

Connected Intersections Committee Meeting

The following are meeting notes from meeting of the Connected Intersections (CI) Committee on Monday August 17, 2020 scheduled from 3:00 PM EDT to 5:00 PM EDT by web conference on GoToMeeting.

The agenda and chatlog is provided at the end of these minutes.

All times in EDT.

John Thai called the meeting to order at 3:08 PM.

Siva Narla reviewed ITE's anti-trust guidelines.

Roll Call of Committee

The committee members in attendance are highlighted in yellow:

Roy Goudy, Nissan (co-chair)	Faisal Saleem, Maricopa County	Ray Starr, Minnesota DOT
John Thai, City of Anaheim (co-chair)	Jason Graves, DENSO	Raj Ponnaluri, Florida DOT
Christina Spindler, Wyoming DOT	Jay Parikh, CAMP	Steve Bowles, 360 Network Solutions
Doug Schmidt, Aptiv	Jim Misener, Qualcomm	Whitney Nottage, Intelight/Q-Free
Ed Seymour, TTI	Mike Schragrin, McCain	Vivek Vijayakumar, GM
	Mike Shulman, Ford	
	Mike Stelts, Panasonic	

Also in attendance were:

Dale Thompson, USDOT	Haydar Issa, Transport Canada	Michael Clifford, TNA
Aaron Moore, Omniair	Ivan Vukovic, Ford	Michael Maile
Adam Hillier, Lear	Jasja Tijink, Kapsch	Michaela Vanderveen
AJ Lahiri, ConSysTec	Jean Johnson, NEMA	Nicola Tavares, ITE
Alan Clelland, Applied Information	Jesus Ruiz, McCain	Patrick Chan, ConSysTec
Animesh Balse, Leidos	Jim Alfred, Blackberry	Peter Jager, UDOT
Anthony Gasiorowski, WSP	Jimmy Upton, Integrity Security Services	Ralph Boaz, Pillar Consulting
April Wire, Maricopa County DOT	John Kenney, TNA	Randy Roebuck, OmniAir
Barry Einsig, Econolite	Justin McNew, JMC Rota	Richard Deering, CAMP
Brian Simi, CalTrans	Justin Anderson, Noblis	Robert Saylor, City of Plano
Bob Rausch, TransCore	Kellen Shain, Noblis	Scott Geisler, GM
Charles Felice, UDOT	Ken Yang, AECOM	Shah Hussein, CAMP
Christopher Poe, Mixon Hill	Kevin Balke, TTI	Siva Narla, ITE
Danyang Tian, Honda	Kevin Chan, Minnesota DOT	Steve Sill, USDOT
David Aylesworth, Ceve	Kevin Vitta, ITS America	Steve Sprouffske, Kapsch
David Benevelli, TransCore	Kingsley Azubike, USDOT	Ted Sadler, Integral Blue
Ed Leslie, Leidos	Linda Nana, Noblis	Venkat Nallamothu, AASHTO
Greg Barlow, Rapid Flow	Manny Insignares, ConSysTec	William Whyte, Qualcomm
		Zhitong Huang, Leidos

Meeting Objectives

- Purpose: Update the CI Committee on the ConOps and progress of each Task Force
- Objectives: Present the draft context diagram and user needs

Reviewed the ConOps Outline

- Patrick Chan reviewed the outline of the ConOps document being developed.
- Patrick Chan reviewed the context diagram that depicts the scope of the Connected Intersection. He noted that there were several comments from the Task Forces (TF) that have not been addressed yet.
- GNSS receiver interface needs to be reviewed – whether it can only interface with OBU and MU via the RSU

Task Force Presentations

- **SPaT/MAP Task Force**
 - Michael Maile presented the accomplishments and user needs for the SPaT/MAP TF
- **Positioning Task Force**
 - Jim Misener presented the accomplishments and user needs for the Positioning TF
 - There were some discussions on certifying RTCM messages
- **Security Task Force**
 - William Whyte presented the accomplishments and user needs for the Security TF
 - Jean Johnson asked if SCMS/Security backend needs to connect with OBU and MU in the context diagram. William noted that it was assumed. It was not included because that interface is not considered as part of the scope of the document. It really depends on how the context diagram is to be used.
- **Testing/Conformity Task Force**
 - Christina Spindler presented the accomplishments and user needs for the Testing and Conformity TF
 - There were some discussions on testing to match the SPaT message with the (observed) signal indicates, and a connection from the MAP data server to the RSU directly.
 - Leidos noted they do have test procedures to validate SPaT and MAP messages, but those test procedures validate conformance to the SAE J2735 standard, and does not compare the outputs from the transportation field cabinets with the outputs from the RSU.
- **Traffic Controller Issue Task Force**
 - Roy Goudy presented the accomplishments and user needs for the Traffic Controller Issue TF.
 - Noted that a Traffic Controller Manufacturers Subcommittee and a Confidence Factor Subcommittee were formed.

Next Steps

- Roy Goudy noted that a draft ConOps document will be distributed on August 18, and the ConOps walkthrough scheduled for August 31, September 1 and September 2.
- Roy presented the milestone dates.

Meeting adjourned 4:48 PM.

Agenda

1. Call to Order
2. Anti-Trust Guidelines
3. Roll call of committee members
4. Meeting Purpose and Objectives
5. Introduce ConOps document
6. Report from Task Forces (Accomplishments + User Needs identified)
7. Next Steps

Chat Log

ITE Headquarters (to Everyone): 2:56 PM: Welcome. There will be silence as we folks enter the web room. We will start shortly. Please mute your phone line.

