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# **Connected Intersections (CI) Committee Meeting**

Mon Sept 21 (3:00 PM – 5:00 PM EDT)

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## Agenda (Goudy, Thai)

1. Call to Order
2. Anti-Trust Guidelines
3. Roll Call of Committee members
4. Meeting Purpose and Objectives
5. Progress to Date
6. Report from each Task Force
  - Accomplishments
  - Next Steps
7. Project Schedule

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## 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.

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## Roll Call of Committee Members (Goudy, Thai)

- 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 Schagrín, McCain
- Mike Shulman, Ford Motors
- Vivek Vijayakumar, General Motors
- Michael Stelts, Panasonic
- Jim Misener, Qualcomm
- Doug Schmidt, Aptiv
- Jay Parikh, CAMP/I00-OEM Forum
- Justin McNew, JMC Rota
- Vacant

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## Review Purpose and Objective (Thai)

- Purpose:
  - Update the CI Committee on the progress
- Objectives
  - Present the draft ConOps document and the progress of each Task Force

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## Progress (Thai)

- Initial Draft ConOps document – Distributed August 19
- ConOps Walkthrough – August 31 to September 2
- Draft ConOps document – Distributed September 15 for 2-week comment period.
- Each Task Force meeting regularly
- Task Force Chairs and Subject Matter Experts (SMEs) meeting every Friday for progress and coordination

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# **Positioning Task Force**

**Justin McNew / Jim Misener (co-chairs)**

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# Positioning Task Force

## Accomplishments since August Committee Meeting

- 1. Moving from ConOps/User Needs → Requirements
- 2. Validated primary user needs assigned to TF, *Positioning Correction* and *RTK*

2.4.2.5.1	Positioning Corrections	A connected intersection needs to provide data in a standardized format that helps vehicles to achieve the required positioning accuracy at intersections where this is needed. For example, position corrections data may provide information that allows an application on an OBU/MU to calculate its current position with enough accuracy to determine which lane it is in.	S	S	P
2.4.2.5.2	Real-Time Kinematic	When implementing Real-time Kinematic (RTK) positioning, all GNSS devices in the broader IOO system implementation need to use and broadcast a common RTK source as an RTCM broadcast, or the devices need to use a common (network-based, not broadcast) RTK source for their position correction.			P



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## Positioning Task Force

### Accomplishments since August Committee Meeting (cont'd)

#### 3. Did not accept secondary user need assigned to TF, *Time Source*

##### 2.4.2.2.1 Time Source

A connected intersection needs to use the same time reference and with sufficient precision as OBUs/MUs so non-infrastructure applications can properly interpret time points. This allows the proper interpretation of time-sensitive data by applications and permits reactions to be based on the same understanding of time.

Reasoning: Mismatch of time scale – this user need does not need high-precision timing information.

Issue: This is an orphan. No primary TF has been assigned the *Time Source* user need. TCI, SPaT/Map and Positioning TFs have been given “secondary” assignments.

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## Positioning Task Force

Next Steps: Move toward requirements definition

1. (Next meeting) Determine split between map and accuracy definition

High definition maps → lower positioning accuracy and vice versa

2. Recognizing *RTK* user need:

Determine RTCM version

Determine how to provide position accuracy when RTK is not available

Explore/note other alternatives to support RTK (RTCM broadcasts from the CI is not the only solution)

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## Q & A

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# **Security Task Force**

**Jimmy Upton / William Whyte (co-chairs)**

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## **Security Task Force**

1. Accomplishments since August Committee Meeting
2. Next Steps
3. Q&A

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## **Accomplishments Since August Committee Meeting**

- User needs were presented last month
- They were discussed during the ConOps review
- No substantial changes were made
- Security TF has begun the process of developing requirements from those needs

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## Next Steps

- Michaela (SME) is developing candidate set of requirements for review at our next meeting
- We will review and update those requirements over the next few meetings
- Will liaise with other Task Forces on some security matters as appropriate
- Next meeting: Thursday, September 24, 3pm Eastern

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## Q & A



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# **Testing/Conformity Task Force**

**Jay Parikh / Christina Spindler (co-chairs)**

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## Testing/Conformity Task Force

