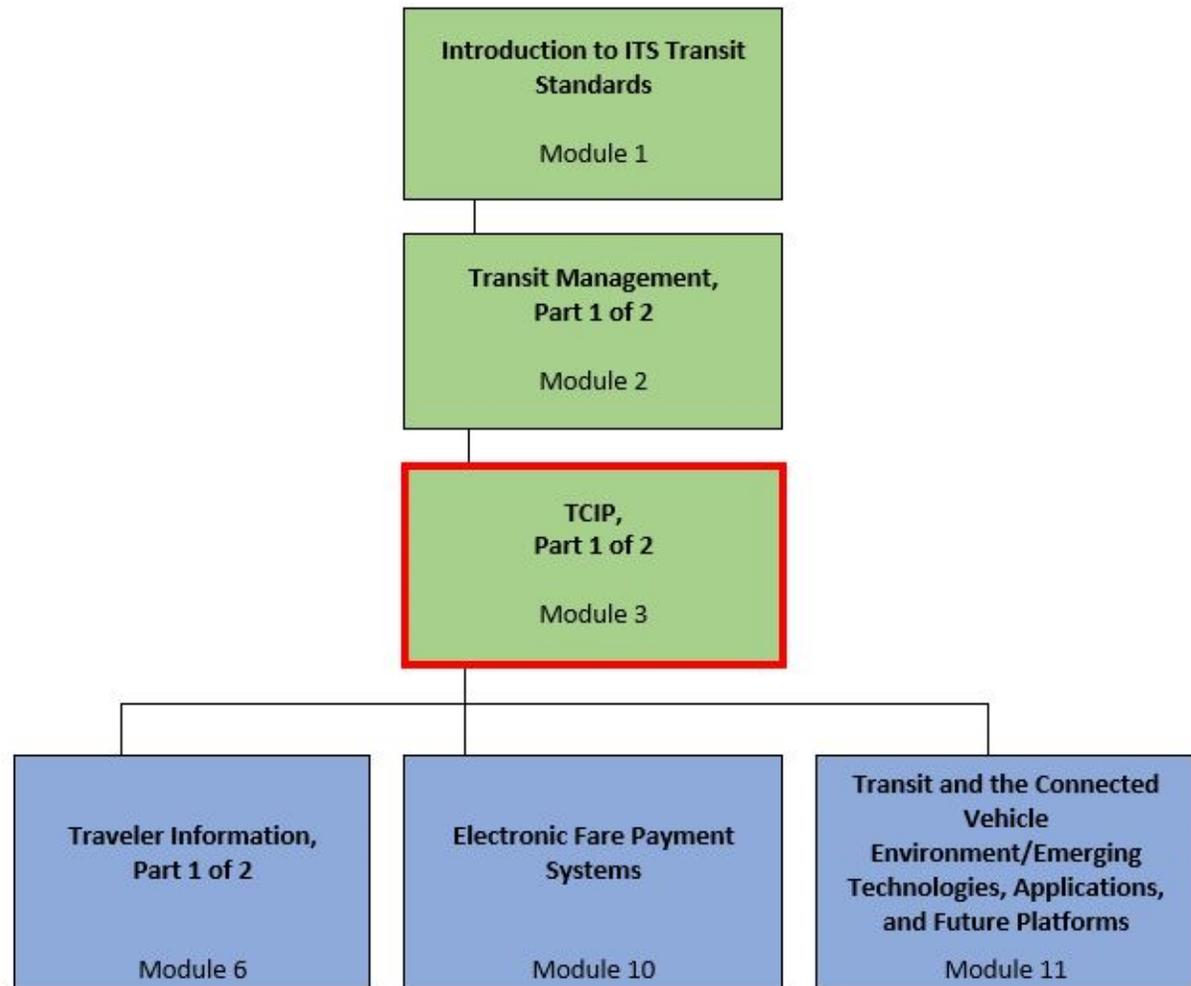
Target Audience

- Transit Managers;
- Transit procurements staff;
- Transit IT staff;
- Metropolitan Planning Organizations (MPO) staff;
- Department of Transportation (DOT)/ITS staff;
- Transit ITS contractors and consultants; and
- Transit technology vendors.

Recommended Prerequisite(s)

	Decision-Maker	Project Manager	Project Engineer
Module 1: Introduction to ITS Transit Standards	✓	✓	✓
Module 2: Transit Management Standards, Part 1 of 2	✓	✓	✓
Module 5: Transit Management Standards, Part 2 of 2	N/A	✓	✓

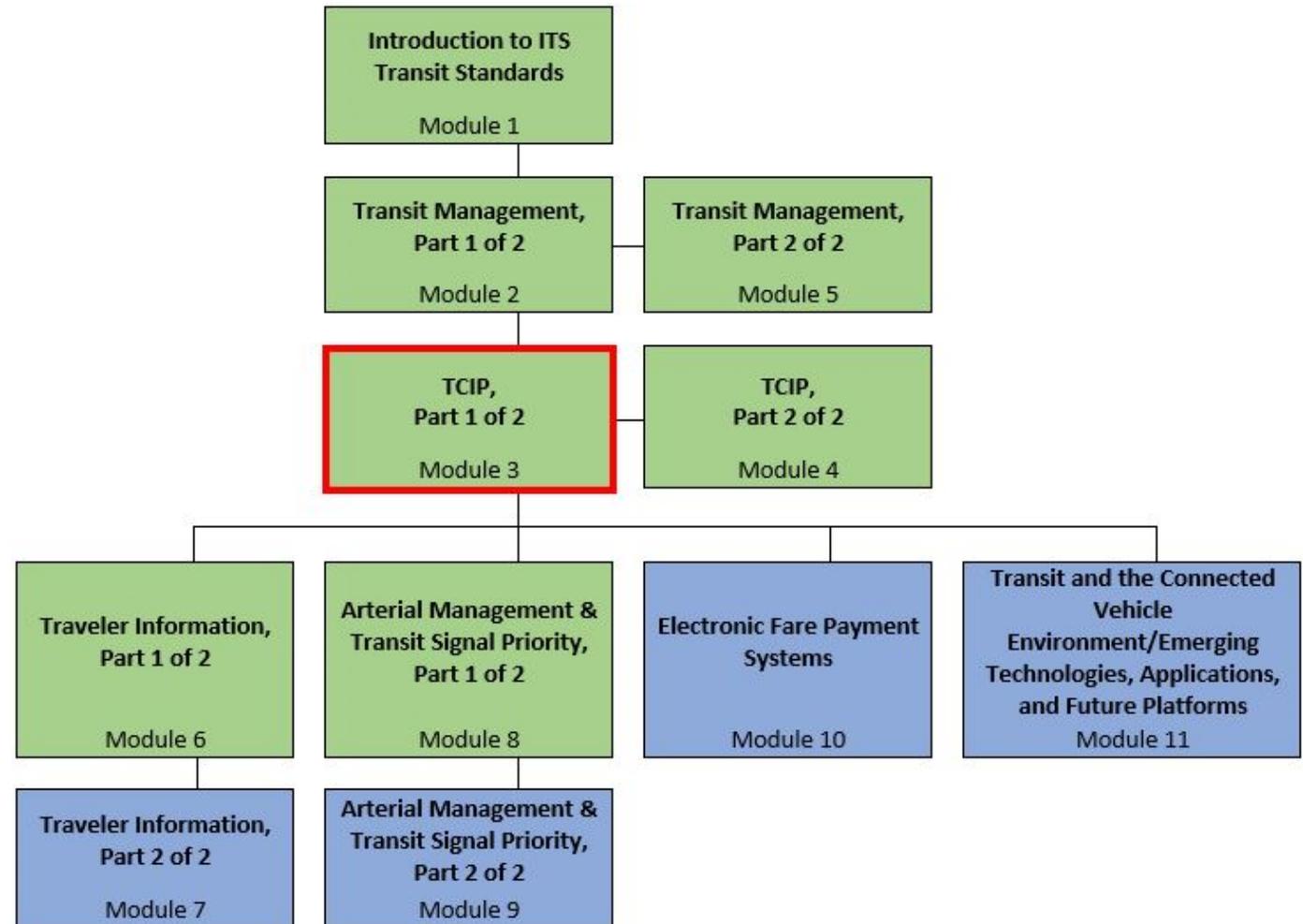
Curriculum Path (Decision-Maker)



 Recommended Prerequisite Modules

 Optional Modules

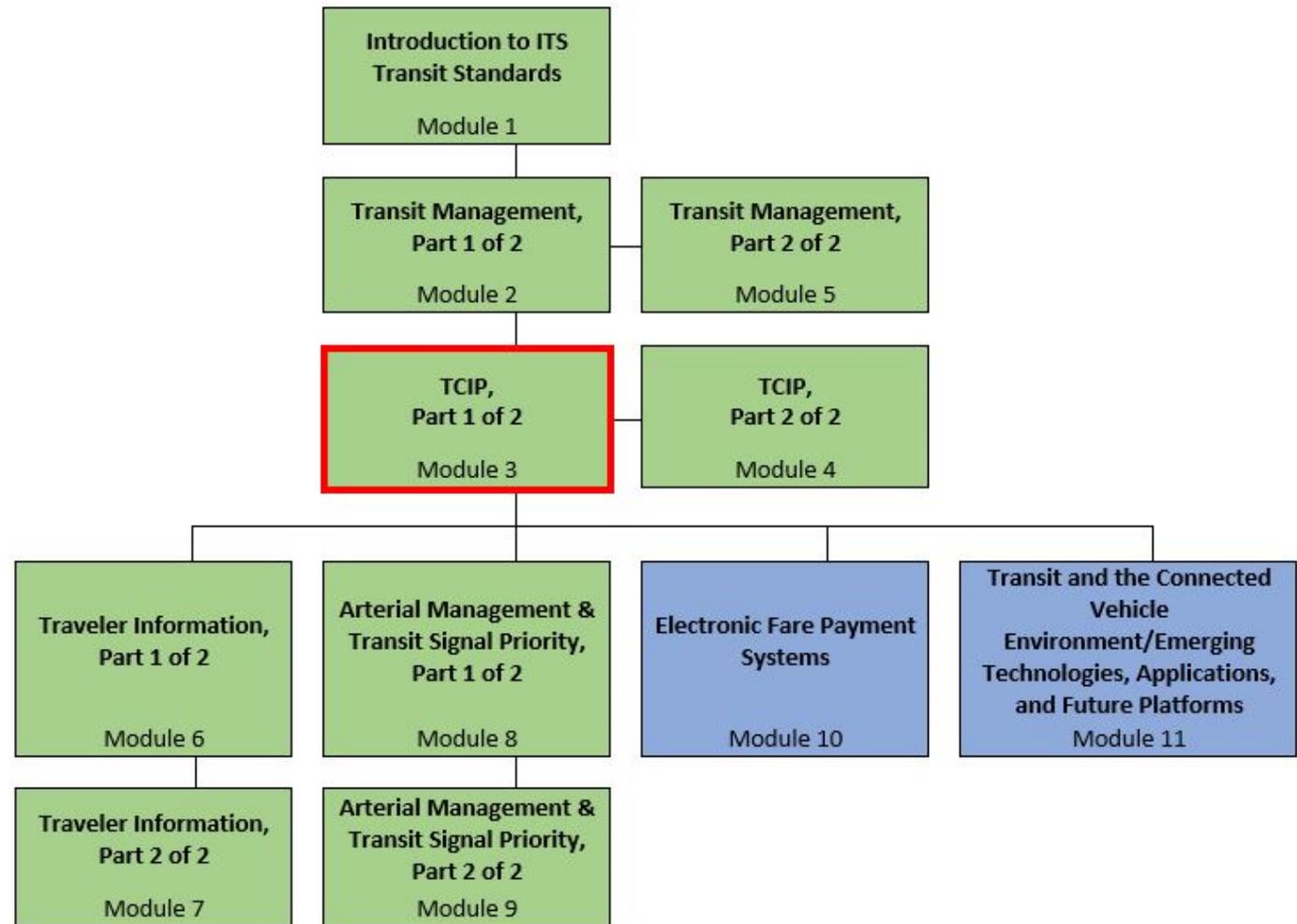
Curriculum Path (Project Manager)

