

Connected Intersections Requirements Walkthrough

The following are meeting minutes from meeting of the Connected Intersections (CI) Committee Functional Requirements (FR) walkthrough, scheduled for Monday December 7, 2020 – Thursday December 10, 2020 from 11:00 AM to 5:30 PM each day by web conference on Microsoft Teams.

The agenda and chatlog is provided at the end of these minutes, as well as the schedule followed.

All times in EST.

Roll Call of Committee

As indicated by X, the committee members in attendance were

Committee Members	Day 1	Day 2	Day 3	Day 4
Roy Goudy, Nissan (Co-Chair)	X	X	X	X
John Thai, City of Anaheim (co-chair)	X	X	X	X
Christina Spindler, Wyoming DOT	X	X	X	X
Doug Schimidt, Aptiv	X	X	X	X
Doug Tarico, Q-Free (alternate for Whitney Nottage)		X	X	X
Ed Seymour, TTI	X	X	X	
Faisal Saleem, MCDOT	X	X	X	
Jay Parikh, CAMP	X	X	X	X
Jesus Ruiz, McCain (Alternate for Mike Schagrin)	X	X	X	
Jim Misener, Qualcomm		X	X	
Justin McNew, JMC Rota	X	X	X	X
Michael Maile (Alternate for Mike Shulman)	X			
Mike Schagrin McCain	X	X		
Mike Stelts, Panasonic	X	X	X	X
Raj Ponnaluri, Florida DOT	X		X	
Ray Starr, Minnesota DOT	X	X	X	X
Steve Bowles, 360	X			X
Steve Sprouffske, Kapsch	X	X		X
Vivek Vijayakumar, GM	X	X	X	X
Whitney Nottage, Q-Free	X	X		
William Whyte, Qualcomm (Alternate for Jim Misener)	X	X	X	X

Also, in attendance were:

Attendees	Day 1	Day 2	Day 3	Day 4
Aaron Moore, OmniAir	X	X	X	X
AJ Lahiri, ConSysTec	X	X	X	X
Alan Clelland, Applied Information	X	X	X	
Alan Davis, GDOT	X	X	X	X
Amanda Hamm, VDOT	X	X		
Animesh Balse	X		X	X
Anthony Gasiorowski	X	X	X	X
April Wire, MCDOT	X	X		
Austin Averkamp		X		
Barry Einsig, Econolite	X	X	X	
Blaine Leonard, UDOT	X	X	X	X
Bob Rausch, TransCore	X	X		
Brian Reed	X			
Brian Simi, CT DRISI	X	X		
Chuck Felice (UDOT)		X	X	X
Dale Thompson (FHWA)	X	X		X
Danyang Tian, Honda	X	X	X	X
David Benevelli, TransCore	X	X	X	X
Dean Deeter, Athey Creek	X	X	X	
Drew Van Duren, Qualcomm	X	X	X	X
Dustin Devoe	X			
Ed Fok, FHWA		X	X	X
Ehsan Moradi Pari	X			
Eric Raamot, Econolite	X			
Geoff Knapp	X		X	
Hassan Charara	X	X		
Hassen Alwalie	X	X	X	
Harsh Vipat				X
Haydar Issa	X		X	X
Iouri Nemirovski	X			X
Ivan Vukovic		X		
Jean Johnson, NEMA	X	X	X	X
Jeremy Schroeder				X
Jim Alfred, Blackberry	X		X	
Jimmy Upton, ISS	X	X	X	X
Jingtao Ma, Traffic Technology Services	X	X		
Joachim Taiber				X
John Kenney, TNA	X	X	X	
Julie Evans	X	X		
Justin Anderson, Noblis	X	X	X	X

