CAT Coalition – Infrastructure-Industry Working Group

July 15, 2021 Meeting Summary

Action Items:

- Jeremy will send meeting invites for the upcoming meeting.

Notes:

Opening

- Tracy herself and Ed as co-chairs of this working group.
- The role of this group is to: 1) support pre-competitive industry research that will advance infrastructure development and maintenance; 2) Connect IOOs with industry; 3) Support the natural evolution of infrastructure to accelerate CAVs; and 4) Clarify terms, definitions and target audiences.
- Tracy provided a brief recap of the previous working group meeting, which featured presentations on the IOO-OEM Forum product "Connected Intersections Consistent Procedures for Operations" by Blaine Leonard and the SAE ADS Standards Roadmapping Initiative by Tim Weisenberger. These presentations are available on the CAT Coalition I-I WG webpage: https://transportationops.org/CATCoalition/infrastructure_industry_WG.

I-I WG Work Plan Activities: Primer of Terms and AV Scan

Tracy provided a brief recap about the Primer of Terms resource and noted that the second round AV scan questions have been distributed for four different groups:

1. Private-sector AV providers - https://www.surveymonkey.com/r/HXPN57F
2. Public-sector: AV Shuttle deployers - https://www.surveymonkey.com/r/AV_Shuttles
3. Public-sector: Personal Delivery Device (PDD) deployers - https://www.surveymonkey.com/r/AV_PDD
4. Public-sector: Other AV deployers - https://www.surveymonkey.com/r/AV_Deployment