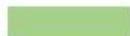


 Recommended Prerequisite Modules

 Optional Modules

Curriculum Path (Project Engineer)



 Recommended Prerequisite Modules

 Optional Modules

Learning Objectives

1. Describe the purpose and contents of the TCIP standard
2. Recognize what is involved in growing traveler information and communication systems from basic systems to regional multi-modal applications
3. Explain how TCIP is used to procure and implement transit ITS systems
4. Illustrate the need for, and structure of, a transit agency architecture
5. Articulate the fundamentals of exchanging information among transit business systems and devices using TCIP building blocks
6. Summarize the content of the TCIP standard, tools, and available resources
7. Provide examples of who is using TCIP

Learning Objective #1: Describe the Purpose and Contents of the TCIP Standard

- Requirements to use standards
- History and development of TCIP
- Overview of TCIP volumes 1 through 4
- Normative and non-normative content

Requirements to Use Standards

- Over the past ten years, the U.S. transit industry has spent 18 billion dollars on ITS including communications, fare revenue collection, and information systems
- ITS Standards are voluntary within the industry—they are not required by law, but they may be required by policy within your organization
- ITS Standards are consensus-based—they are developed by working groups of industry experts who ballot the standard
- ITS Standards are open and are not proprietary—they can be used by all
- ITS Standards are the “nuts and bolts” connecting transit management systems

TCIP* – Transit Communications Interface Profiles

- TCIP is the ITS standard for exchanging information among transit ITS systems and components
- Published by the American Public Transportation Association (APTA)
- Difference between a “protocol” and a “profile” for data exchange—a protocol contains rules and a profile can contain *both* rules and content
- TCIP references other ITS standards and definitions. This helps to ensure: “-a functional system (by adopting proven standards), and -cross-discipline consistency, helping to simplify integration with non-transit systems”

Purpose of the TCIP Standard

- Defines standardized interfaces for the exchange of information (data) among transit business systems, subsystems, components, and devices primarily for intra-agency use
- However, TCIP allows transit agencies to comply with Federal requirements to implement regional architectures because it provides a standard to exchange data with other transportation agencies
- Other data exchange standards and protocols such as Google's GTFS may be used to communicate information to the public, but they do not incorporate many of the data needed to manage a transit system such as operator ID or vehicle mechanical health data

History of the TCIP Standard

- The primary transit component of the US DOT ITS Standards Initiative; TCIP's development was funded by USDOT
- Originally developed by the program, National Transportation Communications for Intelligent Transportation System (ITS) Protocol (NTCIP), TCIP was transferred to APTA in 2001
- APTA added dialogs, file transfers, the TCIP Model Architecture, a Concept of Operations, and Transit Signal Priority
- TCIP was balloted* and approved as an APTA Standard in 2006; "Balloting" of the TCIP standard is done by technical working groups (TWG's) of stakeholder entities (primarily transit agencies, vendors, and consultants). The standard is considered approved when consensus is achieved by 75% of a representative sample of the voting entities
- Current version is APTA TCIP-S-001 4.0*

**Except the Fare Collection Business Area*

TCIP Standard – Documents

TCIP has been published in four volumes.

- **Volume I** contains an introduction and overview of the standard
- **Volume I** also contains concepts of operations for ten business process areas found in most transit agencies
- It also provides guidance on conformance and procurement

TCIP Standard – Documents

- TCIP presents much more information than a set of rules typically included in a standard. It includes “profiles” which are the actual building blocks to exchange information between business systems
 - **Volume II** contains these building blocks
- TCIP uses extensible markup language (XML) to provide a widely-known and supportable data exchange format between business systems, but allows for other transfer syntaxes to be used
 - **Volume III** contains the XML schema

TCIP Standard – Documents

- **Volume IV** contains six technical annexes (F-K). Only four are used at this time
- Annex K includes sample procurement documents for TCIP:
 - Profile Requirements List (PRL)
Mechanism for conveying an agency's TCIP requirements to a developer
 - Profile Implementation Conformance Statement (PICS)
Developer provides, which describes their product as part of the proposal submittal

Normative and Non-Normative Content

- Normative content is defined as that which has been balloted and is used to implement the standard
- Non-normative material has not been balloted and is included to explain:
 - How TCIP may be used by transit agencies and product developers;
 - To provide context for the normative portions of the standard; and/or
 - To contain technical material that has been developed, but is not yet deemed mature enough for balloting and implementation.
- The TCIP Task Force, responsible for TCIP developments, has determined that the Fare Collection Business Area is not yet mature enough for balloting and/or implementation

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What is the purpose of the TCIP standard?

Answer Choices

- a) Ensure that all transit agencies conform to the same requirements
- b) Federal requirement on uniformity for all procurements
- c) Exchange information for transit ITS systems and components
- d) TCIP is the only standard allowed for transit ITS systems

Review of Answers



- a) Ensure that all transit agencies conform to same requirements

Incorrect. Agencies can develop their own requirements to meet their needs.



- b) Federal requirement on uniformity for all procurements

Incorrect. TCIP use is voluntary. It is not required by the Federal government.



- c) Exchange information for transit ITS systems and components

Correct! TCIP was developed specifically to meet the needs of the transit industry.



- d) TCIP is the only standard allowed for transit ITS systems

Incorrect. TCIP is only one of a number of standards that can be used.

What is the role of balloting in developing a standard?

Answer Choices

- a) To elect members to standards bodies
- b) Ensure that a consensus has been achieved on the standard
- c) Transit agencies' majority vote is needed to create a standard
- d) Ensures that Federal reps agree to require the standard

Review of Answers



a) To elect members to standards bodies

Incorrect. Standards bodies are comprised of industry volunteers.



b) Ensure that a consensus has been achieved on the standard

Correct! Industry working groups use balloting to develop standards.



c) Transit agencies' majority vote is needed to create a standard

Incorrect. Standards are created by industry groups with a variety of stakeholders.



d) Ensures that Federal reps agree to require the standard

Incorrect. The Federal government does not require ITS standards by law.

Summary of Learning Objective #1

Describe the Purpose and Contents of the TCIP Standards

- Requirements to use standard
- History and development of TCIP
- Overview of TCIP volumes 1 through 4
- Normative and non-normative content

Learning Objective #2: Recognize What is involved in Growing Traveler Information and Communication Systems from Basic Systems to Regional Multi-Modal Applications

- Planning for communication systems
- Legacy systems, technological change, and obsolescence

Planning for Communication Systems

Communications are Fundamental to Transit Management

- Transit management systems need to accommodate increased data collection and distribution for:
 - Large vehicle fleets over significant distances
 - Facilities at multiple locations
 - Staff operating in the field
 - Customers spread over a region
- Systems planning must include the need to:
 - Add capabilities over time
 - Replace systems that can no longer be supported
 - Interchange information seamlessly and flawlessly

Legacy Systems, Technological Change, and Obsolescence

- Transit vehicle lifecycles range from 12 to 30 years or more
- Computer technology becomes obsolete in 18 to 24 months
- Replacement parts become more difficult to replace over time
- Operating systems and storage media can be phased out and not supported by vendors
- Existing systems may be incapable of accommodating new software system requirements
- Expect to replace components and systems several times during the life of a bus or rail vehicle
- Expect to replace management systems over time as well

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Which factor is most likely to lead to changes in communication systems?

Answer Choices

- a) New technology becomes available
- b) Transit systems expand into new modes
- c) New management requirements increase information demand
- d) New transit vehicles require new radios

Review of Answers



- a) New technology becomes available

Incorrect. The availability of new technology does not mean your existing system will not continue to meet your needs.



- b) Transit systems expand into new modes

Incorrect. Transit systems usually can add new vehicles and facilities without fundamental changes to their communication systems.



- c) New management requirements increase information demand

Correct! Transit managers are seeking new kinds of information and more data to better manage their systems.



- d) New transit vehicles require new radios

Incorrect. New vehicles may be configured to work with existing radios.

Summary of Learning Objective #2

Recognize What is Involved in Growing Traveler Information and Communication Systems from Basic Systems to Regional Multi-Modal Applications

- Planning for communication systems
 - Communications are fundamental to transit management
 - Systems planning must include the need to add capabilities over time
- Legacy systems, technological change, and obsolescence
 - Systems that can no longer be supported must be replaced over time
 - Information must be exchanged seamlessly and flawlessly

Learning Objective #3: Explain How TCIP is Used to Procure and Implement Transit ITS Systems

- Procurement and implementation of transit ITS components
- Using TCIP to facilitate competitive procurements
- Integrating systems using TCIP

Procurement and Implementation of Transit ITS Components

ITS Technology Applications

- Transit ITS projects are usually implemented incrementally in an agency and often through separate procurements
 - For example, an agency may purchase a CAD/AVL in year 1 and a multimedia traveler information system in year 5
- Integration issues arise when these separately procured systems need to exchange data in order to maximize benefits
- If agency staff do not have the capacity to define interfaces, experienced outside consultants can help prepare TCIP procurement documents that will enable competitive procurements and systems integration

Procurement and Implementation of Transit ITS Components

TCIP Can Help Overcome the Following Technical Challenges

- Exchanging information with subsystems (within an agency and between agencies)
- Integration with legacy systems
- Defining requirements for connections between a subsystem being procured and future subsystems
- Accommodating future system growth

Procurement and Implementation of Transit ITS Components

TCIP Can Help Overcome the Following Technical Challenges (cont.)

- Difficult to use multiple vendors, causing agencies to lose flexibility and control
- Hardware obsolescence
- Distribution of transit data to third party developers
- Procurement lag

Using TCIP to Facilitate Competitive Procurements

- TCIP does so by providing a non-proprietary standard, allowing the transit agency to go beyond a single vendor when looking to upgrade or add to an existing system
- TCIP allows the transit agency to select sub-systems that best fulfil its needs (given the resources available), rather than limiting selections only to those that can be integrated with the proprietary standards and interfaces used in an existing system

Using TCIP to Facilitate Competitive Procurements

TCIP Standard Approach

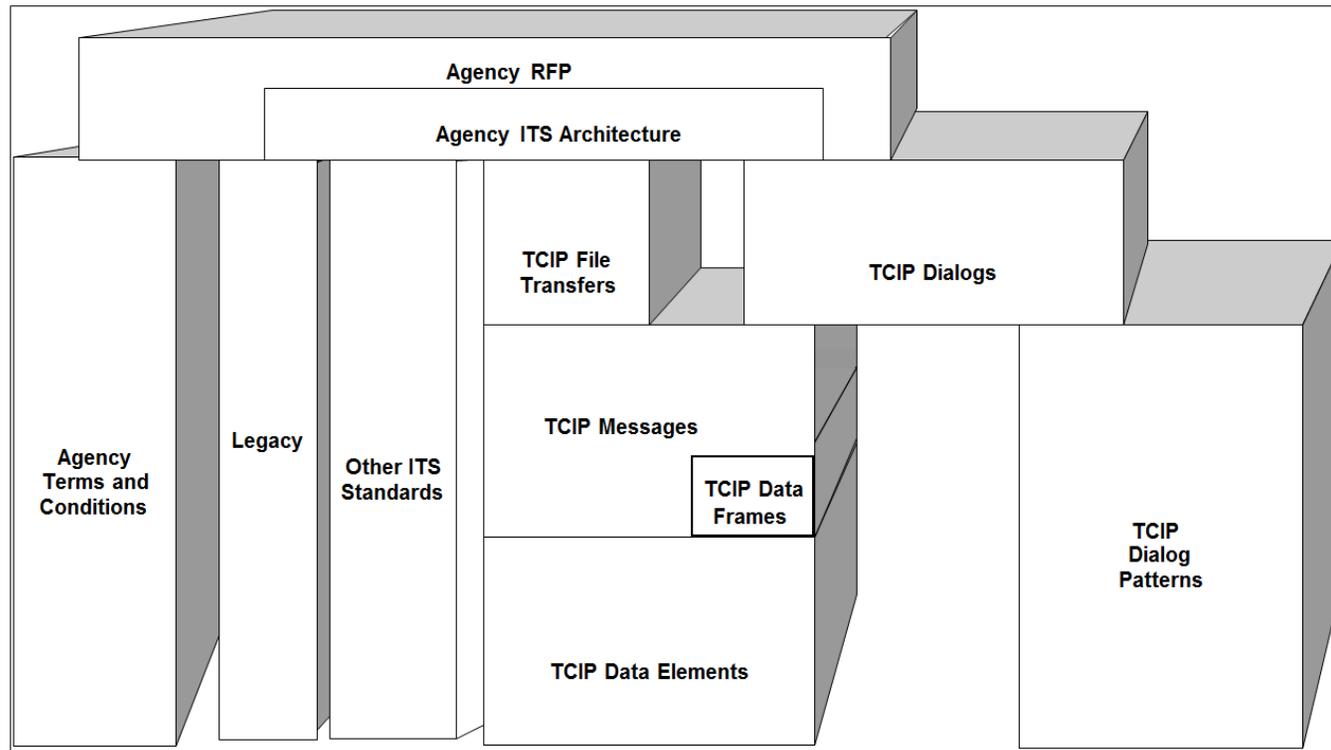
- Recognizes each agency operates differently
 - TCIP provides a large variety of information exchanges that agencies can use on an a-la-carte basis according to their needs
- TCIP is **not intended** to be adopted as a whole or all at once
 - Agencies can purchase TCIP compliant business systems, vehicles, devices, and equipment gradually over time
 - Enables agencies to maintain legacy systems

