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- 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  
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# Jeffrey Spencer



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A photograph of several people in a conference room setting, looking at a presentation on a screen. A laptop is visible on a table in the foreground.

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# **ITS Transit Standards Professional Capacity Building Program**

## **Module 4:**

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



# Acknowledgments

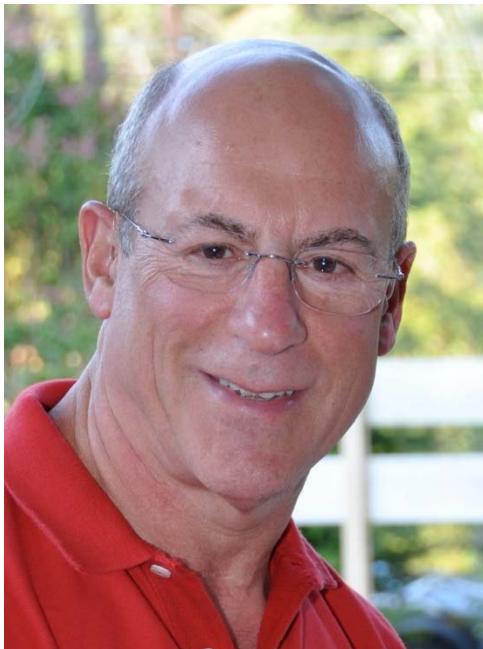
- Ayers Electronic Systems, LLC
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# A C T I V I T Y



# Instructor



**Jerome M. Lutin, Ph.D., P.E., AICP**  
**Senior Director (Retired)**  
**New Jersey Transit**  
**South Brunswick, NJ, USA**

# Target Audience

- Transit procurements staff;
- Transit IT staff;
- Metropolitan Planning Organizations (MPO) staff;
- Department of Transportation (DOT)/ITS staff;
- Transit ITS contractors and consultants;
- Transit technology vendors;
- Transit Traveler Information System managers; and
- Traffic Management Center (TMC) / Traffic Operation Center (TOC) managers.

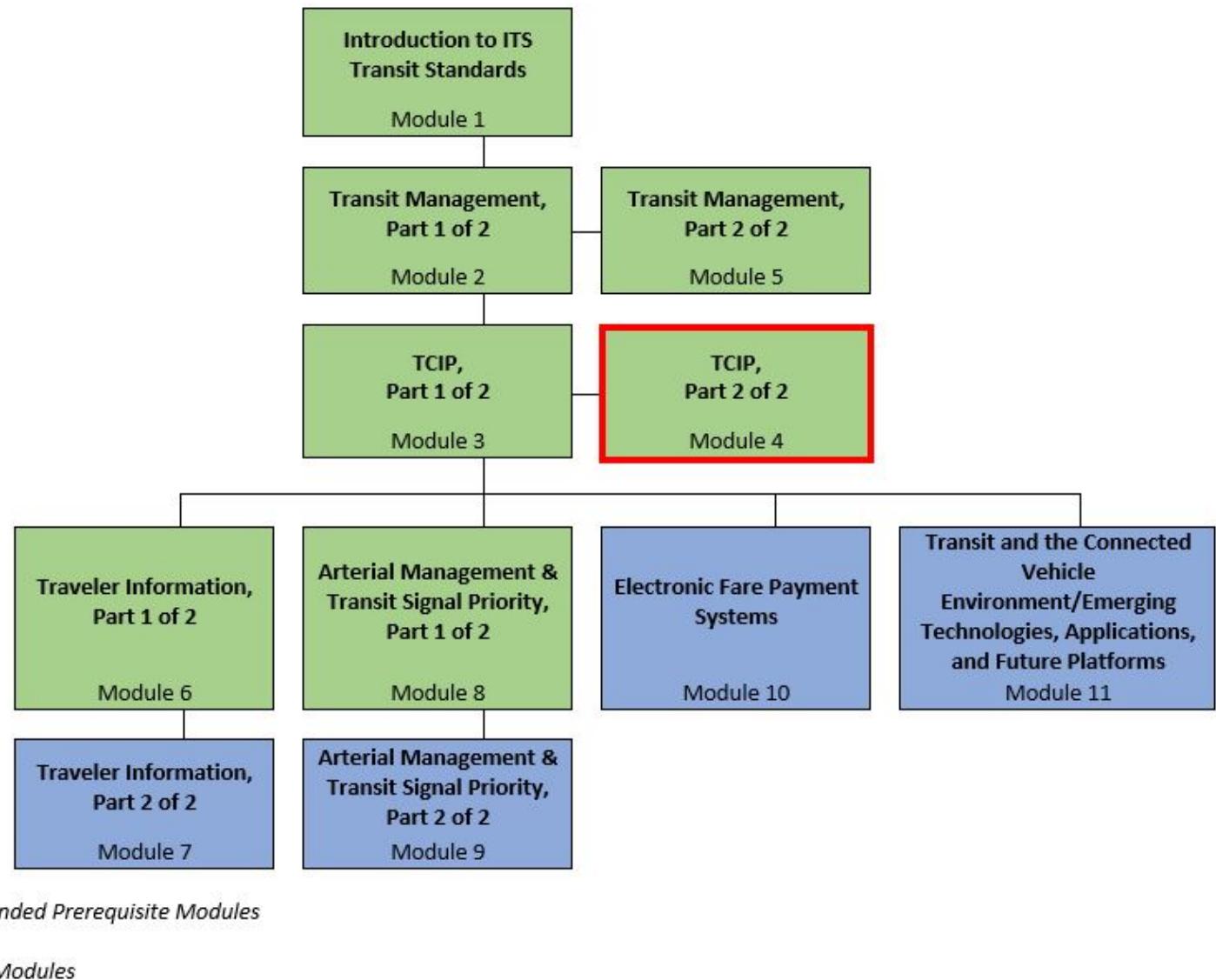


# Recommended Prerequisite(s)

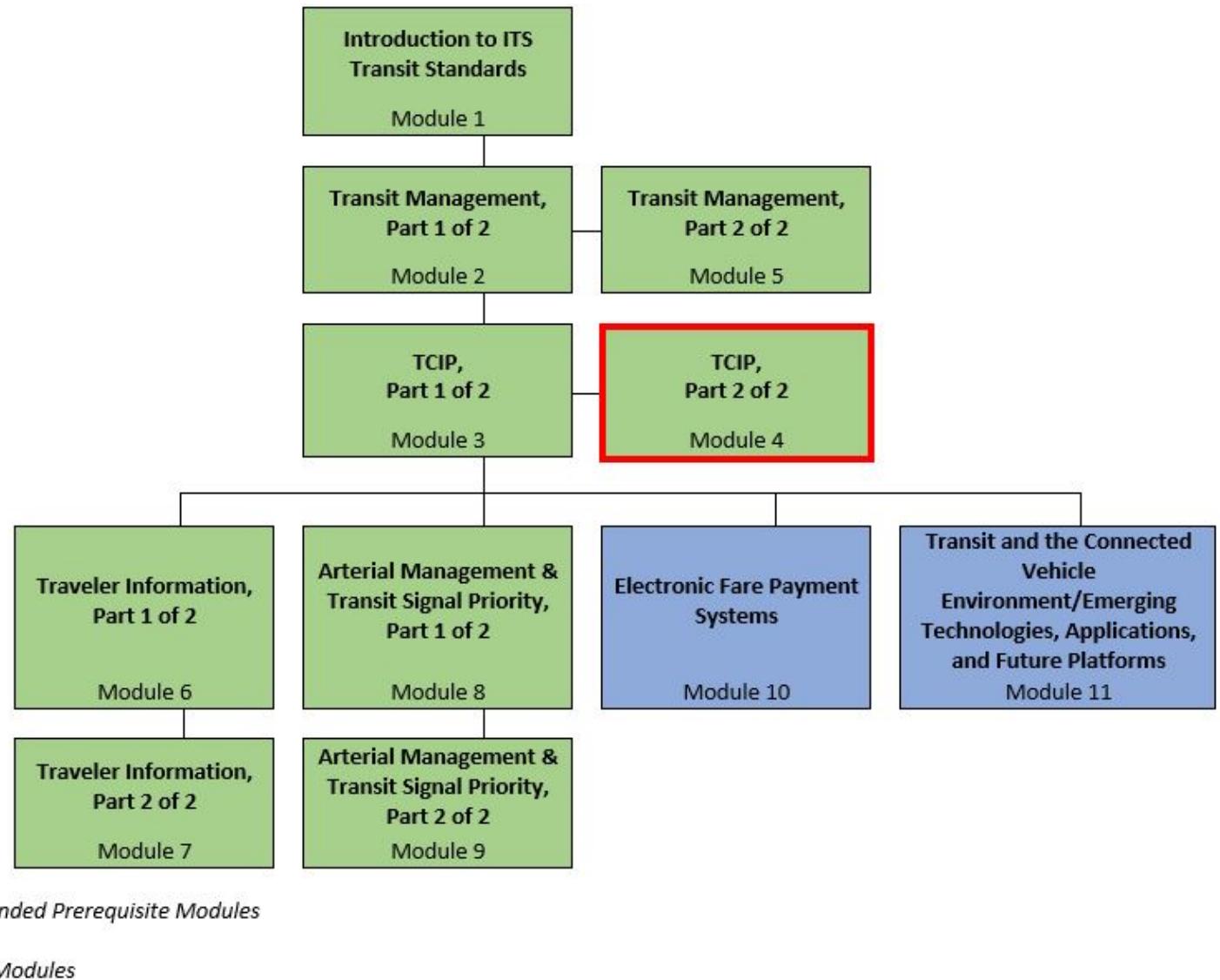
	Decision-Maker	Project Manager	Project Engineer
<b>Module 1:</b> Introduction to ITS Transit Standards	N/A	✓	✓
<b>Module 2:</b> Transit Management, Part 1 of 2	N/A	✓	✓
<b>Module 3:</b> Transit Communications Interface Profiles (TCIP), Part 1 of 2	N/A	✓	✓
<b>Module 5:</b> Transit Management, Part 2 of 2	N/A	✓	✓



# Curriculum Path (Project Manager)



# Curriculum Path (Project Engineer)



# Learning Objectives

1. Illustrate the “communications stack” and show how it relates to TCIP.
2. Describe the TCIP Implementation, Requirements and Capabilities Editor (TIRCE) and how it is used as the key to TCIP.
3. Identify and provide examples of data elements, data frames, messages, and dialogs.
4. Describe how data are organized in TCIP data exchanges
5. Define a Profile Requirements List (PRL) and explain how it is used to specify TCIP requirements in a transit ITS project.
6. Articulate and describe the uses of each tool in the TCIP suite of tools.
7. Summarize the range of TCIP applications, implementation tools, and additional training.



# Learning Objective #1: Illustrate the “Communications Stack” and Show How It Relates to TCIP

- Communications layers
- TCIP model for data exchange
- File transfer and real time



# Open Systems Interconnection (OSI) Model

## Open Systems Interconnection (OSI) Model

**7. Application Layer – Message Format – TCIP is used in this layer**

**6. Presentation Layer – Encryption/decryption – XML is used in this layer**

**5. Session Layer – Manages connection between computers**

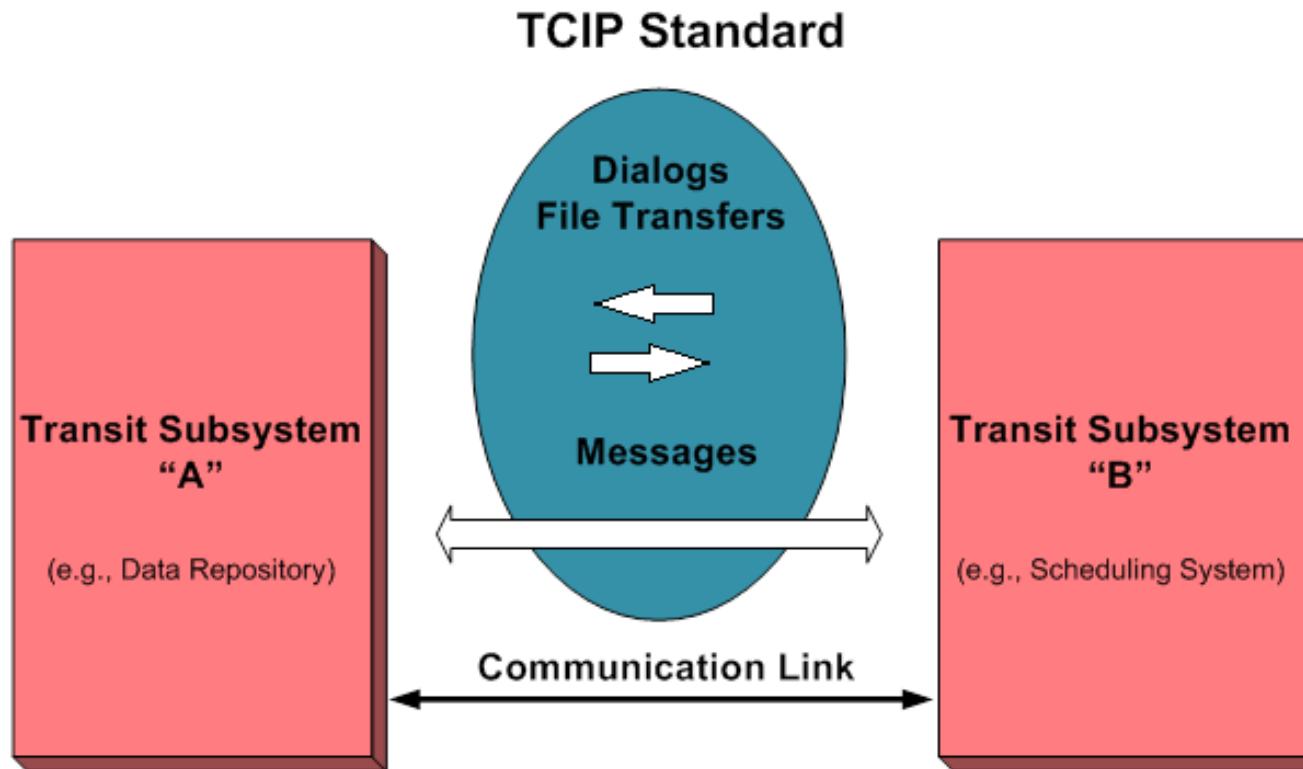
**4. Transport Layer – Creates segments or “packets” of data**