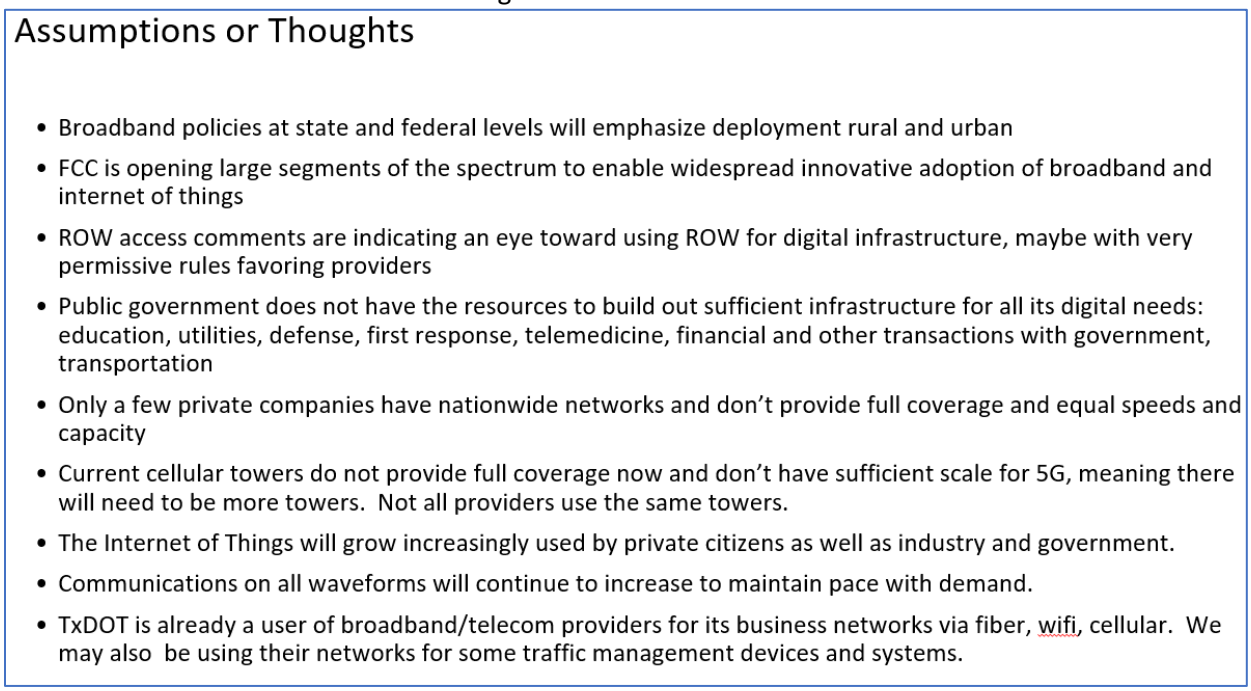
Digital Infrastructure Discussion

Public-Sector Perspective

Darran Anderson of Texas DOT discussed his perspective of digital infrastructure. He has seen potential for the expansion of digital infrastructure in urban areas and the state DOT, and has been involved in discussions about what that means for the infrastructure. DOTs and organizations have been challenged by COVID, but have also recognized that the existing infrastructure is not adequate to serve the needs of the public, particularly in rural areas. Infrastructure is needed to support a lot of needs, including telemedicine and mobility. Smart infrastructure is being extended to a broader concept beyond transportation with a need to include other public and private sector needs. TxDOT has had conversations that no individual organization can build out infrastructure to support their own needs, and so there is a need to look for efficiencies and opportunities for collaboration.

Darran acknowledged the FCC opening the spectrum for innovative adoption of broadband and the internet of things (IoT), as well as new opportunities in the right-of-way given changes in permitting allowances. He noted a future need for an increased number of towers to support 5G, as well as other sensors and systems for both private citizens and operations of vehicles. Greater location accuracy is going to be required for GPS systems and different types of radar. The roadway right-of-way becomes almost as important for the digital infrastructure as it is for the roadway itself. TxDOT is wrestling with how to break down silos between state agencies and with local entities.

Darran Anderson also shared the following slide:



Jeff DeCoux of the Autonomy Institute works with Darran and Texas DOT on digital infrastructure. He noted that it is a vital need to deploy. The density of digital infrastructure that needs to be deployed is greater now, and will appear on sidewalks and be much more prevalent than previous models of a dozen towers around the city. Jeff showed a graphic of public infrastructure network nodes (PINN). He noted that it is not about picking any one technology, but selecting the physical substantiation or "condo" that can support many technologies. He said it is not just about transportation technologies, although this has become very important, there are also 5G, edge computing efforts, and cities looking to deploy smart sensors. Currently there are security and operational issues with how technologies are being strapped to poles. It is not just about wireless. There are different carriers, transportation providers, IoT and smart city devices, a variety of sensors and security equipment, and other services that drive this densification of digital infrastructure. Jeff noted that we are moving to a lower-latency and higher-fidelity world that now requires more sensors and equipment in order to support automated vehicle (AV) movements.

Jeff acknowledged the tremendous amount of data that will now be generated. We rely on the cloud now for data needs, but this will not be possible without intentional thinking about how to process data at the edge. The "condo" will be used to facilitate unified infrastructure to deploy new technologies and applications far more readily. Within this "condo" structure, what gets deployed today for AT&T or Verizon for 5G may be re-used for 6G in the future to be upgraded and maintained over time. Jeff showed an ITS cabinet in Austin as an example of how collaboration is taking place with various entities to intelligently deploy this digital infrastructure for a variety of use cases.

The PINN is the next evolution of the edge system for new applications and makes systems installed today interoperable, which will make the infrastructure easier to manage and update in the future. Smart poles are now available that incorporate this PINN approach. Digital twinning is a very big piece

and first step in working with the city. This helps identify where locations should be (e.g., where the radar is needed to support various applications). Digital twinning is a major effort. Singapore has done a good job using digital twinning for a variety of applications (e.g., construction). The USDOT initiated a Voices program to bring in more advanced tools (e.g., TENA, Simdisk) that have been used by the Department of Defense to allow increased advantages that will benefit road construction activities, among other things.

Jeff described three core needs for a smart city: edge infrastructure, active digital twin, and data exchange. Edge infrastructure is to support local data storage that cannot be pushed to the cloud. This will help keep as much data "sovereign" to the local agency as possible. Robert Heilman asked if the PINNs would have capabilities to process data at the Edge? Jeff said that yes, private partners are working to process data at the PINN itself and the only thing that gets transferred is the data that is desired to archive and keep.

Private Sector Perspective

Monali Shah of Google shared how digital infrastructure will be used to understand and interpret the world around us, and the role of data platforms to support the evolution of transportation and technologies. Google's mission is to organize the world's information and make it universally accessible and useful, which is achieved through machine learning. This results in applications like Android Auto, Waymo, and Waze that collect data from a variety of different methods, process that information, and deliver a variety of experiences to benefit travelers. All of the images that Google has access to are used to help strengthen machine learning capabilities for use in consumer products.