J Thai (to Everyone): 3:15 PM: We can hear you Roy but can you hear us?

Shah Hussain (to Everyone): 3:16 PM: Turn off your PC speaker..

Jean Johnson (to Everyone): 3:22 PM: Is this outline consistent with TPG?

Steve Sprouffske (to Everyone): 3:23 PM: Graphic Does not appear to incorporate the GNSS group work. Is this still being considered?

Steve Sprouffske (to Everyone): 3:24 PM: Ok thanks.

Jean Johnson (to Everyone): 3:27 PM: Doesn't SCMS/Security backend need to connect with OBU, if not MU, as well?

Jean Johnson (to Everyone): 3:42 PM: I may be reading the ConOps figure too literally, but SCMS is the means of providing certs to OBU, and maybe MU. If that is SCMS backend role, then I think both OBU and MU should be part of the system (the "other" end of the interface).

J Thai (to Everyone): 3:49 PM: It is a draft drawing Jean and will go further refinements, incorporating your and Committee comments.

J Thai (to Everyone): 3:50 PM: You have feedback Faisal.

Jim Misener (to Everyone): 3:51 PM: Thx!

Jim Misener (to Everyone): 3:52 PM: There's an email where I captured some of this needed items as well!

Ray Starr (to Everyone): 4:08 PM: Rather than comparing the RSU data with the data from the controller, would it be better to compare the RSU data with the signal indications. Otherwise, the controller could send the wrong data and the RSU correctly transmit the wrong data and the testing would not detect that.

Charles Felice (to Everyone): 4:10 PM: What is the difference between the Map Data server feeding the TMC and the Map Data feeding the RSU from a field data?

Charles Felice (to Everyone): 4:12 PM: Correction to my question. "...and the Map data feeding the RSU from a field device".

Robert Rausch (to Everyone): 4:21 PM: The RSU should be connected directly to the MAP server

Jim Misener (to Everyone): 4:31 PM: Have you estimated size difference between this proposed SPaT message and the current standardized message?

Ralph Boaz (to Everyone): 4:34 PM: The size of the SPaT message is not addressed. We are only stating needs. This will have to be discussed in a requirements stage if necessary.

Kevin Balke (to Everyone): 4:34 PM: We are not necessarily proposing a "new" SPaT, but looking how to

achieve consistency between manufacturers to produce the values used to populate the J2735 SPaT.

Jim Misener (to Everyone): 4:35 PM: But it will have new information...that's a definition of a new message.

Jim Misener (to Everyone): 4:36 PM: Once we get to size, we will have to talk about reliability... as there are bounds for PRR.

Jim Misener (to Everyone): 4:36 PM: In order for it to be effective.

Connected Intersections (CI) Committee Meeting

Mon Aug 17 (3:00 PM – 5:00 PM EDT)

Agenda (Goudy, Thai)

1. Call to Order
2. Anti-Trust Guidelines
3. Roll Call of Committee members
4. Meeting Purpose and Objectives
5. Introduce the ConOps document
 - Context Diagram
6. Report from each Task Force
 - Accomplishments
 - User Needs Identified
7. Next Steps

Anti-Trust Guidance (Narla) – 1 minute

- The Institute of Transportation Engineers is committed to compliance with antitrust laws and all meetings will be conducted in strict compliance with these antitrust guidelines. Further if an item comes up for which you have conflict of interest, please declare that you have a conflict of interest on the matter and recuse yourself from action on that item.
- The following discussions and/or exchanges of information by or among competitors concerning are prohibited:
 - Prices, price changes, price quotations, pricing policies, discounts, payment terms, credit, allowances or terms or conditions of sale;
 - Profits, profit margins or cost data;
 - Market shares, sales territories or markets;
 - The allocation of customer territories;
 - Selection, rejection or termination of customers or suppliers;
 - Restricting the territory or markets in which a company may sell services or products;
 - Restricting the customers to whom a company may sell;
 - Unreasonable restrictions on the development or use of technologies; or
 - Any matter which is inconsistent with the proposition that each company must exercise its independent business judgement in pricing its service or products, dealing with its customers and suppliers and choosing the markets in which it will compete.

Roll Call of Committee Members (Goudy, Thai) – 5 minutes

- John Thai, City of Anaheim
- Raj Ponnaluri, Florida DOT
- Christina Spindler, Wyoming DOT
- Ray Starr, Minnesota DOT
- Ed Seymour, Texas A&M Transportation
- Faisal Saleem, AZ McDOT Maricopa County
- Whitney Nottage, Q-Free/Intelight
- Steve Bowles, 360 Network Solutions
- Roy Goudy, Nissan
- Mike Schagrin, McCain
- Mike Shulman, Ford Motors
- Vivek Vijayakumar, General Motors
- Michael Stelts, Panasonic
- Jim Misener, Qualcomm
- Doug Schmidt, Aptiv
- Jay Parikh, CAMP/IOO-OEM Forum
- Jason Graves, Denso International
- Justin McNew, SAE Tech Committee

Review Purpose and Objective (Goudy, Thai) - 5 minutes

– Purpose:

- Update the CI Committee on the ConOps and progress of each Task Force

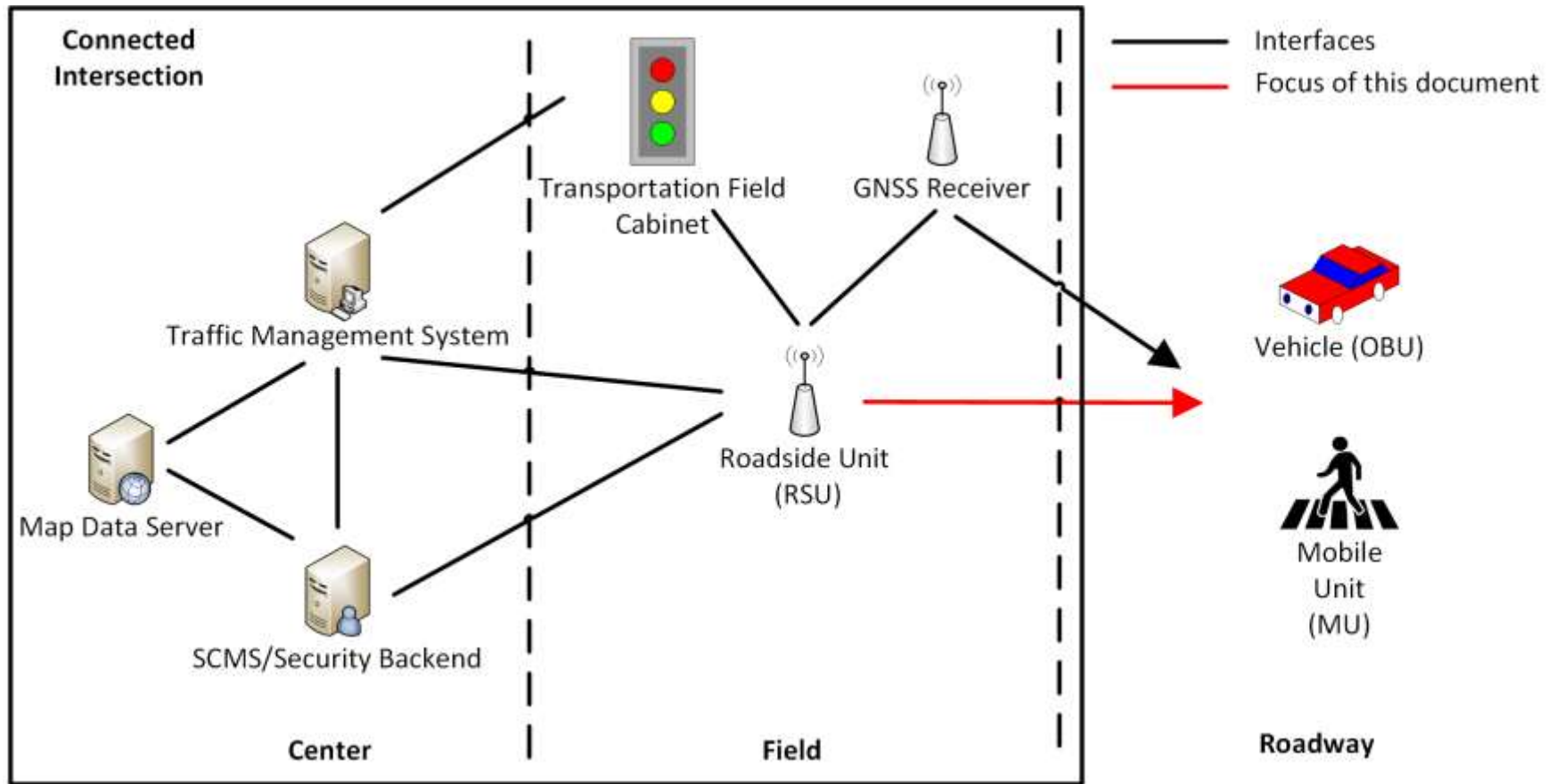
– Objectives

- Present the draft context diagram and user needs

Introduce the ConOps Document (Chan)

1. General Information
 - 1.1 Scope
 - 1.2 References
 - 1.3 Terms
 - 1.4 Abbreviations
2. Concept of Operations
 - 2.1 Tutorial
 - 2.2 Current Situation and Problem Statement
 - 2.3 Reference Physical Architecture
 - 2.4 Needs
 - 2.5 Operational Policies and Constraints
 - 2.6 Operational Scenarios
 - 2.7 Relationship to the ITS National Architecture

Introduce the ConOps Document (Chan)



SPaT/MAP Task Force

SPaT / MAP Task Force

1. Accomplishments since the Plenary Meeting
2. User Needs
3. Operational Scenarios (if appropriate)
4. Other significant accomplishments
5. Q&A

SPaT / MAP Task Force

Accomplishments since the Plenary Meeting

1. Added several new needs
2. Completed review of needs
3. Interacted with the controller vendor subcommittee of the controller task force
4. Engaged in discussion concerning indeterminate interval order and end times

SPaT / MAP Task Force

User Needs for SPaT

1. Intersection Identification
2. Intersection Status
3. Movement State – Including Ped Indication State
4. Time Change Details – Including Ped Timing
5. Rest in Green
6. Next Green
7. Enabled Lanes

SPaT / MAP Task Force

User Needs for MAP

1. Intersection Geometry
2. Lane Attributes
3. Allowed Maneuvers
4. Connections Between Lanes
5. Approach Speed Limit Information

SPaT / MAP Task Force

Additional User Needs Being Identified

1. Transition Information
2. Additional needs for adequate warning time
3. Some testing needs

SPaT / MAP Task Force

Q&A

Positioning Task Force

Positioning Task Force

Accomplishments Since the Plenary Meeting

Primary:

- Modified positioning aspects of ConOps
- Genericized positioning from being GNSS-only

Note: Timing accuracy still open point, given that WAVE devices are both DSRC and C-V2X. Needs further discussion.