**3. Network Layer – Addressing and routing**

**2. Data Link Layer – Access to physical layer, error detection**

**1. Physical Layer – Electrical properties of connection**

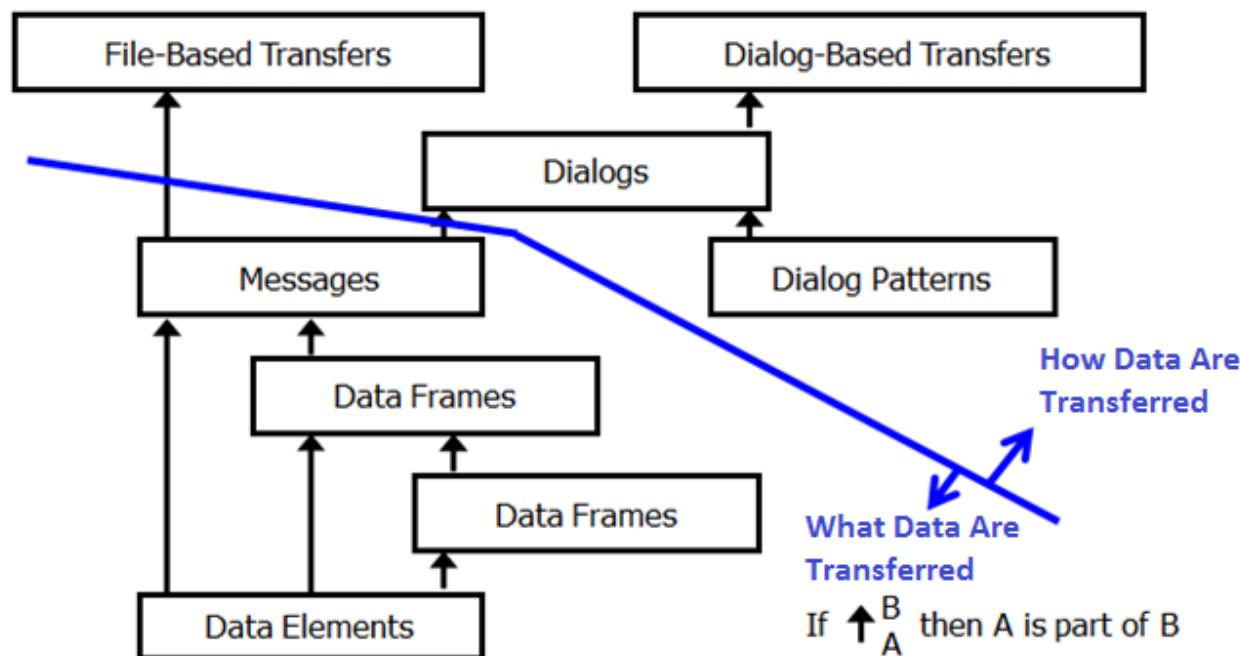
# TCIP Model for Data Exchange



# TCIP Building Blocks

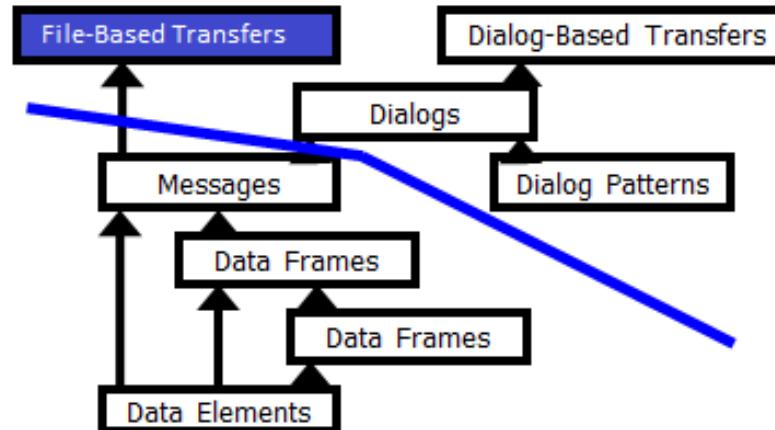
This graphic illustrates the distinction between what data are transferred, which is shown below the blue line; and how the data are transferred, which is shown above the blue line.

## TCIP Building Blocks



# How Data Are Transferred – File-Based Exchange

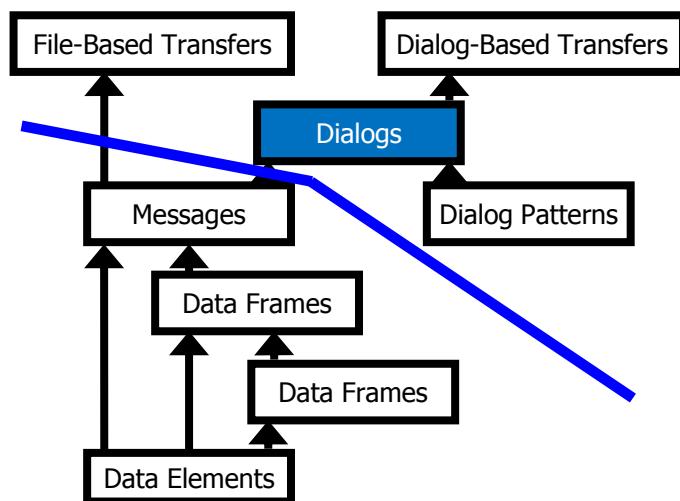
## Transfer Data Without the Use of Dialogs in a Non-Real-Time Manner



- 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

# Dialogs

Specify the Operational Purpose, Dialog Pattern, Messages, and Other Special Conditions/Constraints



## Publication Dialog Definition – Refer to Section 7.1

Dialog Name: Publish Fleet Locations      Business Area: CC

Dialog Purpose:  
Allows a subscriber to obtain PTV locations by subscribing through a single business system (e.g. CAD/AVL) rather than subscribing to each PTV individually.

Publication Type: Event

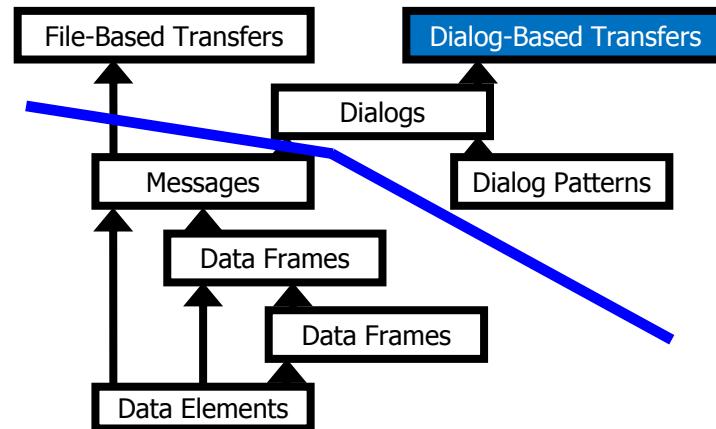
Row Updates Supported: None

Publication Request and Response	Name	Identifier
Messages:	[CcFleetLocationSub]	Cc 2063
Request:	[CcFleetLocation]	Cc 2064
Response:	[CptSubErrorNotice]	Cpt 2000
Error response:		



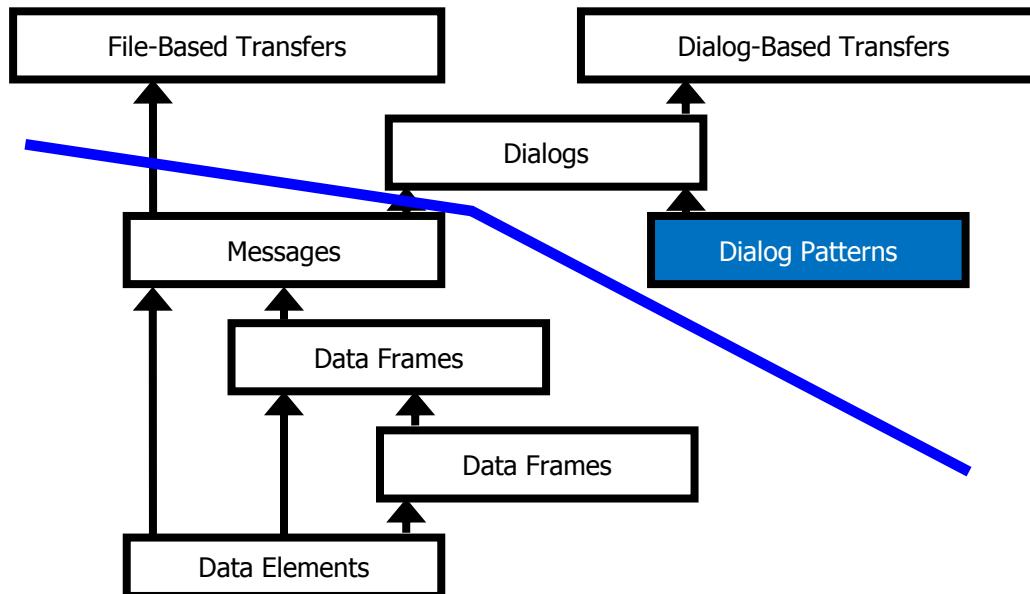
## Dialog-Based Transfer

### Real-Time Transfer (Machine-to-Machine) Using Dialogs



- Does not define:
  - How data are stored, translated, and manipulated
  - How data are formatted and presented to human users
  - How systems/components trigger or initiate dialogs
  - Details of the interactions with human users

# Dialog Patterns



- Defines the sequence of actions for a dialog
- Can be reused for multiple purposes

# A C T I V I T Y



## Which of the following is defined in a TCIP dialog?

### Answer Choices

- a) How data are stored and translated
- b) How data are formatted
- c) How systems present data to human users
- d) How messages are sequenced



## Review of Answers



- a) How data are stored and translated

*Incorrect. Dialogs do not determine how data are stored and translated.*



- b) How data are formatted

*Incorrect. Dialogs do not determine how data are formatted.*



- c) How systems present data to human users

*Incorrect. Dialogs do not determine how data are presented to human users.*



- d) How messages are sequenced

***Correct! Dialogs specify the sequential order of messages.***

# Summary of Learning Objective #1

## Illustrate the “Communications Stack” and Show How It Relates to TCIP

- There are seven layers in the OSI model “communications stack”
- TCIP model for data exchange includes the “what,” which are data elements, data frames, and messages, and the “how,” which are file transfers, dialogs, and dialog patterns
- TCIP can exchange data in both file transfer and real time



## **Learning Objective #2: Describe the TCIP Implementation, Requirements and Capabilities Editor (TIRCE) and How It Is Used as the Key to TCIP**

- Interface specification
- Agency perspective – defining business applications by creating a Profile Requirements List (PRL)
- Vendor perspective – testing product compliance using a Profile Implementation Conformance Statement (PICS)



# Interface Specification

## Detailed Interface Specifications Are Critical for Success

- Ability to understand (and specify) exactly what information is to be exchanged across the interface (both the “how” and the “what”)
- Minimizes opportunities for agency/vendor technical disconnects
- Provides verification test criteria
- Maintenance and future upgrades



## Interface Specification (cont.)

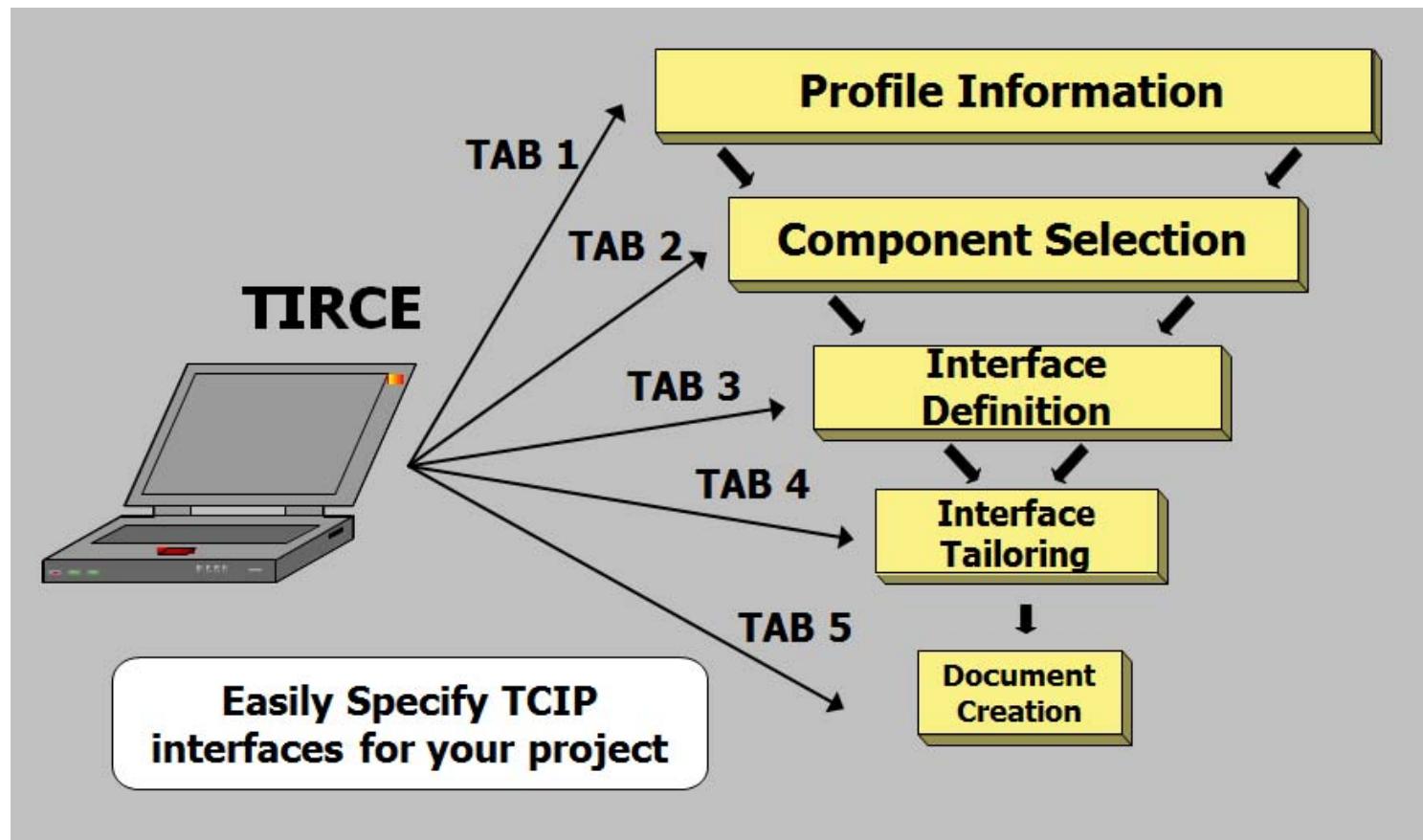
### TIRCE – for Interface Specification

- Guides 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



# Interface Specification (cont.)

## The Five Tabs of TIRCE



## PRL and PICS

### Profile Requirements List (PRL)

### Profile Implementation Conformance Statement (PICS)

- PRL and PICS are very similar in structure
  - PRL defines the interface from the agency's perspective
  - PICS defines the interface from the vendor's perspective
- Both define the TCIP dialogs and messages for each interface in the system



## TIRCE – Agency Perspective

### Profile Requirements List (PRL)

- Generates detailed interface requirements
  - Top-down systems engineering approach
  - Interface requirements embodied in the PRL
- Allows an agency to define a project incrementally over time
- Quickly compare vendor responses to RFP requirements as stated in the PICS

## TIRCE – Vendor Perspective

### Profile Implementation Conformance Statement (PICS)

- Provides TCIP-compliance “spec-sheet” for vendors’ products (PICS)
- Provides a structured, precise response to interface requirements in a PRL
- Quickly evaluate RFPs against existing product capabilities (Diff)
- Software development support
  - Tailored XML Schema

## TIRCE – Agency and Vendor Perspective

- TIRCE includes a Diff function to compare the PRL and PICS



# A C T I V I T Y



## **Which statement best characterizes a Profile Requirements List (PRL)?**

### **Answer Choices**

- a) A PRL includes a Diff function
- b) A PRL is developed by the vendor
- c) A PRL specifies the size of the files in the data exchange
- d) A PRL is developed by the agency