Using TCIP to Facilitate Competitive Procurements

TCIP Standard Approach

- Minimizes impact on developers/vendors
 - TCIP **does not** specify interactions **within** the components
 - TCIP **does** provide standard formats to facilitate the exchange of information
- Does not limit an agency's communication architecture

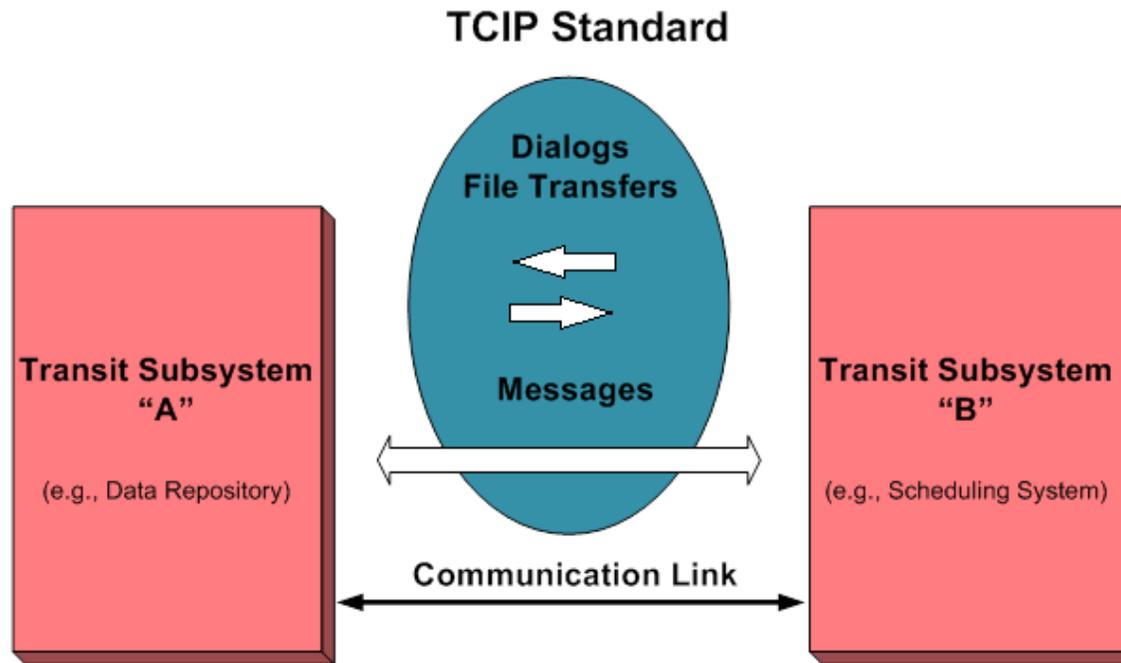
Using TCIP to Facilitate Competitive Procurements



This graphic illustrates how TCIP is used in agency procurements for ITS systems. TCIP comprises building blocks at several levels in conjunction with other ITS standards.

Integrating Systems using TCIP

TCIP Model for Data Exchange



TCIP standard enables transit subsystems "A" and "B" to exchange information using TCIP exchange protocols.

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Which is a key risk in transit ITS procurements?

Answer Choices

- a) Separately procured systems won't communicate
- b) Transit agencies may be overcharged for ITS systems
- c) Legacy systems do not have backups
- d) Standards are not available to integrate systems

Review of Answers



- a) Separately procured systems won't communicate

Correct! Without use of common standards, systems developed by different vendors may not be able to communicate.



- b) Transit agencies may be overcharged for ITS systems

Incorrect. Transit agencies can use low price as a way to evaluate bids to avoid overcharging.



- c) Legacy systems do not have backups

Incorrect. A legacy system is typically defined as one that is outdated, but it may include backup features.



- d) Standards are not available to integrate systems

Incorrect. There are a number of standards that may be used to integrate systems, including TCIP.

Which is a benefit of using TCIP in transit ITS procurements?

Answer Choices

- a) Standardize internal components of a vendor's ITS system
- b) Lower initial procurement costs
- c) Allow multiple vendors to compete
- d) Expand the bandwidth for communications between systems

Review of Answers



- a) Standardize internal components of a vendor's ITS system

Incorrect. TCIP is intended to standardize only the interfaces between systems.



- b) Lower initial procurement costs

Incorrect. In the long run, TCIP may help reduce costs, but there is no guarantee.



- c) Allow multiple vendors to compete

Correct! TCIP is intended to allow many vendors to offer systems that can be integrated.



- d) Expand the bandwidth for communications between systems

Incorrect. Bandwidth is communication system property. It is unaffected by TCIP.

Summary of Learning Objective #3

Explain How TCIP is Used to Procure and Implement Transit ITS Systems

- TCIP is used to facilitate competitive procurements when procuring and implementing transit ITS systems by providing a non-proprietary standard, allowing the transit agency to go beyond a single vendor
- TCIP allows the transit agency to select sub-systems that best fulfill its needs (given the resources available), rather than limiting selections only to those that can be integrated with the proprietary standards and interfaces used in an existing system
- TCIP allows each agency to select those interfaces and capabilities within each interface to reflect that particular agency's needs. TCIP is intended to operate alongside legacy interfaces, even over the same communications media and networks

Learning Objective #4: Illustrate the Need for, and Structure of, a Transit Agency Architecture

- Capital and project planning for transit ITS
- Linkage of transit agency architecture to national ITS architecture and regional architectures
- Business areas and concepts of operations
- Diagramming an agency architecture
- Case study – development of a transit agency architecture

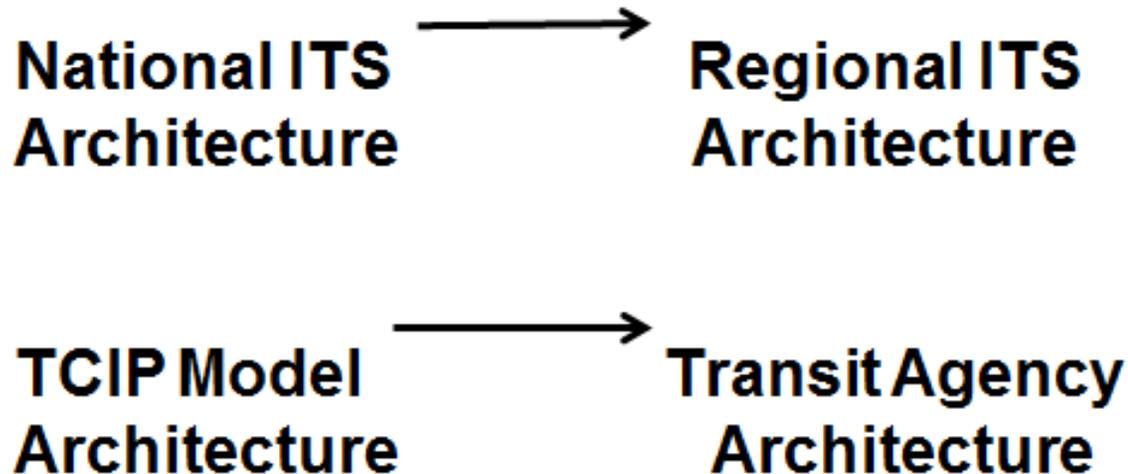
Capital and Project Planning for Transit ITS

- Transit ITS system acquisitions are usually included as projects in the agency's capital program and budget
- Projects may be implemented in phases
- The overall planning framework for an ITS project is called an architecture
- The architecture explains how all systems are integrated and phased over time

Relationships Between ITS Architectures

Generic

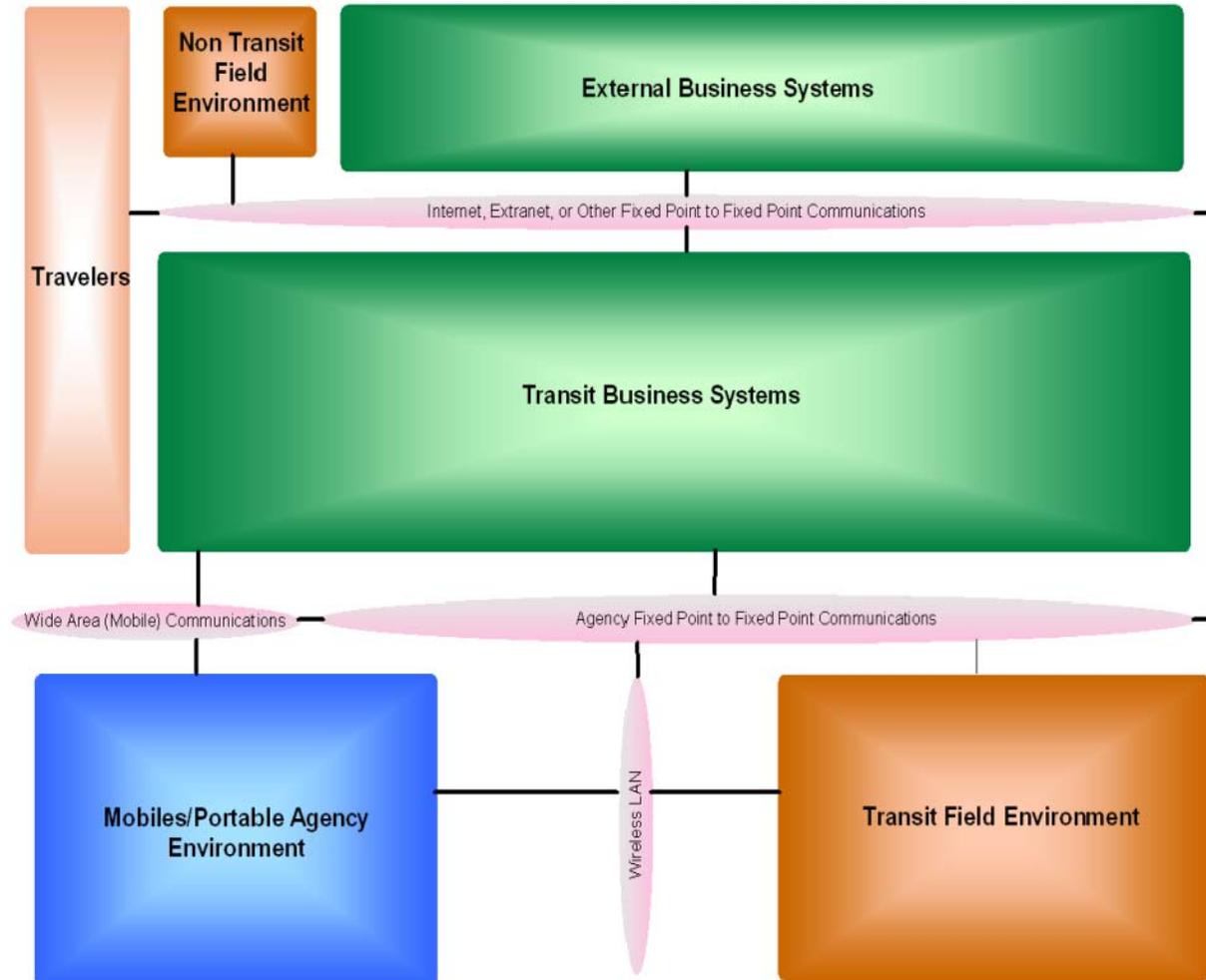
Specific



What is the TCIP Model Architecture?

