
Connected Intersections (CI) Plenary Meeting

Monday July 20 (02:00 PM – 5:00 PM EDT)

Virtual Meeting

Meeting Agenda

1. Call to Order
2. Anti-Trust Guidelines
3. Welcome
4. Meeting Purpose
5. Project Overview
6. Task Force Presentations (15 minutes + 5 minute Q&A each)
7. Questions and Answers Session (20 minutes)
8. Participation
9. Connected Vehicle Pooled Fund Study Presentation (20 minutes)
10. Adjourn

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.

Welcome Remarks (Narla)

- USDOT Remarks
- All participants have been muted.
 - Please enter your questions in the chat box.
 - Questions to be addressed during the Q&A session after the presentations

Meeting Purpose (Goudy, Thai)

- Quarterly plenary meeting
- Update the stakeholder community about the progress and accomplishments of the CI project

Project Overview (Goudy, Thai)

– Committee Scope

- The scope of the Connected Intersections (CI) Committee is to develop and publish document(s) that defines the minimum requirements a connected intersection must support to ensure national interoperability among road users, equipped devices/vehicles and connected intersections.

– Project Scope

- The project purpose is to develop and publish a CI implementation guide that standardizes the key capabilities and interfaces for a connected intersection. ...the [guide] should address the ambiguities and gaps identified by early deployers and provide enough guidance to generate messages and develop applications for signalized intersections that are truly interoperable across the United States, especially for automated transportation systems.

Project Overview (Goudy, Thai)

– ITE Project Website

- <https://www.ite.org/technical-resources/standards/connected-intersections/>
- Updating the Project Management Plan (PMP)

– Systems Engineering Process

- Concept of Operations
 - Describes the scope, the current problem and the needs
 - Operational Scenarios are optional

Project Overview (Goudy, Thai)

– Project Schedule

- Kickoff Meeting (April 8, 2020)
- Concept of Operations (September 2020)
 - Draft of needs from each Task Force - August 14, 2020
 - Concept of Operations Walkthrough – Week of August 31/September 7. Maybe (3) 5-hours days
 - Final Concept of Operations (September 30, 2020)
- Requirements Document (Complete December 2020)
- Draft Implementation Guidance Document (Complete April 2021)
- Validation (to be determined April – June 2021)
- Publish Final Implementation Guidance Document (Complete September 2021)

Task Force Composition

Task Force	Co-Chairs	SDO	SME Consultant
SPaT/MAP	Ray Starr (MnDOT)/Michael Maile	AASHTO	Patrick Chan Jay Parikh
Testing/ Conformity	Jay Parikh (CAMP)/Christina Spindler (Wyoming DOT)	AASHTO	Manny Insignares Randy Roebuck
Security	William Whyte (Qualcomm)/Jimmy Upton (ISS)	NEMA Alt: ITE	Wolfgang Buckel William Whyte Team Michaela Vanderveen
Positioning	Jim Misener (Qualcomm)/Justin McNew (JMC Rota)	NEMA	Steve Sprouffske Md Shah Imran
Traffic Controller Issues	Roy Goudy (Nissan)/Kevin Balke (TTI)	ITE	Ralph Boaz Chris Poe Md Shah Imran

Task Force Roles & Responsibilities

- CI TF Co-Chairs
 - Preside over TF meetings
 - Focuses the TF to review inputs and provide feedback to the SME
 - Build consensus
 - Report progress to CI Committee at each monthly conference call
- Standards Development Organization
 - Provide support to coordinate and manage the Task Force meetings
- Subject Matter Expert (SME) Consultant
 - Develop the document contents (gaps, ambiguities) for the Task Force
 - Keep minutes of meetings
 - Provide guidance

Traffic Controller Issue Task Force

Traffic Controller Issue Task Force

- Purpose:
 - Identify and address how SPaT data should be provided

Task Force Scope

- Task Force and the appropriate Standards WG to identify gaps and ambiguities; then prioritize common problems that break interoperability
- Reach out to users, integrators and early deployers to survey problems and solutions to interoperability issues
- Establish level of severity and estimate time/effort to address each item (what can be resolved within the CI Committee project schedule)
- Work with the appropriate Standards WG on the problem resolution
- Systems engineering process shall be employed
 - Concept of Operations (including a Walkthrough)
 - Requirements (including a Walkthrough)
 - Design (including a Walkthrough)

Task Force Objective

- Submit Task Force Work Plan with schedule
- Publish Interim Findings Report
- Publish Final CI Implementation Guidance Report for traffic signal controller issues
 - Include recommended solutions to gaps/ambiguities using problem/resolution form
 - Include items that were not resolved due to schedule and budget constraints
 - Recommend next steps
 - All work to be accomplished by June 30, 2021

Task Force Focus

- Focus on identifying and describing what output from the traffic signal controller/cabinet is needed to populate the current J2735-2016 SPaT message
 - How infrastructure elements produce the time and status values that result in the proper messaging
- Establish a uniform expectation between regions that the same operating conditions are consistently being described in the SPaT
- Collectively describe a set of scenarios that drivers/vehicles typically encounter at signalized intersections then describe how the traffic signal operates under those scenarios
- Work with MAP/SPaT TF to develop a list of operating conditions / situations / scenarios that drivers / vehicles are likely to encounter
 - What the infrastructure does & what the vehicle / driver expects to be told under that situation

Activities Carried Out

- Met twice
- Developed initial list of operational scenarios to consider in identifying traffic signal controller issues
- Identified “volunteers” to develop operational scenario descriptions
- Formed a subcommittee of traffic controller manufacturers to address known consistency and ambiguity issues when generating the SPaT message
- Established meeting cadence (meet every Wednesday)

List of Potential Scenarios

- Isolated intersection control (normal operations under “Free” Mode) with:
 - Consistent demands on all phases (base case)
 - Light Demand conditions
 - Termination of a phase
 - Phase skipped due to light demand
 - Activation of Pedestrian indications
 - Light night operations -- transitioning from “resting” to servicing call (vehicular and/or pedestrian)
- Volume/Density control

List of Potential Scenarios

– Coordinated operations

- Actuated coordinated operations with floating force-offs
- Actuated coordinated operations with fixed force-offs
- Fully actuated/coordinated control
- Pedestrian activations during coordination
- Coordinated conditions under light volume conditions
- External coordination (adaptive control)

List of Potential Scenarios

– Left-Turn Treatments

- Protected left-turns
- Permissive left-turns – Flashing yellow arrow
- Permissive left-turns – Flashing red
- Protected/permissive operations
- Conditional service

List of Potential Scenarios

- Transitions
 - Free to Coordinated
 - Between coordination plans
 - Coordination to free

List of Potential Scenarios

- Special operations
 - Programmed flash
 - Emergency flash
 - Exclusive Pedestrian/bicycle phases
 - Leading pedestrian phases/Queue jumps
 - Overlaps
 - Preemptions
 - Phase Transition/clearance
 - Dwell
 - Exit from Transition
 - Priority
 - Activation of dynamic turn prohibitions (e.g., no turns for concurrent transit line)
 - Dynamic all-red
 - Test mode (controller continues to cycle, but signal indications in flash)

List of Potential Scenarios

- Special intersection control
 - Diamond intersections
 - Multiple leg intersections (requiring more than 8 phases and two rings)
 - Diverging diamonds