## Review of Answers



- a) A PRL includes a Diff function

*Incorrect. The Diff function is used to compare the PRL and PICS.*



- b) A PRL is developed by the vendor

*Incorrect. The PRL is developed by the procuring agency.*



- c) A PRL specifies the size of the files in the data exchange

*Incorrect. The PRL does not specify the size of the files.*



- d) A PRL is developed by the agency

***Correct! The PRL is developed by the procuring agency.***

## **Summary of Learning Objective #2: Describe the TCIP Implementation, Requirements and Capabilities Editor (TIRCE), and How It Is Used as the Key to TCIP**

- **Interface specification:** TIRCE provides detailed specifications and XML schema for interfaces between machines that are exchanging data
- **Agency perspective:** Create a PRL that defines the components to be connected, the interfaces needed, and the dialogs to be implemented to facilitate the data exchange
- **Vendor perspective:** Create a PICS document that allows a vendor's product to be compared with an agency's requirements



# Learning Objective #3: Identify and Provide Examples of Data Elements, Data Frames, Messages, and Dialogs

- Data elements
- Data frames
- Messages
- Dialogs
- Dialog patterns



## Data Element

- An atomic piece of information related to a person, place, thing, or concept
  - Examples:
    - SCH-TimepointID – a timepoint alphanumeric identifier
    - SCH-TimepointName – a timepoint name
    - LRMS.Latitude – latitude in microdegrees



## Data Elements (cont.)

- TCIP Data Types are based on Abstract Syntax Notation (ASN.1)
  - BOOLEAN
  - ENUMERATED
  - INTEGER
  - UTF8String
  - Numeric String
  - OCTET String
- TCIP has extended ASN.1 – created subtypes
  - Integer subtypes
  - Date and Time subtypes
  - String, Name, and Identifier subtypes



## Data Frames

- Groupings of data elements and other data frames to describe more complex concepts
- The groupings help organize information to describe or identify objects or concepts in the real world
- Examples:
  - SCHTimepointIden identifies a timepoint
    - Contains the data element with its unique alphanumeric identifier (SCH-TimepointID) and can also contain optional data elements including agency number and name
  - SCHTimepointInfo describes a timepoint
    - Contains its identifier and location



## TCIP Messages

- Aggregations 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, CptStoppointList is a message transmitting a list of all stop points



# TCIP Message Example “SchTimepointList”

## C.319 Message SchTimepointList {Sch 2007}

### Use:

Provide a specified version of timepoint information

### Remarks:

A timepoint may be used in more than one pattern.

An agency may decide to include all timepoints for the agency within a timepoint version, or to limit a version to the timepoints included on a route or group of routes, however all timepoints referenced in a pattern list (SchPatternList message) must be included in the version of the timepoints referenced by that pattern list. The update-thru field that the information provided reflects all updates thru the indicated datetime.

This message can be used to convey changes to a timepoint list version since a specified time. In such a case, the update-since field indicates the date/time from which updates are provided. The deleted-timepoints field indicate timepoints deleted from the list since update-begin.

### ASN1:

```
SchTimepointList ::= SEQUENCE {
    subscriptionInfo          CPTSubscriptionHeader,
    languages                  CPTLanguageList OPTIONAL,
    update-since                CPT-DateTime OPTIONAL,
    timepointVersion           SCH-TimetableVersionID OPTIONAL,
    effective                  CPT-DateTime,
    expires                    CPT-DateTime OPTIONAL,
    timepoints                 SEQUENCE (SIZE(1..10000)) OF SCHTimepointInfo OPTIONAL,
    deleted-timepoints         SEQUENCE (SIZE(1..25000)) OF SCHTimepointIden OPTIONAL
}
```

### The following dialogs use this message:

[Publish Timepoint List](#)



## TCIP 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



# TCIP Dialog Example: “Publish Timepoint List”

## D.147 Dialog Publish Timepoint List

### Use:

Allows a subscriber to obtain timepoint information by effective datetime or version number. The subscriber can determine the required timepoint effective date/ version number using the Publish Master Schedule Version dialog.

### Remarks:

The dialog may be used to request updates to a timepoint list since a specified date/time if the subscriber has previously obtained the complete timepoint list with the specified effective date or version number.

### Dialog Contents

Message	Role	File Transfer
SchTimepointListSub	Request	No
SchTimepointList	Response	Yes
CptSubErrorNotice	ErrorResponse	No

### Dialog Row Updates

Message	Field	Data Frame
SchTimepointList	timepoints	SCHTimepointInfo

## TCIP Has 11 Types of 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
  - Dispatch-initiated
8. Signal control and prioritization
9. Blind notification
10. Push
11. Traveler service request

## TCIP Dialog Patterns 1 - 4

1. Publication (query, periodic, and event)
2. Command-Response
3. Report
4. Silent alarm



## TCIP Dialog Patterns 5 - 8

5. Load
6. Unload
7. Voice radio call
  - Operator-initiated
  - Dispatch-initiated
8. Signal control and prioritization



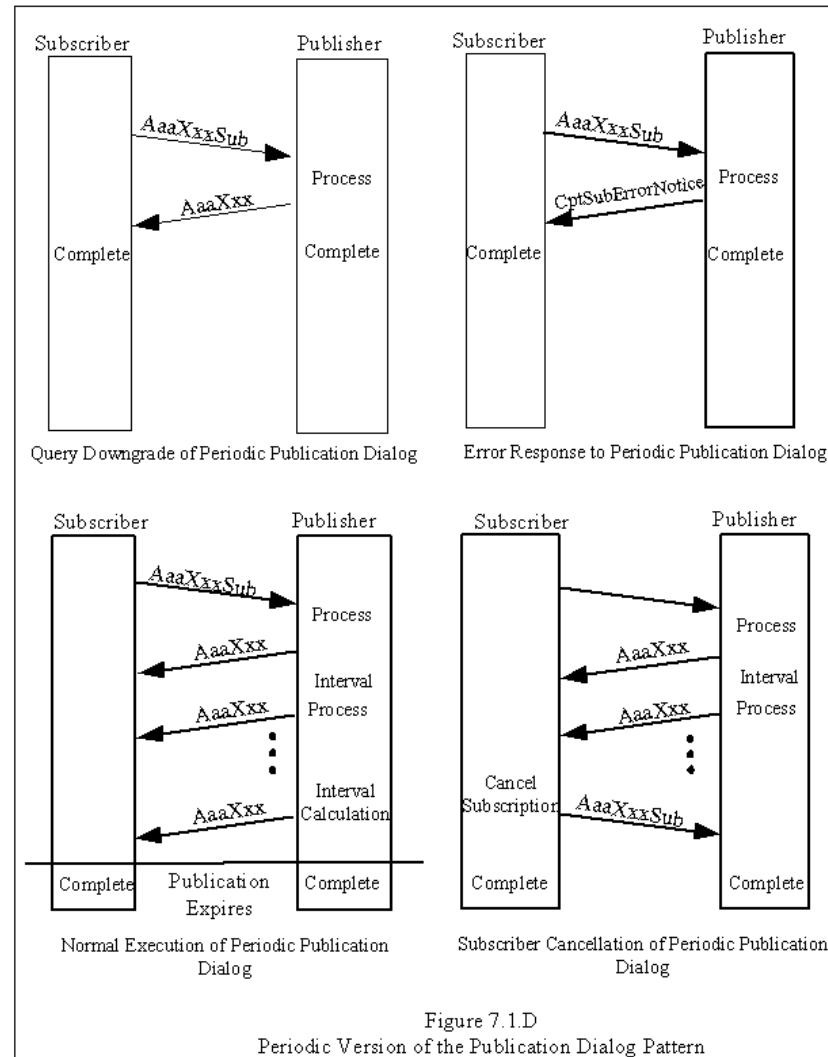
## TCIP Dialog Patterns 9 - 11

9. Blind notification
10. Push
11. Traveler service request



# TCIP Dialog Pattern Example

## Periodic Variations of Publication Dialog



# A C T I V I T Y



## **Which of the following statements about data elements is correct?**

### **Answer Choices**

- a) A data element can include a data frame
- b) A data element can only include integers
- c) A data element cannot be used to identify a person
- d) A data element can be used to represent a concept

## Review of Answers



- a) A data element can include a data frame

*Incorrect. A data frame can include a data element, but a data element cannot include a data frame.*



- b) A data element can only include integers

*Incorrect. A data element can include several types of ASN.1 representations.*



- c) A data element cannot be used to identify a person

*Incorrect. A data element can be a person's name or other identifier.*



- d) A data element can be used to represent a concept

**Correct! A data element can represent a person, place, thing, or concept.**

# **Summary of Learning Objective #3: Identify and Provide Examples of Data Elements, Data Frames, Messages, and Dialogs**

- **Data Element:** An atomic piece of information related to a person, place, thing, or concept
- **Data Frame:** Groupings of data elements and other data frames to describe more complex concepts
- **Message:** Aggregations of data elements and data frames into a complete, understandable, one-way communication conveying metadata and information
- **Dialog:** Specified sequence of messages for an operational purpose including any special conditions
- **Dialog Pattern:** Common forms of dialogs that can be used repeatedly for multiple purposes



## Learning Objective #4: Describe How Data Are Organized in TCIP Data Exchanges

- TCIP identifiers
- Optional items (fields)
- Versioning
- Row updates
- Applicability
- Local extensions
- Multilanguage support



## TCIP Identifiers

- Allow an agency to provide information about items (e.g., bus stop inventory, timepoint inventory) to an application once, and then refer to the item in subsequent messages
  - For example, if we want to associate passenger count information with a bus stop, we can associate it with the identifier, and not send a complete description of the bus stop with each set of passenger counts

## TCIP Identifiers (cont.)

# TCIP Identifiers

- Allow items to be uniquely identified across all transit agencies in the US
  - Employees
  - Intersections
  - Operator bases
  - Operators
  - Organizational units
  - Shelters
  - Stop points
  - Transfer clusters
  - Transit facilities
  - Vehicles
  - Fare policies
  - Fare zones
  - Trips
  - Incidents
  - Amenities
  - Announcements
  - Geographic zones
  - Service bulletins
  - Travelers
  - Blocks
  - Notes
  - Patterns
  - Pattern segments
  - Routes
  - Runs
  - Timepoints
  - Trains

## TCIP Identifiers (cont.)

- TCIP Iden Frames ALWAYS contain:
  - Alphanumeric identifier (e.g., vehicle\_id)
- TCIP Iden Frames MAY contain:
  - Optional agency number
  - Optional string designator that uniquely represents the item within the agency (e.g., route\_designator)
  - Zero or more optional string name fields for the identified item (e.g., first-name, last-name, VIN)



## Optional Items (Fields)

- Support a functional requirement that is not common to all agencies (e.g., an announcement can be text, audio, or both)
- Support a capability that is only required in certain contexts (e.g., a warning in a message)
- Convey information that may or may not be available (e.g., photographs of a stoppoint)

### Annex B.79 Data Frame: CPTStoppointIden {CPT 1016}

Use: Uniquely identify a stoppoint whether in a single, or multi agency environment.

#### ASN.1 Representation:

```
CPTStoppointIden ::= SEQUENCE{
    stoppoint-id      CPT-StoppointID,
    agency-id         CPT-AgencyID          OPTIONAL,
    name              CPT-StoppointName        OPTIONAL,
    nameLangs         CPTAdditionalLanguageContents OPTIONAL,
    designator        CPT-StoppointDesignator OPTIONAL,
    designatorLangs   CPTAdditionalLanguageContents OPTIONAL,
    agencydesignator  CPT-AgencyDesignator OPTIONAL,
    agencydesignatorLangs CPTAdditionalLanguageContents OPTIONAL
}
```



# Versioning

- Data items in TCIP need to be updated from time to time
- TCIP's primary means of tracking versions of these items is by updating the effective date-time
- Some TCIP data items also have optional integer-based version numbers to provide backward compatibility with legacy business systems

## ASN.1 Representation:

```
SchPatternList ::= SEQUENCE {
    subscriptionInfo      CPTSubscriptionHeader,
    languages              CPTLanguageList           OPTIONAL,
    patternVersion         SCH-TimetableVersionID   OPTIONAL,
    effective               CPT-DateTime,
    update-since            CPT-DateTime           OPTIONAL,
    update-thru             CPT-DateTime,
    stoppointVersion        CPT-StoppointVersion   OPTIONAL,
    stoppointEffective      CPT-DateTime,
    timepointVersion        SCH-TimetableVersionID   OPTIONAL,
    timepointEffective      CPT-DateTime,
```

## Row Updates

- Many TCIP messages provide lists of items that can be lengthy
  - Bus stops
  - Timepoints
  - Employees
  - Vehicles
- Row updates allow changes to be sent to previously provided lists



# Row Updates

## Example

Stoppoint 234



Stoppoint 132
Stoppoint 146
Stoppoint 149
Stoppoint 200
Stoppoint 211
Stoppoint 245
Stoppoint 249
Stoppoint 288
Stoppoint 291
Stoppoint 310



Stoppoint 132
Stoppoint 146
Stoppoint 149
Stoppoint 200
Stoppoint 211
Stoppoint 234
Stoppoint 245
Stoppoint 249
Stoppoint 288
Stoppoint 291
Stoppoint 310

## Row Updates (cont.)

- A message requesting row updates includes a field indicating the date-time when changes are requested
- A message providing row updates contains a field indicating the date-time that changes are provided
- A row update message may contain rows to be added, rows that replace old rows, or rows to be deleted

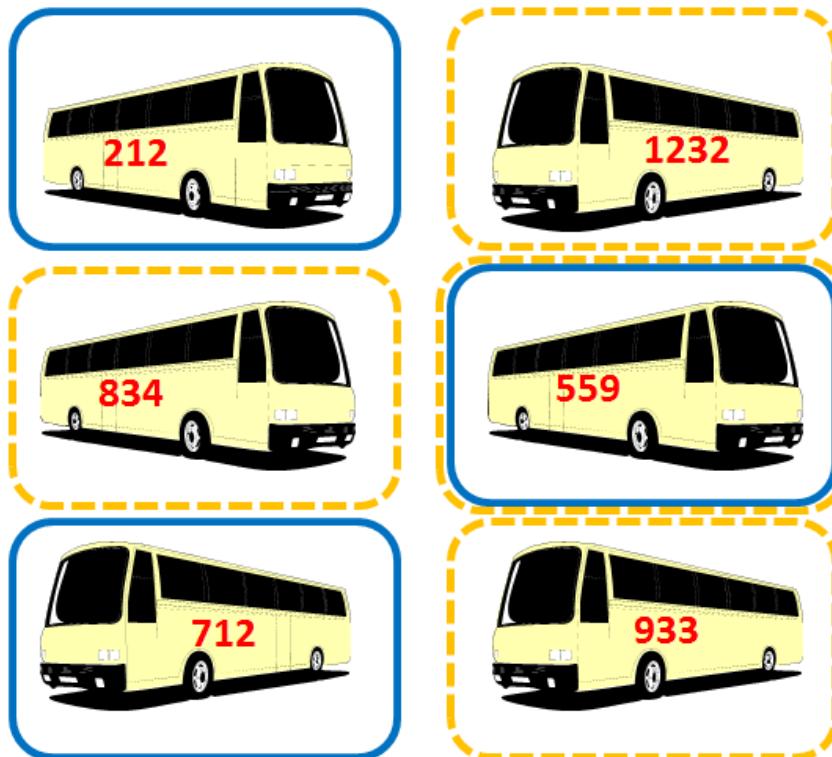


# Applicability

- A TCIP message may contain an Applicability Field indicating the scope of the information requested or provided by that message
- Applicability Field (if present) usually occurs in the message application header

