CAT Coalition Technical Resources Working Group Quarterly Meeting

May 12, 2021

11:00-12:30 (Eastern)

Agenda

11:00-11:05	Welcome and Introductions, Outreach and Knowledge Transfer
11:05-11:10	Resources Recap
11:10-11:20	Partner Reports (USDOT, ITS America, ITE, Other Partners)
~~11:20-11:30~~	~~IOO/OEM Forum RSZW Working Group Update~~
11:30-11:45	Update on USDOT/ITE Connected Intersections Effort
11:45-12:05	New Resource: CI Consistent Procedures for Operations
12:05-12:25	New Resource: Practical Considerations for Deployers of V2X Roadside Equipment in Light of the Recent FCC Ruling
12:25	WG Meeting Schedule, Member Updates, Closing

Ongoing Commitment to Outreach & Knowledge Transfer

- Suggestions from WG Members on Ways to Enhance Impact:
  - Proposed new WG Members
  - Communications with/involvement in other initiatives
  - Knowledge resources to include on CAT Coalition website
    - ❖SPaT deployment, related to the full V diagram
    - ❖OBU deployment documentation for Connected Fleet Challenge
    - ❖Cybersecurity and network security resources
    - ❖New or planned SPaT deployments, or updates

Resources WG Recap

Jeremy Schroeder, Athey Creek

Resources WG Recap

- Proposed new resource to support agencies transition from DSRC to C-V2X given FCC announcement

- C-V2X update on standards currently available and under development, and related efforts

- Update on RSU Standard Development Efforts

- ITS America overview of Mobility as a Service and Mobility on Demand

Presentations and notes posted on Resources WG website:

https://transportationops.org/CATCoalition/technical_resources_WG

Partner Reports from **USDOT**, **ITSA**, **ITE**

Update on USDOT/ITE Connected Intersections Effort

Siva Narla, ITE

New Resource:
CI Consistent Procedures for Operations

Jeremy Schroeder, Athey Creek

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Need & Purpose of Resource

- Identifies and begins to clarify approaches to operations and disruption scenarios that will regularly or periodically occur with fully operational Connected Intersections (CIs)
  - Short- or long-term maintenance, road work, or closures, power outages, etc.
  - Conflict monitoring is critical to signal operations; an equivalent approach for Connected Intersections is also needed

- Identifies need for ongoing activities as Connected Intersections are deployed and operated
  - Does not identify or prescribe roles
  - Builds on USDOT/ITE Connected Intersections and RSU Standardization efforts

- Identifies situations and considerations for when operational decisions are needed

Resource Status

- Initial draft developed and reviewed by the IOO/OEM Forum SPaT/RLVW Working Group
- Posted to the CAT Coalition website as a dated draft document
  - Plan is to update and evolve the document
  - We'd appreciate input from this working group (email Faisal or Jeremy)
  - Available at: https://transportationops.org/sites/transops/files/CI%20Consistent%20Procedures%20for%20Operations%20v1.2%2004192021.pdf

Connected Intersections –

Consistent Procedures for Operations (CPO)