1. Accomplishments since August Committee Meeting
2. Next Steps
3. Q&A

# T&C TF Topics

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1. Testing Scope
2. Testing Methodology
3. Dependencies Influencing Testing
4. Challenges and Opportunities
5. Candidate List of Test Tools
6. Candidate List of Test Documentation

# CI Testing Scope – Identifies Testing Needs and Requirements of Various Interfaces

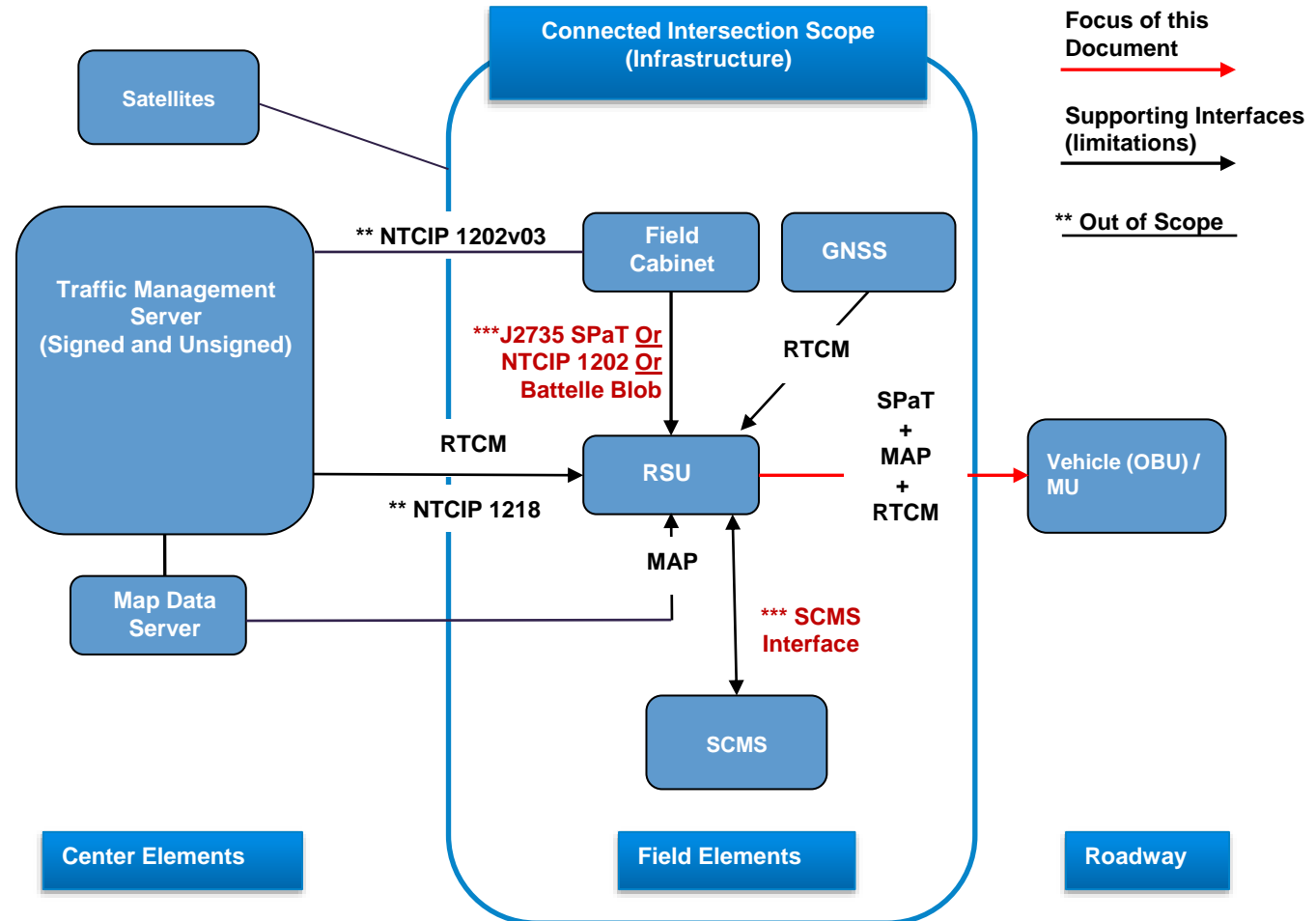
Note: RSU HSM needs to be located where the message is being signed.