Affected by  
brake recall

Wirelessly  
load maps



## Local Extensions – Two Types

### Type 1 – Code Extension

- Adds a value to a specified enumerated list of values
  - Data Element: SCH-ServiceType {SCH-41}
    - Describes the type of transit service provided
  - Local use example:
    - BayFerryConnector (128) – ongoing service
    - SuperBowl (129) – one time event



# Local Extensions (cont.)

## Type 1 – Code Extension

### Local Extensions – Type 1

```
SCH-ServiceType ::= ENUMERATED {  
    regular      (1), -- Regular,  
    express      (2), -- Express,  
    circular     (3), -- Circular,  
    radial       (4), -- Radial,  
    feeder       (5), -- Feeder,  
    jitney       (6), -- Jitney,  
    limited      (7), -- Limited,  
    nonRevenue   (8), -- Non-revenue,  
    unknown      (9), -- Unknown,  
    charter      (10), -- Charter Service,  
    school       (11), -- School Service,  
    special      (12), -- Special Service,  
    operatorTraining (13), -- Operator Training,  
    maintenance   (14), -- Maintenance Service,  
    noService    (15), -- No Service,  
    standBy     (16), -- Stand-by,  
    extra        (17), -- Extra,  
    -- 18-127 reserved  
    -- 128-255 local use  
    ... -- # LOCAL_CONTENT  
}
```

# Local Extensions (cont.)

## Type 2 – Frame/Message Extension

Type 2 - Frame/message extensions – add locally specified data to the sequence Data Frame: CCBLOCKWorkRecord

- Describe events related to work done by a PTV

```
CCBLOCKWorkRecord ::= SEQUENCE {
    block              SCHBlockIden,
    begin-time        CPT-DateTime
                      OPTIONAL,
    end-time          CPT-DateTime
                      OPTIONAL,
    timepoints        SEQUENCE (SIZE(1..15000)) OF CCTimepointHistory
                      OPTIONAL,
    stoppoints        SEQUENCE (SIZE(1..15000)) OF OBStoppointRecord
                      OPTIONAL,
    deviations        SEQUENCE (SIZE(1..1000)) OF CCRouteDeviationRecord
                      OPTIONAL,
    passenger-miles  CC-PassengerMiles
                      OPTIONAL,
    ... -- # LOCAL_CONTENT
}
```

- Local use example:  
dailySamples SEQUENCE(SIZE(1..1000)) OF ABCAirQualitySample                    OPTIONAL

# Multilanguage Support

- TCIP can support multiple languages, beginning with TCIP version 3.0.4
- Languages are specified using ISO 639 codes
- “CPTLanguageList” data frame specifies the default and additional languages
  - Optional item
  - Where string content appears in a message, “CPTAdditionalLanguageContent” data frames provide the information in the additional languages

# A C T I V I T Y



## **Which statement best characterizes a TCIP identifier?**

### **Answer Choices**

- a) Uses a shorthand code to represent an item
- b) Identifies a TCIP-generated message
- c) Identifies a unique data frame
- d) Always includes a string designator to identify an item

## Review of Answers



- a) Uses a shorthand code to represent an item

***Correct! A TCIP identifier can be used to represent an item that may have a longer description.***



- b) Identifies a TCIP-generated message

*Incorrect. A TCIP identifier represents items in the real world, not TCIP elements.*



- c) Identifies a unique data frame

*Incorrect. A TCIP identifier would not be used to represent a TCIP data frame. An identifier is a data element.*



- d) Always includes a string designator to identify an item

*Incorrect. String designators are optional types of identifiers; alpha-numeric identifiers are mandatory.*

# **Summary of Learning Objective #4: Describe How Data Are Organized in TCIP Data Exchanges**

## **TCIP Provides a Way To:**

- Create unique identifiers for information across all transit agencies
- Identify version of information provided
- Incrementally update large data sets
- Define and use groups of items/entities
- Include locally defined data in TCIP messages



# **Learning Objective #5: Define a Profile Requirements List (PRL) and Explain How It Is Used to Specify TCIP Requirements in a Transit ITS Project**

- Profile Information
- Component selection
- Interface definition
- Interface tailoring
- Document creation



# Profile Information

TIRCE 3.0.8 - Project\_PRL

0%

Step 1 - Profile Information Step 2 - Component Selection Step 3 - Interface Definition Step 4 - Interface Tailoring Step 5 - Document Creation

Please enter your project information below.  
If you are unsure what to enter, hover your cursor over the field for details.

Project Name:

Agency/Company Name:

Agency/Company ID:

Agency Model:

Will languages other than English be used?  Yes  No

Will agency-defined applicability groups be used?  Yes  No (Answer "Yes" if unsure)

TCIP Version: 3.0.6

Next >>

Profile Information  
Project Component  
External Components  
Interfaces  
Create Document

Help  
Glossary  
View TCIP  
View Database  
Utilities  
Feedback

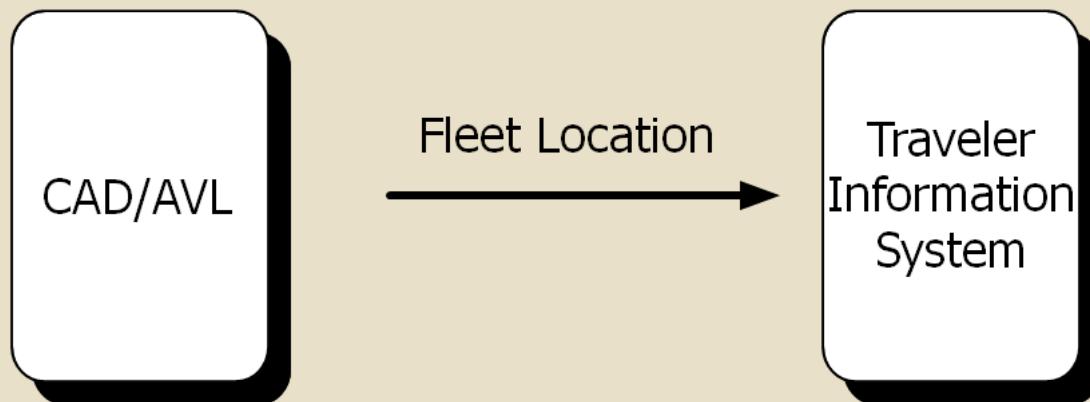
Exit Open Save Diagram



## TIRCE Example – Component Selection

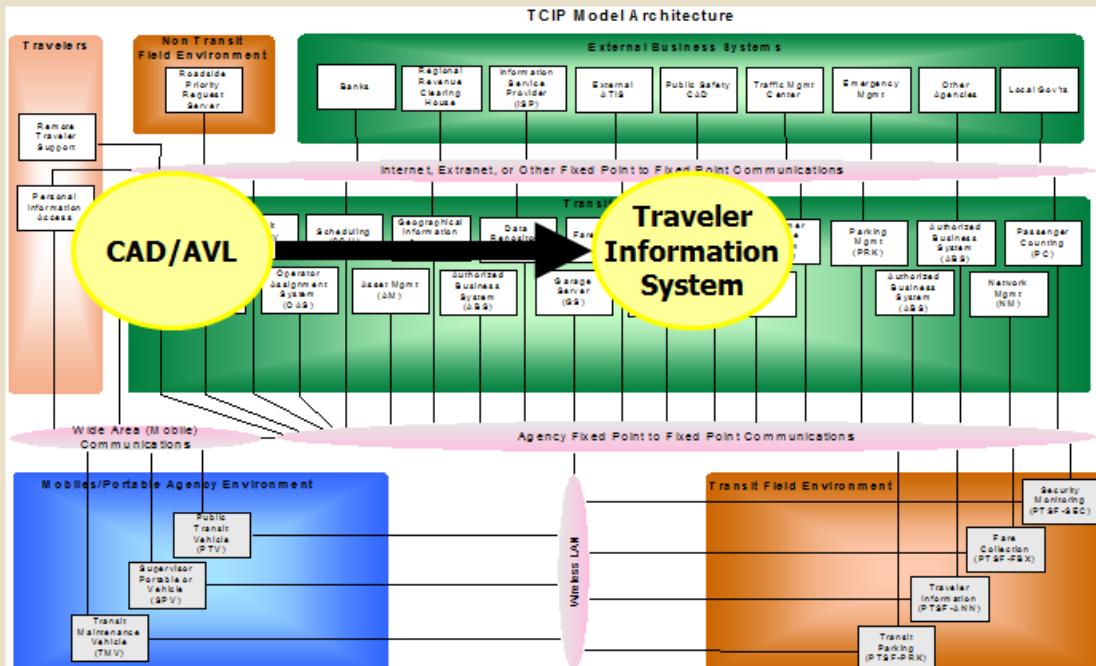
### TIRCE Example

- Transferring fleet location information between a CAD/AVL system and a Traveler Information System



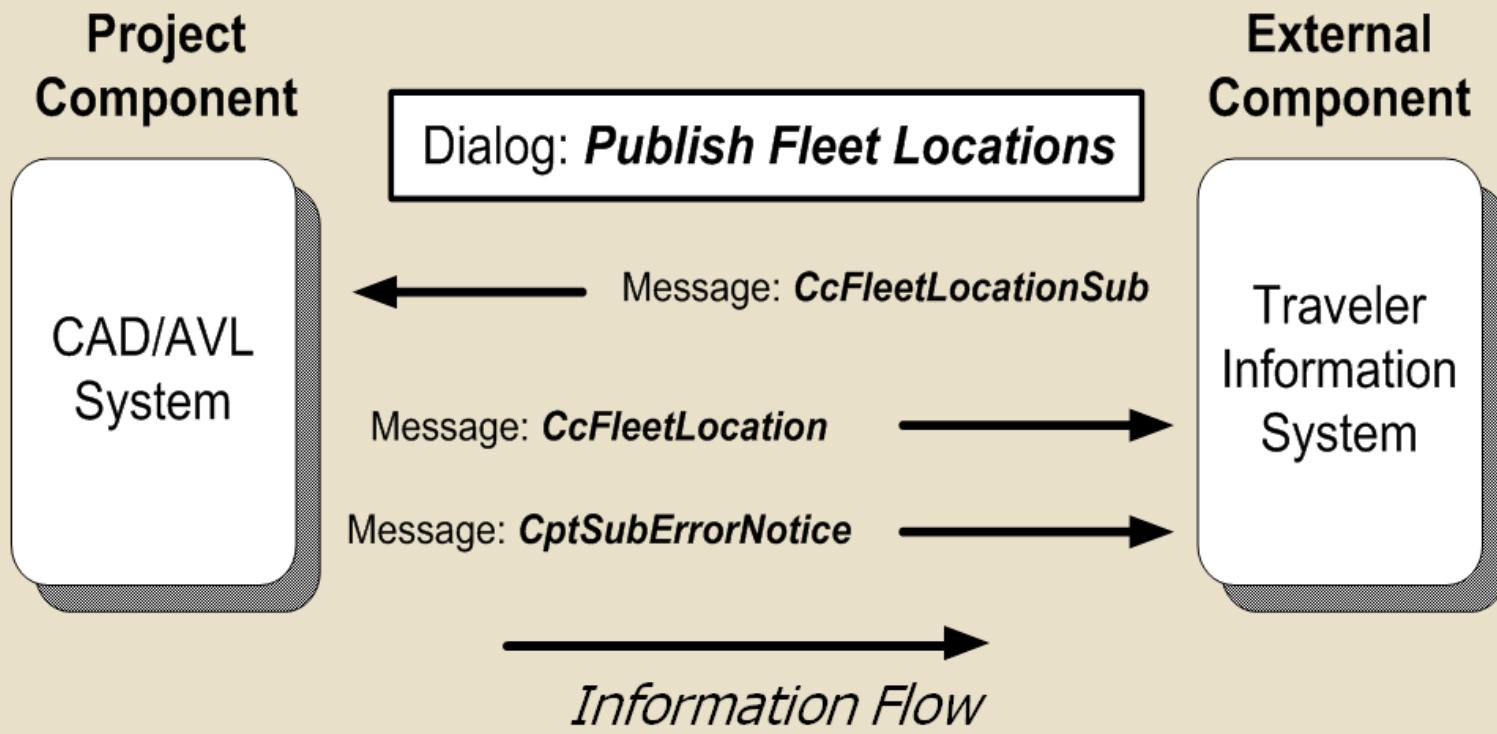
# TIRCE Example – Component Selection

## Fleet Location Transfer Example



# TIRCE Example – Interface Definition and Tailoring

## Fleet Location Example



# TIRCE Example – Document Creation

Profile Requirements List (PRL) Cover Sheet			
<b>Project Name:</b> abc			
<b>Creation Date:</b> August 17, 2014			
<b>Agency/Company Name:</b> abc			
<b>Agency ID:</b> <b>Agency Model:</b> Unknown			
<b>Project Component(s):</b> Computer Aided Dispatch/Automatic Vehicle Location			
<b>External Component(s):</b> Traveler Information System			
Profile Requirements List (PRL)			
<b>Project Name:</b> abc			
<b>Agency/Company Name:</b> abc	<b>Agency ID:</b>	<b>Agency Model:</b> Unknown	
<b>Project Component:</b> Computer Aided Dispatch/Automatic Vehicle Location	<b>IP/Network Address:</b> CAD_AVL	<b>Port/Transport Address:</b> CAD_AVL_PORT	
<b>External Component:</b> Traveler Information System	<b>IP/Network Address:</b> TIS	<b>Port/Transport Address:</b> TIS_PORT	
<b>Non TCIP Interfaces Supported:</b>			
<b>Exceptions to TCIP Requirements:</b>			
Conformance Class 1A: Supported Dialogs			
<b>Project Component:</b> Computer Aided Dispatch/Automatic Vehicle Location			
<b>External Component:</b> Traveler Information System			
Dialog Name		Role	TCIP Version
Publish Fleet Locations	Publisher	3.0.6	1A.1
Conformance Class 2A: TCIP Message Files Accepted			
<b>Project Component:</b> Computer Aided Dispatch/Automatic Vehicle Location			
<b>External Component:</b> Traveler Information System			
<b>File Attributes &amp; Limitations:</b>			

## Example of XML-Encoded TCIP Message Produced by TIRCE for a PRL

```
<?xml version="1.0" encoding="UTF-8"?>
<ccLocationReport sourceport="62627" sourceip="192.168.0.65" created="2013-04-24T17:17:29.960Z" sourceas="10000" schemaLocation="http://www.tcip-3-0-4-local/TCIP-Final_3_0_4.xsd" xmlns:local="http://www.tcip-3-0-4-local" xmlns:tcip="http://www.TCIP-Final-3-0-4" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <request-id>4001</request-id>
  <status-info>3</status-info>
  <time-reported>2016-01-07T13:10:23</time-reported>
  <latitude>31000000</latitude>
  <longitude>-89000000</longitude>
  - <direction>
    <deg>90</deg>
    <rad>0</rad>
    <cdeg>0</cdeg>
  </direction>
  <speed>50</speed>
</tcip:ccLocationReport>
```