List of Potential Scenarios

– Rest in Green

- Urban arterial under low-volume conditions
 - Signal running “free”
 - Recall on main street approaches (no detections)
- Signal resting in green on main-street approach and steady DON'T WALK to permit immediate transitions to cross street in response to actuation
 - Timer have become dormant waiting for input
- CV vehicle on main-street approach
 - Time to change Min and Time to change Max → undefined
- With cross-street demand, signal immediately activates and transitions to yellow clearance
 - CV vehicle on main-street has no notice to transition
- Potential Implementation Guidance
 - Rest in “Walk” to make Main-street signal indications time Pedestrian Clearance
 - Have CV place Extension call on Main-street approach

Next Steps

- Review and revise / remove from / add to list of operational scenarios
- Identify known issues affecting connected vehicles

SPaT/MAP Task Force

Task Force Composition

- SPaT/MAP Task Force (TF)
 - Co-Chairs
 - Michael Maile
 - Ray Starr, Minnesota DOT
 - SDO Support
 - AASHTO
 - Consultant Support
 - Patrick Chan, ConSysTec
 - Jay Parikh, CAMP
 - 51 Members on Roster

SPaT/MAP Task Force Purpose

- **Purpose.** Identify and address gaps, ambiguities, interoperability issues and the validity of the contents of the SPaT and MAP message.
- Make RLVW deployable and interoperable nationwide (as a minimum)
- **List of additional specific goals**
- **Minimum** SPaT and MAP data elements a vehicle should expect from a connected intersection

Relationship with Traffic Controller Task Force

- SPaT/MAP Task Force
 - Identify SPaT and MAP needs from the viewpoint of the vehicle
- Traffic Controller Issues Task Force (TF)
 - Address how the controller provides the needed data

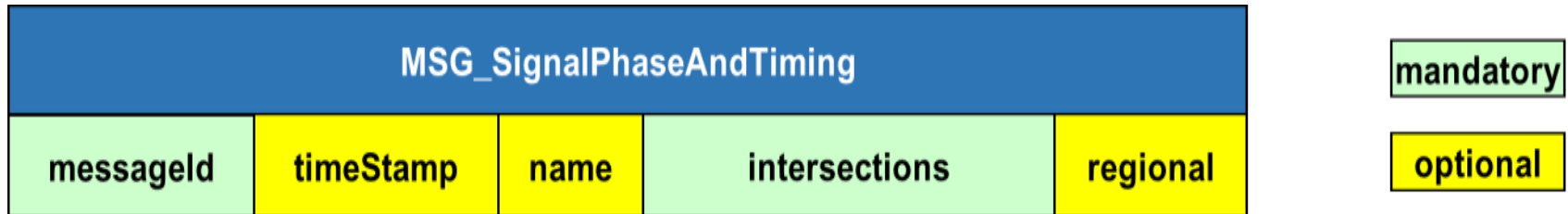
First Task Force Meeting July 16, 2020

- 39 Participants via web and phone
- Reviewed the contents of the SAE J2735 standard messages for SPaT and MAP
 - Noted mandatory versus optional items
 - Some discussion of need for optional items
- Reviewed previous ConOps and Requirements for RLVW for applicability to the task force effort
- Requested input from the task force members
 - Input on content and use of existing documents
 - Input on issues to focus on

Excerpts of Review of J2735 SPaT and MAP Messages

- SPaT Message
- MAP Message
- Thanks to Patrick Chan and the USDOT's ITS Professional Capacity Building Program for providing SPaT/MAP message slides
- Thanks to Michael Maile for presenting
- The following few slides are a taste of the review the task force carried out

SPaT Message



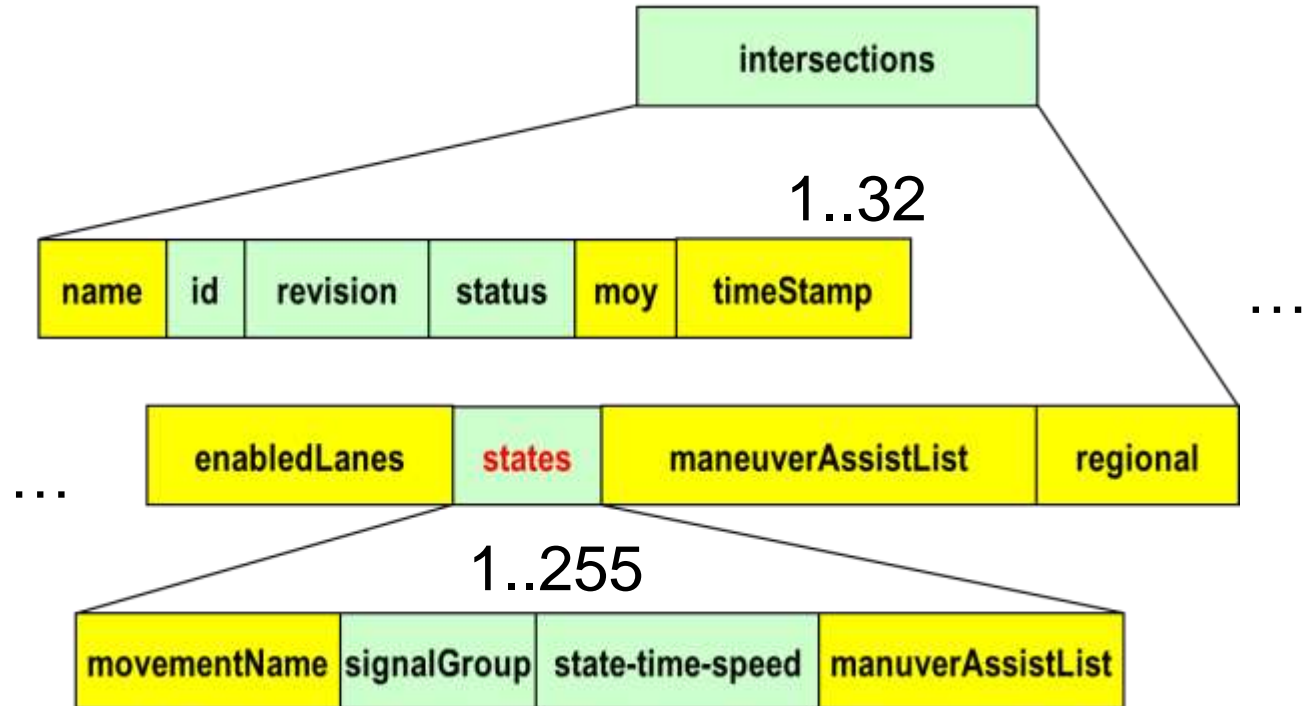
1..32

- **messageld.** DE_DSRCmsgID = 19
- **timeStamp.** Number of elapsed minutes in the year
- **name.** Name of the group of intersections for testing purposes
- **intersections.** Data for each intersection
- **regional.** Regional extensions