## In Scope Interfaces

1. SPaT
2. MAP
3. RTCM

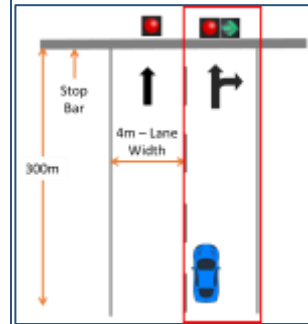
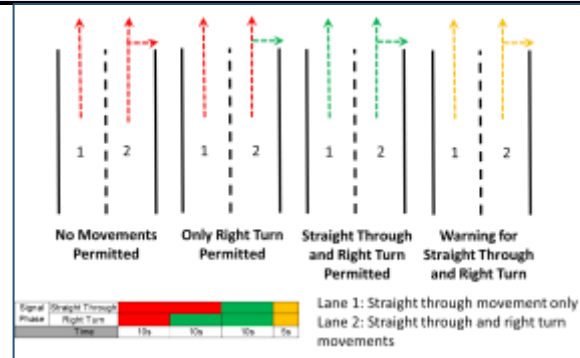
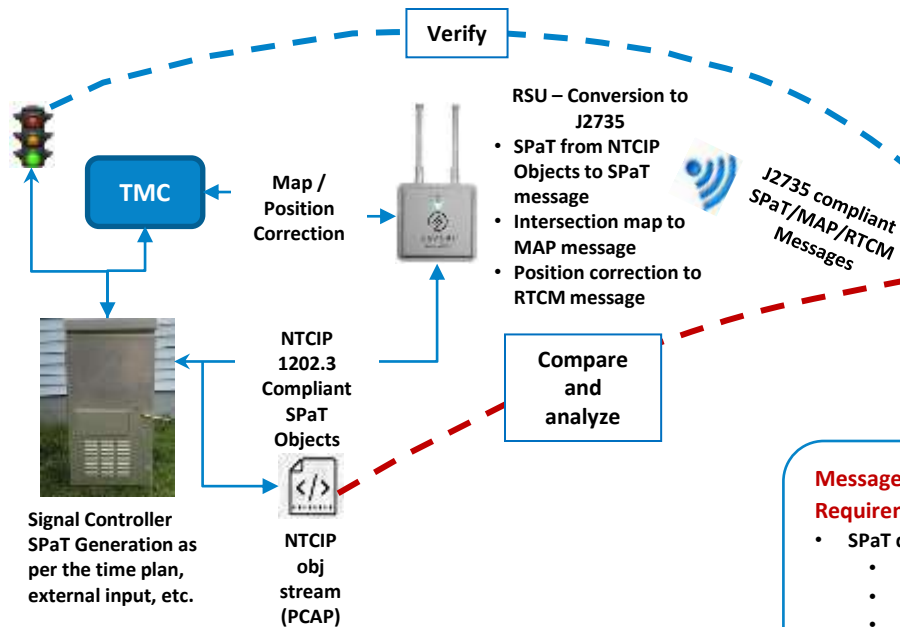
\*\* Indicates Out of Scope.

\*\*\* Indicates limited to what is minimally necessary to accomplish testing.



# CI Test Environment – Identifies Test Points and Test Methodology

## Field Test



### SPaT/MAP/RTCM (PCAP) analysis tool

- Kapsch Tool –
  - Visual confirmation + PCAP
- Wireshark –
  - Sniffer Packet Capture
- Other –

### Message Level Test.

#### Requirements Verification Method: Test

- SPaT data from controller – NTCIP Objects to RSU
  - Capture SPaT objects (PCAP)
  - Verify and confirm SPaT data as per NTCIP 1202.3 standard
  - Verify and confirm signal state in SPaT data with signal light
- 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.)