Cooperative Automated Transportation Coalition

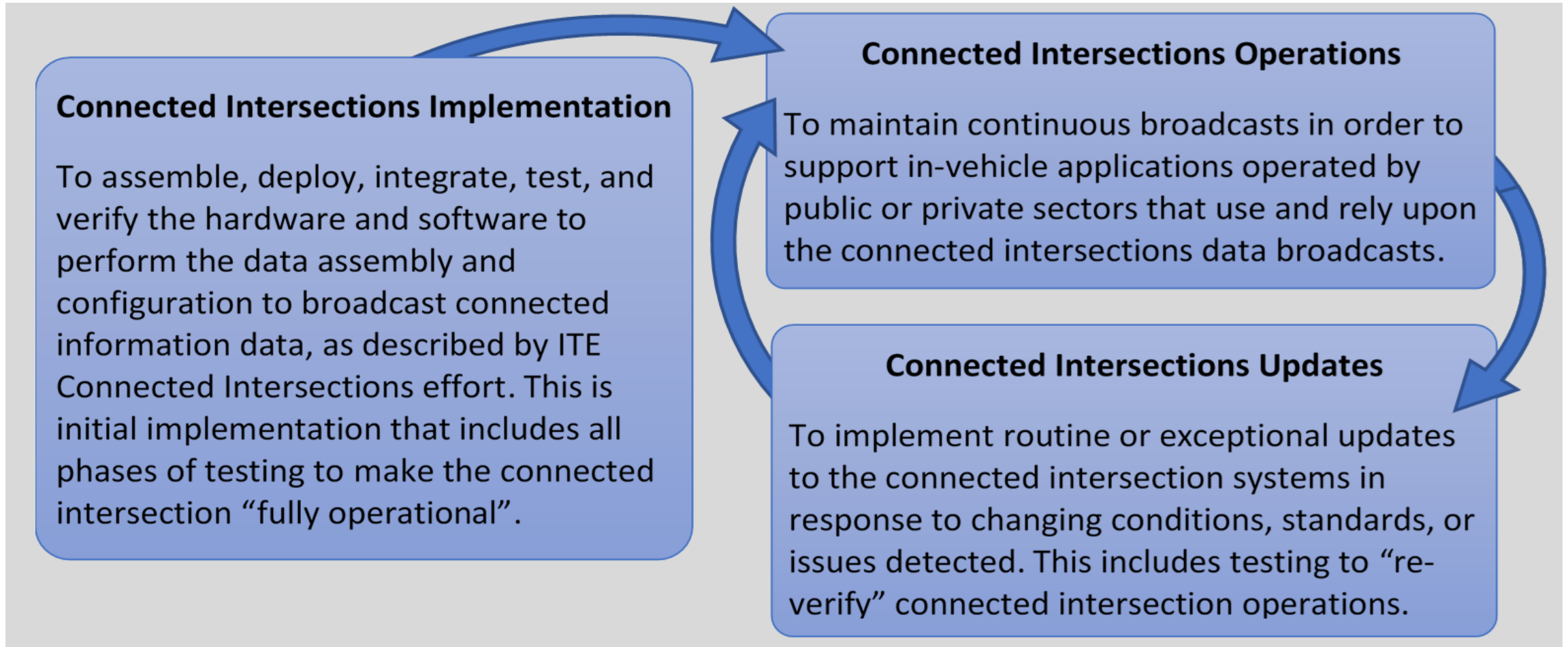IOO/OEM SPaT/RLVW Working Group

DRAFT Version 1.0

April 2021

Resource Content

- Current structure of the resource

- We will highlight several sections today

Table of Contents

Connected Intersections: Role of Operations

Connected Intersections Implementation

To assemble, deploy, integrate, test, and verify the hardware and software to perform the data assembly and configuration to broadcast connected information data, as described by ITE Connected Intersections effort. This is initial implementation that includes all phases of testing to make the connected intersection "fully operational".

Connected Intersections Operations

To maintain continuous broadcasts in order to support in-vehicle applications operated by public or private sectors that use and rely upon the connected intersections data broadcasts.

Connected Intersections Updates

To implement routine or exceptional updates to the connected intersection systems in response to changing conditions, standards, or issues detected. This includes testing to "re-verify" connected intersection operations.

Four Principles for Connected Intersection Operations

- ***Principle #1:*** ***No Broadcasts of Incorrect Messages.*** A broadcast message containing incorrect information has the risk of doing greater harm than if no message were broadcast at all. Any broadcast message should always contain correct information.

- ***Principle #2:*** ***Restore Correct Broadcasts Progressively as Soon as Practical.*** Functionality of the connected intersection should be restored in a progressive, gradual, reliable approach that results in messages containing correct information being broadcast as soon as is practical. Rather than hasty restoration of broadcasts that may be valid for a period of time and then not valid again, a gradual restoration process that minimizes the transitions from valid to not valid is preferred when restoring functionality once intersection operations have returned to a normal, operational state.