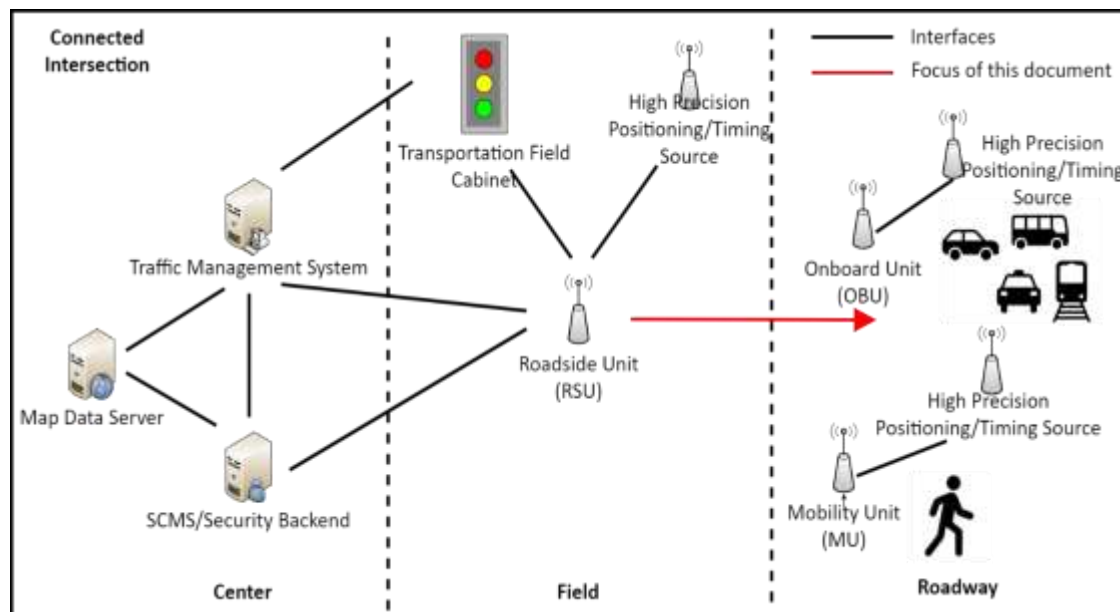
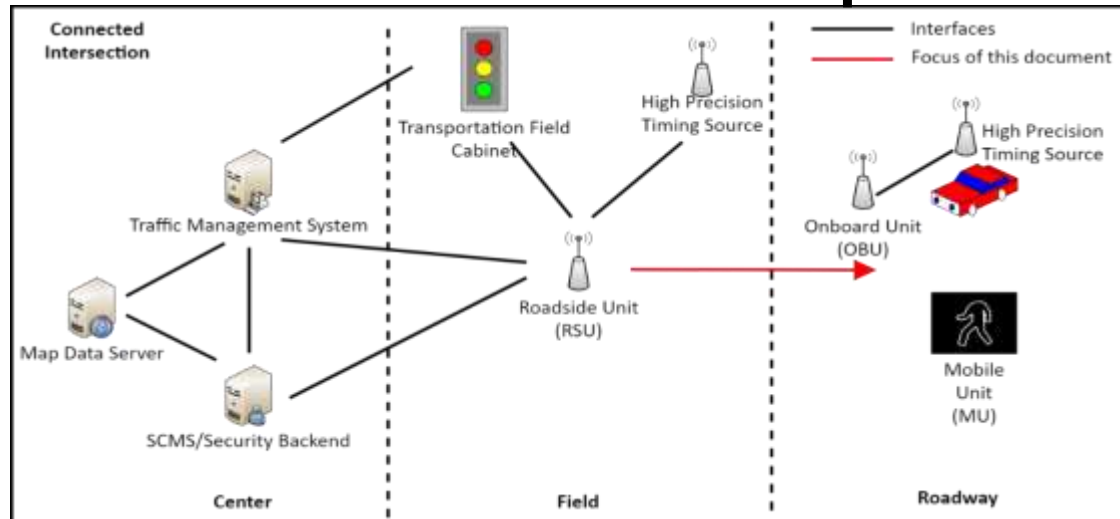
User Needs

“Which lane” accuracy (generally), high precision timing, TBD high availability

Operational Scenarios (if appropriate)

Added modified HDOP environmental spec from SAE J2945/1 and J3161/1. HDOP < 1.5 “clear sky” and HDOP < 2.5 “urban”

Clarified Physical Architecture: Generic Position/Timing Source + Added Mobile/Vehicular Aspects



Security Task Force

Security Task Force

1. Accomplishments since the Plenary Meeting
2. User Needs
3. Operational Scenarios (if appropriate)
4. Other significant accomplishments
5. Q&A

Accomplishments since the Plenary Meeting

Developed User Needs material

CI System Needs: Correct operations (1)