SPaT Message

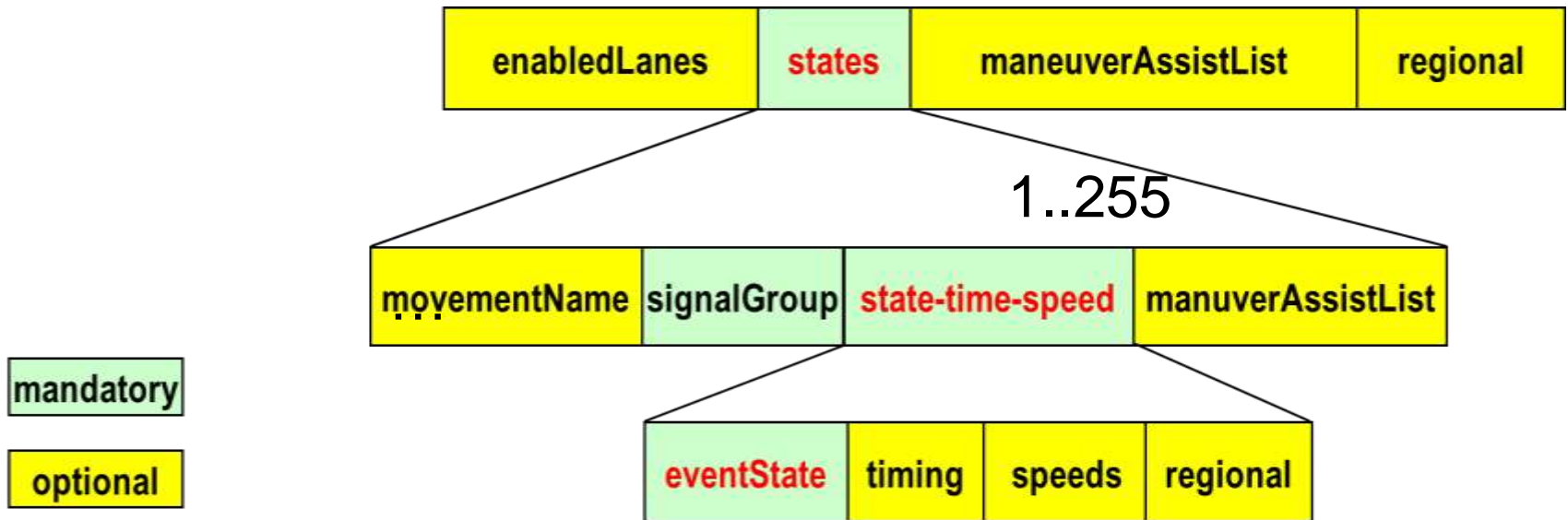
mandatory

optional



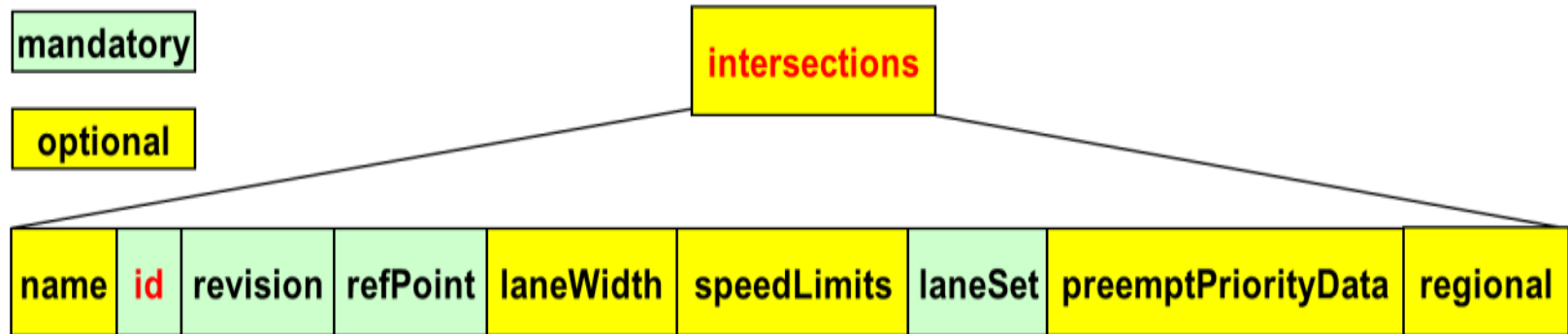
- **states** provide information for each movement at the intersection
- **signalGroup** is an identifier tying the SPaT data to a specific lane-to-lane movement in the **MAP** message

SPaT Message



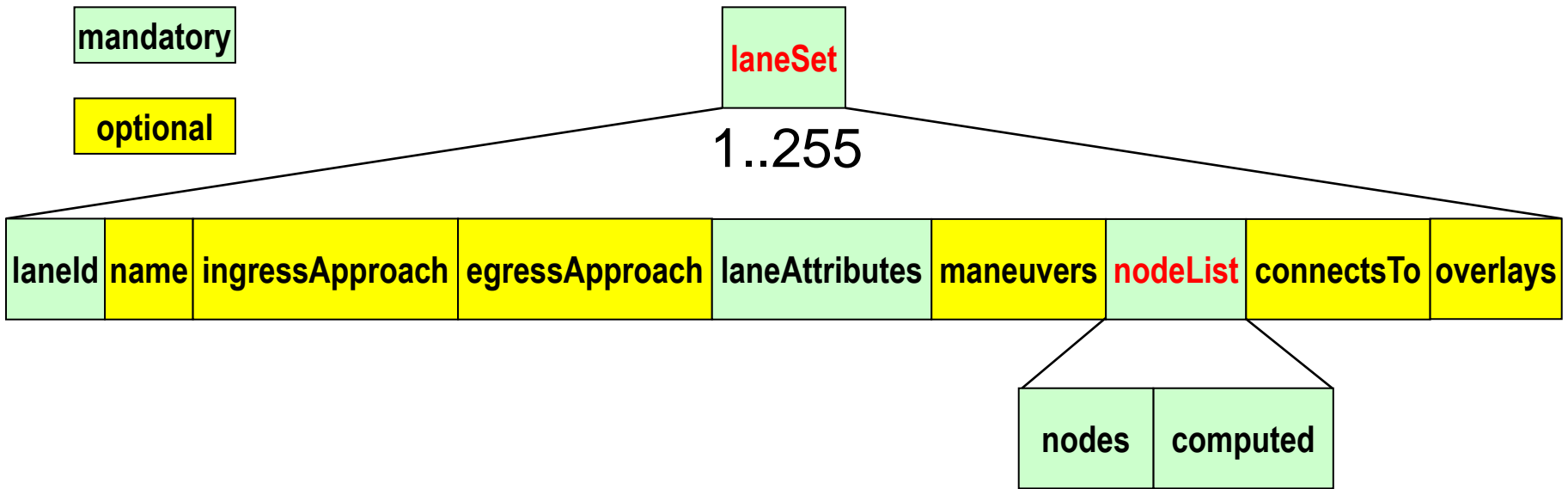
- **eventState.** Unavailable, dark (signal indication is dark), stop then proceed (e.g., flashing red, red turn on red), stop and remain, permissive movement, protected movement, permissive clearance, protected clearance, proceed with caution (e.g., flashing yellow)

MAP Message



- **id.** Identifier of the responsible agency (optional) + regionally unique identifier for the intersection
- **revision.** Message counter to indicate if the road geometry for the intersection has changed
- **refpoint.** Geographic reference (anchor) point for this intersection. Latitude-Longitude. Elevation is optional.
- **laneSet.** Data describing a lane