Google is trying to democratize AI by packaging data up to make it more accessible and usable, such that answers can be achieved at a faster pace than in the past. Google has a 10X mindset about deploying systems in days and weeks, instead of years to bring about solutions sooner. Monali encourages everyone to consider what changes can be achieved now, not to take away from longer-term plans but to have benefits sooner.

Monali shared a variety of examples to illustrate this approach. As Google works with agencies and others in the industries to generate solutions, they consider the business drivers: community engagement, insight generation, reducing manual work, and prioritizing for impact. Community engagement, for example, includes consideration of ways to help technology reach more people and communities that may have been left behind in the past. Google looks at the infrastructure planning and maintenance to understand asset conditions to help prioritize investments; traffic and safety analytics to help identify patters and needs to improve operations; and equity and climate resilience to help identify communities that have been left behind and identify where the greatest needs are, as well as understanding and interpreting climate impacts that are happening now as well as what may happen in the future.

There are many approaches for leveraging data platform. Monali referenced work with the Colorado DOT that has a bold approach for using a serverless platform across a variety of areas that are now able to be done faster and with fewer resources. This includes secondary crash analysis, performance measurement, and other applications. This approach helps them process a large amount of data that would have otherwise not have been possible with limited resources and also identify needs in the transportation network.

Monali noted there are new data sources and insights that agencies may consider bringing in to use. For example, search trends can be used as an early indicator of transportation needs in an area. Crowdsourcing, social media, and videos are other potential sources that could be used. For example, video intelligence streaming features can be used to detect/track objects, monitor road conditions, detect scene changes like graffiti, and recognize road signs to generate new insights.

Google worked with the City of Memphis to generate more insights on road defects using cameras that were already mounted on buses. AI detected potholes and property conditions in order to identify physical infrastructure needs and neighborhood decline where investments may be needed.

Google also worked with Indiana to better understand snow and traffic management. This resulted in insights for optimized road treatment, improved mobility, and increased safety. AI was used to help determine where snow plows should be deployed and materials to use to treat the roadway. Safety and traffic analytics help identify patterns for crashes and congestion, and can be used by agencies to focus actions for the greatest impact.

Google has also used AI for wind turbine inspections. Drones are used to collect images and conduct manual reviews, but in this case study the operators helped train the AI to identify defects, which greatly streamlined the time required and allowed operators to focus on other issues. Monali also shared a similar example of how the US Navy applies these technologies. Geospatial AI can be used for climate needs as well. Monali described how AI is monitoring the global environment, plan for clean infrastructure deployments, and make infrastructure more resilient.

Monali also shared the approach the Kentucky Transportation Cabinet used for infrastructure modernization. Their effort initially started by a desire to modernize their equipment and move to the cloud, but it resulted in a variety of new use cases to leverage a lot of data for a variety of applications, including work zone data.

Questions and Discussion

- How are we thinking about resiliency of digital infrastructure? What are some of the key factors/drivers/dimensions that we should be building this resiliency for?

  Monali has been hearing a lot of questions about what the impact of digital infrastructure will be on the road network. There are also a lot of tangible practical things also, like flooding impacts and re-routing, vegetation control, and heat management given higher temperatures. Working to understand what can be done from an operational perspective as well as a longer-term planning perspective.

  Darran noted that even now, vegetation control can be an issue and is easy to forget about. Darran provided some thoughts on what supports resiliency, and is applicable for transportation needs as well as emergency management and responders:
  - Co-location and redundancy of systems helps during an emergency event with rapid discovery and replacement of lines and tower devices if infrastructure is impacted, so that it can be easily replaced;
  - Ensuring a system is self-healing and can establish dynamic communications routing such that one device down does not break the network;
  - Much more power will be needed and to make systems redundant and more rugged;

- Flexible conduit or duct banks that are more forgiving of changing soil;
- Fire/flood proofing;
- Cybersecurity standards that incorporate the whole physical system of systems, not just data, such as DoD specifications to Secret level for protection of wire/fiber lines or sensors from physical or signal penetration or interference.