#### End-to-End Test. (Test-point to Test-point)

#### Requirements Verification Method: Data Collection and Analysis

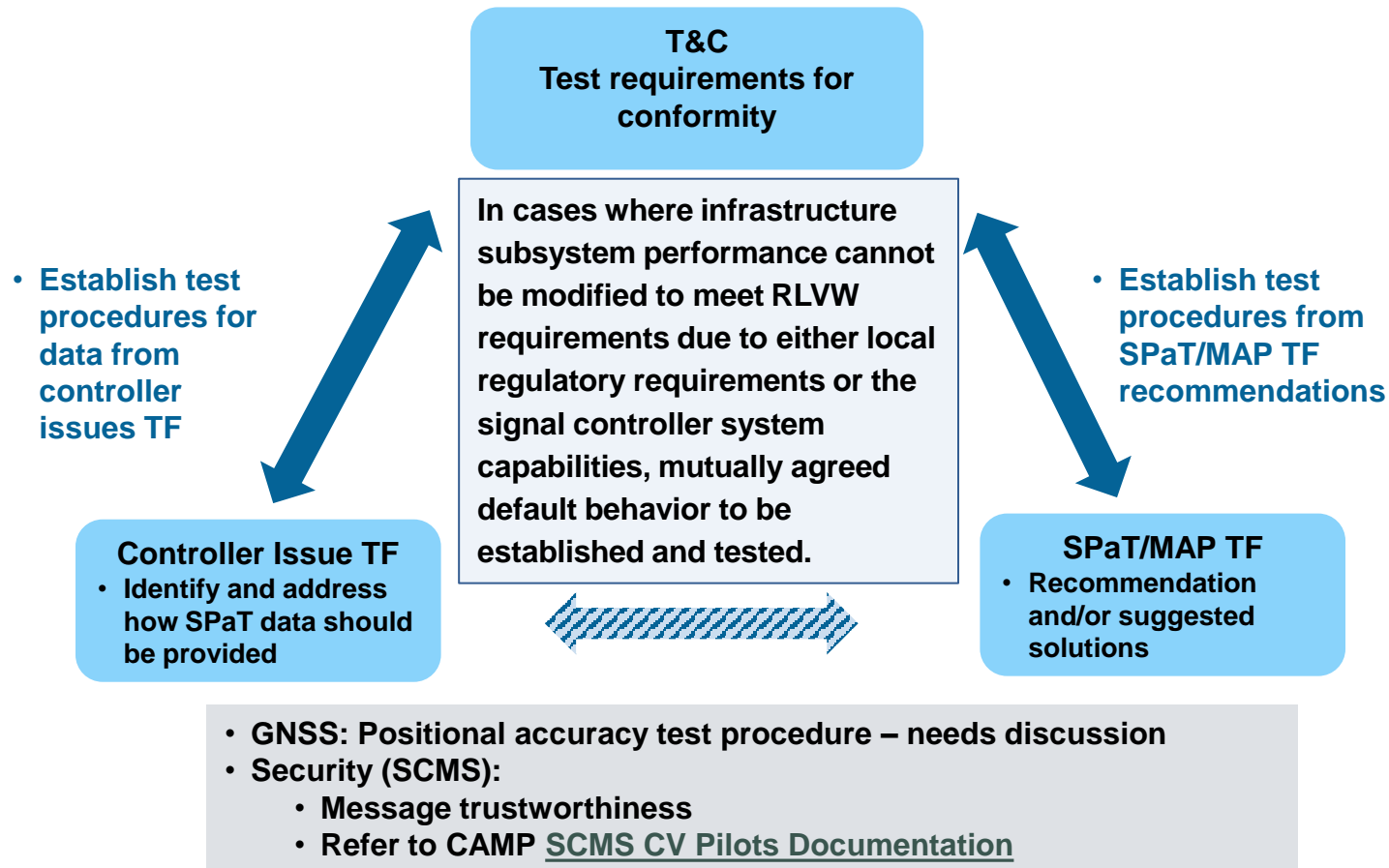
- Compare and analyze data values in PCAP (packet capture) streams.
- Field test (Ref. Implementation)

### 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 TS-2, etc.

# CI Test Dependencies – May refine (alter) what elements need to be tested at test points.

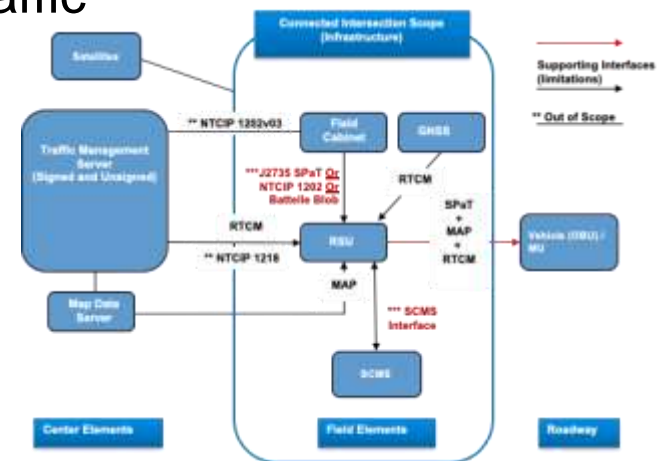
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# Challenges and Opportunities