# A C T I V I T Y



## **Which of the following is not included in the preparation of a Profile Requirements List (PRL)?**

### **Answer Choices**

- a) Profile information
- b) Component selection
- c) Vendor conformance
- d) Interface tailoring

## Review of Answers



- a) Profile information

*Incorrect. Profile information is included in a PRL.*



- b) Component selection

*Incorrect. Component selection is included in a PRL.*



- c) Vendor conformance

***Correct! Vendor conformance is not included in preparing a PRL. The DIFF function would be used.***



- d) Interface tailoring

*Incorrect. Interface tailoring is used in preparation of a PRL.*

# **Summary of Learning Objective #5: Define a Profile Requirements List (PRL) and Explain How It Is Used to Specify TCIP Requirements in a Transit ITS Project**

- Profile information includes entering data to describe the project and identify the agency developing the profile
- Component selection involves choosing the subsystems that will exchange data
- Interface definition involves selecting the file transfers and dialogs
- Tailoring involves selecting specific messages to be exchanged
- Document creation involves producing the Profile Requirements List (PRL) specifications and XML schema

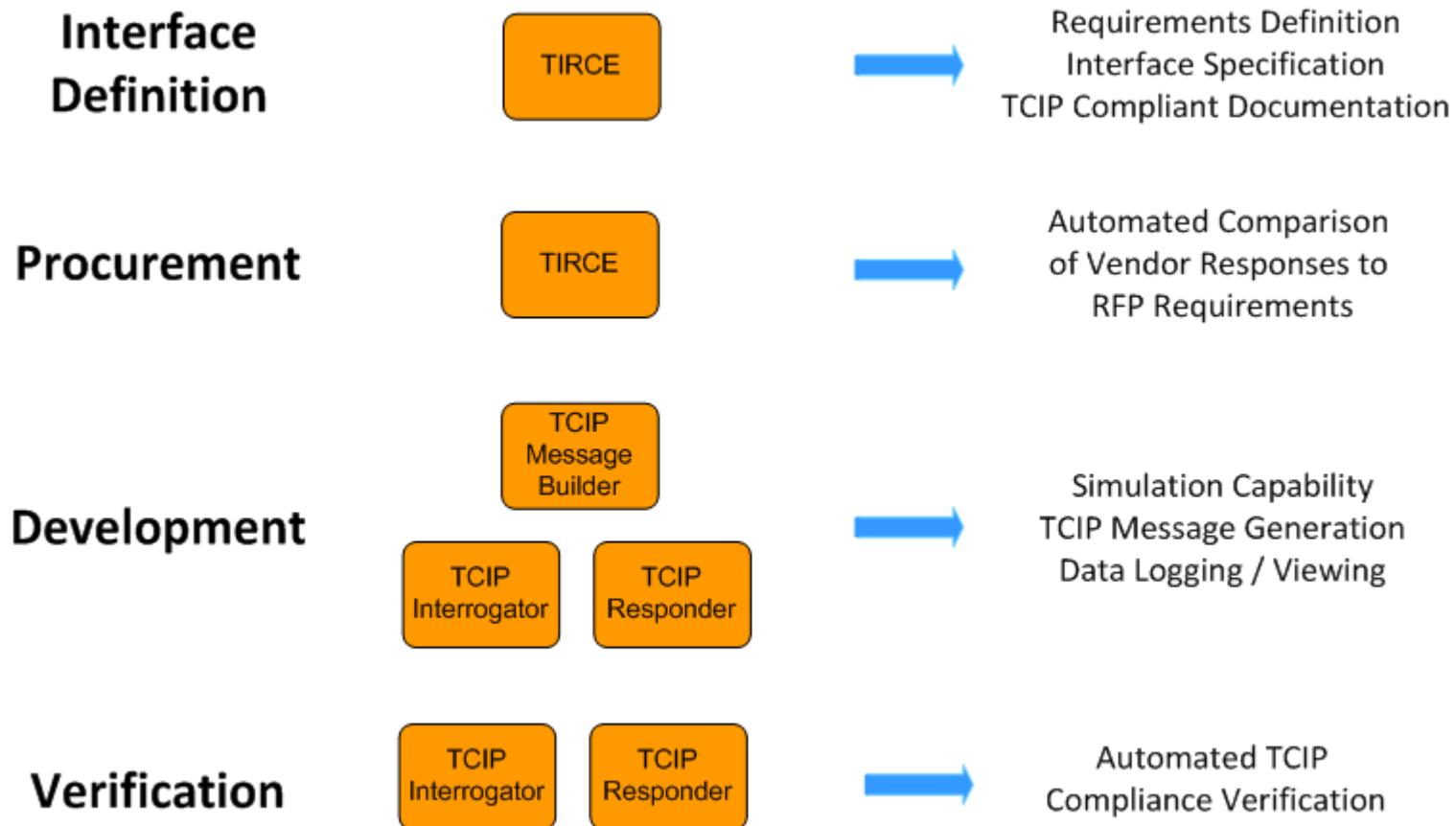


## **Learning Objective #6: Articulate and Describe the Uses of Each Tool in the TCIP Suite of Tools**

- Interface Definition – TIRCE
- Procurement –TIRCE
- Development – Message Builder, Interrogator, Responder
- Verification – Interrogator, Responder



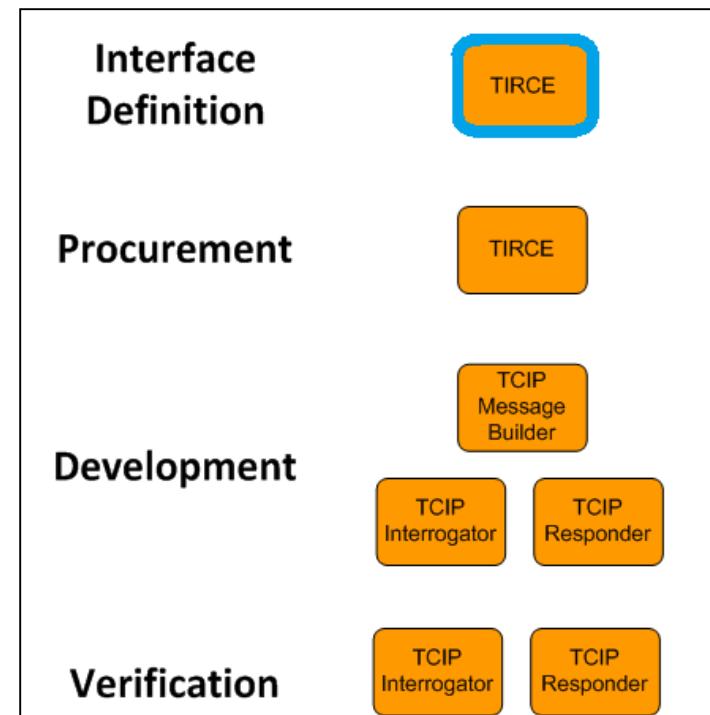
# TCIP Tool Suite



# Uses of TCIP Tools: Interface Definition – TIRCE

## TIRCE Allows a User to Specify an Interface in Five Steps

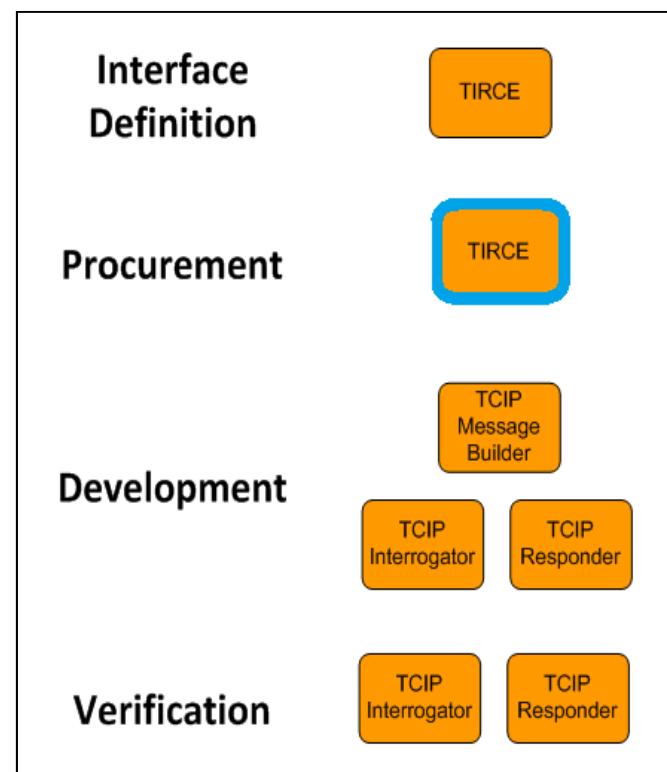
- Specify profile information
- Select components
- Define interfaces
- Tailor interfaces
- Produce documents



# Uses of TCIP Tools: Procurement – TIRCE

## TIRCE Produces Two Key Documents to Facilitate ITS Procurements

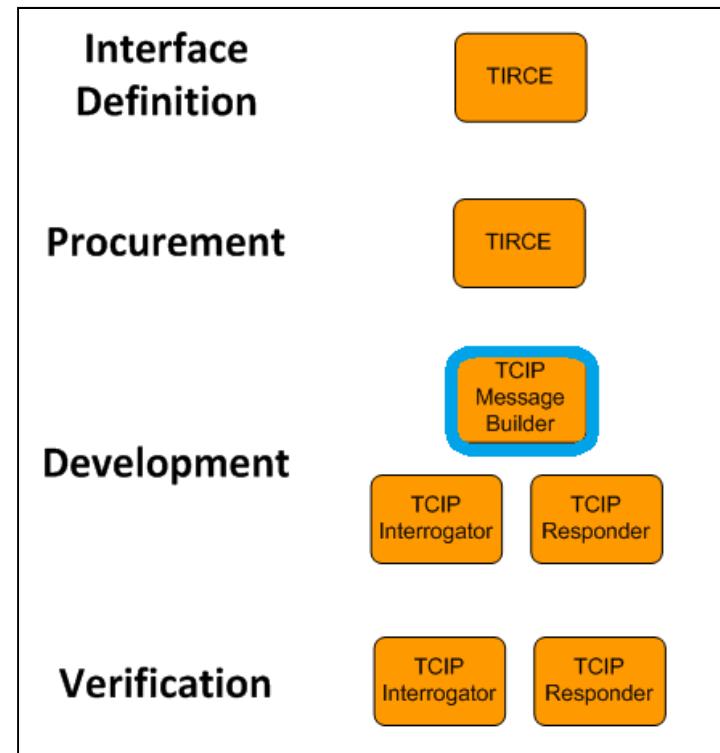
- Profile Requirements List (PRL)
- Profile Implementation Conformance Statement (PICS)
- TIRCE provides a Diff function:
  - To compare agency requirements (PRL)
  - With vendor product specifications (PICS)



# Uses of TCIP Tools – Development

## TCIP Message Builder

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



# TCIP Message Builder – Example

Enter Message Data for File: CcFleetLocation

Message: CcFleetLocation

Enter data for each field in the form below:

Name	Type
subscriptionInfo	CPTSubscriptionHeader
requestedType	CPT-SubscriptionT
expirationDate	CPT-Date
expirationTime	CPT-Time
reportInterval	CPT-Duration
requestIdentifier	CPT-RequestIdent
subscriberIdentifier	CPT-ApplicationID
publisherIdentifier	CPT-ApplicationID
locations	CCPTVLocation
vehicle	CPTVehicleIdent
vehicle-id	CPT-VehicleID
vin	CPT-VIN
name	CPT-VehicleName
designator	CPT-VehicleDesign
date-time	CPT-DateTime
loc-lat	Irms:Latitude