- Digital twinning and ownership

  Darran said that Texas DOT may not be able to take this on alone but is really just one user of a broader network. Texas DOT may be able to "play" in that world with other partners; can the 3D models developed by Bentley be something that is also used by TxDOT? If so, that would be a more effective way for multiple systems to use a single architecture. The overall city does not see the same level of granularity in all aspects of the city, only where it is going to be used. Monali said Google has worked with Detroit on digital twin technology, and the potential to spin this up has increased. More data is now available to create the digital twin, and modeling capabilities allow for rapid scenarios to be run on transit, lane closures, and other situations in a way that could not have been done in the past given the time to both assemble and run these models.

  Katherine Petros noted that Utah DOT developed a digital twin strategic plan: https://drive.google.com/file/d/1-lNEg_0_xQYLS4Mwv_YaQ6XZtNTxuSfI/view.

- Once models (e.g. digital twins) and high-fidelity simulations are available for regional infrastructure, mobile entities, networks, and data, can they be used to identify failure modes, assess resiliency, and develop contingency plans?

  Jeff noted that Google Earth has been around for 20 years and has now advanced to complete tremendous simulation modeling. With AVs, the amount of data to create and keep an up-to-date model has increased tremendously for a far more productive model that is now updated so much faster. Darran noted it depends on what you are willing to pay for high-performance computing, material, visual, and physical properties that are rolled into a digital model. He thinks it is possible, but will be an incremental build over time. Robert Heilman noted that no one will have all of that model to the extent that is needed, so will there be interoperability to perform co-simulation to bring this vision to reality? He noted the use of the term "natural evolution" and asked how much regulation and coordination would be needed to achieve this, as well as the divide between the business space and shared space.

  Darran noted the need for a common architecture and common geospatial system. Everything Robert described needs to be built out in the simulation environment, which is overwhelming. Monali said that technology and capabilities are present, but what is the appetite and demand for adopting technologies that have been around for a long time? Even when there's new tools and technologies to break down historical silos, often it's a question of who is willing to make changes in the business processes to leverage those capabilities. This is what gets developed and used in a practical way. A lot is possible, but what is really going to matter and get adopted? Maybe it is not the same as you do it today and won't get all you want to get, but you will get some new things and get things faster; is that reason enough to adapt to the change in approach?

Jeff agreed that it is not technical issue. A lot of activities the DOT brought forward were right on. Data gravity is now going to the edge and will stimulate new processes, which is easier than process reengineering. In 1926, the Air Commerce Act passed, 4 years later an air control tower was built, and this stimulated the air industry. Autonomous vehicles are developing within their own areas. The same challenge we have on the physical domain (e.g. too expensive) we also have in digital domain, so it is a collaborative market.

- I know what my investment was (e.g., internet of things) but now we have so much data. Should there be interoperability standards and is there a way to expand and use this data, for example to at least partially interface with City of Austin and the Department of Energy, versus just bubbles of information?

  Monali noted that for some things it is helpful to have standards to accelerate an outcome, but there are things where the process of getting there can be different approaches (not standards) where outcomes are commonly beneficial. She noted that the context of the general transit feed specification (GTFS) and work zone data make sense to standardize. Where are these places where some piece of information needs to be shared in the eco-system to make it better? Can we have a way of doing this that by starting with something? Is it adaptable and can it develop quickly, versus a traditional very lengthy standards process?

  Jeff noted the opportunity in the United States for infrastructure to lead and help rebuild communities in this space. Monali agreed that collaboration is a great place to start this evolution.

- John Corbin noted the internal USDOT digital infrastructure framework that will be heavily informed by this discussion. He hopes to offer an accountability report in the coming months to share with the group. This will hopefully be a resource both for USDOT and to this group. Federal, state, and local transportation agencies are not just about mobility, but also increasingly about broader connections. The USDOT ITS JPO just released a new product on digital infrastructure called "Putting People First" about smart cities and communities in which digital and physical infrastructure are two key components: https://its.dot.gov/smartcities/SmartCities.pdf. Rhetorically, John recommends everyone think about how to catalyze the transformation from 20th century infrastructure to 21st century connected transportation and digital infrastructure.