MAP Message



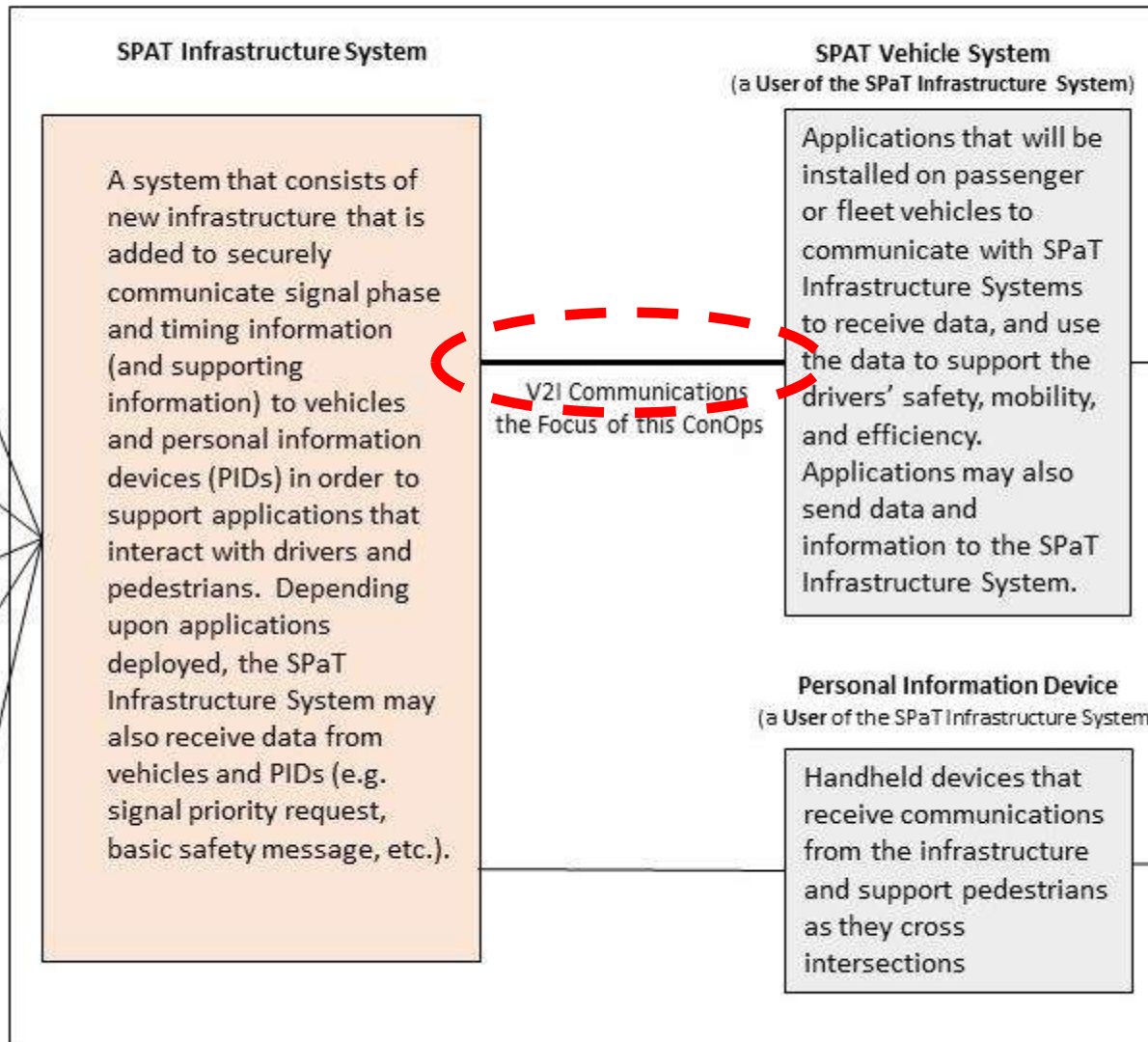
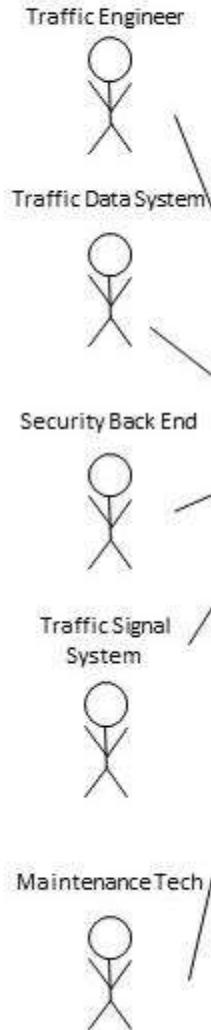
- **nodeList.** Sequence of signed offset node points representing the centerline of the lane. CHOICE of:
 - **nodes.** A sequence of 2 to 63 node points defining the centerline of the lane
 - **computed.** A lane that has similar (lane) attributes as another lane

Excerpts of Existing Documents

- SPaT V2I Interface ConOps
- SPaT V2I Interface Requirements
- The following few slides are a taste of the review that the task force carried out.

SPaT Enabled V2I CV System -- System Illustration

Users
(of the SPaT Infrastructure System)



Indirect Users
(of the SPaT Infrastructure System)



Example of ConOps Need Statement

3.8 Coverage

A SPaT Vehicle System needs the SPaT Infrastructure System to provide data far enough in advance of the intersection, with respect to both time and distance, so that the SPaT Vehicle System will be able to process the data by the time the applications require it.

Reference: SPaT Challenge Verification Document, 3.2.4 Mapping Requirements

Reference: Test Procedure 2.1.1 Node Points

Reference: CCIs, 2.2.1 SPaT message frequency of transmission

Reference: SPaT Data Needs, MAP Data Needs 1

Consideration of Additional Need Statements

5 Consideration of Additional Applications

This ConOps supports the RLVW application. Other applications that an IOO may want to implement at an intersection, and other applications that an OEM may want to implement within the vehicles, would entail additional needs. Other needs that may be considered for other applications that were intentionally omitted from this focused ConOps include:

- The need for state and timing information for pedestrian movements
- The need for speed limit information associated with the approaches to the intersection
- The need for information about when the next permitted state (green) will come up for the movement
- The need for information about queues at the intersection
- The need for an indication of detection of pedestrians and bicycles in the crosswalk

Example of Requirement Statement

2.3.14.1 Minimum End Time

The SPaT Infrastructure System shall provide the soonest time that the current interval could end in the absence of unpredictable events such as preemption or priority calls.

Need: ConOps 3.20 Time Change Details

NOTE: The soonest time that a traffic dependent green interval could end may be constrained by the minimum green time setting, pedestrian WALK and flashing DON'T WALK times, coordination holds or vehicle extensions.

2.3.14.2 Resting in Green

If a traffic dependent green interval could end immediately upon a conflicting detector call, the SPaT Infrastructure System shall identify the soonest time that the current interval could end as being one tenth of a second from the current time.