Kellen Shain, Noblis	X		X	X
Ken Yang, AECOM	X	X		
Kevin Balke, TTI	X			
Kevin Chan, Minnesota DOT	X			
Kevin Vitta, ITS America	X	X	X	X
Kezhen Shen	X		X	
Kingsley Azubike, FHWA	X			X
Krishna Bandi		X		
Linda Narla, Noblis	X	X	X	X
Manny Insignares, ConSysTec	X	X	X	X
Masoud Motamedi, JMC Rota		X	X	X
Mateusz Malinowski	X	X	X	
Matt D'Angelo, Gresham Smith	X	X	X	X
Michael Lockerman	X	X	X	X
Michael McNett	X			
Michaela Vanderveen, Still Water	X	X	X	
Mohammad Hadi, FIU	X	X	X	
Nicholas Hegemier	X	X		
Nicola Tavares, ITE	X	X	X	X
Oliver Maillet Glas		X	X	X
Patrick Chan, ConSysTec	X	X	X	X
Paul Avery			X	
Peter Jager, UDOT	X	X	X	X
Purser Sturgeon (SwRI)		X		
Ralph Boaz, Pillar Consulting	X	X	X	X
Randy Roebuck, OmniAir	X	X	X	X
Rich Deering, CAMP	X	X	X	X
Robert Saylor, City of Plano	X	X	X	X
Sathyanarayana Palakonda		X	X	
Shah Husssain	X			X
Shahram Rezaei		X		
Shane Zumpf	X	X		
Siva Narla	X	X	X	X
Steve Sill (USDOT)	X			
Suzanne Murtha	X	X	X	
Tony Ahmad	X			
Venkat Nallamothu, AASHTO	X	X		X
Walton Fehr, Volpe	X	X	X	X
Wolfgang Buckel			X	X

Day 1

Meeting began at 11:05 AM.

Siva Narla reviewed ITE's anti-trust guidelines.

Roll Call of Committee took place. A quorum was present.

Roy Goudy went over the Meeting Logistics and Purpose.

Roy Goudy went over Project Status.

Discussed Walkthrough Process

Roy Goudy went over Meeting Rules.

Patrick Chan went over walkthrough Roles and Responsibilities.

Patrick Chan discussed the walkthrough entry inputs (what everyone is beginning walkthrough with).

Patrick Chan went over the criteria for expected well-written user needs and requirements.

Patrick Chan went over how what procedures will be followed during walkthrough.

Patrick Chan discussed the walkthrough exit outputs (what is expected to be completed by end of walkthrough).

Walkthrough of Draft Functional Requirements Document

- 3.3.1.1 IEEE 802.11 (DSRC)
 - Need to limit to channels 180, 182, and 184 due to FCC Ruling. Exclude 172, 174, 176, 178.
- 3.3.1.2 3GPP PC5 Mode 4 (Release 14 or 15 (C-V2X))
 - Need to specify channel 183.

Walkthrough of TSC-RSU Requirements

- 3.3.2.1.1 NTCIP 1202 v03 SPaT Information
 - Use term TSC infrastructure where applicable. Term TSC is too specific.
 - O.2 (1..*) means at least one requirement in the group must be selected (more than one is allowed).
- 3.3.2.1.2 V2I Hub ICD SPaT Information
 - Need to add third optional requirement for controller sending SPaT message complementing 3.3.2.1.1 and 3.3.2.1.2
 - Controller needs to know that the SPaT/MAP is in sync
- 3.3.2.1.4 SPaT Transmission Rate Tolerance
 - Need to consider external control latency impact
- 3.3.2.1.5 SPaT Update Latency
 - **Action:** Manny, Randy, and Ralph to discuss how to test
- 3.3.2.1.6 Controller Processing Latency
 - **Action:** Manny, Randy, and Ralph to discuss how to test
- 2.4.2.2 Provide Signal Timing Status to an RSU
 - Does not apply if the TSC Infrastructure is generating the J2735 SPaT message

- Requirements for this need apply to UPER encoded SPaT, NTCIP 1202, and TSCBM.
 - **Action:** Ralph to confirm these provided in TSCBM
- 3.3.2.2.1 Manual Control Indication
 - Need to expand the definitions into NTCIP 1202 during the design phase.
 - SPaT Information message needs clear definition
- 3.3.2.2.7
 - Pre-timed. Will spell out during the design phase.
- 2.4.2.3 Provide Assured Green Time to an RSU
 - **Action:** Ralph to review need language