## – Challenges

- Multiple configuration options (message standards) for communications between traffic controller → RSU
  - J2735 SPaT data vs. message
  - NTCIP 1202 v03 (data objects)
  - “Battelle Blob” (NTCIP 1211 data objects)
- Multiple configuration options for position corrections
  - RTCM (DGNSS) from local base station
  - Vendor specific implementation (eg. NYC Pilot)
  - RTK (subscription based)
    - J2735 provides encapsulation of RTCM
- Multiple configuration options for MAP message
  - Intersection geometry + allowed movement
- Outside of SCMS, Security is largely undefined



# Challenges and Opportunities

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## – Opportunities

- Leverage existing Test Tools and Test Documentation
- Vehicle centric (CAMP, CV Pilots)
- Infrastructure centric
- We want to bring together a harmonized package (across various ongoing standards and deployments) into one package with a “focus” on infrastructure.



# Candidate List of Test Tools

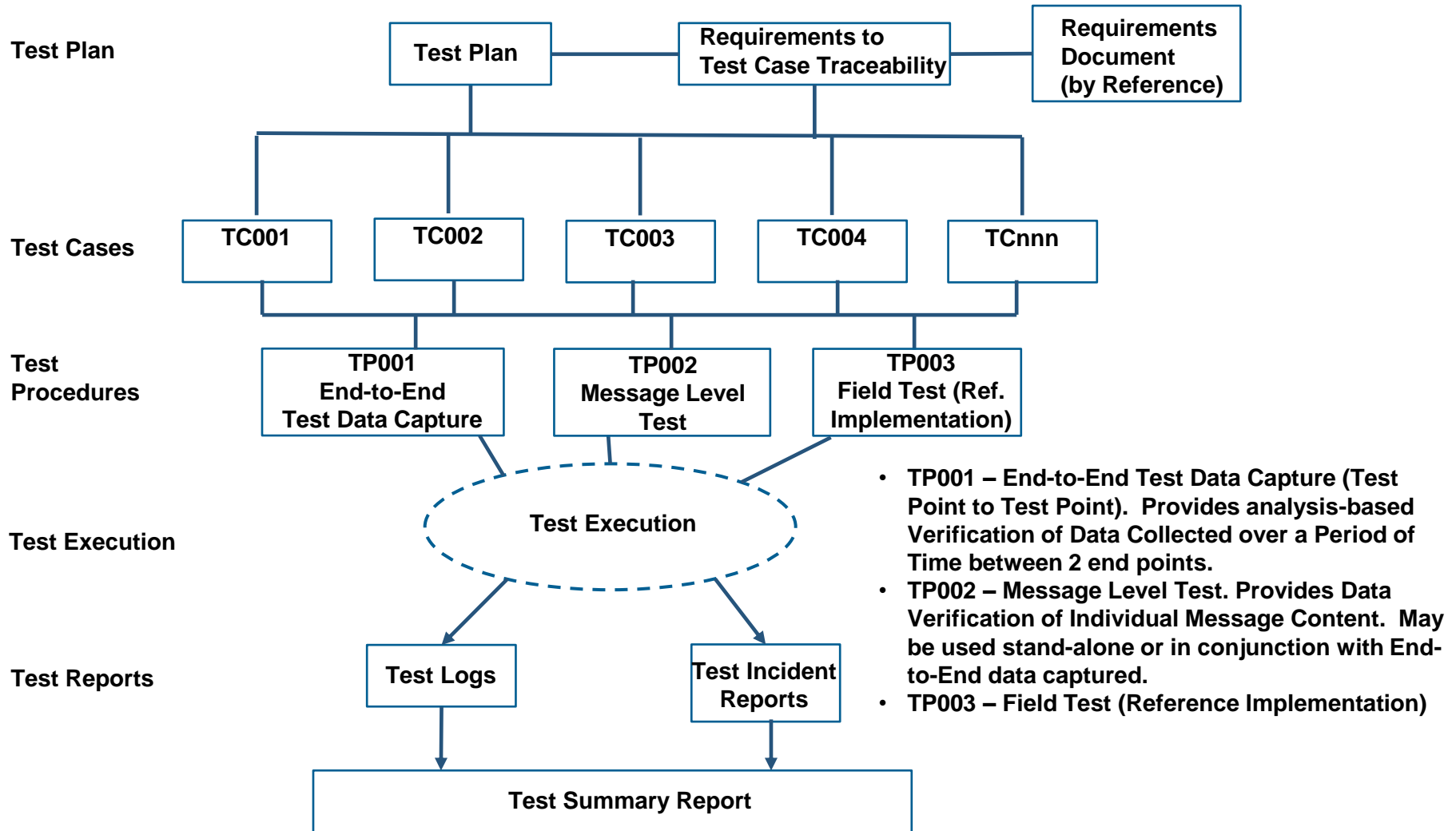
Interface	Test Tool	Owner	Comment
RSU → OBU (SPaT/MAP)	CAMP Visualization Tools	CAMP	Information provided by J. Parikh. Tool provides info about movements associated with the lane, data capture, and post analysis. Covers MAP.
RSU → OBU (SPaT/MAP)	Certification Tools	Part of OmniAir Certification Process (Use V2X Hub)	Information provided by R.Roebuck. Covers MAP. Will add V2X Hub.
Traffic Controller → X	NTCIP 1202 v03 Conformance Test Tool	City of Anaheim / FHWA	Information provided by M. Insignares. Under Development. J. Thai is the COTR.
Traffic Controller → X	NTCIP 1202 v03 connection to RSU	FHWA / Saxon Labs (developer Leidos)	Randy. Incl. Test Cases for SPaT.
Traffic Controller → X	Collects SPaT (Battelle Blob) Data	TTI	Jay/CAMP & Hassan/TTI. Demonstration: Sep 18 by TTI. Tool synchronizes data from controller (movement) and SPaT data. Provides intersection status (preempt, flash, etc) Available on FHWA web site.