- ***Principle #3:*** ***Anomalies Must Self-Report to Ensure Accurate Messages.*** Detection of anomalies (specifically, situations where the connected intersection broadcast does not match the current signal controller mast head displays, the MAP message is incorrect, or the RTCM message is incorrect) should be self-reported by individuals causing the outage (e.g., a utility company closing an approach lane to the intersection) whenever possible. Self-reporting of anomalies by automated processes or system detection is also a preferred option.

- ***Principle #4:*** ***Clearly Identify Fully Operational Connected Intersections.*** Connected intersections should be considered "in deployment" until they are fulling tested, verified, and secured; upon which they should be considered "fully operational".

Evolving Tactics for Operating Connected Intersections:
Normal Operations

- **SPaT Operations.** Operating and maintaining the connection between the signal controller and the RSU to ensure content is continuously generated for broadcast to connected vehicles.

- **MAP Updates.** Creating and implementing an approach that any time the intersection geometry is altered or the assignment of signal groups changes, the MAP message is updated, tested, verified, secured, and uploaded to be broadcast by the RSU.

- **Position Correction Operations.** Operating the selected approach to generate and secure location position correction messages (e.g., RTCM messages) continuously without interruption.

- **Malfunction Monitoring.** Operating malfunction monitors to detect situations when the signal controller data does not match SPaT broadcasts. Emerging approaches are expected to be developed and tested in the coming years. These could include:

  - Expansions of existing malfunction monitoring equipment and systems that monitor traffic signals today.

  - Deployment of new approaches, such as comparisons of basic safety message (BSM) data received from connected vehicles in an around the intersection against current signals (e.g., a series of BSMs that shows vehicles are turning left from lane 7 to lane 10, may indicate a left-turn for Signal Group B. a check of whether Signal Group B is reported as left turn protected could determine if the SPaT message is matching the signal head).

- **Security Operations**. Operating security credentialling business practices to ensure credentials are being created on a continuous basis, as needed.

Evolving Tactics

In 2021, it is likely not practical for an IOO to immediately respond to all types of outages that may impact the quality of connected intersection broadcasts, nor does the number of production vehicles operating in-vehicle applications justify prioritization of resources to such a response. However, over the coming 10-20 years, several things are likely to occur:

- More intersections are likely to become connected, with increasing numbers of products to support easier more efficient management of the broadcasts;

- More vehicles are likely to be equipped with in-vehicle applications;

- The role of in-vehicle applications is likely to change, possibly beyond supplemental warning systems to supporting partial or automated driving functions, increasing the reliance on the data broadcast by the infrastructure; and

- The operations that IOOs perform will evolve with potentially an increased emphasis on maintaining the operational status of infrastructure broadcast.

Evolving Tactics for Operating Connected Intersections:
During Outages and Disruptions

Possible tactical approaches that may be chosen by an agency for various types of disruptions, include:

- **Take no action.** Wait for the temporary disruption to end. In situations where a lane is closed temporarily, the lane may reopen shortly after and no action may have been performed in response to the outage.

- **Pause Broadcasts.** Implement a temporary stop/pause in broadcasting the messages. In situations where a physical activity impacts the intersection, the RSU broadcast may be paused while either the MAP or SPaT messages are not valid.

- **Supplemental warning**. It may be more efficient to continue to broadcast SPaT/MAP messages while adding an indication in either the SAE J2735 message or the security WSA message to indicate the messages are not valid;

- **Broadcast Road Safety Messages (RSMs).** RSMs describing the maintenance or construction work zone event could be broadcast to help indicate to passing vehicles that the intersection operations may be disrupted.

- **On-site Responder Broadcasts**. Alerts could be broadcasts by vehicles (e.g., law enforcement or first responder vehicles) at the intersection (e.g., stationary location, flashing beacons activated) that would help indicate to passing vehicles that intersection operations may be disrupted.