Walkthrough of SPaT Requirements

- 3.3.3.1.2.1 Accuracy - SPaT Message
 - **Action:** Manny and Randy to discuss
- 3.3.3.3.5.2 Unknown Time Change Detail
 - Testing needs to allow deviation for Timemark using 2016 version
- 3.3.3.3.5.8 Unknown Maximum End Time
 - Testing needs to allow deviation for Timemark using 2016 version
 - **Action:** Randy to review vendor self-declaration for leap second
- 3.3.3.1.5.2 Advanced Notification – Time
 - **Action:** Patrick to reconcile the differences between this requirement and the RLVW application requirements
- 2.4.3.1.3 Robustness
 - **Action:** SPaT/MAP Task Force to review robustness requirements for MAP messages
- 3.3.3.1.7.4 SPaT Quality Assurance
 - May not be feasible to fully test
 - Assumption: for Testing: not testing edge cases.
- 3.3.3.3.2.14 No SPaT Available
 - Reference noValidSPaTIsAvailable
- 3.3.3.2.2.1 SPaT - Revision Counter Increment
 - For a rest in green, the SPaT revision counter may increment every tenth of a second
- 3.3.3.2.3.1 SPaT - Message Time Stamp
 - There is a timestamp in the IEEE 1609.2 header that would make it unambiguous.
- 3.3.3.2.3.3 MAP Message Time Stamp
 - Delete. Not needed
- 3.3.3.3.2.7 Traffic Dependent Mode
 - **Action:** Need to review
- 3.3.3.3.2.9 Failure Mode
 - **Action:** Ralph to find corresponding requirement for the TSC-RSU interface.
- 3.3.3.3.2.11, 3.3.3.3.2.12, 3.3.3.3.2.13
 - **Action:** Patrick to review requirements not needed by RLVW application
 - Term Recent is not defined. Not needed if revision counter is used.
- 3.3.3.3.3.3 Flashing Yellow Arrow Permissive Movement
 - Can't distinguish between permissive and protected in TSCBM. May need to configure the RSU to distinguish between them

- Review in design phase
- 3.3.3.3.7 No Conflict Causes Protected
 - Need examples such as bicycle movement noted.
- 3.3.3.3.5.7 Maximum End Time
 - Need to add requirement the max end time for the NEXT state.
 - **Action:** Ralph to review

Adjourned 5:30 PM

Day 2

Reconvened 11:07 AM

Siva Nara reviewed ITE Anti-Trust Guidance

Roll Call of Committee. A quorum was present.

Patrick Chan reviewed Walkthrough procedures.

Walkthrough of Positioning Requirements

- 3.3.3.5.1 Positioning Corrections
 - Use term RTCM corrections in place of RTK
 - The station should support both 1005 and 1006, the design will indicate which one.
- 3.3.3.5.2.1 RSU Proximity
 - RSU should broadcast a calculated RTK if it is far from a surveyed reference station
 - **Action:** provide guidance on how close the station should be to the RSU in the design phase
- 3.3.3.1.1.9 RTCM - SAE J2735
 - Lacking explicit requirement that a vehicle needs lane level accuracy
 - **Action:** Positioning Task Force to review
- 3.3.3.1.1.12 RTCM PSID
 - **Action:** Positioning Task Force to look at which PSID to use for RTK
- 3.3.3.1.6.4 RTCM Messages - Broadcast Frequency
 - Delete. Redundant with 3.3.3.5.2.2.
- 3.3.3.2.2.7 RTCM Message - Revision Counter Increment
 - **Action:** Positioning Task Force to provide guidance when the revision counter (MsgCount) for MSG_RTCMcorrections should be incremented.

Complete walkthrough of SPaT Requirements

- 3.3.3.3.6.1 Provide Assured Green Time
 - **Action:** Ralph to provide formal definition for AGT
 - there are also some conditionals for AGT. Need to specify those conditions because AGT is not always needed.
 - **Action:** Ralph to document the calculations for the AGT in the Annex
- 3.3.3.3.6.2, 3.3.3.3.6.3, 3.3.3.3.6.4
 - Delete
- 2.4.3.3.7 Confidence Factor
 - Mark for potential move to parking lot after design.