RSU → OBU	waveBEEtouch	Nordsys	Tablet-based tool. Jay provided link to the cut-sheet. <a href="https://www.nordsys.de/en/v2x-products/283-wavebeetouch.html">https://www.nordsys.de/en/v2x-products/283-wavebeetouch.html</a>
RSU, OBU	CAVE Device	FHWA / Saxton Labs	D. Curtis is the COTR. Combines RSU, Signal Controller, V2X Hub. Presentation: Sep 18 by Leidos.
GNSS → RSU	TBD	TBD	Jay to reach out.to GNSS TF. Needs to support J2735 formats.
RSU → OBU	Danlaw	CV Deployments	Ask Bob R. and David B. about NYC. Danlaw has tools. Used in NYC. Incl. Visualization of PCAP data collected. Randy will reach out to Danlaw.
TBD	TBD	TS10 Group	Based on RSU 4.1.

# Candidate List of Test Documentation

Document Name, Date	Comment	Sponsor	Test Plan	Test Procedures	Test Cases	Test Log	Test Report
Test Plan for Connected Vehicle (CV) Pilots Phase 2 Interoperability Testing, May 15, 2018	Provided by J. Anderson, also D. Benevelli	FHWA	X	Data Collection	X		
Connected Vehicle Pilots Phase 2 Interoperability Test Test Report, November 9, 2018	Provided by J. Anderson	FHWA	X		X		X
Test Procedure for Verifying SPaT and MAP Messages, September 18, 2019	Provided by J. Parikh	CAMP		X			
SPaT Challenge Verification Document, October 30, 2017	Provided by J. Parikh	CAMP		X			
Test Readiness Review Checklist	Provided by J. Anderson. Useful for tracking/conducting test readiness review (TRR) which is the final go/no-go decision for conducting the test.	FHWA	X	X			
Interoperability Test Notebook	Provided by J. Anderson. Used to create physical notebooks for data collection and tracking of each test.	FHWA				X	
Interoperability Test Compiled Notebook	Provided by J. Anderson. Spreadsheet format to consolidate information collected from the notebooks.	FHWA				X	
Actual Run Order and Start Times	Provided by J. Anderson Consolidated list of all test runs and in what order.	FHWA				X	