subscriptionInfo - CPTSubscriptionHeader

requestedType  CPT-Subscripti

expirationDate  CPT-Date

expirationTime  CPT-Time

reportInterval  CPT-Duration

requestIdentifier  CPT-RequestIder

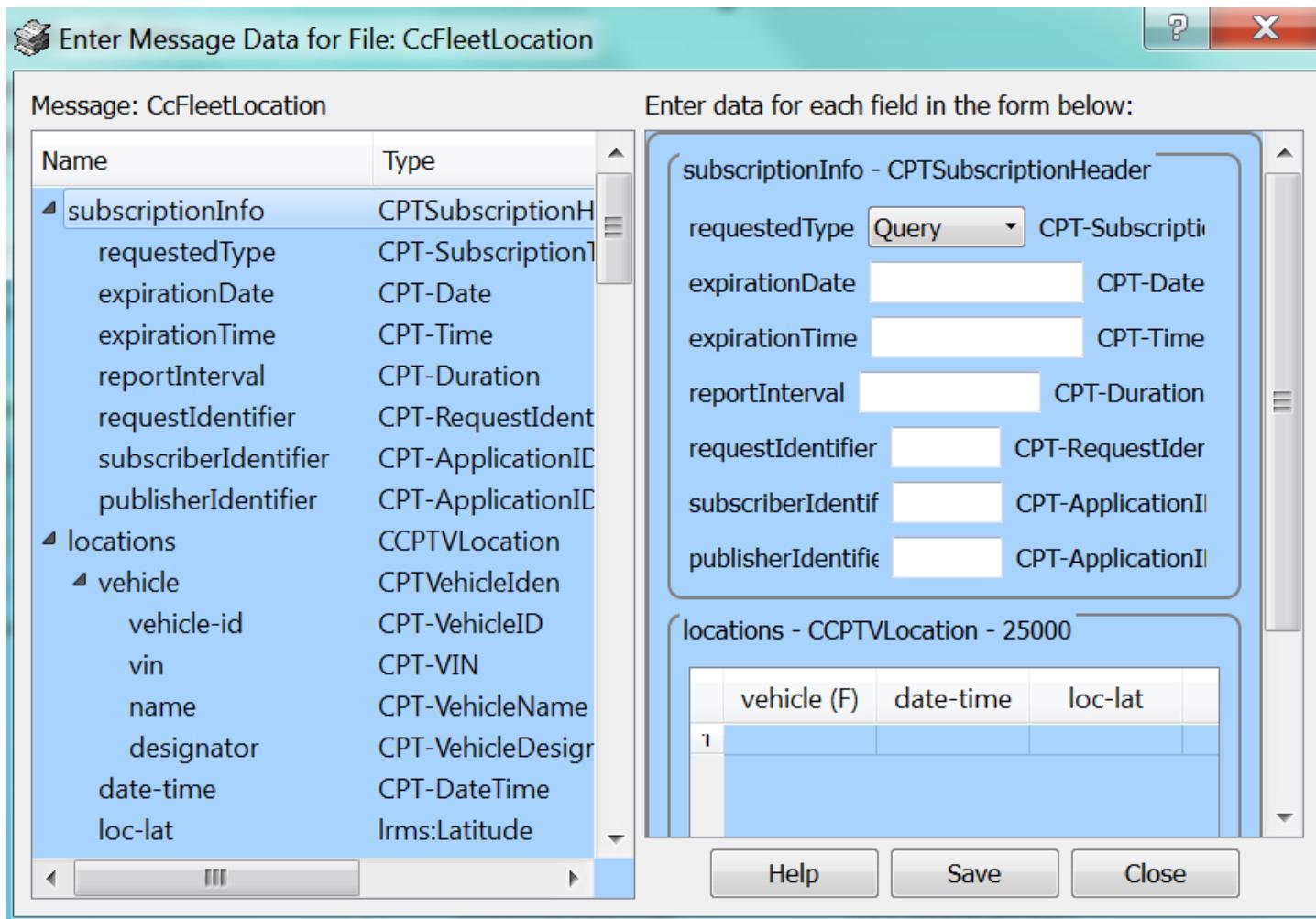
subscriberIdentif  CPT-ApplicationI

publisherIdentifie  CPT-ApplicationI

locations - CCPTVLocation - 25000

vehicle (F)	date-time	loc-lat
1		

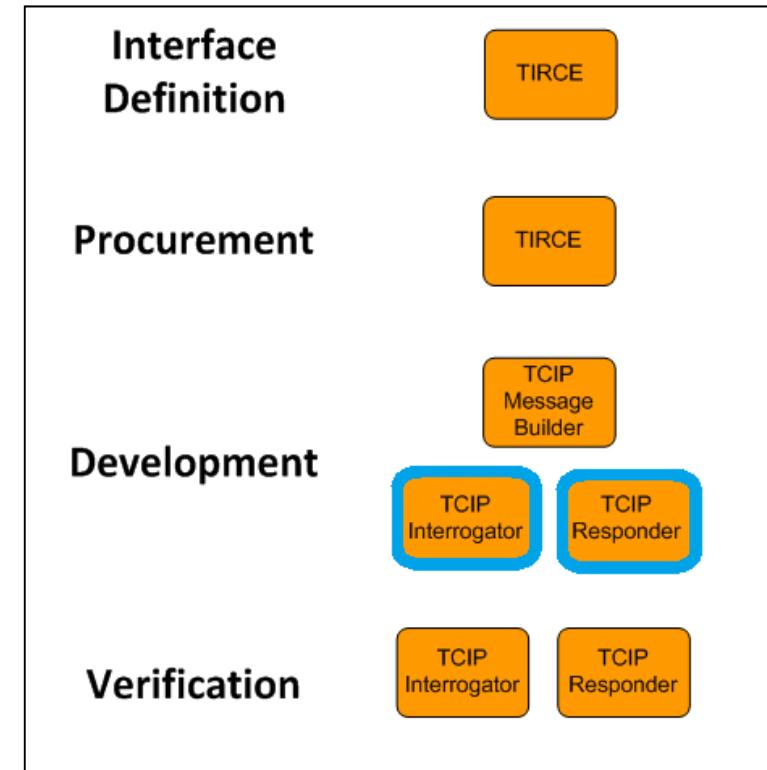
Help Save Close



# Uses of TCIP Tools – Verification

## TCIP Test Console

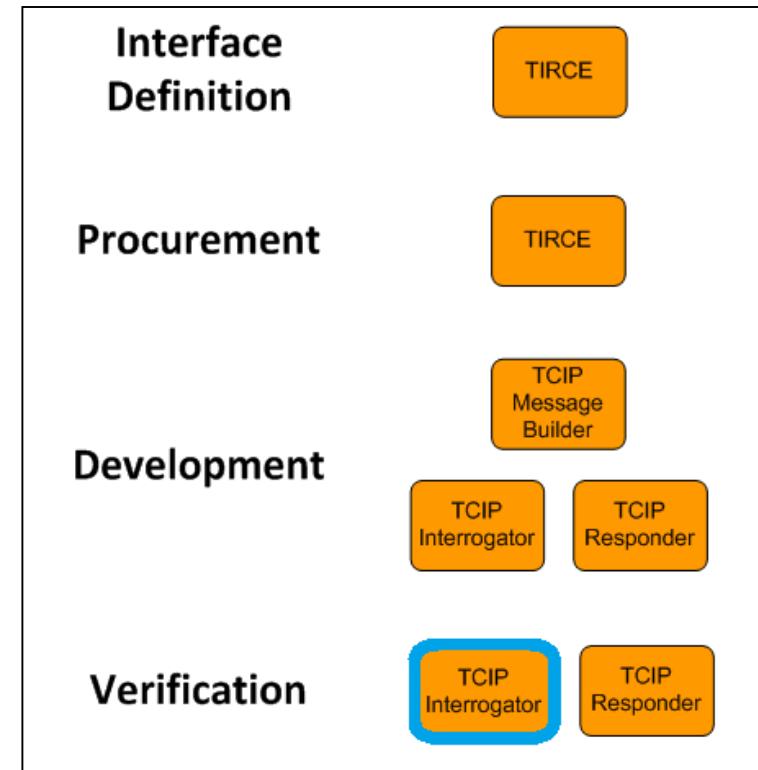
- Provides capability to simulate one, or both, ends of a TCIP interface
- Consists of two functions:
  - TCIP Interrogator → requests TCIP data
  - TCIP Responder → supplies TCIP data



# Uses of TCIP Tools – Verification (cont.)

## TCIP Interrogator

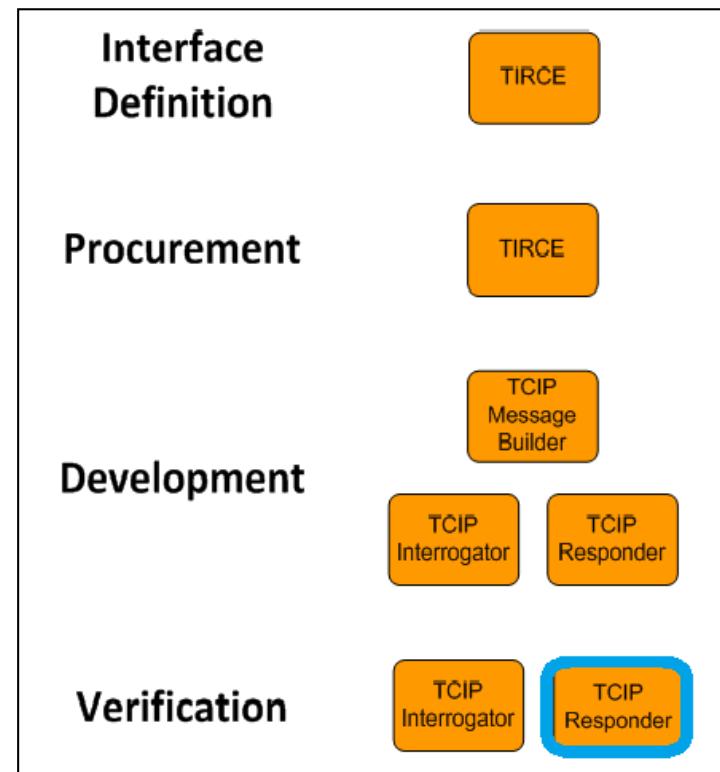
- Simulates a TCIP-compliant device
  - Client side of interface
  - Subscribes to a provider (publisher) of TCIP data
- Establishes a TCIP communications link with a TCIP device under development or test
- Transmits/receives TCIP messages
- View/log TCIP messages
- Automated TCIP message verification



# Uses of TCIP Tools – Verification (cont.)

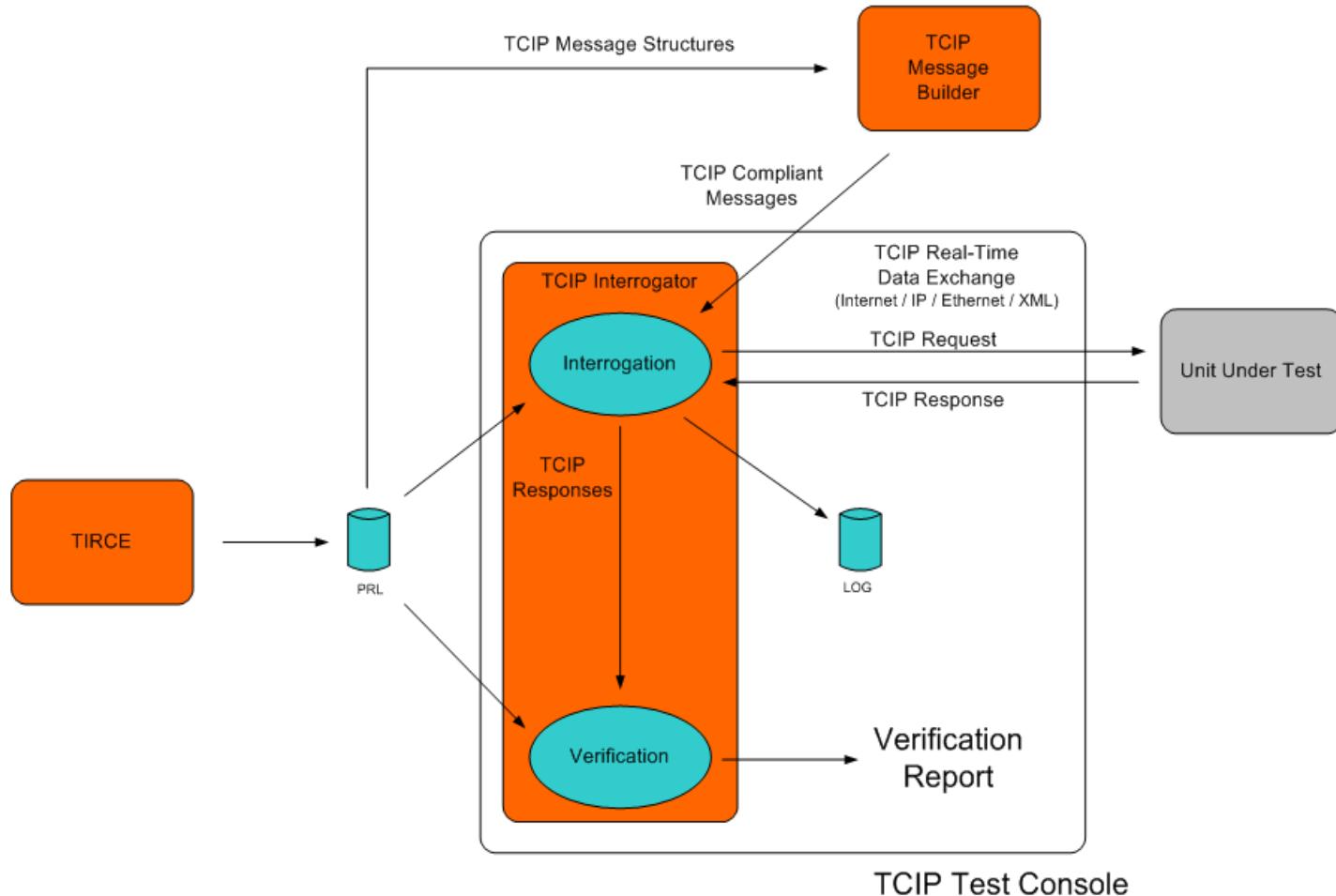
## TCIP Responder

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



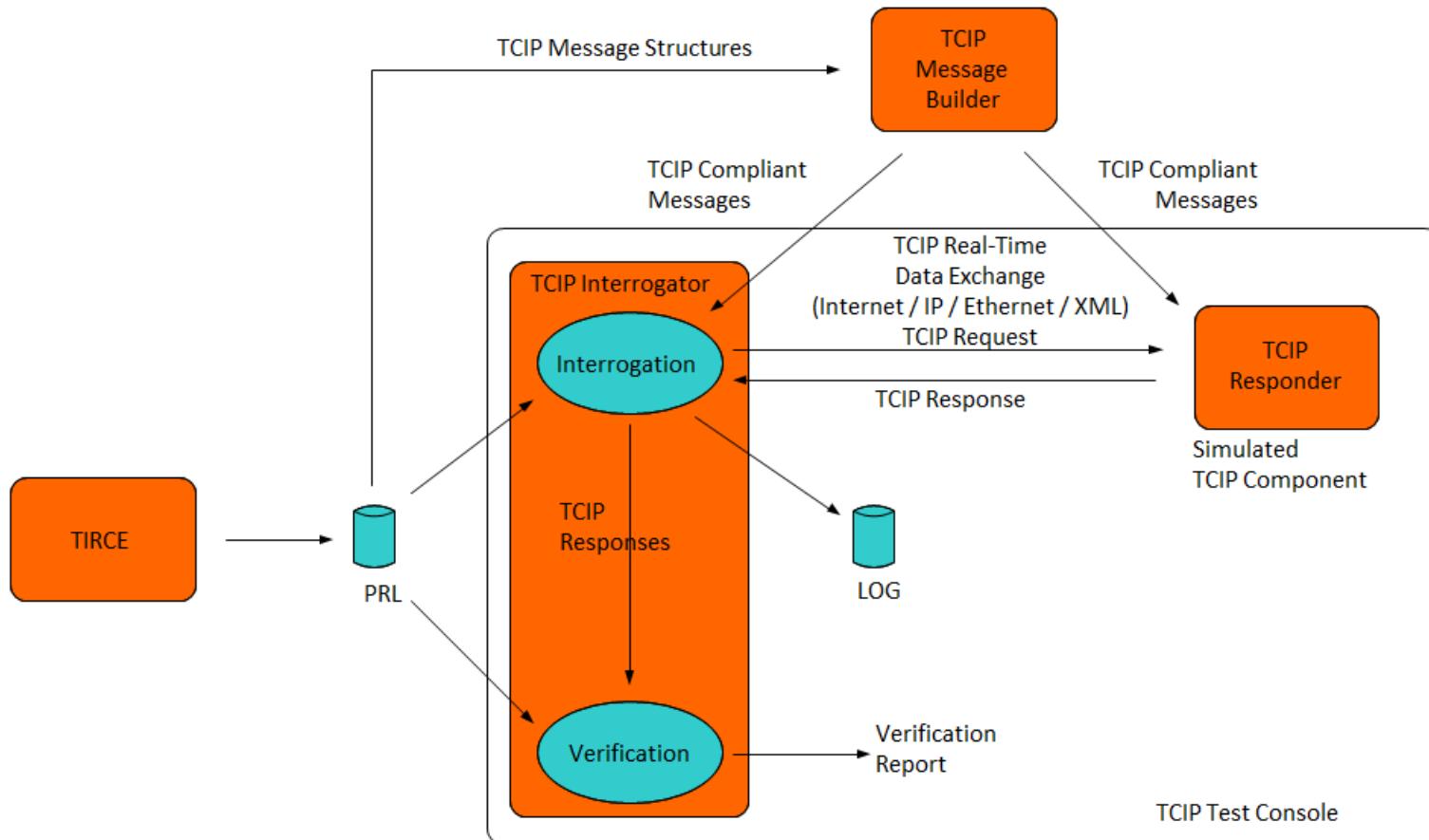
# TCIP Tool Suite – Test Console

## Testing a Component



# TCIP Tool Suite – Test Console

## Testing a Simulated Component



# A C T I V I T Y



## **Which of the following statements about the underlined TCIP tool function is FALSE?**

### **Answer Choices**

- a) Interrogator simulates a client component requesting data
- b) Responder simulates a server providing data
- c) Test Console corrects errors in XML schema
- d) TIRCE (Diff function) compares a PICS with a PRL



## Review of Answers



- a) Interrogator simulates a client component requesting data  
*Incorrect. This statement is true.*



- b) Responder simulates a server providing data  
*Incorrect. This statement is true.*



- c) Test Console corrects errors in XML schema  
**Correct! This statement is false. The test console does not correct XML errors.**