- **Action:** Patrick to write testable requirement
- 3.3.3.3.8.1 Time of Next Green
 - **Action:** Traffic Controller Task Force to review
- 3.3.3.3.8.2 Confidence Factor - Time of Next Green
 - Delete

Walkthrough of MAP Requirements

- 3.3.3.4.1.3 Intersection Geometry - Intersection Identifier
 - SPaT and MAP intersection id has to match
- 3.3.3.4.1.4.1, 3.3.3.4.1.4.2, 3.3.3.4.1.4.3
 - Merge into one requirement, listing options
 - Add the reference point should be a surveyed point e.g., light pole, and not an imaginary point at the center of the intersection. Note: the MAP tool has the center of the intersection and a surveyed point
- 3.3.3.4.1.7 Center of Vehicle Lane Geometry
 - Add requirement- max is 63 node points
- 3.3.3.4.1.12 First Node - Egress Vehicle Lane
 - **Action:** Check the MAP tool, can it support all the requirements for testing purposes.
- 3.3.3.4.1.17 Advanced Notification - Ingress Vehicle Lane
 - **Action:** Review RLWW
 - 85% of the 7 mph above the speed limit
 - add requirement not to extend into another upstream intersection
 - Discuss design phases
- 3.3.3.4.1.20 Maximum Distance between Nodes
 - Need to reword
 - **Action:** See if trajectory difference should be smaller because node accuracy requirement is 0.2 meters
 - **Action:** Weigh against transport message size. Verify there is a requirement for this.
- 3.3.3.4.1.22 Node Accuracy
 - **Action:** SPaT/MAP Task Force to reword
 - Needs to describe the process in the design.
 - May need a reference to open skies.
 - Discussed methods - map companies for AV, aerial photography
 - Each node can be surveyed may and needs to be certified within 0.2 meters
- 2.4.3.1.5 Advanced Notification
 - Need to add requirement for 327.56 meters for nodes away for the MAP
- 3.3.3.4.3 Lane Maneuvers
 - Need to specify data element
- 3.3.3.4.4.4 Connection Maneuvers
 - Need to specify data element
- 3.3.3.4.4.5 Connection Signal Group
 - Add to parking lot. How does TSCBM handle mapping to signal groups
- 3.3.3.4.5.2 Node Speed Limit
 - **Action:** Check if this value applies to all succeeding nodes

- 3.3.3.4.7.1 Matching Intersection Reference Identifier
 - Need to update for versioning
 - Need the SPaT and MAP for an intersection to correspond to each other
 - David Benevelli asked there is internal way to verify
 - **Action:** Patrick to review general requirements for versioning.
- 3.3.3.1.4.1.2 Computed Lanes
 - Need requirements added for X and Y offsets
 - Need guidance on what's positive and what's the reference lane
 - Need to consider if computed lanes minimize message size during design
- 3.3.3.1.6.3 MAP Messages – Broadcast
 - **Action:** SPaT/MAP Task Force to define broadcast period
- 3.3.3.1.7.5 MAP Quality Assurance
 - Potentially delete
 - Need to discuss how this requirement would be verified
- 3.3.3.1.7.7 MAP Revisions
 - Moved to Parking Lot. Needs to be addressed in design
- 2.6.2.5
 - New operational scenario needed for outside knowledge of the controller.
- B.1
 - SAE add recommendation to provide a mechanism to send a bigger map message than what will fit in the WSM protocol, perhaps by sending the message in multiple parts.

Adjourned 5:35 PM

Day 3

Reconvened at 11:05 AM

Siva Nara reviewed ITE Anti-Trust Guidance.

Roll Call of Committee. A quorum was present.

Patrick Chan reviewed walkthrough process and criteria

Resumed walking through testing and conformity needs

- 3.4.1.6 Test Anomaly Requirements
 - Manny mentioned that reports need to have enough information to address
- 2.8.6 Test Cases
 - This need is mandatory
- 2.8.9 Identify Existing Test Documentation
 - Compiled documents may be published on ITE website as decided by the chairs
 - **Action:** Randy and Manny to review what can be public and add the URLs to the documents, minimally in Teams
 - **Action:** Talk with IOOs about their process for testing and their lessons learned
- 2.8.10 Identify Existing Test Tools
 - **Action:** Randy and Manny to review datasheets for the test tools and provide the URLs.
 - **Action:** Randy and Manny to work with other task forces on how/what requirements to test.