- **Data trustworthiness:**
 - Ensure that data sources are **trustworthy and provide correct data**
 - Use in creating CI messages so message data reflects near-real time CI operating conditions, and applications and users respond appropriately
- **Data processing:**
 - Ensure platforms that modify or perform any transformation on data subsequently used to create CI messages are **trustworthy and operate correctly**
 - Includes producing correct outputs so that transformed data reflects near-real time operating conditions, and applications and users respond appropriately
- **Input validation:**
 - Ensure components **reject incorrect inputs**, or inputs that do not communicate appropriate levels of trustworthiness
 - Components do not provide data that mis-represents the CI operating environment
- **Cyberattacks:**
 - Ensure all components involved in generating CI messages or inputs into CI messages are **protected from cyberattack**
 - malevolent actors' access and harm to the CI system is limited

CI System Needs: Correct operations (2)

- **Cyberattack recovery:**
 - Ensure all components involved in generating CI messages or inputs into CI messages can **recover from cyberattacks**
 - Disruption due to cyberattacks is limited, allowing components to provide near-continuous CI operating environment data
- **Resilience:**
 - Ensure all components **operate correctly** and produce correct output in the case **where the CI operating environment does not meet ideal performance conditions**
 - Applications and user actions remain safe and appropriate during these conditions
- **Secure administration:**
 - Enable components to be **updated or reconfigured by appropriately authorized actors** if necessary to improve resilience / security against cyberattacks
 - Selected components may be modified, as appropriate
 - Example: if some, but not all, components are vulnerable, it may be appropriate for an authorized actor to update/reconfigure selected components to allow those that are not affected by the cyber attack to continue operation, without interruption
- **Secure update:**
 - Support **remote, authenticated, verified security updates**
 - Components maintain a consistent level of current cyber-hygiene
 - Example: as new cyber threats are identified, protection libraries are updated for all system components

CI System Needs: Communications & interface security

- **Data trustworthiness:**
- Provide components receiving CI data with sufficient **information to evaluate trustworthiness of received data**
 - Components receiving CI data receive some assurance that CI data reflect near-real time CI operating conditions, and applications and users respond appropriately
- **Data Integrity:**
- Ensure that CI **data is not corrupted or changed as it passes across interfaces**
 - Transformed data reflects near-real time operating conditions, and applications and users respond appropriately
- **Network Monitoring:**
 - **Misbehavior Reporting by OBUs:**
 - Mechanism to **allow OBUs to report incorrect data** from the infrastructure
 - Faulty CI messages do not compromise applications or user actions.
 - **Misbehavior Reporting by IOO field devices:**
 - Mechanism to **allow IOO field devices to report incorrect data** from the infrastructure
 - Faulty CI messages do not compromise applications or user actions.
 - **Misbehavior Reporting by Network Administrators:**
 - Mechanism to **allow IOO network administrators to detect incorrect data**
 - Faulty CI messages do not compromise applications or user actions.

CI System Needs: Credential management

– **Credential provisioning:**

- Ensure components that send trusted information communicate using up-to-date credentials
 - Components establish trust with each other, as well as OBUs and MUs

– **Management of untrustworthy devices:**

- Mechanism to modify ability of any component determined to be untrustworthy to participate in the system
 - Untrustworthy devices do not have a negative impact on CI system operations
 - Example: untrustworthy devices credentials/certificates may be temporarily or permanently revoked

Operational Scenario

- Initial CII document proposed that CI project provided guidance for operating without an SCMS, i.e. deployment without certificates
 - Proposed operational scenarios include non-SCMS mode
- Security TF recommends against supporting non-SCMS mode for deployment
 - May be appropriate to do early testing without integrating SCMS / security but deployment should always use certificates