- d) TIRCE (Diff function) compares a PICS with a PRL  
*Incorrect. This statement is true.*

## **Summary of Learning Objective #6: Articulate and Describe the Uses of Each Tool in the TCIP Suite of Tools**

- TCIP Implementation, Requirements and Capabilities Editor (TIRCE) can be used to specify interfaces between components
- TIRCE also can be used to prepare procurement documents representing the agency view, Profile Requirements List (PRL), and vendor's view, Profile Implementation Conformance Statement (PICS)
- TCIP Message Builder can be used to construct TCIP-compliant messages using XML. Messages can be saved, viewed, and edited.
- TCIP Test Console can simulate one or both ends of a TCIP interface. It includes an interrogator, which simulates the client side of the data exchange, and a responder to simulate the server side of the data exchange



# **Learning Objective #7: Summarize the Range of TCIP Applications, Implementation Tools, and Additional Training**

- Non-normative TCIP content – model architecture and concept of operations
- Normative TCIP content – building blocks, data elements to dialogs
- Implementation tools
- Examples of TCIP implementation at transit agencies
- Overview of National Transit Institute (NTI) on-site training for TCIP



## **Non-Normative TCIP Content – Model Architecture and Concept of Operations**

- TCIP contains non-normative material that has not been balloted but is useful as context for applying the standard. The following items are non-normative:
  - TCIP Model Architecture
  - TCIP Concept of Operations



# **Non-Normative TCIP Content – Model Architecture and Concept of Operations (cont.)**

## **Where do I find it?**

- American Public Transportation Association (APTA)
  - Transit Communications Interface Profiles (TCIP) Standard Development Program
  - APTA-TCIP-S-01 4.0 Volume I

## **How do I get it?**

- Download FREE from:
  - <http://www.aptacip.com/APTA-TCIP-S-01%204.0.htm>

# Normative TCIP Content – Building Blocks, Data Elements to Dialogs

## Where do I find it?

- TCIP 4.0 Volume I - Basis for conformance
- TCIP 4.0 Volume II - Data and Dialog Definitions
  - Annex A - TCIP Data Elements
  - Annex B - TCIP Data Frames
  - Annex C - TCIP Messages
  - Annex D - TCIP Dialogs
- TCIP 4.0 Volume III - TCIP XML Schema
  - Annex E – TCIP XML Schema

## TCIP Implementation Tools

- TIRCE
- Message Builder
- Test Console

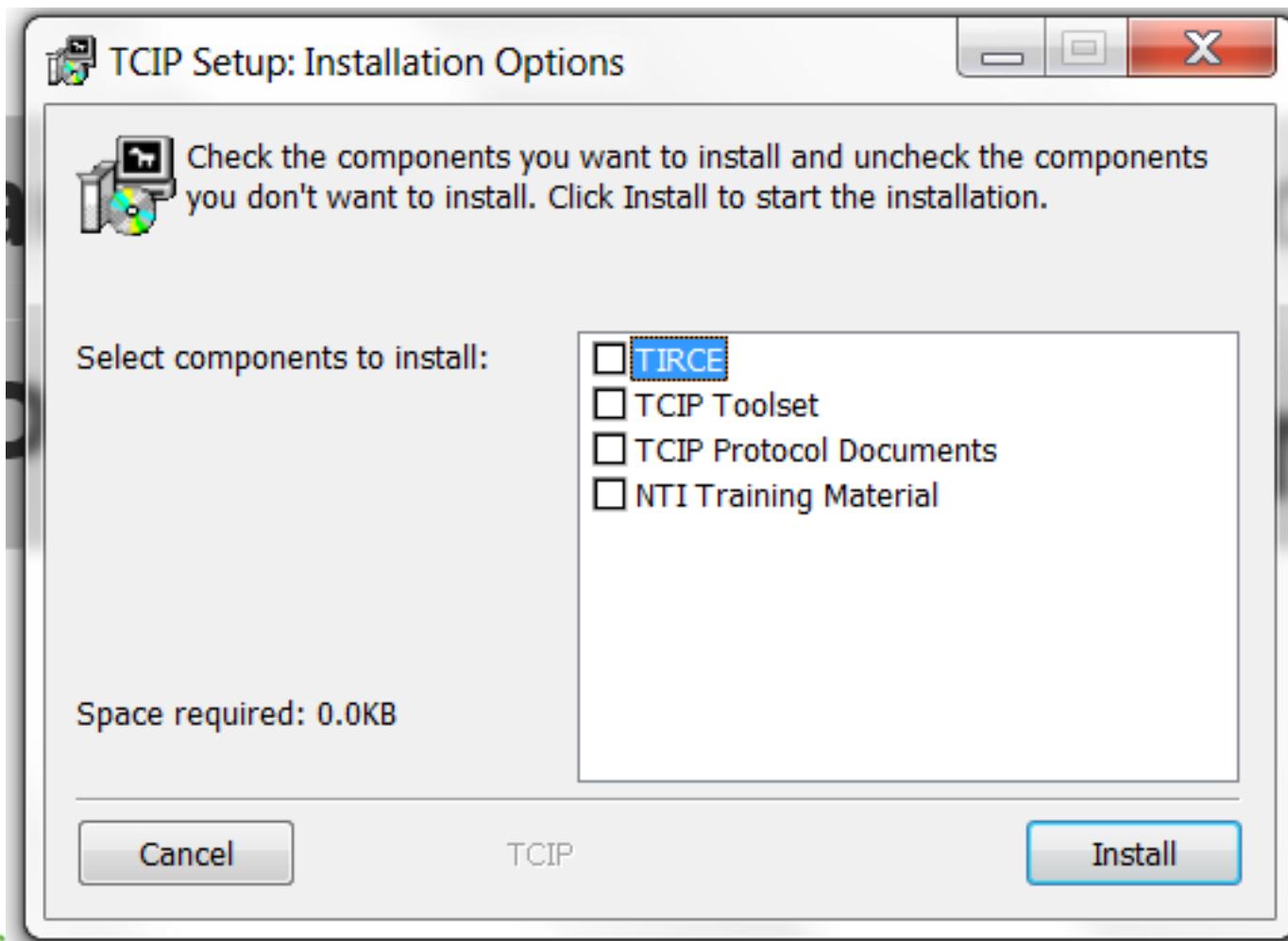
### Where do I get them?

- Transit Communications Interface Profiles (TCIP) Standard Development Program APTA-TCIP TIRCE & Support Tools and Support Tool Installation Instructions

### Download FREE from:

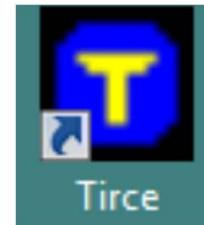
- <http://www.aptacip.com/APTA%20TCIP%20TIRCE%20&%20Support%20Tools.htm>

# TCIP Tools Download - Implementation Tools

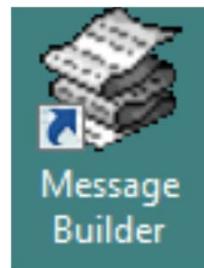


# TCIP Tools Download – Implementation Tools

**TIRCE Icon**



**TCIP Message Builder Icon**



**TCIP Test Console Icon**

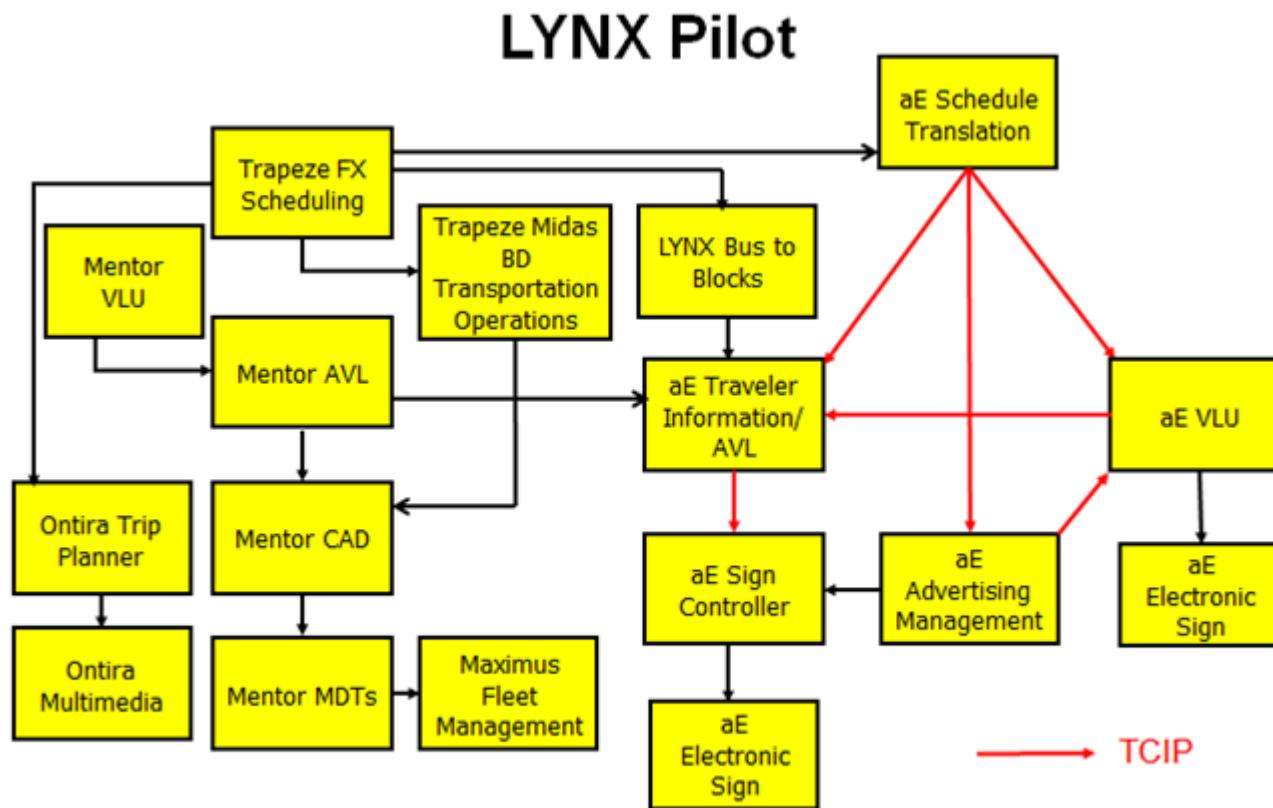


# Who Is Using TCIP? Examples and Real World Applications

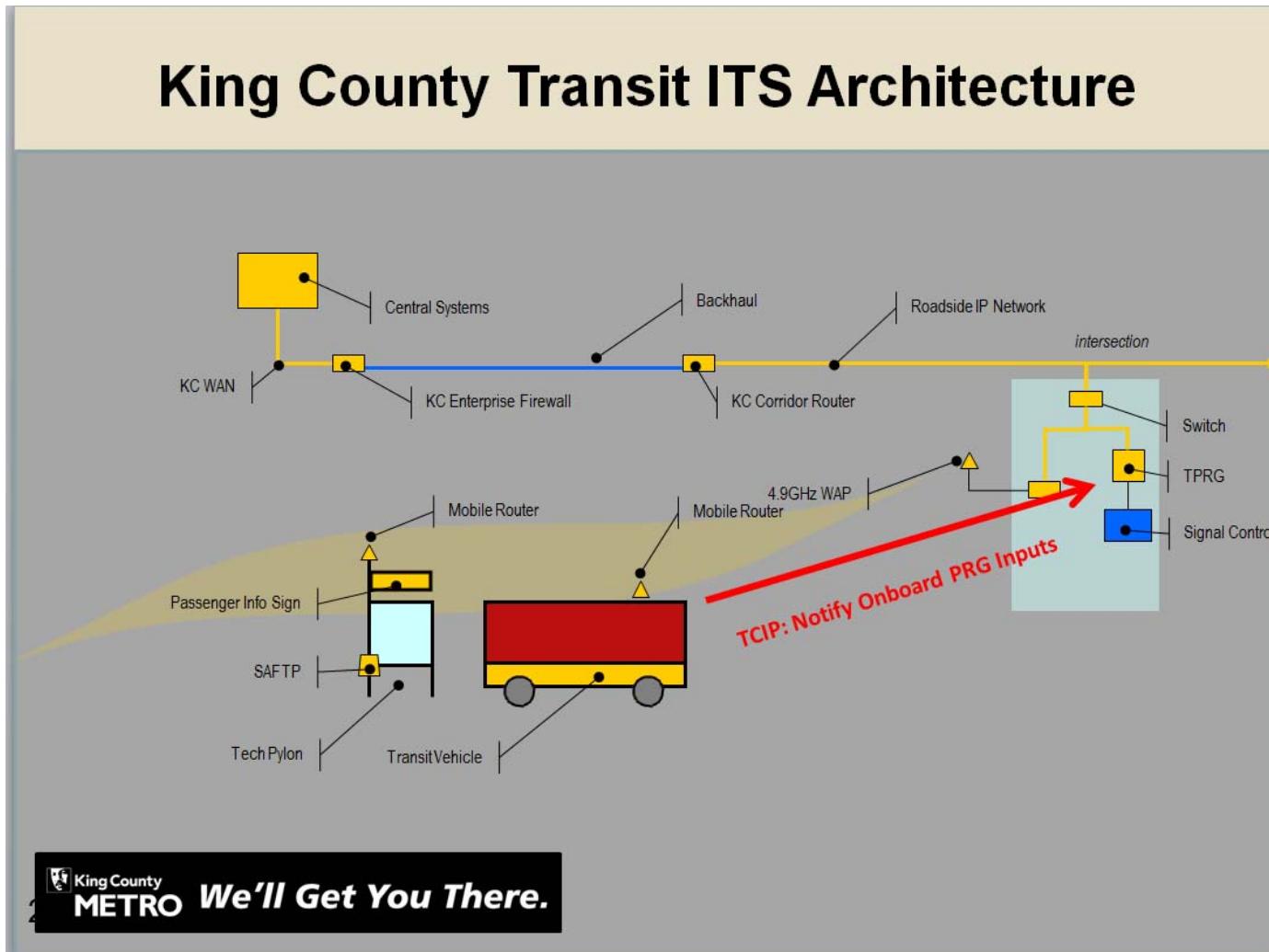
## Current TCIP Projects

- LYNX (Orlando)
- King County Metro (Seattle)
- New York MTA (NYC)
- AMT (Montreal)
- WMATA (Washington DC)
- DART (Dallas)