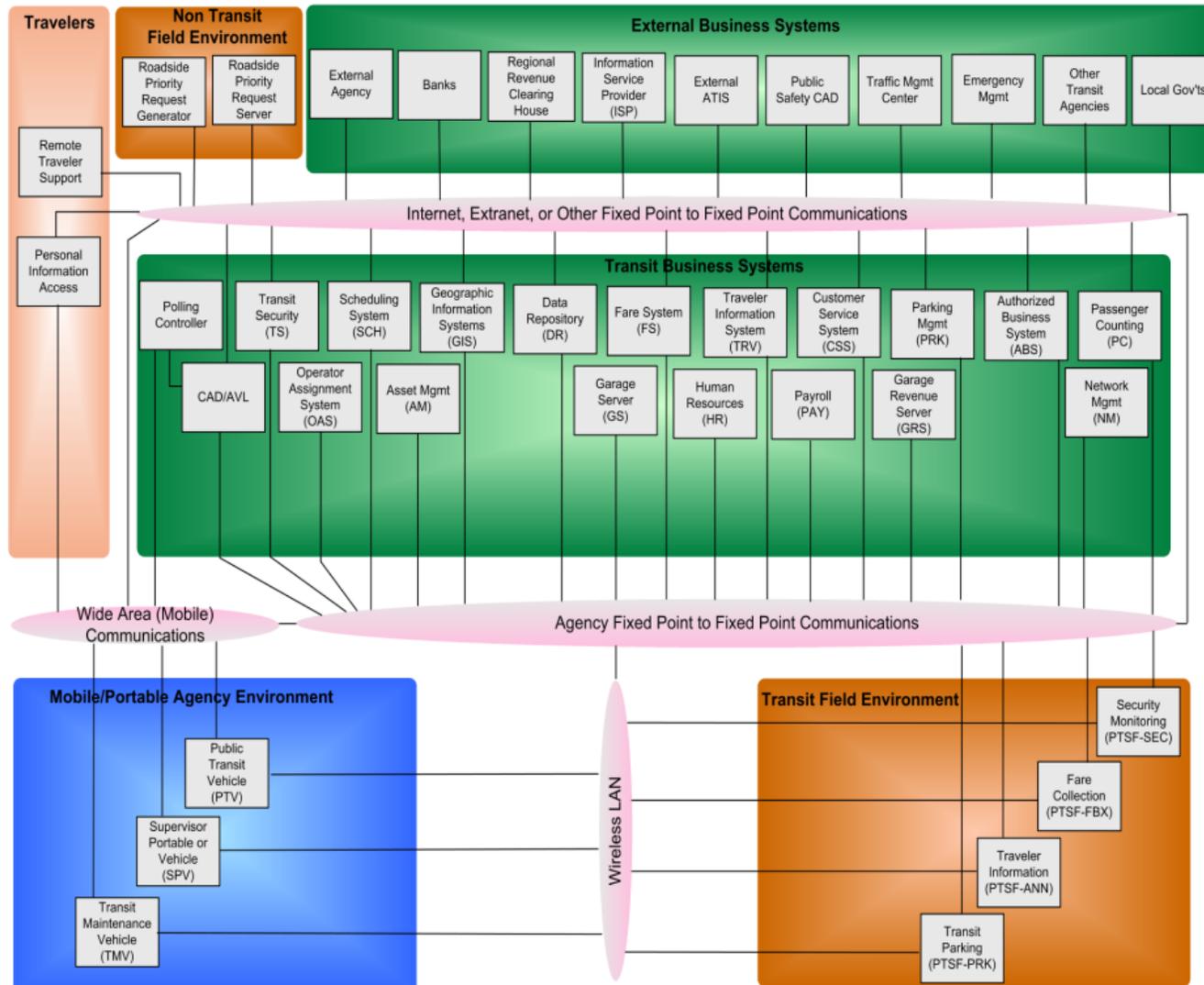
- Generic illustration of ITS subsystems and interfaces that a transit agency **might** employ
- Organized in a similar fashion to the National ITS Architecture (NIA), showing how components are connected using communications links
- Not all agencies will have all components, but all agencies will have some components
- Where equivalents exist, TCIP Annex G maps TCIP Model Architecture Logical Entities to the NIA Process specifications and maps TCIP Dialogs to the NIA data flows

TCIP Model Architecture



Generic Transit Agency Architecture

TCIP Model Architecture



What is a Transit Agency ITS Architecture?

- Modeled after the TCIP Model Architecture
- Specific to a transit agency
- Captures the agency's near- and long-term plans for technology implementation
- Illustrates an agency's **legacy** and **planned** systems, interfaces, communication networks, external systems, and physical components

Benefits of a Transit Agency ITS Architecture

- Provides a framework for interdepartmental ITS planning and coordination
- A visual representation of the plan and vision for ITS development within the agency
- Depicts internal and external interfaces between subsystems
- Electronic model of agency's business

Transit Core Business Processes

1. Security and Incident Management Process
2. Public Transit Vehicle (PTV) Operations Process
3. Revenue and Fare Collection Process
4. Scheduling Process
5. Personnel and Work Assignment Management Process
6. Asset Management Process
7. Customer Information Process
8. Data Repository Operations Process
9. Spatial Data Management Process
10. Transit Signal Priority Process

TCIP Concept of Operations

- Describes the 10 Transit Core Business Processes
- Explains how TCIP can be used to facilitate communication among transit applications
- Provides “typical” agency implementations of TCIP – does not include all possible processes
- Examine how your agency’s business processes relate to the TCIP Core Business Processes
- Additional transit business processes may be added in the future, e.g., paratransit

Example – Scheduling Process

- Purpose is to develop transit schedule products and distribute those products to a data repository or other business systems
- Sub-processes within the scheduling process:
 - Gather data for schedule writing
 - Think – “Where does the data reside?”
 - Develop scheduling products
 - Schedule writing, block-building, and run cutting
 - Distribute scheduling products

TCIP Standard Volume I Section 5.5.4.3 – Distributing Scheduling Products

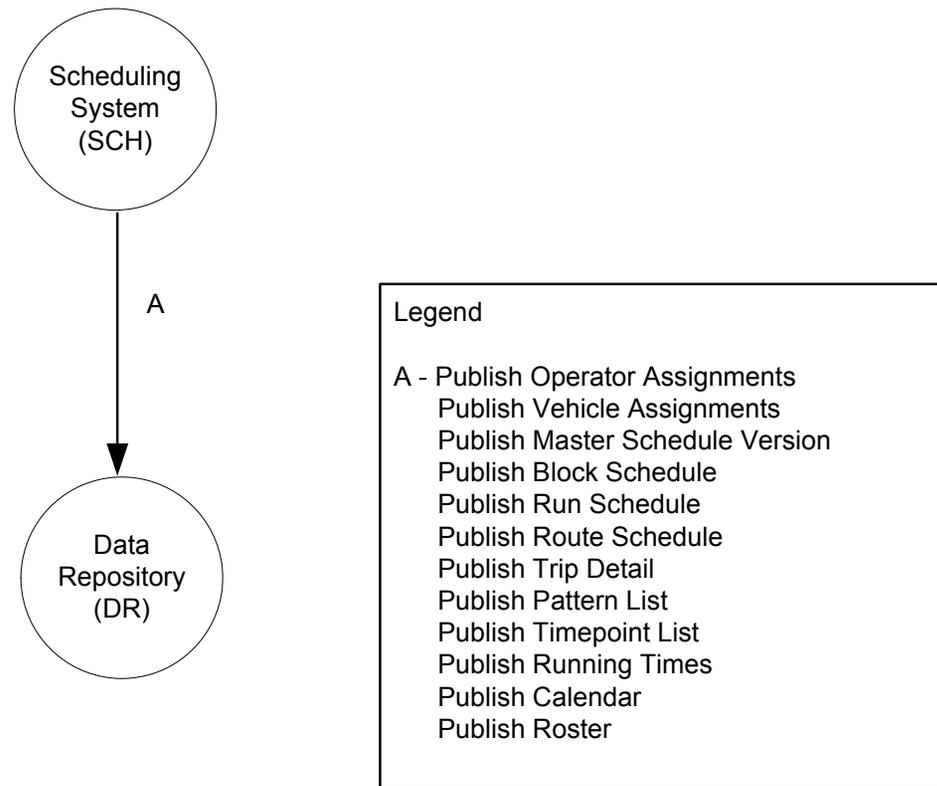
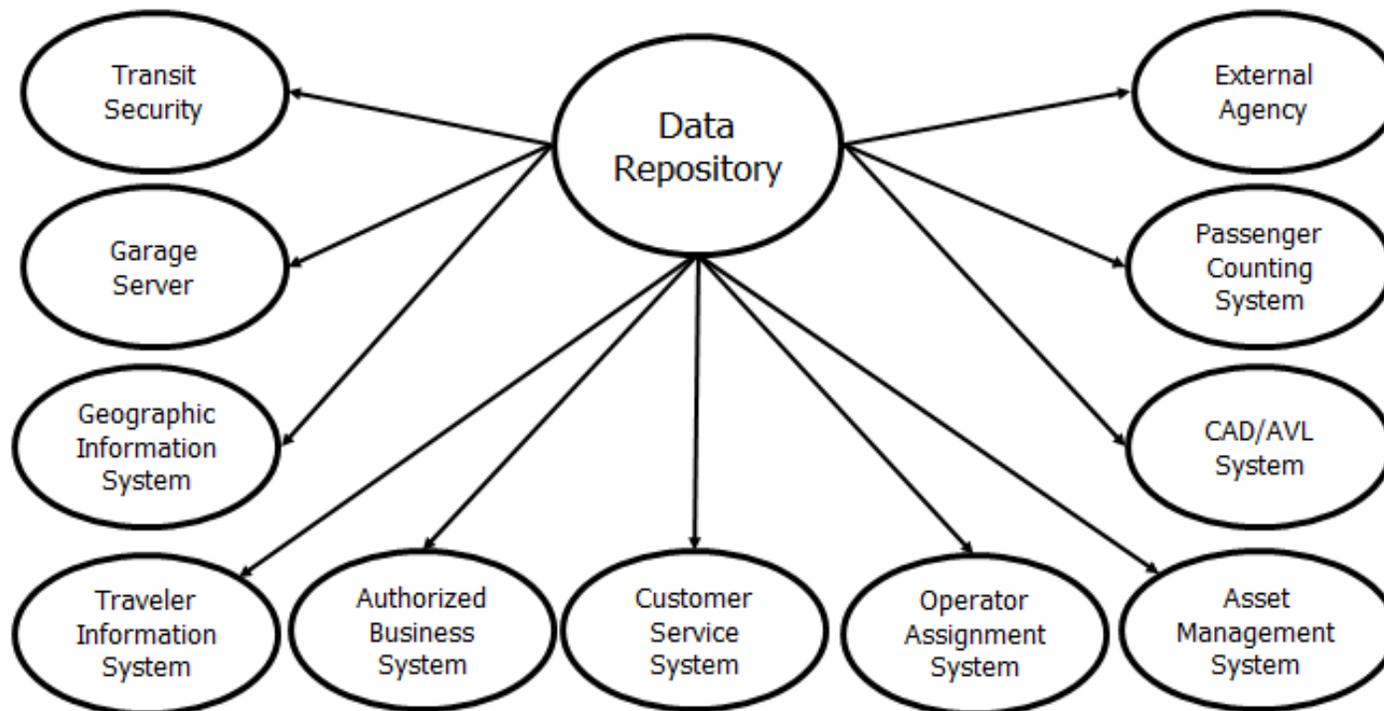


Figure 5.5.4.3.A
Schedule Information Transfers to a Data Repository Based on Publish Dialogs.