Need: ConOps 3.20 Time Change Details

Example of Message Design

3.2 SPaT Message

SPaT Data E		Applications:	J2735	RLVW
messageId=DE_DSRC_MessageID			M	M
timeStamp=DE_MinuteOfTheYear			O	M
intersections=DF_IntersectionStateList			M	M
id=DF_IntersectionReferenceID			M	M
region=DE_RoadRegulatorID			O	M
id=DE_IntersectionID			M	M
revision=DE_MsgCount			M	M
status=DE_IntersectionStatusObject			M	M
timeStamp=DE_Dsecond			O	M
enabledLanes=DF_EnabledLaneList			O	M
states=DF_MovementList			M	M
signalGroup=DE_SignalGroupID			M	M
state-time-speed=DF_MovementEventList			M	M
eventState=DE_MovementPhaseState			M	M
timing=DF_TimeChangeDetails			O	M
minEndTime=DE_TimeMark			M	M
maxEndTime=DE_TimeMark			O	M

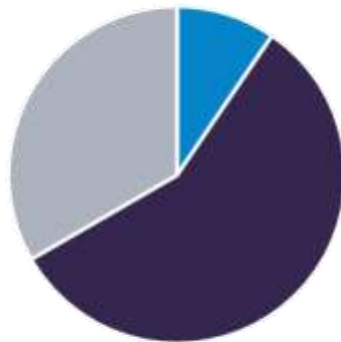
Solicited Input

- SPaT MAP List of Issues
- Use of Existing Document

Positioning Task Force

Positioning Task Force

- Purpose
 - Identify and address gaps, ambiguities and interoperability issues with positional accuracy
- 21 members



- Automotive Suppliers (2)
- Gov't, Associations and Support Consultants (12)
- System Integrators /A&E Consultants (7)

- Individual Motivations (round robin from meeting 1 of 2)
 - Leveraging expertise into recommendations and clarifications
 - Facilitating deployment by assuring interoperability

Weekly Meetings Until ConOps Completion

Monday 10- 11 am Pacific

- Two Starting Points in Identifying Gaps
 - Clarifications for Consistent Implementations (CCIs)
 - V2X Intersection Safety Experience (See CICAS Case Study)
- Likely CCIs of Interest
 - 2.1.5 Bonus: Channel utilization – DSRC deployments (Chair and Co-Chair volunteered due to familiarity with MCO)
 - 2.2.1 Time accuracy and synchronization (Requires interaction with SPaT/MAP TF)
 - 2.1.11 Inclusion of vehicle position correction data
 - 2.2.4 RLVW vehicle position correction data exchange clarification
 - 2.6.4 GNSS scenarios: Position with open skies, limited sky and when location correction are available (Requires interaction with Testing/Conformity TF)

CICAS Case Study

- Why corrections
- Vehicles approaching intersections with dedicated turn lanes with their own phase need to lane match themselves to the correct lane so that the correct phase and time information is processed
- This requires a combined map and positioning accuracy of less than 1/2 lane width at 95 percentile (needs to be higher for automated vehicles)
- This can be achieved with RTK GPS corrections
- Corrections would need to be generated locally (open for debate)
 - Local corrections take into account the local positioning environment

Positioning correction via GPSC

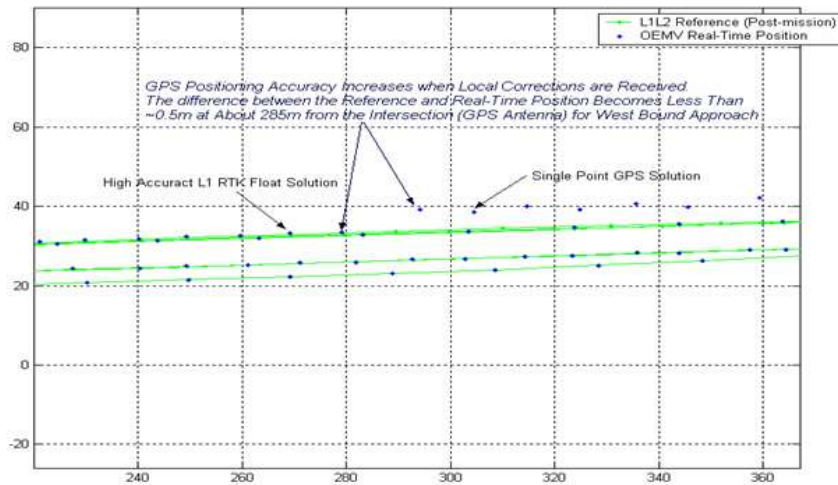
- Positioning correction sent out at 1 Hz
- Corrections generated locally with Novatel OEMV L1 receiver
- 3-4 epochs are needed to get to positioning accuracy of 30-50 cm
- Satellite coverage of the intersection is a factor
- Dual frequency receivers reduce the error to a few cm

Intersection coverage

- Overall, about 15 intersections were instrumented with GPS correction
- During the pilot FOT no false lane matching due to positioning error was detected, even with relatively simple lane matching algorithm
- L1 GPS receiver have an accuracy of at best 20 cm but 50 cm were stable after 4 epochs

Positioning correction

- Orchard Lake and 10 miles



Security Task Force

Security Task Force

- Purpose
 - Address gaps, ambiguities and interoperability issues with security across the V2X interface, including minimum requirements.
- Strategy
 - Broad scope in ConOps to capture feedback
 - Requirements may be narrower

Security Task Force Composition

- Co-Chairs
 - William Whyte (Qualcomm)
 - Jimmy Upton (INTEGRITY Security Services)
- SDO
 - NEMA, Alt: ITE
- SME Consultants
 - Wolfgang Buckel
 - William Whyte Team
 - Michaela Vanderveen
- 26 Members on Roster

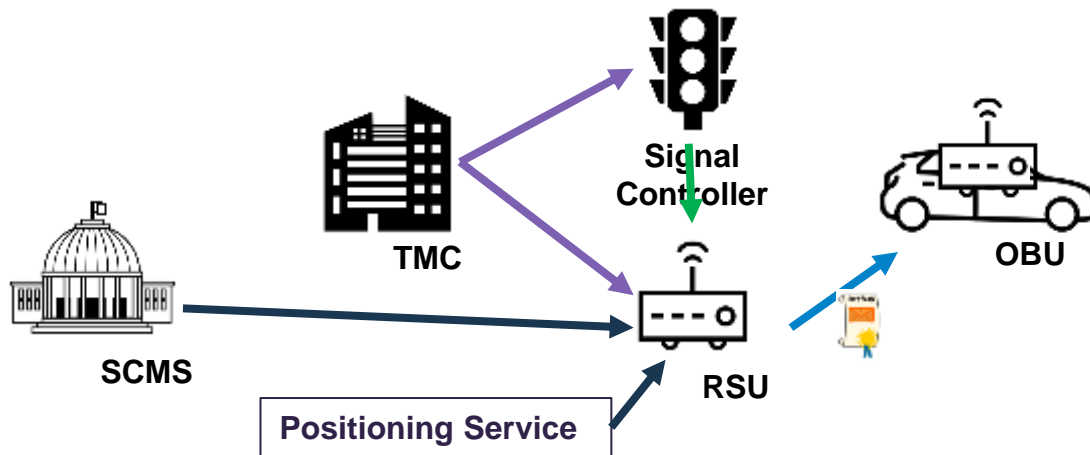
Security Task Force First Meeting July 16, 2020

- Reviewed questions to be asked of TF members
- Requested feedback from TF members for additional questions
- Identified that some feedback may be needed from outside the TF
- Weekly meetings until ConOps complete
 - Thursdays, 3pm Eastern