Evolving Tactics for Operating Connected Intersections: Tracking

As Connected Intersections are implemented, industry and the broader community of stakeholders need to have a general understanding of the number and location of "fully operational" connected intersections. Tracking operational connected intersection is currently envisioned to have the following characteristics:

1. A **self-reporting process coupled with a web-enabled platform** to support reporting and viewing is needed for tracking deployments of Connected Intersections that are "fully operational".
   a. The tracking is **not intended to be a real-time depiction** of which intersections are fully functioning vs. those that may be experiencing a temporary malfunction, but rather a **representation of the number of sites "fully operational"** as connected intersections.
2. As a minimum, the self-reporting process would result in a **high-level count of Connected Intersections by state and/or metro area**.
3. **Tracking may also consider relative number of Connected Intersections that are operating at different thresholds of standards or capabilities**. Examples may include:
   a. To distinguish connected intersections using the latest standards versus those that use earlier standards;
   b. To distinguish intersections with additional capabilities (beyond basic SPaT, MAP, RTCM) such as queue length detection and green window reporting (required for TOSCo and other cooperative driving automation applications).
   c. IOOs may also track and report connected intersections that are "in deployment" but require additional testing to be "fully operational", however this information is likely less valuable to OEMs.

Four Use Cases Describing Possible Disruptions

- Complete unplanned malfunction such as a loss of power (e.g., to everything versus specific elements like RSU and/or controller);

- Partial malfunction where the RSU is operational but data is not guaranteed;

- Maintenance, construction, incident, or planned special event; and

- A geometry change at the intersection

5.4 Geometry Change at the Intersection

Activity:	Signal Controller Status:	SPaT Message:
• An additional turn lane is added to the intersection. Signal timing (and signal groups) are adjusted to reflect the change. • There is a construction period and a period where the MAP message is updated.	• Signal may continue to operate as timed during construction, with flaggers directing traffic when needed. • Signal timing changes will be implemented just prior to the opening of the new lane.	SPaT Message is still derived from the controller data. When the new timing plan is implemented, SPaT data will immediately be output.
		MAP Message: MAP message (initial geometry) will exist and may be broadcast and valid during the construction period. A new MAP message will be needed to reflect the additional lane and connections.

Considerations and Possible Solutions:
- This represents a combination of several use cases above:
  - There will likely be times when intersection work is active, that the original MAP message is inaccurate and the broadcast should be paused.
  - There will likely be times when intersection work is inactive and all lanes are open (e.g., evenings) when the broadcast of SPaT/MAP is appropriate.
- There will be a need to test the newly configured intersection to verify the SPaT/MAP are properly represented upon reopening the intersection.

Feedback Requested

- Any initial thoughts or reactions?

- Available at: https://transportationops.org/sites/transops/files/CI%20Consistent%20Procedures%20for%20Operations%20v1.2%2004192021.pdf

- Email comments and feedback to Faisal or Jeremy

Connected Intersections –

Consistent Procedures for Operations (CPO)

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IOO/OEM SPaT/RLVW Working Group

DRAFT Version 1.0

April 2021

New Resource:
Practical Considerations for Deployers of V2X Roadside Equipment in Light of the Recent FCC Ruling

Dean Deeter, Athey Creek

Resource Background

- Idea initiated in Strategic Initiatives WG in January

- Consensus to develop new resource to support SPaT Challenge sites given the recent FCC reallocation of 5.9 GHz band

- Small group of about 7 volunteers have been meeting weekly

- Document format is a series of FAQs that we believe the deployer agencies are asking

- Referencing the NCHRP 23-10 papers (as well as other on-line published resources) as much as possible

Resource Status

- 28 Questions Drafted

- Most responses drafted and nearly finalized - still inviting input

- Goal of today:

  - Walk through some questions we have answered to give you the scope of this effort

  - Share the full list of questions

  - Recruit small group from this Working Group representing both IOOs and industry to review and provide comments and feedback

Questions Being Addressed

1. *Please summarize the FCC R&O, FMPRM, and related timelines and key dates*

2. *If the FCC takes away my ability to use DSRC, what are my options?*

3. *When do my DSRC broadcasts need to stop and the transition to C-V2X need to occur?*

4. *What entities will drive the process and on what timeline for transitioning to C-V2X?*

5. *What do I need to do to perform the changeover?*

6. *Will my current applications require modification?*

7. *If software was built around DSRC, it was written to handle multiple channels. Will this need to change?*