TCIP Standard Volume I Section 5.5.4.3 – Distributing Scheduling Products (cont.)

5.5.4.3 – Distributing Scheduling Products

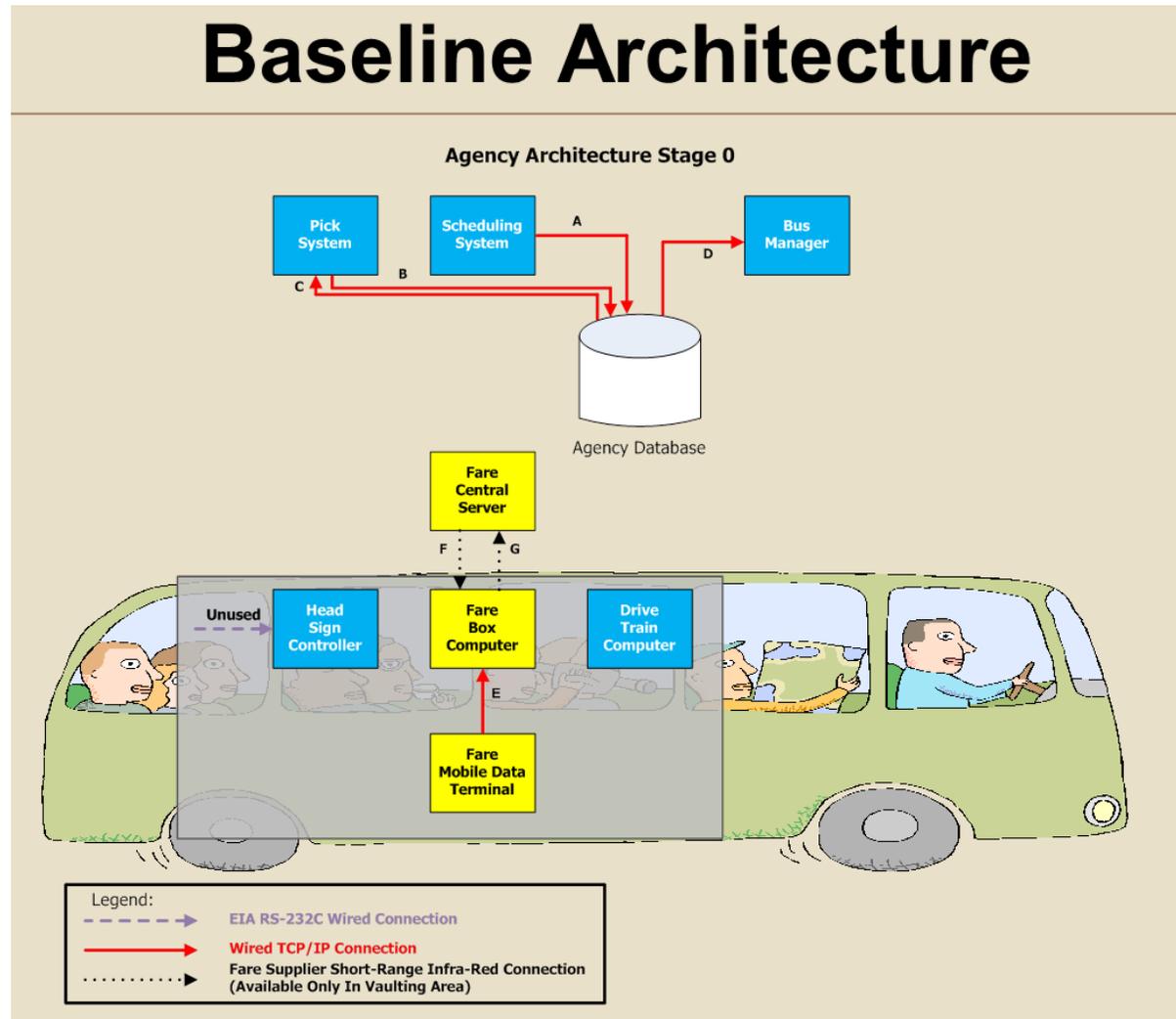


CASE STUDY

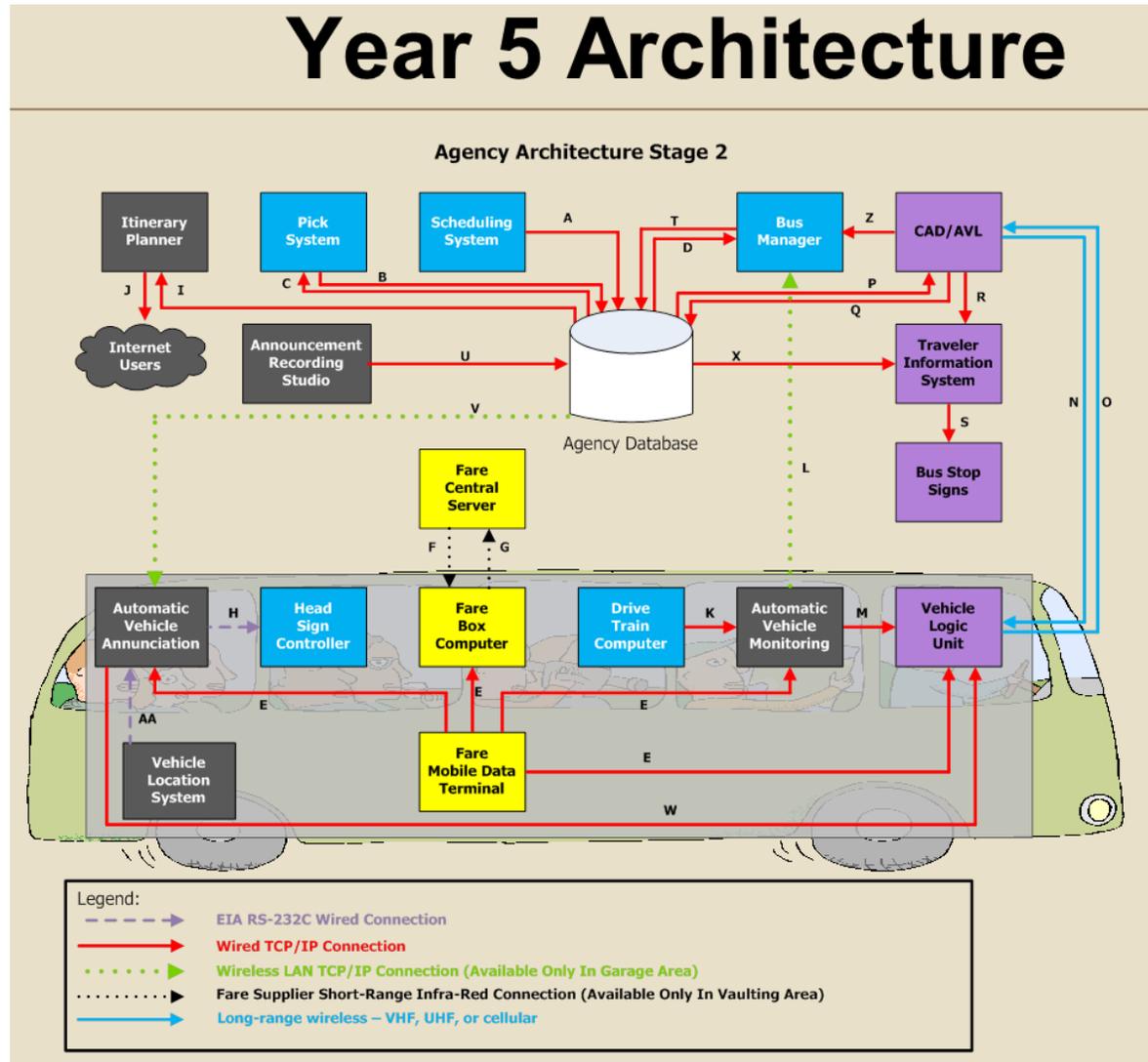


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Diagramming an Agency Architecture



Diagramming an Agency Architecture (cont.)



Architecture Implementation Process

- Define the architecture using block diagrams
- Define the information flows across the interfaces
- Specify the requirements that support the information flows across each interface
- Verify conformance after procurement

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Which answer best describes the use of an agency architecture to aid in capital and project planning?

Answer Choices

- a) Shows the buildings needed to house new systems
- b) Specifies the costs of systems for budgeting
- c) Must specify how vehicles communicate with control center
- d) Shows which systems need to interface with other systems

Review of Answers



- a) Shows the buildings needed to house new systems

Incorrect. Architecture in this context applies to systems, not buildings.



- b) Specifies the costs of systems for budgeting

Incorrect. The architecture can help budgeting, but it does not include costs.



- c) Must specify how vehicles communicate with control center

Incorrect. An architecture could include vehicle-to-base communications, but that is not a requirement. The architecture could include only fixed facilities.



- d) Shows which systems need to interface with other systems

Correct! The architecture explains how all systems are integrated and phased over time.

What are the key elements displayed in an architecture diagram?

Answer Choices

- a) All transit vehicles and fixed facilities in a system
- b) All business processes in agency concept of operations
- c) Only those components that are TCIP compliant
- d) Selected business systems and data flows

Review of Answers



a) All transit vehicles and fixed facilities in a system

Incorrect. The architecture should include representations of only those elements that are linked by communications and information flows.



b) All business processes in agency concept of operations

Incorrect. Only those business processes that exchange (or will exchange) information with other business processes need to be included in the architecture.



c) Only those components that are TCIP compliant

Incorrect. The architecture should include all components that exchange information, not just TCIP compliant ones.



d) Selected business systems and data flows

Correct! Architecture diagrams generally show selected systems and components as boxes or circles and data flows by lines.

Summary of Learning Objective #4

Illustrate the Need for, and Structure of, a Transit Agency Architecture

- The overall planning framework for an ITS project is called an architecture. The architecture explains how all systems are integrated and phased over time
- A transit agency architecture is modeled on the national ITS architecture and can be included in a regional architecture to show interagency data flows
- The model TCIP architecture includes a concept of operations that includes ten common business areas that may be used by most transit agencies

Summary of Learning Objective #4 (cont.)

Illustrate the Need for, and Structure of, a Transit Agency Architecture

- Diagramming a transit agency architecture uses block diagrams to show sub-systems and lines to show information flows
- The case study shows how an agency architecture can be used to show how systems will be added over time and how systems will be integrated

Learning Objective #5: Articulate the Fundamentals of Exchanging Information Among Transit Business Systems and Devices Using TCIP Building Blocks

- Batch and real-time information exchanges
- Data elements, data frames, messages and dialogs

File-Based Transfer

Transfer Data Without the Use of Dialogs in a Non-Real-Time Manner

- Computer application saves data in a file
- File is transferred to another system
- File is loaded and read by another computer application
 - Sometimes involves human interaction
- This interaction requires an agreed-upon description for the files
 - TCIP messages provide this description

Dialog-Based Transfer

Real-Time Transfer (Machine to Machine) Using Dialogs

Dialogs Specify:

- The operational purpose of the exchange of information
- Dialog pattern
- Messages included in the dialog
- Special conditions/constraints
- Relationships with other dialogs

Dialog-Based Transfer (cont.)