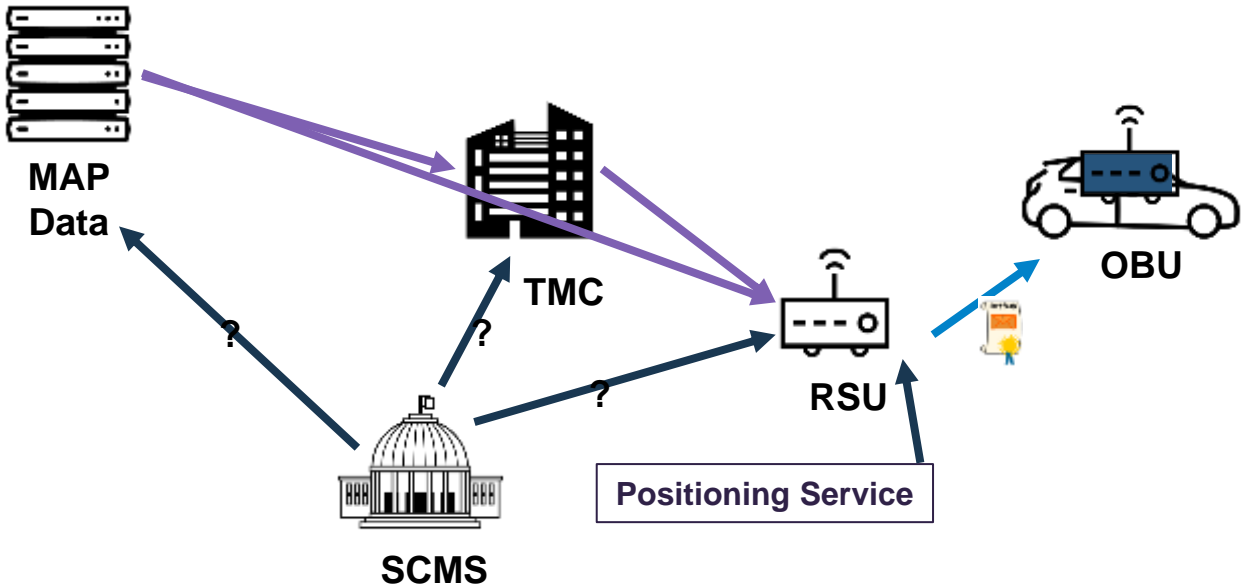
Framing question for Security TF

- How can we enable devices to create SPaTs and MAPs to a sufficiently high quality that OEMs will enable production vehicles to trust them?
- Implication: need to be clear not just about the I2V interface but about all interactions that affect trust across that interface
- Developing questions for stakeholders (within the taskforce and elsewhere) to understand current practice and gaps (gaps relative to RSU Standardization ConOps)
 - Deployment organizers
 - Device suppliers
 - SCMS operators

Simplified diagrams: SPAT



Simplified diagrams: MAP



Core areas for guidance (1)

– Interfaces for SPaT

- RSU-OBU
 - 1609.2 security profile, PSID, SSP, ...
- RSU-Signal Controller
 - How is this secured?
 - How do you manage persistence of the secure connection over power cycles? software upgrades? certificate expiry?
- RSU-TMC interface
 - How is the interface secured?
 - How do you manage persistence of the secure connection over power cycles? software upgrades? certificate expiry?
 - Is there admin access and how is it protected from abuse?
- Secure Positioning Information

– Interfaces for MAP

- 1609.2 security profile, PSID, SSP, ...
- Where are MAPs signed?
 - If MAPs are generated in one location and signed elsewhere, how do you ensure integrity?

Core areas for guidance (2)

- SCMS interactions
 - SCMS provider and certificate policy
 - Enrollment
 - Multiple root CAs
- Misbehavior and intrusion detection
 - How are incorrect / malicious messages detected and reported?
 - end users (“classic” MBD) / administrator-privilege field devices / network monitoring
- Revocation
- Physical security
 - CV Pilot Deployments hardware/software/OS security requirements doc
 - Software / configuration updates?
 - What requirements do you put on the (off-device, maybe off-site) keys that protect the updates?
 - Does the supplier have admin access?
 - If application is provided separately from the hardware, what integrity processes are in place?
 - Do you require security certification for the devices? Which organization(s) provides certification services?
 - Do you have processes in place for supply chain security to prevent tampering with devices between the manufacturer and the deployment site, and between storage and installation at the deployment site? What are they?
 - Do you have processes in place for detecting physical tampering with devices post installation? What are they?

Additional questions

- Do you have an incident response plan for cyberattacks that might affect SPaT / MAP operations? Please provide an overview.
- Do you have training for TMC staff who have logon access that might affect SPaT / MAP operations, to inform them how to use this access safely? Do you have written reference material? Please provide an overview of the guidance provided, if any.
- Do you have an audit or ongoing review process to ensure that cybersecurity best practices that might affect SPaT / MAP operations are adhered to? Please provide an overview.

Testing/Conformity Task Force

Meeting Agenda

1. Purpose
 - a. Situation
 - b. Need
 - c. Task
2. Current Experience of SPaT/MAP Messages
3. Message Testing
4. Related Documents / Issues and Needs
5. Meeting Cadence

Testing / Conformity Task Force

– Purpose

- Define test requirements and criteria for verifying conformity to the CI Implementation Guidance

– Co-Chairs

- Jay Parikh (CAMP)
- Christina Spindler (Wyoming DOT)

– SDO Support

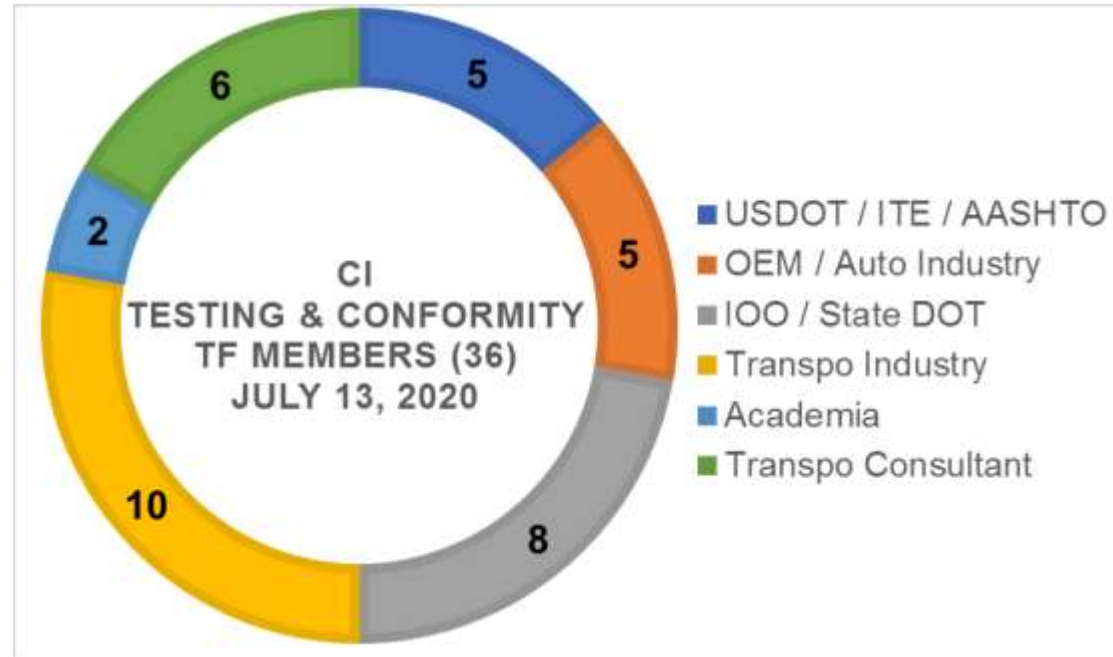
- Venkat Nallamothe (AASHTO)

– Consultant Support

- Manny Insignares (ConSysTec)
- Randy Roebuck (OmniAir)