- 2.8.11 Configuration and Change Management Needs
 - Needs Requirement

Break 12:35 to 2:30 PM

Security Requirements

- 3.3.4.1.3 MAP Data Trustworthiness
 - **Action:** Revise Figure 4 to remove arrow from MAP data server and the RSU.
 - Add requirement for position corrections trustworthiness
- 3.3.4.1.4 Protection of Mechanisms for Data Worthiness
 - People asked for requirements to not be written in negative tense (replaced cannot be subverted with protected from subversion)
- 3.3.4.3.3 Point of Certification
 - Potential parking lot after design
- 3.3.4.4.3 CI Operation Security Standards
 - **Action:** Security Task Force to revise.
 - May be resolved during the design
 - Addresses non-SCMS certificates. TLS/internal certificates like its own keys.
- 3.3.4.6.2 Interface between RSU and SCMS
 - **Action:** Security Task Force to update to reference RSU Standard
- 3.3.4.6.1.2.1 TLS Authentication
 - Questionable whether SNMPv3 can work with TLS v1.3. It may not
- 3.3.4.6.4.1 Use of Secure Transport Protocol
 - Design will specify details of TLS for interoperability and interchangeability
- 3.3.4.6.4.2 Use of TLS protocol
 - Will not use VPN
 - NTCIP 1218 references TLS v1.2 because v1.3 was not available at the time
- 3.3.4.6.7 Interface between MAP Server and the SCMS
 - Generation time is the time the MAP message is signed
 - **Action:** Describe potential scenarios for security that fulfills the requirements
- 3.3.4.7.1.1 RSU Protection
 - Connection should not be blocked permanently. Needs a timeout. Clarify during design.
- 3.3.4.7.2.1 Secure RSU Administration User Interface
 - Reference RSU Standard v1.0
- 3.3.4.7.3 RSU Device Class Requirement
 - Need to define Class 3
 - Ed Fok mentioned danger of class definition conflicting with definition from ARC-IT.
 - **Action:** Review to make sure CAMP definition does not conflict with ARC-IT definition
- 2.4.4.1.6 Resilience
 - Trace cyberattacks recovery to this need
- ECS (External Control System) component Software and Firmware Updates
 - Requirement should be specified. Otherwise, vendor may ignore
 - **Action:** Michaela, Ralph, Wolfgang, Ray Starr to review
- 3.3.4.7.4.3

- **Action.** Security Task Force compare with ECS component Software and Firmware Updates requirement

Adjourned 5:30 PM

Day 4

Reconvened at 12:05 PM

Roy Goudy went over ITE Anti-Trust Guidance.

Roll Call of Committee. A quorum was present.

Patrick Chan summarized progress to date.

Resumed with Security Requirements

- 3.3.4.6.1.1.1, 3.3.4.6.1.1.2
 - **Action.** Security Task Force compare with ECS component Software and Firmware Updates requirement
 - RSU Standard requires SNMPv3 (via NTCIP 1218).
 - REST API is not 1609.2.1 or OmniAir test REST API.
- 3.3.4.6.3 Interface between an RSU and the OBU/MU
 - Point to RSU standard requirement 16.09.2
 - RSU is exit point and will not broadcast message not signed even with timestamp in header
 - if the RTCM, MAP and SPaT are generated elsewhere, those messages may be signed at the source.
 - **Action:** Patrick and Security Task Force to review
- 3.3.4.7.2.7 Operational Logging
 - Add a requirement on Logging for General and Security purposes from the RSU Standard v01.
 - Add a requirement on the TMS to provide similar logging requirements
 - **Action:** Ralph to review new requirements when written
 - **Action:** Security Task Force to discuss Security for an IOO
- 3.3.4.9.2.1 Monitor Certificate Status
 - Need to point to RSU Standard for the allow-list
- 3.3.4.9.3.2 Download SCMS Files
 - It was noted that the current scope of work (according to the context diagram) did not include analyzing security of data (such as BSMs) coming from OBUs/MUs, so no security analysis was performed for that data flow. However, AGT may require BSMs. This discussion was tabled to the co-chairs meeting on Friday.
 - **Action:** Task Force to review performance concern of undue burden on the RSU to check the validity of all the BSMs.
 - **Action:** Randy to update test tools to handle CRLs.
 - **Action:** Security Task Force discuss specifying why we need the CRL - to verify the BSMs, for assured green time (AGT).

Went over next steps.

New Requirements Draft expected 12/24.

Adjourned 1:54 PM.