# DRAFT Connected Intersections Test Documentation Organization Based on Review of Existing Test Documentation gathered.

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# **Traffic Controller Issue Task Force**

**Kevin Balke / Roy Goudy (co-chairs)**

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## Traffic Controller Issues Task Force

1. Accomplishments since August Committee Meeting
2. Red Light Violation Warning (RLVW)
3. Next Steps
4. Q&A

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## Accomplishments since August Committee 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 3 Task Force Meetings
  - Identified User Needs from CI ConOps where the TCI TF may contribute requirements
  - Currently continuing the work on RLVW application that started in the Confidence Factor Subcommittee

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## Accomplishments since August Committee Meeting (cont.)

- Held 2 Confidence Factor Subcommittee Meetings
  - Goal to find a workable solution for a confidence factor for predicting the next change in signal indications
  - Initial simple percentage not suitable for Controller Manufacturers
  - Proposed confidence levels based on controller state not suitable for Automotive OEMs
  - Determined that for safety applications such as RLVW, nearly 100% confidence is required
  - Developed draft document describing RLVW needs
    - Expecting vehicle-side input from CAMP-CVPFS driven activity
  - Suspended Confidence Factor meetings to engage Task Force on RLVW

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## Red Light Violation Warning (RLVW)

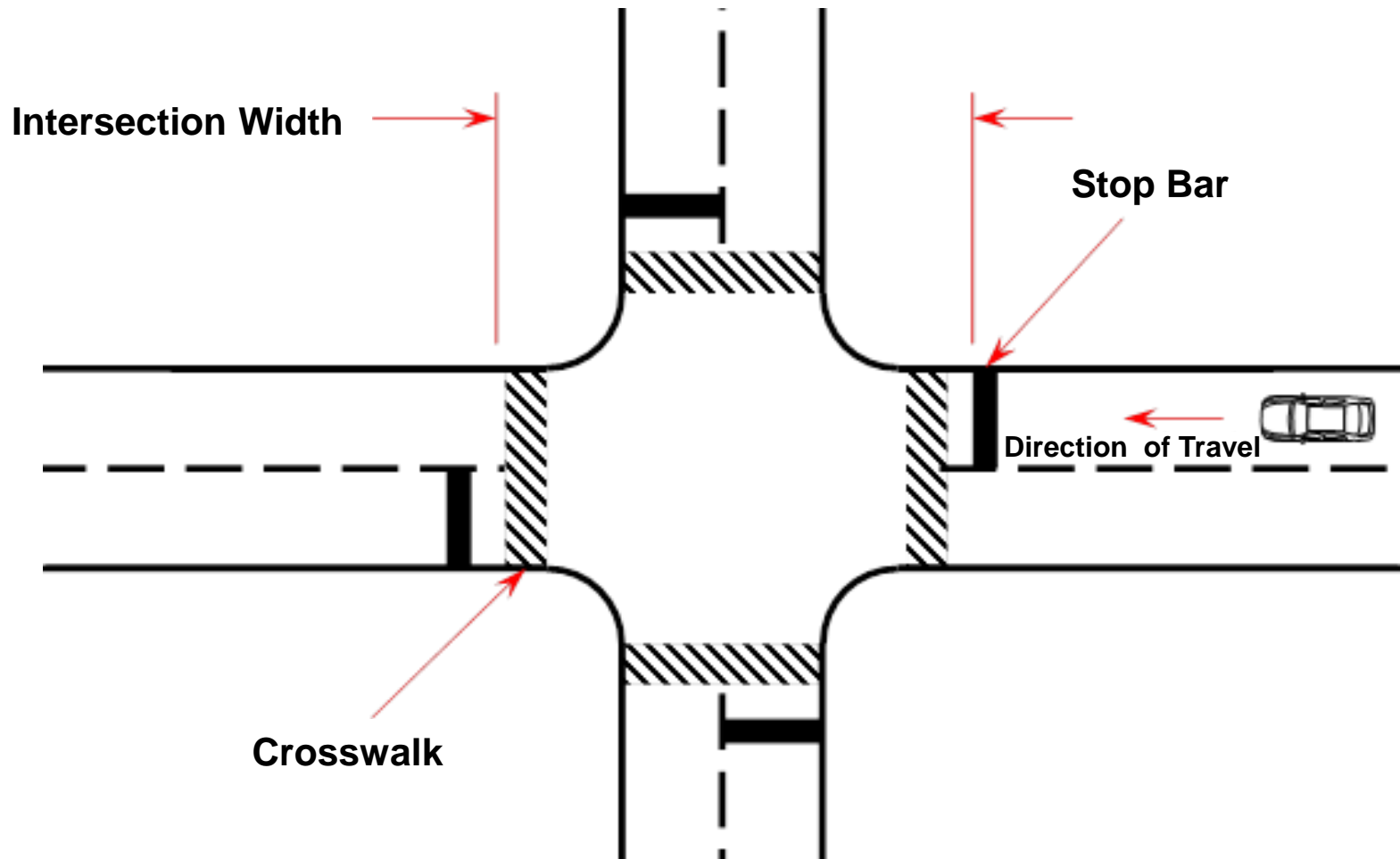
- Traffic signal controllers allow traffic engineers to program them to safely maximize traffic flow
- Under fully actuated signal operation:
  - Termination of green time is not an event that can be predicted with any certainty
  - Yellow change interval timing has a high confidence/certainty (nearly 100%)
- Yellow change interval timings are generally set to allow driver to:
  - Stop before entering the intersection or
  - Enter during yellow but allow signal to change to red while vehicle is still intersection