Real-Time Transfer (Machine to Machine) Using Dialogs

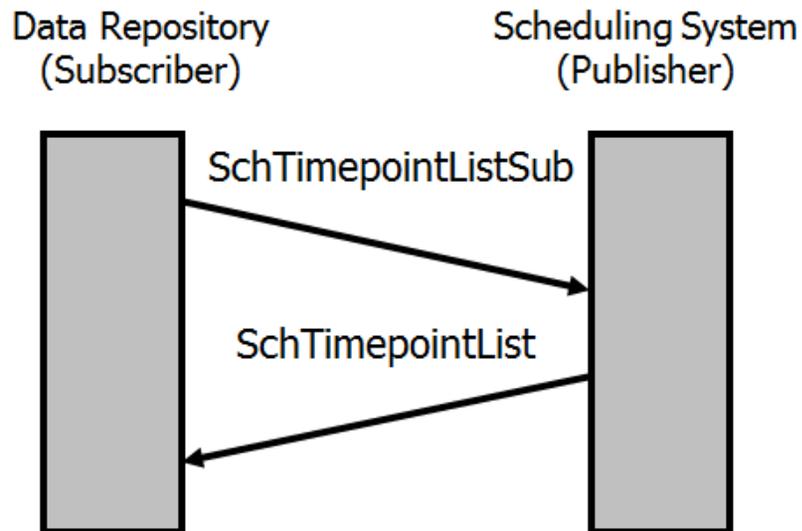
Dialogs do not define:

- How data is stored, translated, and manipulated
- How data is formatted and presented to human users
- How systems/components trigger or initiate dialogs
- Details of the interactions with human users

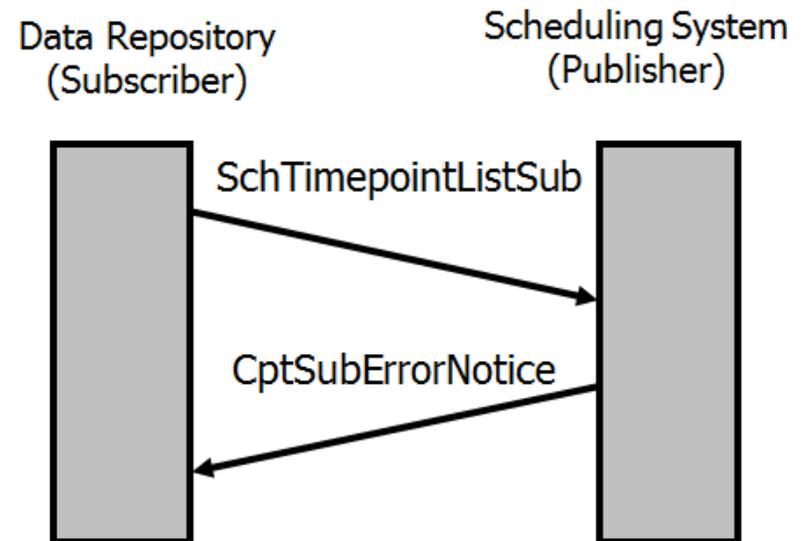
Dialog Patterns

The graphic shows the systems exchanging data as grey rectangles. The arrows illustrate the message flows in the dialog in time sequence starting at the top.

Publish Subscribe **Normal** Execution



Publish Subscribe **Abnormal** Execution



TCIP Building Blocks

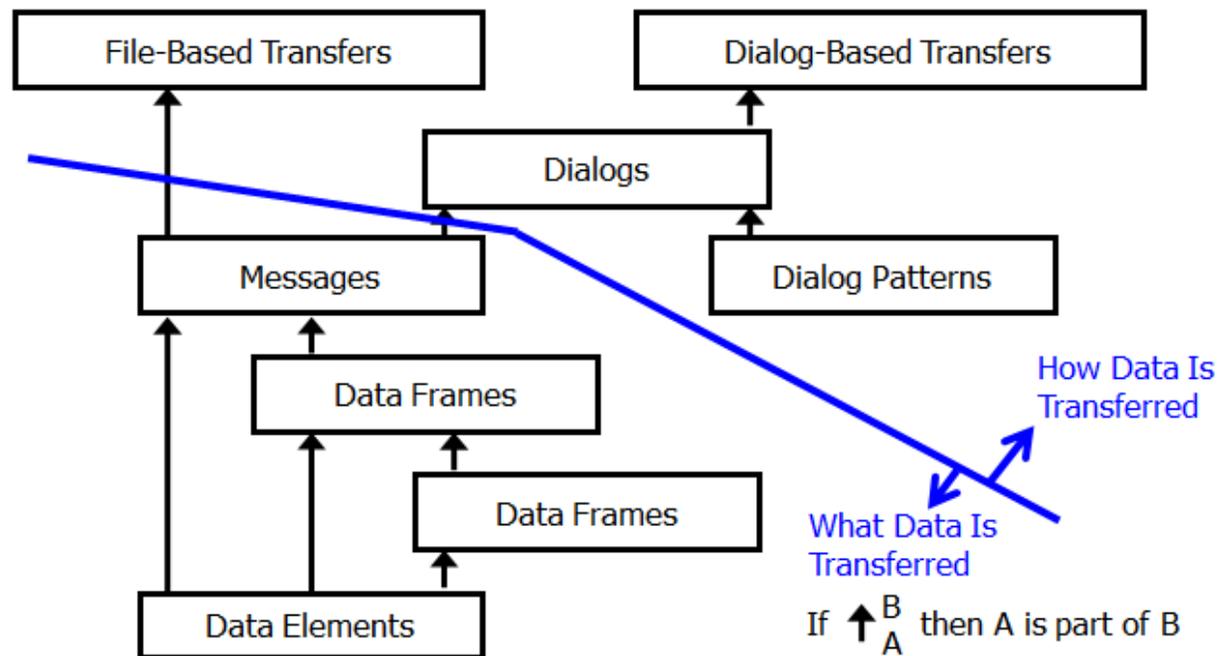
Hierarchy to Help you Define Data

- “How” the data is transmitted
 - File transfers (non-real time)
 - Dialogs (real time; machine to machine)
 - Dialog patterns
- “What” data is transmitted
 - Messages
 - Data frames
 - Data elements

TCIP Building Blocks (cont.)

This graphic illustrates the distinction between what data is transferred, which is shown below the blue line; and how the data is transferred, which is shown above the blue line.

TCIP Building Blocks



Data Element

An Atomic Piece of Information Related to a Person, Place, Thing or Concept

- Examples:
 - SCH-TimepointID – a timepoint identifier
 - SCH-TimepointName – a timepoint name
 - LRMS.Latitude – latitude in microdegrees

Data Frame

Grouping of Data Elements and Other Data Frames to Describe More Complex Concepts

- The groupings help to organize information to describe or identify objects or concepts in the real world
 - SCHTimepointIden **identifies** a timepoint
 - Contains the data element with its unique alpha-numeric identifier (SCH-TimepointID), and can also contain optional data elements including agency number, and name
 - SCHTimepointInfo **describes** a timepoint
 - Contains its identifier and location

Message

An Aggregate of Data Elements and Data Frames into a Larger, More Complex Structure

- A complete, understandable, one-way communication that consists of data elements and data frames conveying metadata and information
- For example, SchTimepointList is a message transmitting a list of all stop points

Dialog

TCIP Includes Eleven Dialog Patterns

1. Publication (query, periodic, and event)
2. Command-Response
3. Report
4. Silent alarm
5. Load
6. Unload
7. Voice radio call (operator-initiated and dispatch-initiated)
8. Signal control and prioritization
9. Blind notification
10. Push
11. Traveler service request

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How can TCIP be used to transfer data?

Answer Choices

- a) Transfer data in files and real-time dialogs
- b) Only transfer data in real-time dialogs
- c) Transfer data in publish-subscribe mode
- d) Transfer data only over the internet

Review of Answers



a) Transfer data in files and real-time dialogs

Correct! TCIP is intended for both batch file and real-time data transfers.



b) Only transfer data in real-time dialogs

Incorrect. TCIP can be used to transfer data in batch file transfers.



c) Transfer data in publish-subscribe mode

Incorrect. There are eleven different dialog patterns to transfer data in TCIP.



d) Transfer data only over the internet

Incorrect. TCIP is neutral with respect to electronic data communication mode.

Which statement most accurately characterizes a TCIP dialog?

Answer Choices

- a) A TCIP dialog is a sequence of data elements
- b) A TCIP dialog is a digital voice communication pattern
- c) A TCIP dialog is a structured exchange of messages
- d) A TCIP dialog is a message with two parts

Review of Answers



a) A TCIP dialog is a sequence of data elements

Incorrect. A TCIP dialog is a sequence of messages.



b) A TCIP dialog is a digital voice communication pattern

Incorrect. TCIP dialogs are used to transfer data.



c) A TCIP dialog is a structured exchange of messages

Correct! TCIP dialogs typically follow a defined pattern that can be repeated.



d) A TCIP dialog is a message with two parts

Incorrect. A dialog contains messages which may have many parts.

Summary of Learning Objective #5

Understand the Fundamentals of Exchanging Information among Transit Business Systems and Devices Using TCIP Building Blocks

- TCIP can be used to transfer data through file transfers, in which a file can be transferred from one system to another electronically or on various types of computer media, such as USB drives
- Or, it can be transferred in real time using TCIP messages and dialogs

Summary of Learning Objective #5 (cont.)

Understand the Fundamentals of Exchanging Information among Transit Business Systems and Devices Using TCIP Building Blocks

- TCIP is comprised of building blocks including
 - Data elements which are “atomic” pieces of data
 - Data frames, which are standardized groupings of data elements
 - Messages, which are complete one-way communications comprised of data elements and data frames
 - Dialogs, which are structured exchanges of messages that specify:
 - An operational purpose
 - The dialog pattern to be used
 - The messages to be used with the specified dialog pattern
 - Any special conditions or constraints associated with the implementation of the specific dialog

Learning Objective #6: Summarize the Content of the TCIP Standard, Tools, and Available Resources