8. *If I want to leave my DSRC operational, is that okay?*

9. *Do I need to transition all my RSUs at once?*

10. *What happens to my existing DSRC licenses during this transition?*

11. *Is the licensing process for C-V2X the same as for DSRC?*

12. *Am I able to get a C-V2X license now?*

Questions Being Addressed

13. *Since the FCC hasn't really refined the licensing and operational requirements of C-V2X, shouldn't I wait until those issues are all resolved before I purchase any C-V2X, so that I don't risk buying hardware / firmware that is soon to be outdated or somewhat obsolete?*

14. *Will C-V2X, which is based on 4G LTE, be forward compatible to 5G ?*

15. *What really is 5G and how does it fit into my options?*

16. *As I transition away from DSRC, is it possible to have both DSRC and C-V2X operating simultaneously in some areas during the transition?*

17. *How will the FCC ruling impact out-of-band emissions?*

18. *If the out-of-band emission issue (from the 45MHz which has been moved to Wi-Fi) isn't solved, will C-V2X end up being unworkable because of interference?*

19. *In the DSRC world, there were issues of incompatibility between the equipment provided by different vendors. Some of that has been resolved. Has there been any field testing identifying or demonstrating that these challenges have been resolved for C-V2X?*

20. *Will future standards be incompatible with C-V2X technologies that I deploy today?*

21. *Are C-V2X devices capable of operating within a Security Credential Management System (SCMS)?*

Questions Being Addressed

22. *Will C-V2X have the same range as DSRC? Is there any opportunity for wider spacing between RSUs with C-V2X?*

23. *How are the [automakers responding](#) to the FCC action and how does that impact my deployment decisions?*

24. *Are there any examples of procurement language that have been used to procure C-V2X RSUs   and/or C-V2X OBUs (e.g. for use on agency fleet vehicles) that we could use to begin to procure C-V2X equipment?*

25. *Where can I find a summary of commercially available C-V2X suppliers/ecosystem (RSUs, OBUs)?*

26. *Where can I find details about C-V2X certification process and associated/verified use cases?*

27. *Where can I access examples of experiences from actual C-V2X deployments?*

28. *Is funding available to recover the costs of the transition?*

Example Questions

What entities will drive the process and on what timeline for transitioning to C-V2X?

The Wireless Telecommunications Bureau and Public Safety and Homeland Security Bureau will define technical rules and a streamlined waiver process on how to operate C-V2X RSUs and OBUs within 30 days of the effective date of the first R&O. Up to that point, C-V2X RSUs can be deployed with an experimental license ; after that point, a waiver can be granted.

Example Questions

What do I need to do to perform the changeover?

- The NCHRP 23-10 March 2021 white paper addresses this question in great detail, including what will need to change with an existing DSRC deployment. While some items like the interface to the traffic signal controller, backhaul communications, connectors, antenna placement, and MAP message can remain the same, other components like the RSU radio technology will not be reusable. Since C-V2X operates in the 5.9 GHz band, the antennas and connectors are in principle the same. You should consult with your RSU/OBU vendor, however.

http://onlinepubs.trb.org/Onlinepubs/nchrp/docs/NCHRP23-10WhitePaper.pdf

Example Questions

Will future standards be incompatible with C-V2X technologies that I deploy today?

Most of the standards used in DSRC deployments will still apply and standards bodies are working to update standards that are not directly compatible. There may be some stumbling blocks along the way that cause standards to be updated, but this is not unique to C-V2X. There were similar needs to update standards as DSRC evolved. As an example, the SAE J2735 standard describing the MAP message is viewed as relatively stable, but SAE is currently working to update this standard.

Next Steps

- Strategic Initiatives WG has a small group that has been meeting to draft questions and responses.
- A small volunteer group within the Technical Resources WG has been identified to offer further input
  - Initial draft will be sent to this group for feedback
  - This group will provide feedback as soon as practical (goal is 1-2 weeks)
- Release date for resource – goal is end of June

Closing Remarks

Any deployment updates or lessons learned to share with the group?

Any other closing comments or questions?

2021 Resources WG Meetings

August 11 and November 10

11:00-12:30 (Eastern)