Next WG meetings and Adjourn

The next meetings for this working group are tentatively scheduled for:

- Thursday, September 30, 1:30-3:00 pm ET
- Thursday, November 18, 1:30-3:00 pm ET

Registered Attendees:

1.	Tracy	Thomason (Co-Chair)	tlarkin@itsa.org
2.	Adam	Shell	adam.shell@iowadot.us
3.	Alex	Wassman	alexander.wassman@modot.mo.gov
4.	Alexis	Zubrow	alexis.zubrow@dot.gov
5.	Amanda	Hamm	amanda.hamm@vdot.virginia.gov
6.	Andrew	Bremer	andrew.bremer@drive.ohio.gov

7.	Anne	Reshadi	anne.reshadi@dot.wi.gov
8.	Asfand	Siddiqui	asiddiqu@dot.ca.gov
9.	Beverly	West	Beverly.West@txdot.gov
10.	Bill	Gouse	S.William.Gouse@sae.org
11.	Brian	Simi	brian.simi@dot.ca.gov
12.	Clayton	Chen	clayton.chen@dot.gov
13.	Dale	Thompson	dale.thompson@dot.gov
14.	Daniel	Halsted	HalstedDB@scdot.org
15.	Daniela	Bremmer	bremmed@wsdot.wa.gov
16.	Darran	Anderson	darran.anderson@txdot.gov
17.	Dave	Huft	dave.huft@state.sd.us
18.	Dean	Deeter	deeter@acconsultants.org
19.	Donna	Clark	donna.clark@atssa.com
20.	George	Lukes	glukes@utah.gov
21.	Ginna	Reeder	vreeder@tetcoalition.org
22.	Gregory	Davis	gregory.davis@dot.gov
23.	Gummada	Murthy	gmurthy@aashto.org
24.	Hyungjun	Park	hyungjun.park@dot.gov
25.	Jag	Mallela	JAG.MALLELA@WSP.COM
26.	James	Gray	James.Gray@dot.gov
27.	James	Kuhr	james.kuhr@txdot.gov
28.	Jeffrey	DeCoux	jeff@autonomy.institute
29.	Jeremiah	Robertson	jeremiah.robertson@qs-2.com
30.	Jeremy	Schroeder	schroeder@acconsultants.org
31.	John	Hibbard	jhibbard@dot.ga.gov
32.	John	Corbin	john.corbin@dot.gov
33.	Katherine	Petros	katherine.petros@dot.gov
34.	Lauren	Isaac	lauren.isaac@easymile.com
35.	Lauren	Parrish	lparrish@odot.org
36.	Marisa	Walker	marisaw@azcommerce.com
37.	Martin	Sullivan	mesullivan@scires.com
38.	Matt	Burt	matthew.burt@dot.gov
39.	Michael	Mollenhauer	mmollen@vt.edu
40.	Michael	Kennerly	michael.kennerly@iowadot.us
41.	Mohammed	Yousuf	mohammed.yousuf@dot.gov
42.	Monali	Shah	shahmonali@google.com
43.	Morgan	Kessler	Morgan.Kessler@dot.gov
44.	Nagham	Matout	nagham.matout@atssa.com
45.	Nate	Deshmukh Towery	nate.deshmukh-towery@dot.gov
46.	Nicholas	Kehoe	nicholas.kehoe@toxcel.com
47.	Nick	Hegemier	nick.hegemier@drive.ohio.gov
48.	Patrick	Zelinski	pzelinski@aashto.org
49.	Pavle	Bujanovic	pavle.bujanovic@dot.gov

50.	Roshani	Durand	roshini.durand@dartagnanconsulting.com
51.	Raj	Ponnaluri	raj.ponnaluri@dot.state.fl.us
52.	Rich	Taylor	rich.taylor@dot.gov
53.	Robert	Heilman	robert.heilman@dot.gov
54.	Roger	Grant	rgrant@nibs.org
55.	Timpone	Karen	karen.timpone@dot.gov
56.	Tom	Kern	tkern@transportationops.org
57.	Val	Rader	val.rader@alaska.gov
58.	Venkat	Nallamothu	venkat.nallamothu@toxcel.com
59.	Zeke	Reyna	zeke.reyna@txdot.gov