T&C TF Composition

- As of July 13th, the TF consists of 36 members representing:
 - SDO
 - Automotive
 - State DOTs
 - Academia
 - Transportation industry / consultants
- Interaction with other TFs
 - SPaT/MAP
 - Controller Issues



T&C Task Force

- Situation: To implement safety and mobility applications based on connected traffic signal information, vehicle manufacturers need to be certain that the information via the Roadside Unit (RSU) is timely, accurate and nationally consistent (as per J2735 & J2945/x, NTCIP 12xx, NEMA TS-xx and other relevant standards)
- Need: To conform to the standards, test procedures are needed to ensure proper application implementation of each CI including ongoing operation and maintenance
- Task: Establish and refine performance guidelines and define test procedures for transmitted SPaT, MAP and RTCM messages that conform to proper format and contain accurate and unambiguous information to ensure in-vehicle RLVW application for national interoperability
 - Out of scope:
 - SCMS – Over arching need for all V2X application
 - Field equipment mounting, equipment performance and interface (assumed to be as per standards at the time of installation)
 - Communication range (technology dependent), certified at the time of installation ???
 - Wireless communication technology and protocols (DSRC, C-V2X PC5 mode, Cellular, Bluetooth, etc.)
 - Signal priority and pre-emption
 - Pre-deployment readiness test procedure???
 - Certification

Learnings from Field Installations

- Implementation inconsistencies, for example:
 - Non-conformance to J2735 spec
 - Different intersection id in SPaT & MAP message for the same intersection
 - Missing or incorrect data/status for required data elements
 - Missing map data of intersection lanes
 - Incorrect status set for “intersection status object” for Advanced Traffic Controller (ATC)
 - Mapped lanes and associated signal group in MAP message are out of phase by 90°
 - Time mark in SPaT does not correlate with ending of current phase
- Operation and maintenance
 - Ensure correct SPaT/MAP anytime RSU or Signal Controller configuration, s/w or firmware is updated
 - Ensure transmission of correct SPaT/MAP on ongoing basis
- Implementation variations due to local needs

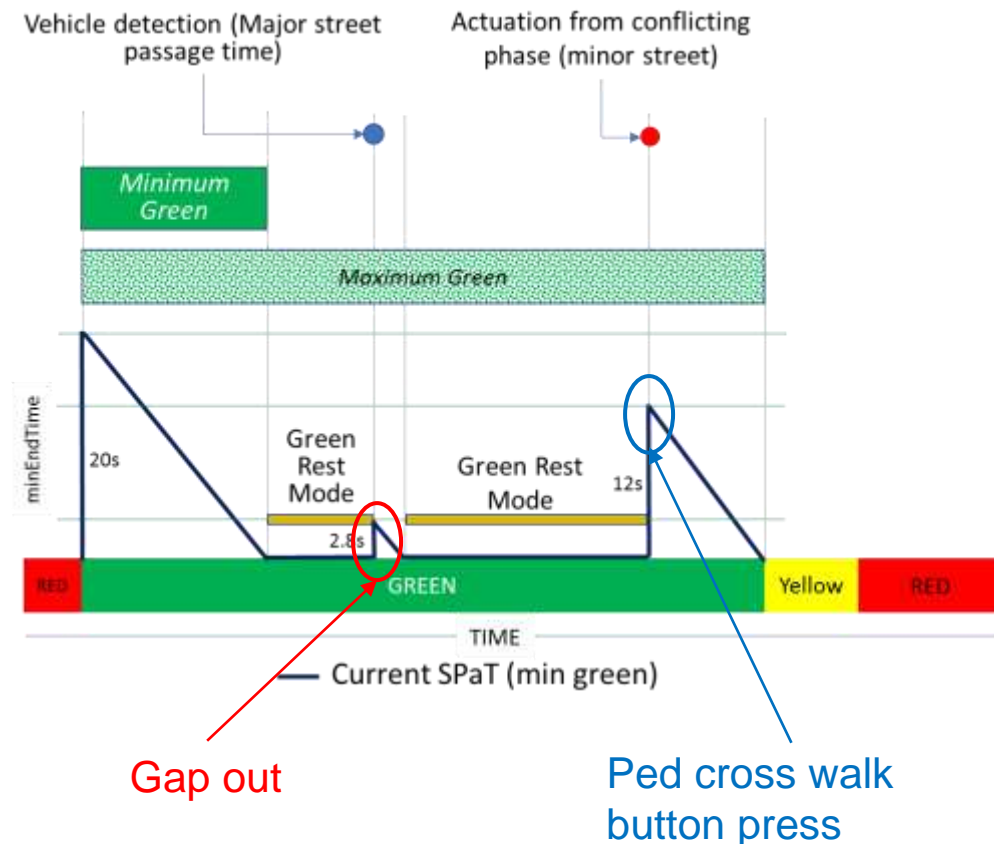
Example: SPaT Message - Actuated signal in Ann Arbor

Situation:

- At the end of *minEndTime* in SPaT, the green phase goes to “Rest Mode”
- In “Rest Mode”, when a vehicle is detected, *minEndTime* jumps to 2.8s for gap out (passage) time and then goes to 0.1s
- This continues until actuation from the cross street (ped cross walk button press)
- The *minEndTime* now jumps to a new value (12s)
- At the end of the new *minEndTime*, the green phase changes to yellow

Inconsistency:

- During “Green Rest Mode”, in SPaT, the phase and time are not correlated
- For actuated signal, *minEndTime* provides predicted time for phase change.
- Confirmed time for phase change is only after an actuation (e.g. Cross walk button press)
- The *maxEndTime* is optional in SPaT



T&C Task

- Establish and refine performance requirements for Red Light Violation Warning (RLVW)
- Test procedures to verify SPaT/MAP/RTCM messages for RLVW
 - Develop test scenarios and procedures (test cases) for:
 - Message level test and verification (from RSU)
 - Follow suggested guidelines in CCI for message
 - Confirm to J2735 specs
 - Confirm all required data elements are in the message
 - Verify correctness of data in the message
 - Application / Field level (Infrastructure to OBU)
 - Received messages in proper format
 - Determine vehicle position to correct lane (lane map accuracy, mapped lane length, placement of nodes on map, etc.)
 - Application (RLVW) requirements are met
 - Ongoing operation and maintenance

SPaT Message Testing

– Correctness of data elements –

- Verify data in message against what is produced by the signal controller:
 - Test signal phase and associated time remaining for:
 - Fixed timed intersection
 - Actuated intersection
 - » gap timeout,
 - » actuation through ped crosswalk button press
 - » actuation through vehicle
 - » Actuation through other modes ???
- Security profile regarding SSP
- Other

MAP/Position Correction Testing

– MAP Message:

- Correct association of signal grouping with mapped lanes
- Lane level map verification as required for the application
 - Map accuracy
 - Minimum length of mapped lane
 - Node representation in XY-Offset (CCI guideline)
 - Distance between nodes (straight vs. curved road segment)
 - For vehicle map matching for lane determination

– Position Correction (RTCM):

- Receive position correction message by the OBU as per J2735 standard
- Message frequency