# Examples of TCIP Implementation at Transit Agencies

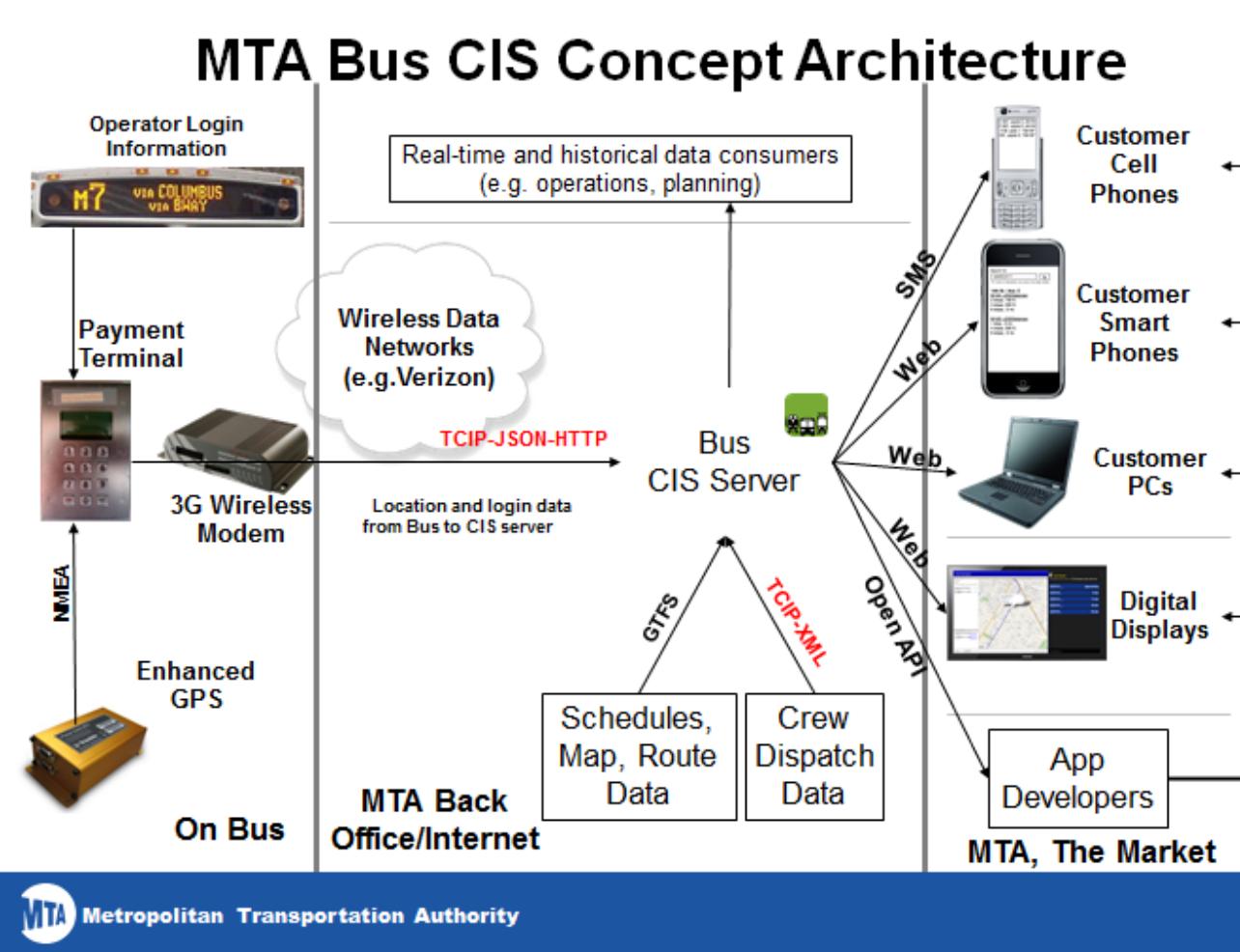


# Examples of TCIP Implementation at Transit Agencies (cont.)



We'll Get You There.

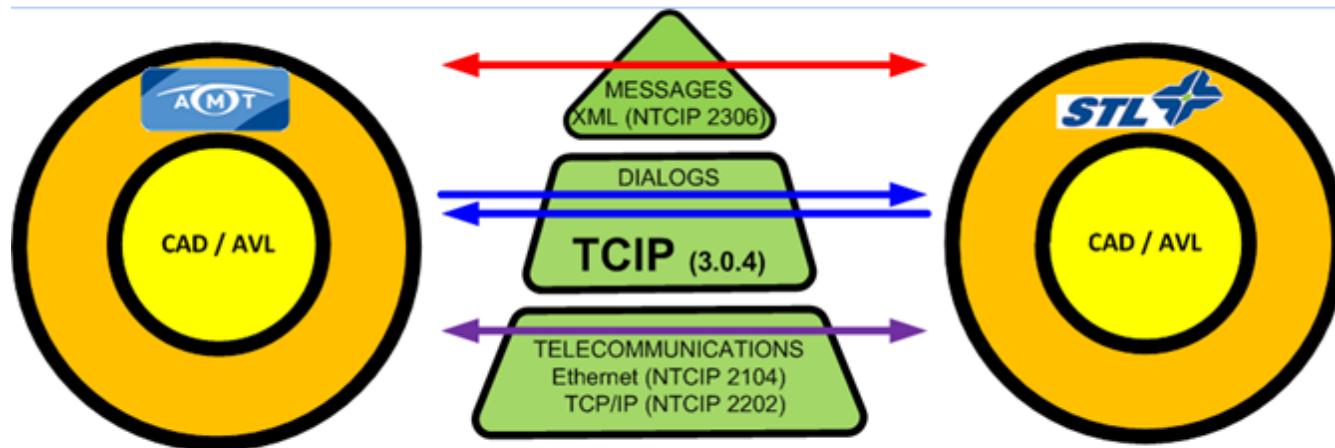
# Examples of TCIP Implementation at Transit Agencies (cont.)



## Examples of TCIP Implementation at Transit Agencies (cont.)

### AMT (Montreal)

#### Center to center data exchange



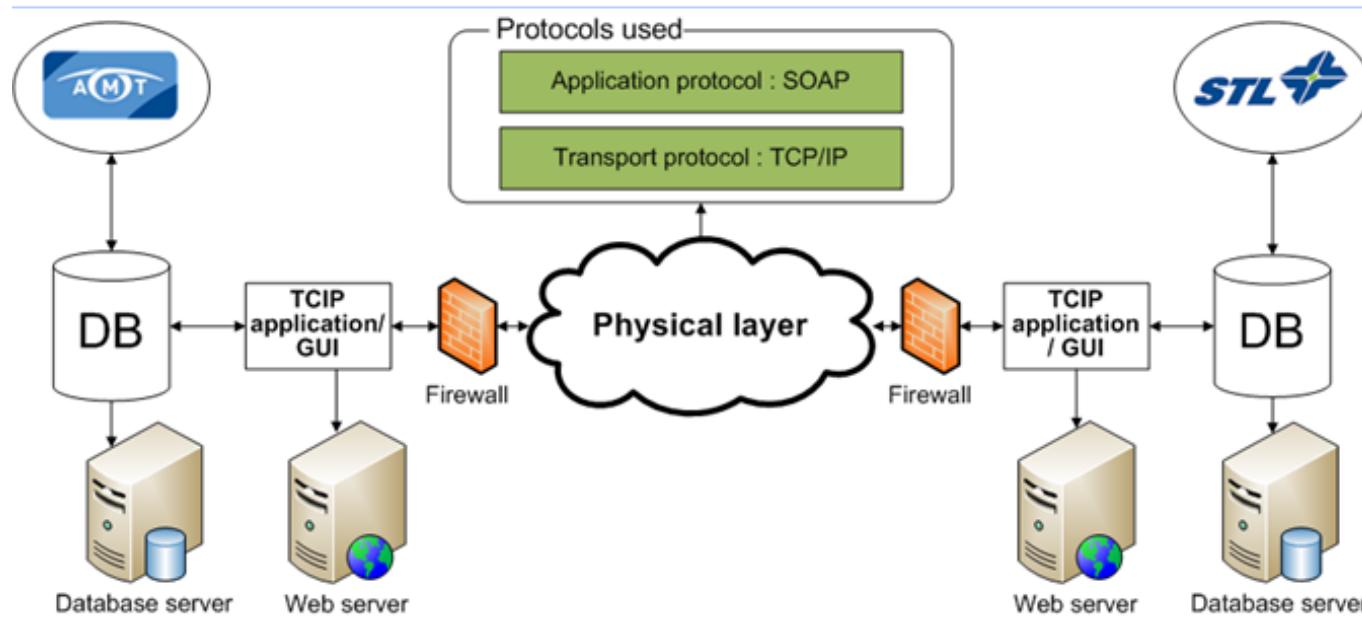
## **Examples of TCIP Implementation at Transit Agencies (cont.)**

AMT (Montreal)

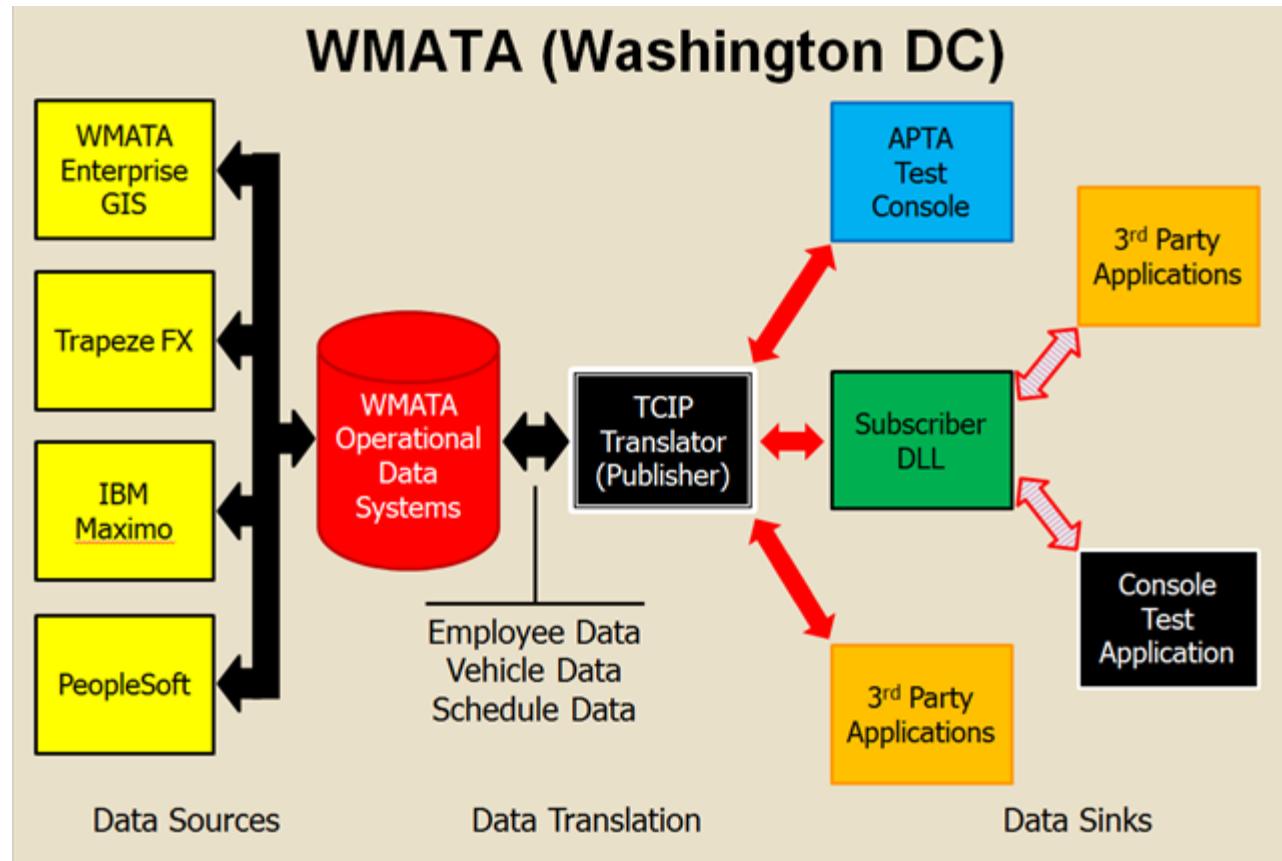
**Two TCIP dialogs utilized:**

## Publish Stop Point ETA

## Publish Service Bulletin List



## Examples of TCIP Implementation at Transit Agencies (cont.)



# National Transit Institute Course

## Integrating Transit Applications: Defining Data Interfaces Using TCIP

- The National Transit Institute offers a two-day course
- Covers material presented in both TCIP online modules
- Provides hands-on instruction
- Register at [www.nzionline.com](http://www.nzionline.com)

# A C T I V I T Y



## **Which one of the following lists includes only normative elements of TCIP?**

### **Answer Choices**

- a) Dialogs, TIRCE, model architecture
- b) TIRCE, dialogs, XML schema
- c) Dialogs, XML schema, data elements
- d) Model architecture, dialogs, XML schema



## Review of Answers



- a) Dialogs, TIRCE, model architecture

*Incorrect. Model architecture is non-normative.*



- b) TIRCE, dialogs, XML schema

*Incorrect. TIRCE is non-normative.*



- c) Dialogs, XML schema, data elements

**Correct! Dialogs, XML schema, and data elements are all normative.**



- d) Model architecture, dialogs, XML schema

*Incorrect. Model architecture is non-normative.*

# **Summary of Learning Objective #7: Summarize the Range of TCIP Applications, Implementation Tools, and Additional Training**

- TCIP contains both normative and non-normative information in four volumes
- TCIP includes a set of tools to implement the standard using XML schema
- TCIP documents and tools can be downloaded FREE from APTA's website
- A number of transit agencies are using TCIP in a variety of ways
- National Transit Institute (NTI) offers a two-day on-site TCIP training course



# What We Have Learned

1. TCIP is used in the top layer of the “communications stack.”
2. The TCIP Implementation, Requirements and Capabilities Editor (TIRCE) is a key tool for use in transit ITS procurements.
3. TCIP building blocks include data elements, data frames, messages, and dialogs.
4. Messages are the highest level for TCIP-encoded data in file transfers and dialogs.
5. A Profile Requirements List (PRL) is used to specify an agency's TCIP requirements in a transit ITS project.
6. The TCIP suite of tools includes: TIRCE, message builder, interrogator, and responder.



# Resources

- APTA TCIP-S-001 4.0.0, APTA Draft Standard for Transit Communications Interface Profiles, <http://www.aptacip.com/Documents.htm>
- [Concept of operations - Wikipedia, the free encyclopedia](https://en.wikipedia.org/wiki/Concept_of_operations)  
en.wikipedia.org/wiki/Concept\_of\_operations
- ITS PCB T3 Webinars on ITS Transit Standards  
[http://wwwpcb.its.dot.gov/t3\\_archives.asp](http://wwwpcb.its.dot.gov/t3_archives.asp)
- “Integrating Transit Applications: Defining Data Interface Requirements Using TCIP – Participant Workbook”  
[https://drive.google.com/file/d/0B15yEPgHsRUAakNLVDMwN3hvN0U/edit?  
usp=sharing](https://drive.google.com/file/d/0B15yEPgHsRUAakNLVDMwN3hvN0U/edit?usp=sharing)
- “J. Fayos, draft “NTI Instructor Materials: Integrating Transit Applications: Defining Data Interfaces Using TCIP,” NTI, August, 2013
- NTI Instructor Materials: Integrating Transit Applications: Defining Data Interfaces Using TCIP,” Power Point Presentation, NTI, February, 2012



# Next Course Modules

Students who have completed Module 4 may delve into the following PCB modules:

- Module 5: Transit Management Standards, Part 2 of 2
- Module 7: Traveler Information, Part 2 of 2
- Module 9: Arterial Management & Transit Signal Priority, Part 2 of 2
- Module 10: Electronic Fare Payment Systems
- Module 11: Transit and the Connected Vehicle Environment / Emerging Technologies, Applications, and Future Platforms



# 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](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)*



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