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## Red Light Violation Warning (RLVW) (cont.)

- Based on RLVW document, the need is to provide an alert so the driver may clear the intersection while in yellow



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## Red Light Violation Warning (RLVW) (cont.)

- This means:
  - A time mark is needed for the imminent termination of green at approximately two seconds before the actual green termination in the field
  - Referring to this as Advance Warning of End of Green (AWEG)
- RLVW based on yellow change interval time + AWEG will provide time for drivers to:
  - Stop before entering the intersection or
  - Enter and clear intersection while signal is in yellow

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## Red Light Violation Warning (RLVW) (cont.)

- TCI TF is seeking to offer some level of AWEG support
- Need different methodologies to accommodate high variability in intersection geometries, control strategies, and existent infrastructure
- Develop a set of recommended changes for CIs based on the local factors
- Provide the maximum amount of AWEG feasible without a negative impact to the intersection safety and efficiency

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## **Red Light Violation Warning (RLVW) (cont.)**

- Original RLVW document has been updated
- Draft contains proposed methods for AWEG under various conditions
- Draft is under review by the TCI TF

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## Next Steps

- Continue with development of proposed RLVW solution(s)
- Develop Confidence Factor method for non-safety critical applications
- Requirements development for user needs

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# Traffic Controller Issues Task Force

Q&A

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## **SPaT/MAP Task Force**

**Michael Maile / Ray Starr (co-chairs)**

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## **SPaT/MAP Task Force**

1. Accomplishments since August Committee Meeting
2. Next Steps
3. Q&A



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## **SPaT/MAP Task Force**

### Discussed Requirements

1. Mandatory, Required and Optional
2. Road Regulator ID
3. Pedestrian movement state
4. Flashing Yellow Arrow state
5. Protected versus Permissive
6. Protected versus Permissive Clearance

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## **SPaT/MAP Task Force**

### Other Activities

1. Interacted with the controller task force and sub-committees
2. Continued discussion concerning end of green

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# SPaT/MAP Task Force

## Next Steps

1. Signal time change details
  - a. Start time
  - b. Min End Time
  - c. Max End Time
  - d. Likely Time
  - e. Confidence
  
2. MAP requirements
  - a. Node placement & representation
  - b. Pedestrian facilities
  - c. Speed limit that varies by approach
  - d. Connection ID for optional data elements
  
3. Performance Requirements

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# SPaT/MAP Task Force

Q&A

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## Project Schedule

- Final Concept of Operations – October 4
- 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)

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## Participation (Thai)

- To participate in a Task Force, send an e-mail to:
  - [standards@ite.org](mailto:standards@ite.org)
- Please indicate which task force(s) in the e-mail
- Participation limited to no more than 3 task forces

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# Adjourn

– Thank you!