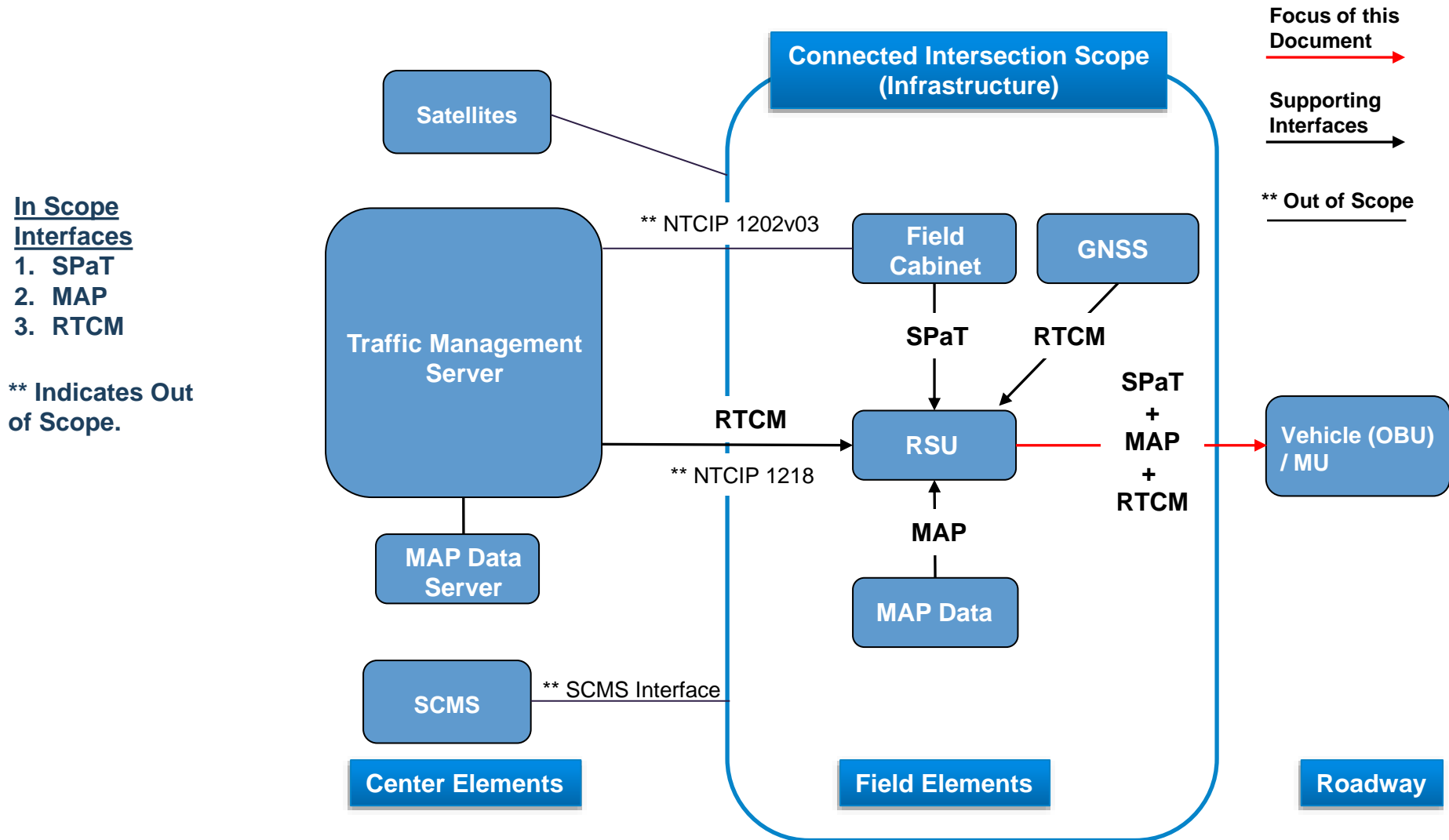
Q&A

Testing/Conformity Task Force

Testing / Conformity Task Force

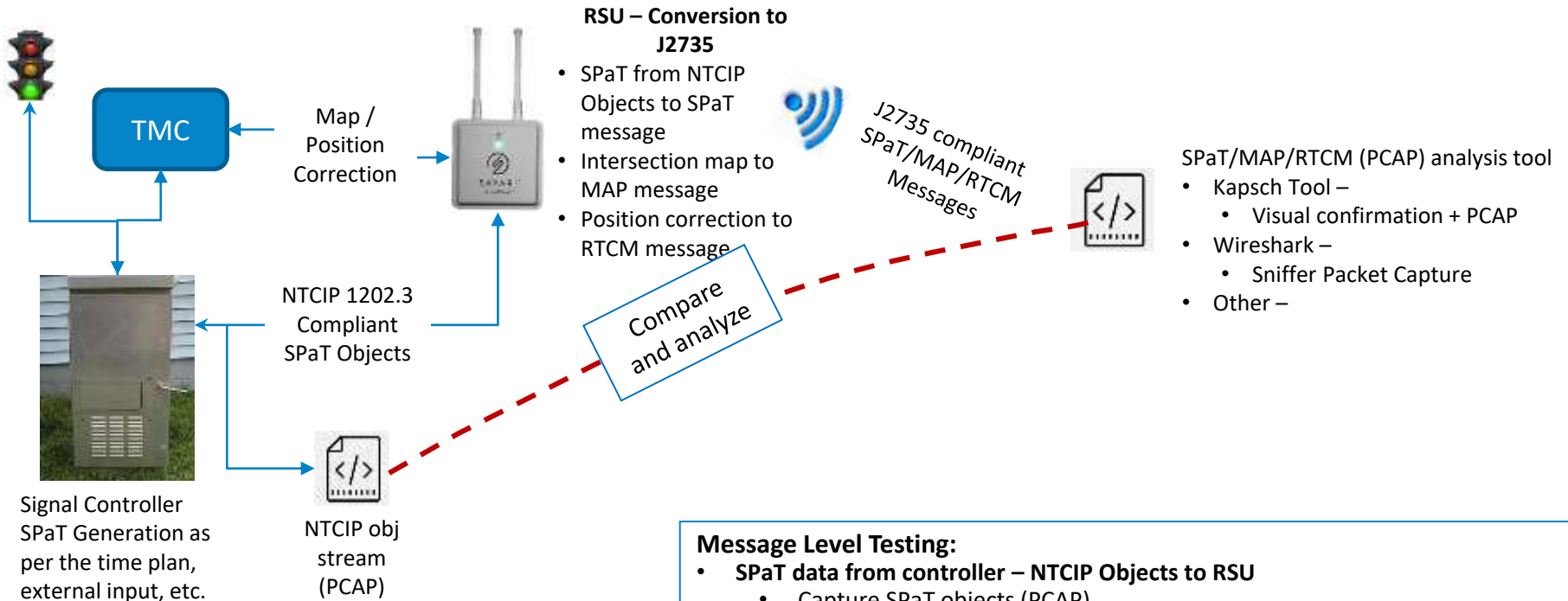
1. Accomplishments since the Plenary Meeting
2. Testing Scope Context Diagram
3. Testing Methodology
4. User Needs Summary
5. Operational Scenarios – Provided by other TFs
6. Other significant accomplishments
7. Q&A

CI Testing Scope Context Diagram



- Assume all interfaces are SCMS Secure.