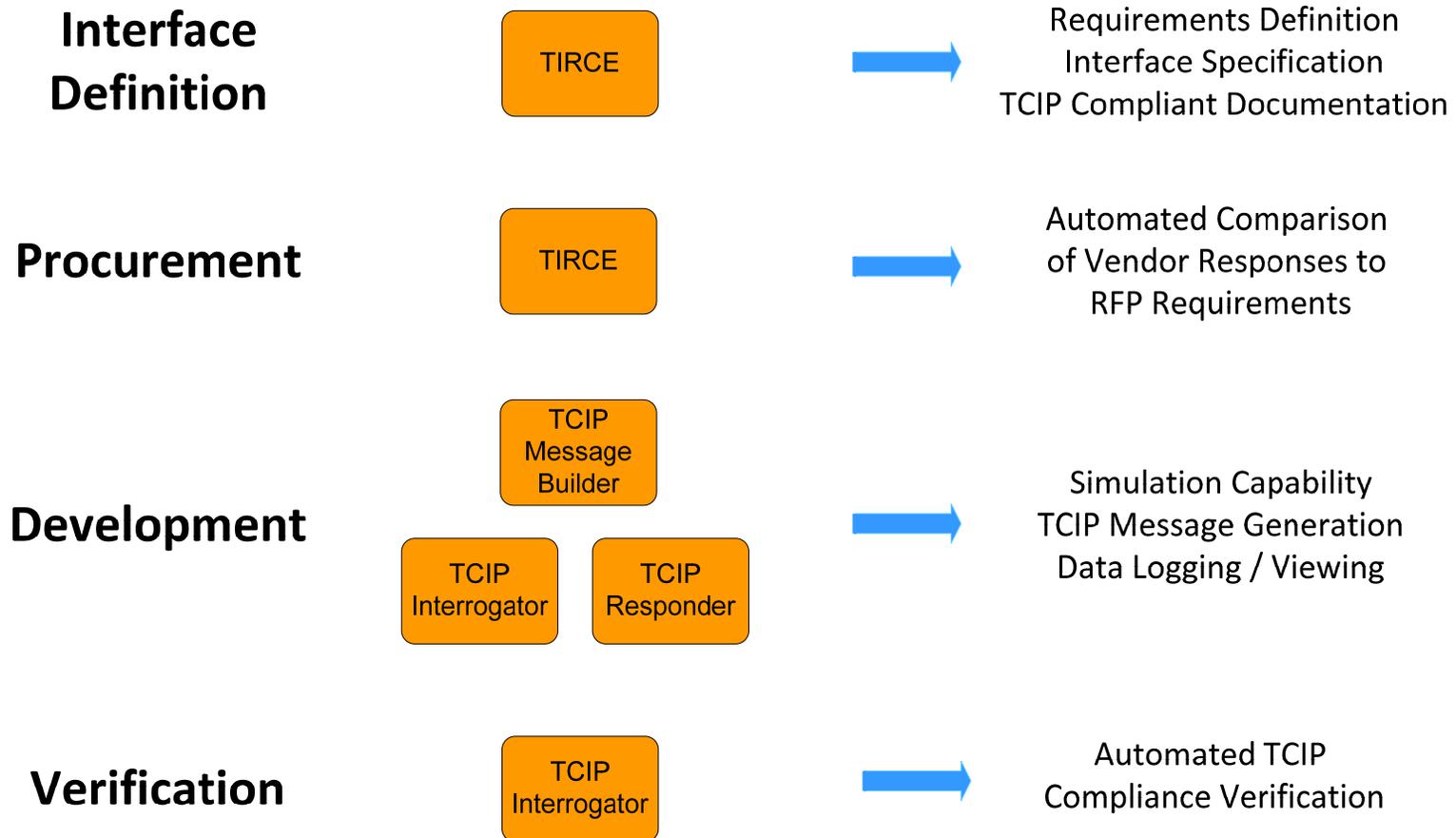
- Downloads available from APTA
- TCIP tools - Using TIRCE to access TCIP (to be detailed in Module 4: TCIP II)
- Message Builder and Test Console
- Overview of National Transit Institute (NTI) on-site training for TCIP

TCIP Downloads Available from APTA

All TCIP Products can be downloaded free of charge from:
<http://www.aptatcip.com/>

- Documents – TCIP Versions contain the standard and non-normative information
 - Current
 - Baseline
 - Working
 - Archive
- Verification – Tools to test TCIP conformance
 - TCIP Test Console
- TIRCE – Tools to access TCIP and develop procurement documents
 - TCIP Implementation, Requirements and Capabilities Editor (TIRCE)

TCIP Support Tool Suite (cont.)



TIRCE – TCIP Implementation, Requirements and Capabilities Editor

- Guide user through a step-by-step process of converting an agency's functional requirements into a TCIP compliant specification
- A top-down systems engineering approach to defining the data exchange interfaces between transit components
 - Information that will be exchanged
 - Manner in which information is exchanged

TIRCE Outputs

- Agency Procurement Specification
 - PRL – Profile Requirements List
- Vendor Product Capabilities Specification
 - PICS – Profile Implementation Conformance Statement
- “Diff” function – A comparison of agency PRL requirements with developer PICS claims of conformance
 - Allows an agency to determine if the offered TCIP implemented interface will meet the agency’s requirements.

TCIP Message Builder

- Enables user to generate XML-encoded TCIP messages
- Messages are used by the TCIP Interrogator and TCIP Server applications
- Load/save/view/edit TCIP messages

TCIP Interrogator

- Simulates a TCIP-compliant device
 - Client side of interface
 - Subscribes to a provider (publisher) of TCIP data
- Establishes a TCIP communications link with a TCIP device under development or test
- Transmits/receives TCIP messages
- View/log TCIP messages
- Automated TCIP message verification

TCIP Responder

- Simulates a TCIP-compliant device
 - Server side of interface
 - Provides TCIP data upon receipt of a subscription request
- Data is pre-loaded
 - Previously created (via TCIP Message Builder) or recorded TCIP messages

Overview of National Transit Institute (NTI) on-Site Training for TCIP Sponsored by FTA

- NTI offers a two-day hands-on course – Integrating Transit Applications: Defining Data Interfaces Using TCIP
- Agencies can host a course by providing an appropriate venue and coordinating with NTI at <http://www.ntionline.com/>
- The course is provided free to agency employees but consultants and vendors are charged a fee
- Students must bring a laptop with a compatible Windows operating system
- Students download TIRCE and TCIP tools onto laptops they use during the course and can take with them

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Why does TCIP include a suite of tools?

Answer Choices

- a) To fix bugs in the standard
- b) To develop an agency architecture
- c) To allow developers to revise and re-ballot the standard
- d) To develop procurement documents and test compliance

Review of Answers



a) To fix bugs in the standard

Incorrect. TCIP tools are not used to fix bugs in the standard.



b) To develop an agency architecture

Incorrect. TCIP Volume 1 provides a concept of operations to aid in developing an agency architecture.



c) To allow developers to revise and re-ballot the standard

Incorrect. TCIP tools are not used in developing and balloting the standard.



d) To develop procurement documents and test compliance

Correct! TCIP tools include TIRCE to develop procurement documents (PRL and PICS) and the Message Builder and Test Console to aid in testing TCIP interfaces.

Summary of Learning Objective #6

Summarize the Content of the TCIP Standard, Tools, and Available Resources

- Downloads available from APTA
- TCIP tools – Using TIRCE to access TCIP (to be detailed in Module 4: TCIP II)
- Message Builder and Test Console
- Overview of National Transit Institute (NTI) on-site training for TCIP

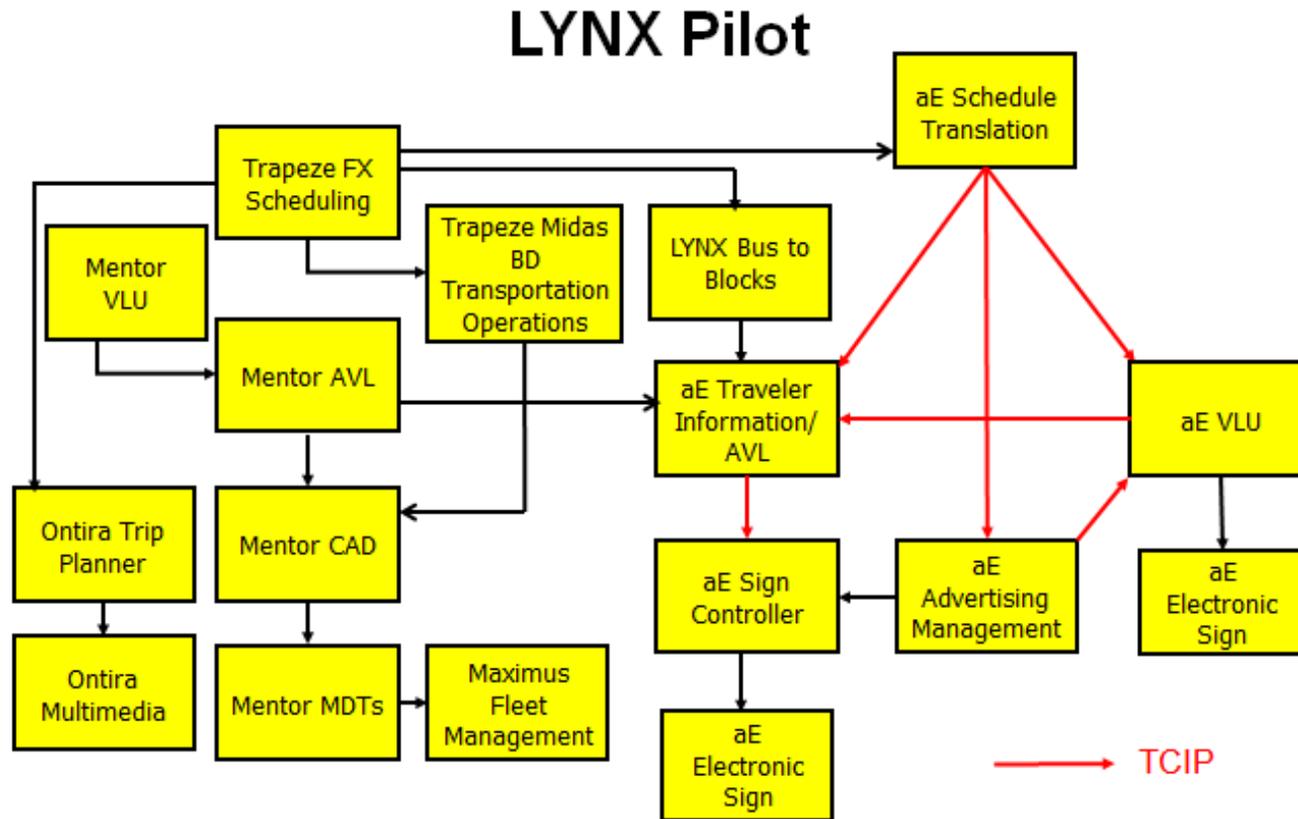
Learning Objective #7: Who is Using TCIP?

Examples and Real World Applications

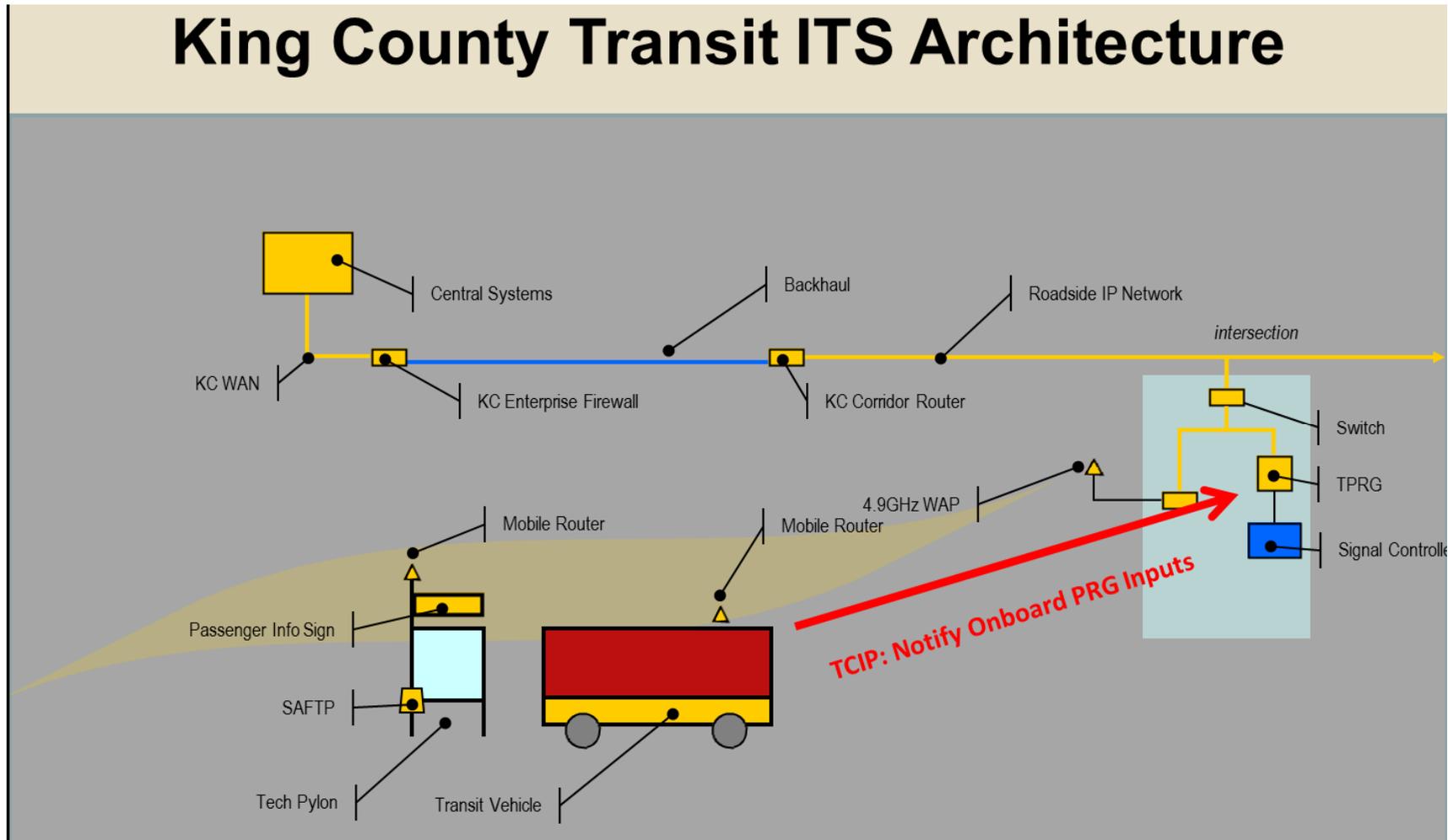
- Current TCIP Projects:
 - LYNX (Orlando)
 - King County Metro (Seattle)
 - New York MTA (NYC)
 - AMT (Montreal)

Who is Using TCIP?