Meeting Agenda

- 1. Call to Order**
- 2. Anti-Trust Guidelines & Logistics**
- 3. Introductions of Committee Members**
- 4. Purpose**
- 5. Project Status**
- 6. Review of the Walkthrough Process**
- 7. Walkthrough – Functional Requirements**
- 8. Next Steps**

Requirements Walkthrough Schedule

- Monday, December 7:
 - Traffic Controller Issues Requirements.
 - SPaT/MAP Requirements. Mostly general message requirements and SPaT Message Requirements
- Tuesday, December 8:
 - Positioning Requirements.
 - SPaT/MAP Requirements. Finish SPaT, then MAP Requirements
- Wednesday, December 9:
 - Testing/Conformity Requirements.
 - Security Requirements (starting 2:30 PM)
- Thursday, December 10:
 - Finish Security Requirements

Chat Log

Day 1

[12:37 PM] Johnson, Jean (Guest)

FYI, MSTeams (as of last week) now includes raised hands in the order that hands were raised. Meaning that the "first" hand raised is on top of participants list, the "second" hand raised is next, etc.

[1:28 PM] Johnson, Jean (Guest)

At 3.3.2.2.X, phrase "in a SPaT information" does not make 'good english.'" Either in a SPaT message, or 'provide SPaT information.' Please be consistent throughout, as well.

[1:31 PM] John Thai (Guest)

Can we say "in a SPaT message from X to Y?"

[1:48 PM] Grand (Guest)

At 2.4.2.3, what if the TSC infrastructure is running fully actuated signal?

[2:22 PM] Johnson, Jean (Guest)

Thank you for indulging me on 3.3.3.1.1.1.X.. I am now not confused, but I had to use each of my available brain cells. It hurt my head. 😊

like 1

[3:14 PM] Spindler, Christina (Guest)

Statutory is the legal speed limit unless otherwise posted.

Day 2

[3:47 PM] Ralph Boaz (Guest)

AWEG was a term that was used as the RLVW concept was being developed (as far as the controllers were concerned). However, it is not suitable to send to vehicles. AGT is appropriate and works with the current SPaT fields. The vehicle can use the AGT and assured yellow interval (yellow intervals are generally assured already) to determine if, given the vehicle's current speed, trajectory, etc., that it can stop before or clear the intersection before the signal turns red.

[3:51 PM] Ralph Boaz (Guest)

Assured time is $\text{minTime} = \text{MaxTime}$.

Day 3

11:11 AM] Nicola Tavares

Hi my email is ntavares@ite.org or send to standards@ite.org

[11:25 AM] Nicola Tavares

For notetaking, please identify yourself when making comments thanks

[11:45 AM] Johnson, Jean (Guest)

At Conformance Summary, I don't think you are indicating whether the Connected Intersection is conformant, but rather the Device Under Test or the feature.

[12:00 PM] Johnson, Jean (Guest)

Annex C.2 needs URL for acquisition of Docs Etc. Jean

[12:07 PM] Johnson, Jean (Guest)

Same comment about Interface/Test Tool table. In this one, provide the URL. JJ

[12:26 PM] Johnson, Jean (Guest)

Can TPG provide a identify "critical" or necessary items to test, or, put another way, minimize the amount of testing needed? JJ

[12:27 PM] Patrick.Chan (Guest)

TPG can't do that.

[12:36 PM] Nicola Tavares

Meeting will resume at 2:30PM Eastern

[2:58 PM] Johnson, Jean (Guest)

Figure 4 in 1.02h still contains the Map server to RSU interface. Please remove it from the figure. JJ

like 1

[3:27 PM] Ralph Boaz (Guest)

Johnson, Jean Thanks for the insight on the hands. Thought it was a bug running through Teams. MS Teams - You can get confused every day...

[3:28 PM] Johnson, Jean (Guest)

Ralph Boaz Yes, it is a Microsoft product, and the coding gnomes are always active.

[3:30 PM] Spindler, Christina (Guest)

There are other means of securing a cabinet outside of the keys, including options that track door opens.

Please feel free to share this with the CI Group

<https://local.iteris.com/arc-it/html/security/deviceclasses.html>

Edward Fok

Day 4

Michaela Vanderveen: Really liked what you said about thinking of the RSU and TSC as a unit as far as security is concerned. Really helps conceptually. TY