CI Testing Methodology



Signal Controller
SPaT Generation as
per the time plan,
external input, etc.

NTCIP 1202.3
Compliant
SPaT Objects

NTCIP obj
stream
(PCAP)

Out of scope:

- Physical h/w mounting/testing of field equipment
- Wireless comm, protocol and message transmission
- Stress test (RSU, Controller, etc.)
 - Physical and interface
- Gap, ambiguity, etc. in other standards
 - NTCIP 1218, NTCIP 1202.xx, NEMA TE-2, etc.

Message Level Testing:

- **SPaT data from controller – NTCIP Objects to RSU**
 - Capture SPaT objects (PCAP)
 - Verify and confirm SPaT data as per NTCIP 1202.3 standard
- **SPaT/MAP/RTCM message broadcast from RSU**
 - Capture SPaT/MAP/RTCM messages
 - Verify and confirm message transformation and data as per:
 - Required and optional elements for RLVW
 - J2735 structure and format and CCI guideline
 - Correctness of data in the message (verify against NTCIP objects for transformation check)
 - TimeMark, signal phase/time as generated by the controller
 - Correlate data in SPaT/MAP for the intersection (e.g. intersection ID, signal group and lane IDs, etc.)

Method of Testing: Analysis

- Compare and analyze data values in PCAP (packet capture) streams.

CI Testing & Conformity User Needs (1)

– Infrastructure Testing Needs

- Need to test/verify message data to Vehicle (OBU) / MU
- Need to test/verify referential integrity of message data (e.g., Intersection IDs)
- Need to Manage Configuration and Changes

– Testing Methodology

- Need to describe methods and approach to testing
- Need to test/verify data format, structure, and content of Messages
- Need to describe and test positive outcomes when correct inputs are provided to a CI
- Need to describe and test error condition handling when incorrect inputs are provided to a CI
- Need to describe and test boundary conditions/values provided to a CI

CI Testing & Conformity User Needs (2)

– Testing Methodology

- Need to describe methods of data collection for analysis-based testing. For example, through packet capture methods.
- Need to define levels of testing. For example: device testing, system level testing (multivendor interoperability), and system level testing (deployer focused)
- Need to develop test documentation to guide comprehensive testing
- Need to describe methods of requirements verification (test cases and test procedures)
- Need to describe test environment for comprehensive and consistent testing
- Need to access information regarding available testing tools

Current Status and Suggested Options for T&C

- Current situation:
 - T&C is in “discovery” mode to see what is made available from other TFs
 - Wait until properly defined requirements are in place from SPaT/MAP and Controller TS (and others) to formulate the T&C guidance
- Suggested options:
 - Develop procedures and guidance for T&C for SPaT/MAP/RTCM as laid out in the project scope
 - Validate/refine/enhance test procedures during April – June reference implementation and testing period
 - Full scope of development of test procedures for a complete intersection
 - (RSU, Controller, physical mounting, RF, stress test, other standards, etc.)
 - Create a Phase 2 of the project for T&C to address end-to-end system
 - Develop T&C implementation guidance for IOOs from deployment readiness to a complete a system including test vehicles

Q&A

Traffic Controller Issue Task Force

Traffic Controller Task Force

1. Accomplishments since the Plenary Meeting
2. Traffic Controller Manufacturers Subcommittee
3. Confidence Factor Subcommittee
4. Traffic Operational Scenarios
5. User Needs
6. Q&A

Accomplishments since the Plenary Meeting

- Focus is on issues that have to do with Traffic Controllers and Traffic Control Operations
 - Gaps and ambiguities that have already occurred
 - Traffic operational scenarios that are potentially problematic
- Held 4 Task Force Meetings
 - Developed Traffic Operational Scenarios
 - Developed User Needs based on gaps, ambiguities and issues that have occurred
 - Created a Traffic Controller Manufacturers Subcommittee
 - Created a Confidence Factor Subcommittee

Traffic Controller Manufacturers Subcommittee

- Group made up of technical representatives from all six of the major US traffic controller manufacturers (and a few invited guests)
 - Led by Eric Raamot of Econolite
- Gained agreement from all manufacturers on base assumptions and timing calculation methods for fields used in the SPaT message
 - Includes what to do in special cases such as flash conditions
 - Proposed a method for representing confidence when predicting the next change in signal indications
 - Have written document that is to updated as needed