Examples and Real World Applications

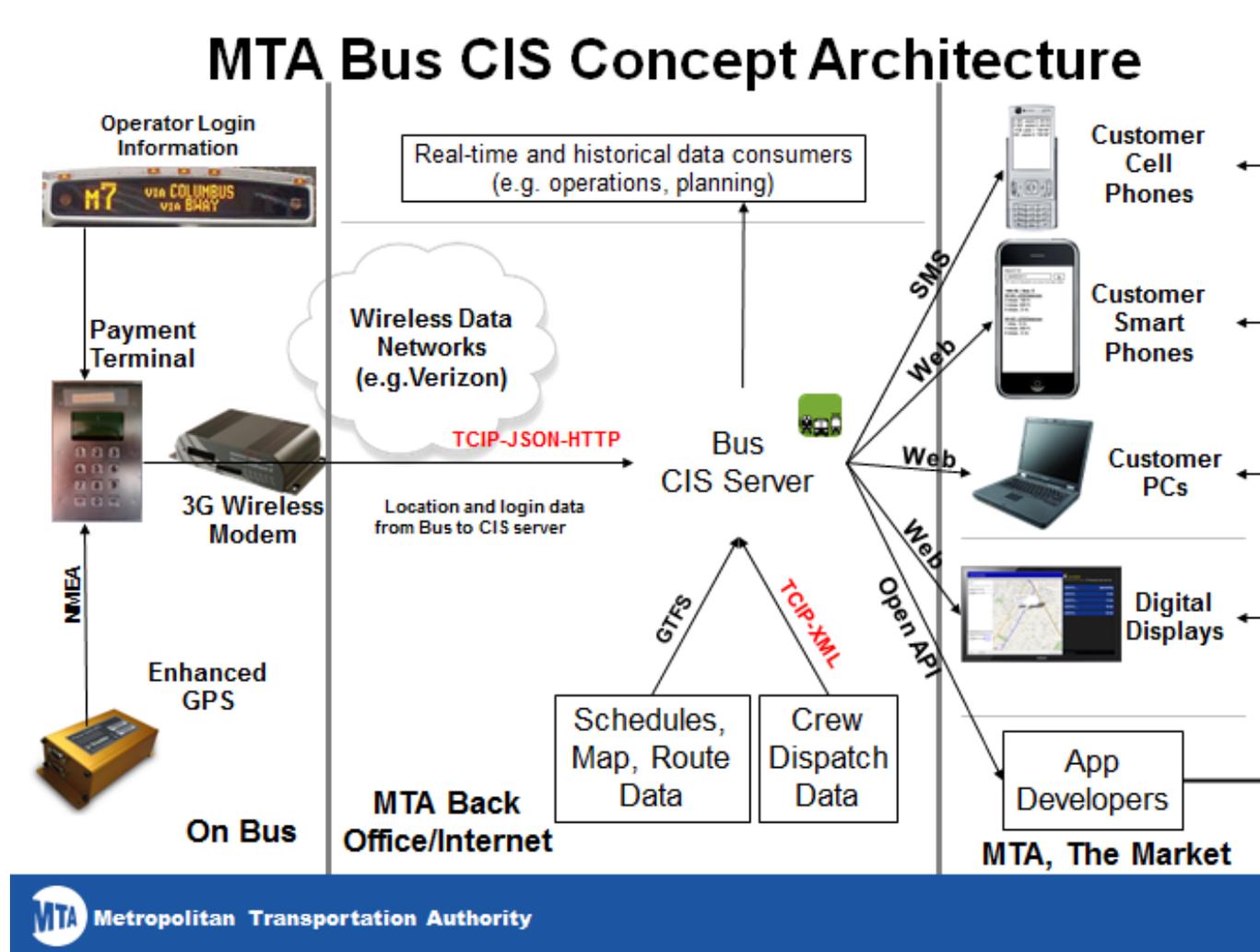


Who is Using TCIP? (cont.)



Who is Using TCIP? (cont.)

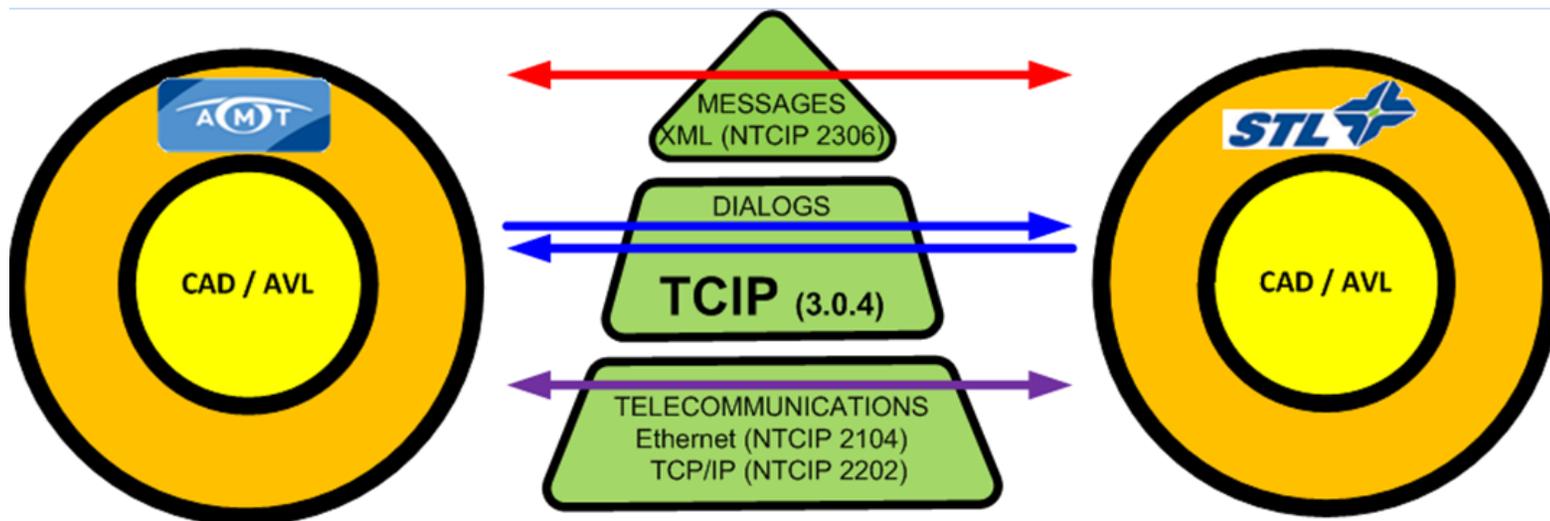
MTA Bus Time Technology: <http://bustime.mta.info/wiki/Main/Technology>



Who is Using TCIP? (cont.)

Examples and Real World Applications – AMT Montreal

Center to center data exchange



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In what types of applications could my agency use TCIP?

Answer Choices

- a) Control center to control center
- b) Provide data to support Transit Signal Priority requests
- c) Communicate real-time bus arrival information
- d) Communicate between vehicles and base
- e) All of the above

Review of Answers



a) Control center to control center

Montreal is using TCIP for center to center.



b) Provide data to support Transit Signal Priority requests

King County is using TCIP to supplement transit signal priority request generation.



c) Communicate real time bus arrival information

MTA NYCT is using TCIP for real time arrival information.



d) Communicate between vehicles and base

LYNX will use TCIP to connect on-board VLU to passenger information system.



e) All of the above

Correct! TCIP has been, and can be used for all of the applications in the question. Can you think of other interfaces for which using TCIP would benefit your agency?

Review of Learning Objective #7

Who is Using TCIP? Examples and Real World Applications

- TCIP is being used by a number of agencies in different ways. Four examples are shown:
 - Lynx in Orlando FL is using TCIP to provide real-time traveler information and to drive electronic display signs including advertising
 - King County, WA is using TCIP to communicate information to support generation of Transit Signal Priority (TSP) requests to a main server
 - MTA New York City Transit is using TCIP to communicate real-time bus arrival information every 30 seconds from 5,500 buses
 - AMT Montreal is using TCIP dialogs to communicate between two different Computer Aided Dispatch/Automatic Vehicle Locator (CAD/AVL) systems in two different control centers

What We Have Learned

1. Transit Communications Interface Profiles (TCIP) is the ITS standard for exchanging information among transit ITS systems and components.
2. TCIP facilitates competitive procurements by providing a non-proprietary standard, allowing the transit agency to go beyond a single vendor when looking to upgrade or add to an existing system.
3. An agency ITS architecture provides a framework for interdepartmental ITS planning and coordination. It is a visual representation of the plan and vision for ITS development within the agency.

What We Have Learned (cont.)

4. The TCIP concept of operations describes ten Transit Core Business Processes and explains how TCIP can be used to facilitate communication among transit applications.
5. TCIP building blocks consist of data element, data frames, messages, and dialogs.
6. TCIP includes a suite of tools including the TCIP Implementation, Requirements and Capabilities Editor (TIRCE) to develop procurement documents (PRL and PICS) and the Message Builder and Test Console to aid in testing TCIP interfaces.

Resources

- “NTI Instructor Materials: Integrating Transit Applications: Defining Data Interfaces Using TCIP,” Power Point Presentation, NTI, February, 2012
- J. Fayos, Draft “NTI Instructor Materials: Integrating Transit Applications: Defining Data Interfaces Using TCIP,” NTI, August, 2013
- Figure 9.2 “TCIP Provides the Building Blocks for Agency ITS architectures and RFPs,” APTA TCIP-S-001 4.0.0 Volume I, p. 328.
- [Concept of operations - Wikipedia, the free encyclopedia](#)
en.wikipedia.org/wiki/Concept_of_operations Wikipedia, accessed July 12, 2014
https://www.google.com/search?q=definition+concept+of+operations&rlz=1C1LDJZ_enUS499US518&oq=definition+concept+of+&aqs=chrome.1.69i57j0l5.7685j0j8&sourceid=chrome&es_sm=122&ie=UTF-8
- ITS PCB T3 Webinars on ITS Transit Standards
http://www.pcb.its.dot.gov/t3_archives.asp
- “Integrating Transit Applications: Defining Data Interface Requirements Using TCIP – Participant Workbook,” accessed September 22, 2014
<https://drive.google.com/file/d/0B15yEPgHsRUAakNLVDMwN3hvN0U/edit?usp=sharing>

Next Course Module

Module 4:

Transit Communications Interface Profiles (TCIP), Part 2 of 2: Structure and Elements of TCIP—Accessing TCIP via TIRCE and TCIP Tools

- The current course, Module #3: Transit Communications Interface Profiles (TCIP), Part 1 of 2: is a prerequisite for Module #4
- Module #4 describes the suite of tools provided to make the standard accessible to users
- Focuses on how to access TCIP using the TCIP Implementation Requirements and Capabilities Editor (TIRCE)

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)



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