Data Elements – SPaT Message

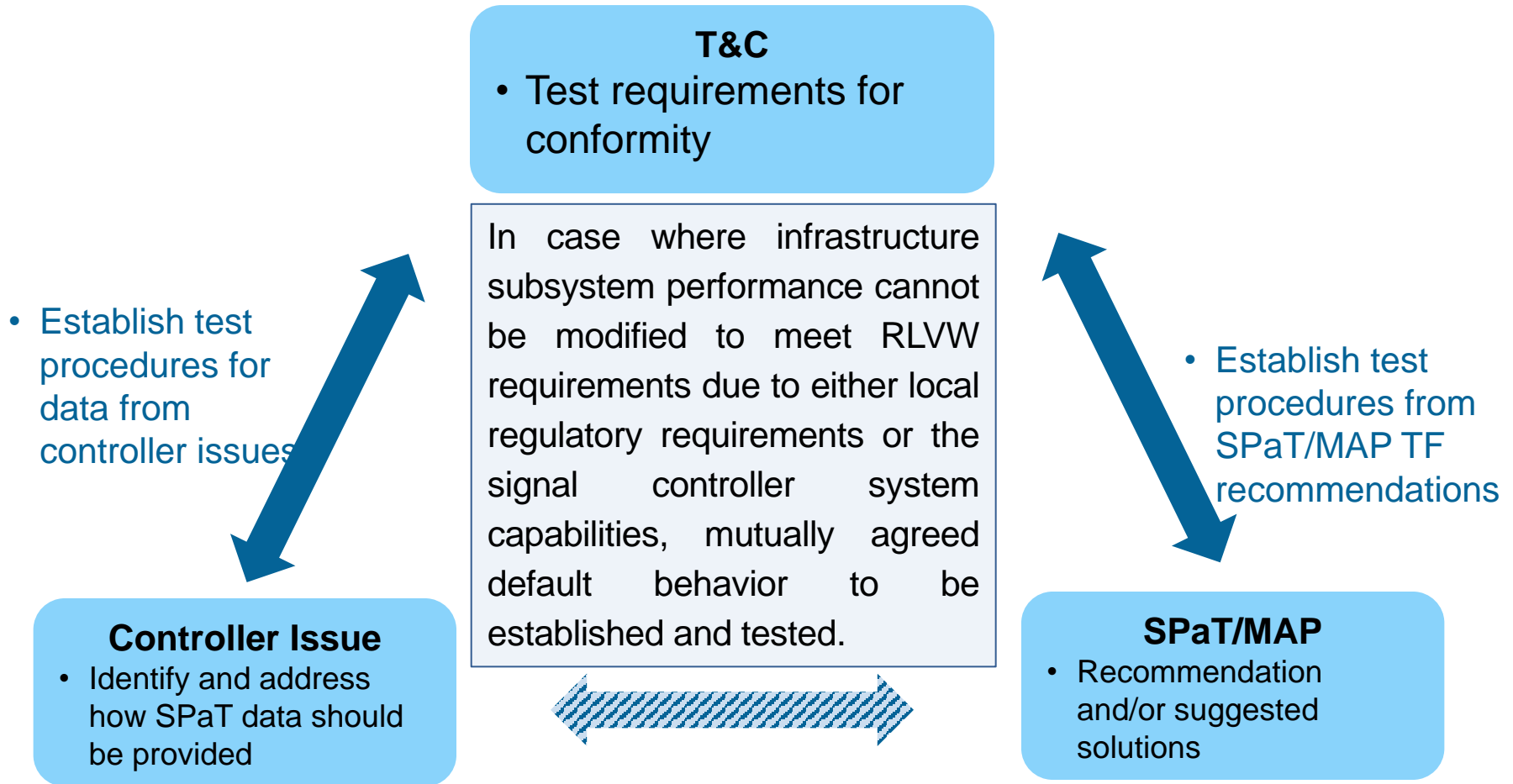
(SPaT Challenge Verification Doc)

	SPaT Message	SAE J2735 (201603)	RLVW Application	CCI Compliant (Y/N)
Spat Message Data	timestamp MinuteOfTheYear (DE)	Optional	Required	
	intersections IntersectionStateList (Sequence of IntersectionState) (DF)	Required	Required	
	IntersectionState (DF)			
	id IntersectionReferenceID (DE)	Required	Required	
	revision MsgCount (DE)	Required	Required	
	status IntersectionStatusObject (DE)	Required	Required	
	timeStamp Dsecond (DE)	Optional	Required	
	states MovementList (Sequence of MovementState) (DF)	Required	Required	
	MovementState (DF)			
	signalGroup SignalGroupID (DE)	Required	Required	
	state-time-speed MovementEventList (Sequence of MovementEvent) (DF)	Required	Required	
	MovementEvent (DF)			
	eventState MovementPhaseState (DE)	Required	Required	
	timing TimeChangeDetails (DF)	Optional	Required	
	minEndTime TimeMark (DE)	Required	Required	
	maxEndTime TimeMark (DE)	Optional	Optional	
likelyTime TimeMark (DE)	Optional	Optional		

Data Elements – MAP Message (SPaT Challenge Verification Doc)

	MAP Message	SAE J2735 (201603)	RLVW Application	CCI Compliant (Y/N)
MAP Message Data	msgIssueRevision MsgCount (DE)	Required	Required	
	intersections IntersectionGeometryList (Sequence of IntersectionGeometry) (DF)	Optional	Required	
	IntersectionGeometry (DF)			
	IntersectionReferenceID (DF) RoadRegulatorID (opt)+IntersectionID			
	id IntersectionID (DE)	Required	Required	
	revision MsgCount (DE)	Required	Required	
	refPoint Position3D-2 (DF)	Required	Required	
	lat Latitude (DE)	Required	Required	
	long Longitude (DE)	Required	Required	
	laneWidth LaneWidth (DE)	Optional	Required	
	LaneList (Sequence of GenericLane) (DF)	Required	Required	
	GenericLane (DF)			
	laneID LaneID (DE)	Required	Required	
	maneuvers AllowedManeuvers (DE)	Optional	Required	
	NodeList (DF)	Required	Required	
	nodes NodeSet (Sequence of Node) (DF)		Required	
	Node (DF)			
	delta NodeOffsetPointXY (DE)		Required	
	[Representation in Node-XY-32b (Offset-B16)] - accuracy 6 decimal place			
	connectsTo ConnectsToList (Sequence of Connection) (DF)	Optional	Required	
Connection (DF)				
connectingLane ConnectingLane (DF)	Required	Required		
lane LaneID (DE)	Required	Required		
maneuver AllowedManeuvers (DE)	Optional	Required		
signalGroup SignalGroupID (DE)	Optional	Required		

T&C Task Force Dependency



- GNSS: Positional accuracy test procedure – needs discussion
- Security (SCMS): Refer to CAMP SCMS CV Pilots Documentation

Related Documents

- Updated CCI Document:
 - Clarification for consistency
 - https://www.ite.org/ITEORG/assets/File/Standards/Updated%20Signalized%20Intersection%20CCI%20-%20June%202020%20ver%201_9_5%20-%20June%202020.pdf
- SPaT Challenge Verification –
 - [Required data elements for SPaT, MAP and RTCM](#)
 - <https://transportationops.org/content/spat-challenge-verification-document>

List of Issues

- Other user needs?
 - Write up a summary of the user need and forward to:
 - Jay Parikh – jparikh@campllc.org
 - Christina Spindler – christina.spindler@wyo.gov
 - Manny Insignares – manny.insignares@consystec.com
 - Randy Roebuck – Rdroebuck@omniair.org
- TF Meeting cadence
 - Tentative Schedule
 - Weekly, Fridays 1-2pm

Questions & Answer Session

Participation

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

Connected Vehicle Pooled Fund Study Presentation

Adjourn

– Thank you!