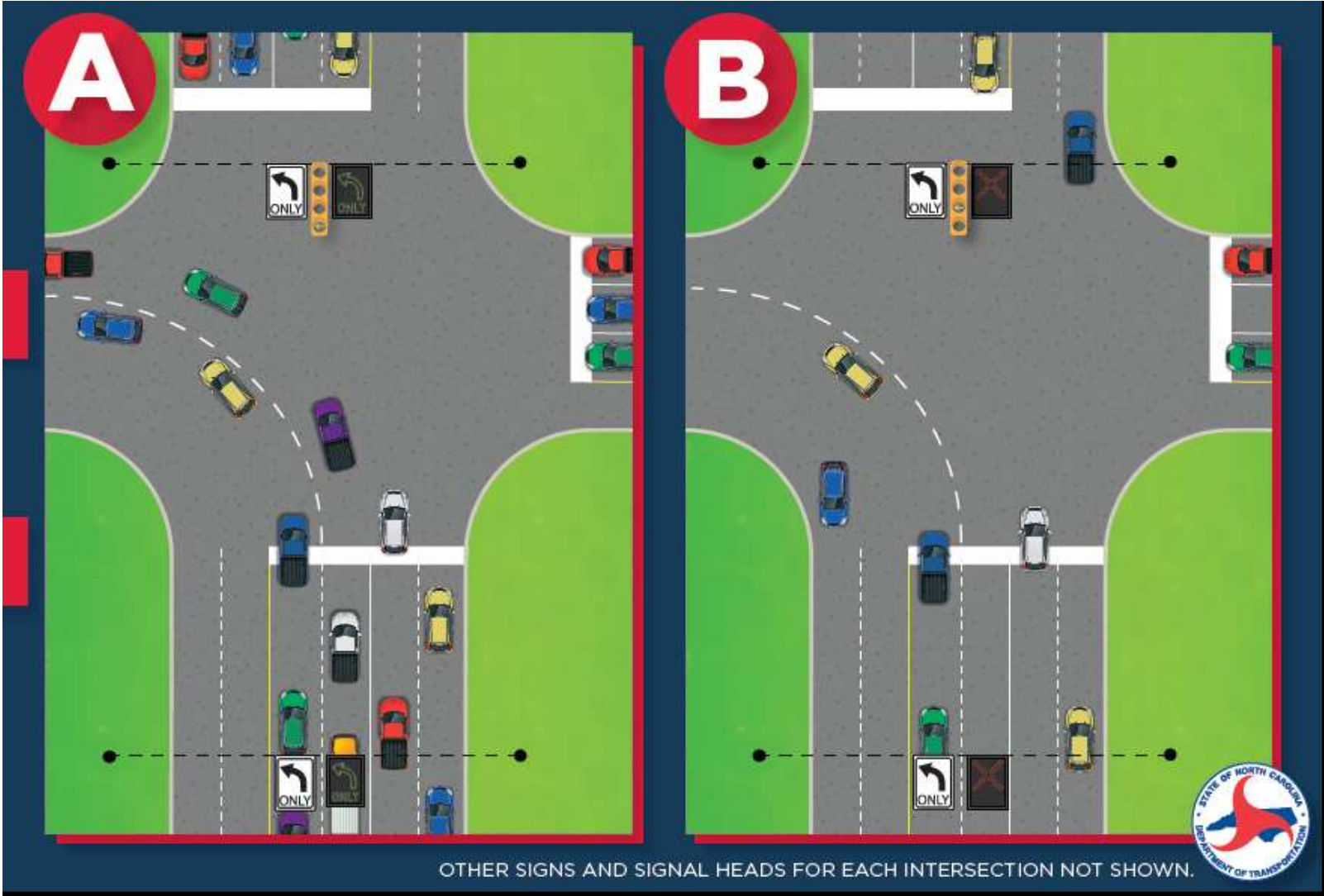
Confidence Factor Subcommittee

- Group made up of representatives of the Traffic Controller Issues TF and SPaT/Map TF
 - Includes Automotive OEMs, Traffic Controller OEMs, infrastructure owner operators, and subject matter experts
- Goal to find a workable solution for a confidence factor for predicting the next change in signal indications
- First meeting to be held Tuesday, 8/18/2020

Traffic Operational Scenarios

- Developed to expose gaps in SPaT and MAP messaging for signalized intersections
- May be used as test cases for proposed changes to SPaT and MAP messaging
- The Traffic Operational Scenarios written so far:
 - Two intersections operated by a single controller
 - Texas Diamond Operation
 - Florida T Intersection
 - High-intensity Activated crossWalk (HAWK) Beacons
 - Intersections with External Logic
 - Intersection with Dynamic Lane Use
- 9 other intersection issues identified

Example – Dynamic Left Turn Intersection



Traffic Controller Issues TF User Needs (so far)

- 1.1 Uniform Signal Phase and Timing Message (SPaT)
- 1.2 SPaT Message Based on Current Intersection Configuration and Conditions
- 1.3 Predicted Change in Signal Indication Confidence Factor
- 1.4 SPaT Accuracy in Externally Controlled Intersections
- 1.5 Robustness
- 1.6 Timing Synchronization
- 1.7 Geographic Synchronization

Example Connected Intersection Need

1.1 Uniform Signal Phase and Timing Message (SPaT)

– Provide a uniform SPaT message

- SPaT message field are subject to a standardized interpretation
- Field values are produced using defined states and functions commonly used by traffic signal programs regardless of the controller manufacturer or software provider
- A uniform SPaT message increases interoperability between traffic signal controller and applications using SPaT data to aid motorists and vulnerable road users

Traffic Controller Issues TF Q&A

Next Steps

- Draft ConOps to be Distributed – August 18
- Concept of Operations Walkthrough – August 31, September 1, September 2 (11:30 AM-5:30 PM EDT)
- Updated draft ConOps document – distribute by September 11 for a 2-week comment period.
- Final Concept of Operations – probably October 4 (September 30)
- Start Requirements phase

Project Schedule

- Requirements
 - Initial requirements from each Task Force – November 12
 - Requirements Walkthrough – week of November 30
 - Complete Requirements – January 4
- Draft Implementation Guidance Document (April 2021)
- Validation (to be determined April – June 2021)
- Publish Final Implementation Guidance Document (September 2021)

Adjourn

– Thank you!