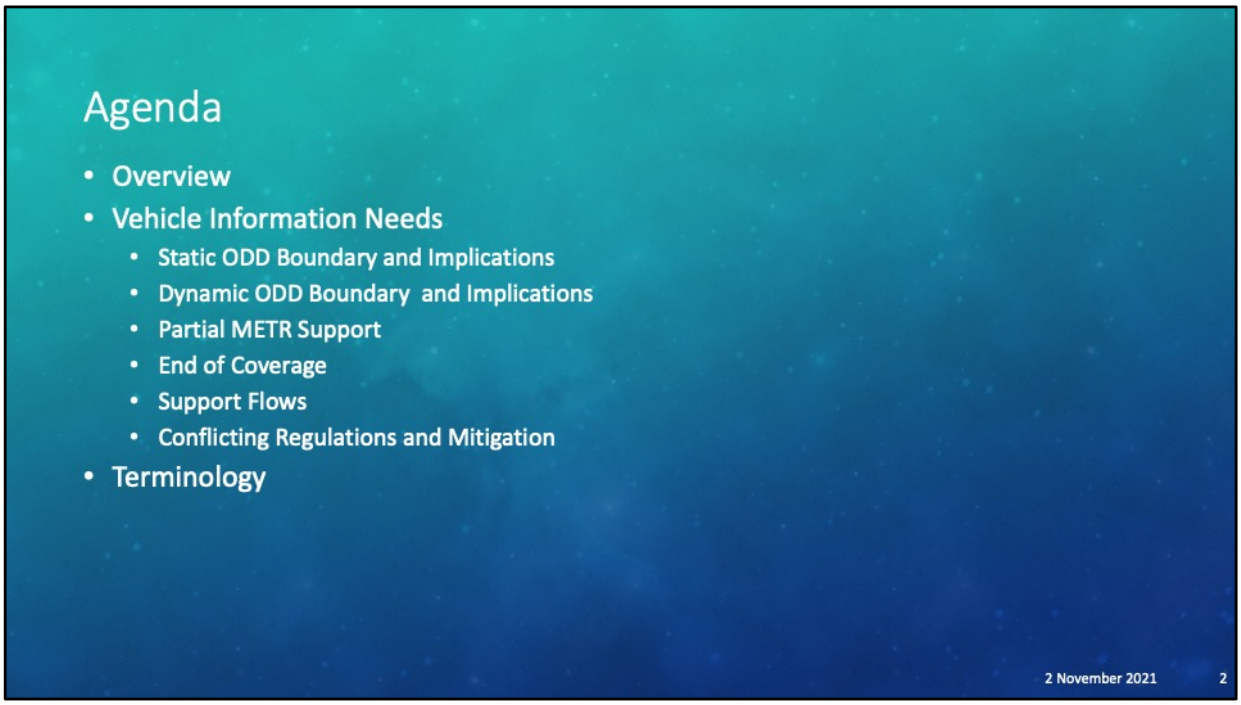
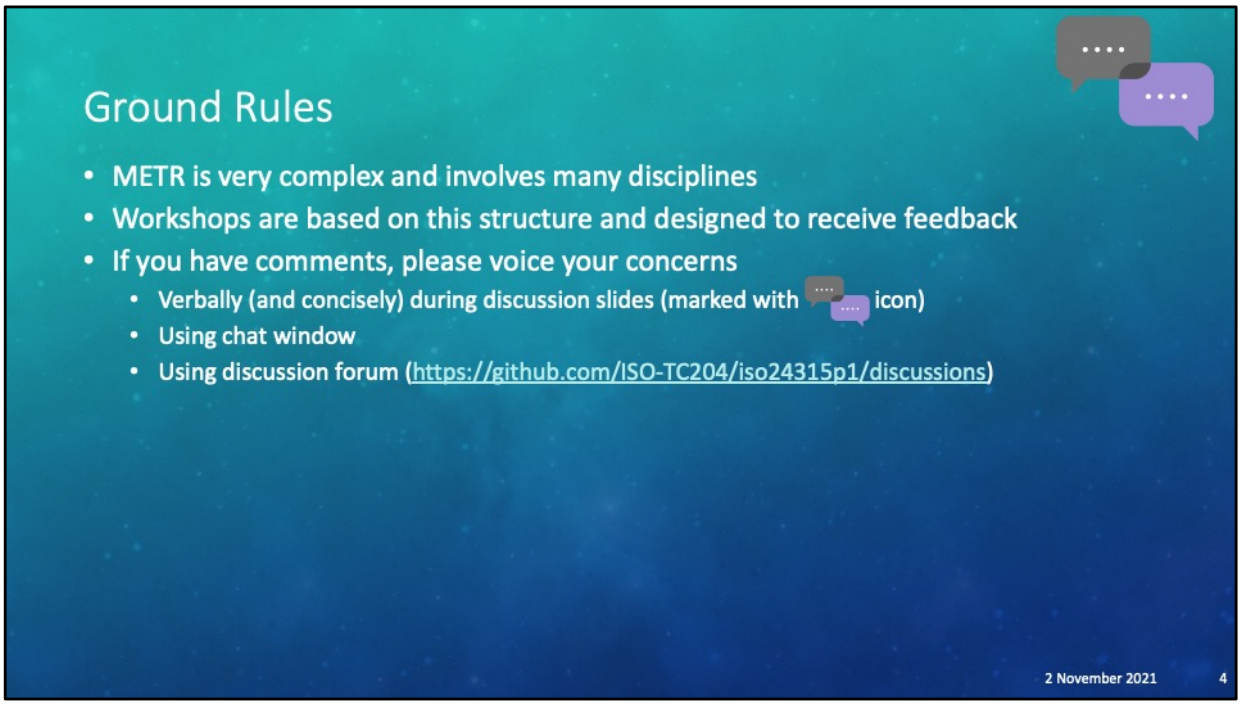
Welcome to the sixth METR workshop. Today, we will talk about vehicle operations.



After our overview, we'll dive directly into a series of discussion topics covering the variety of issues shown here.

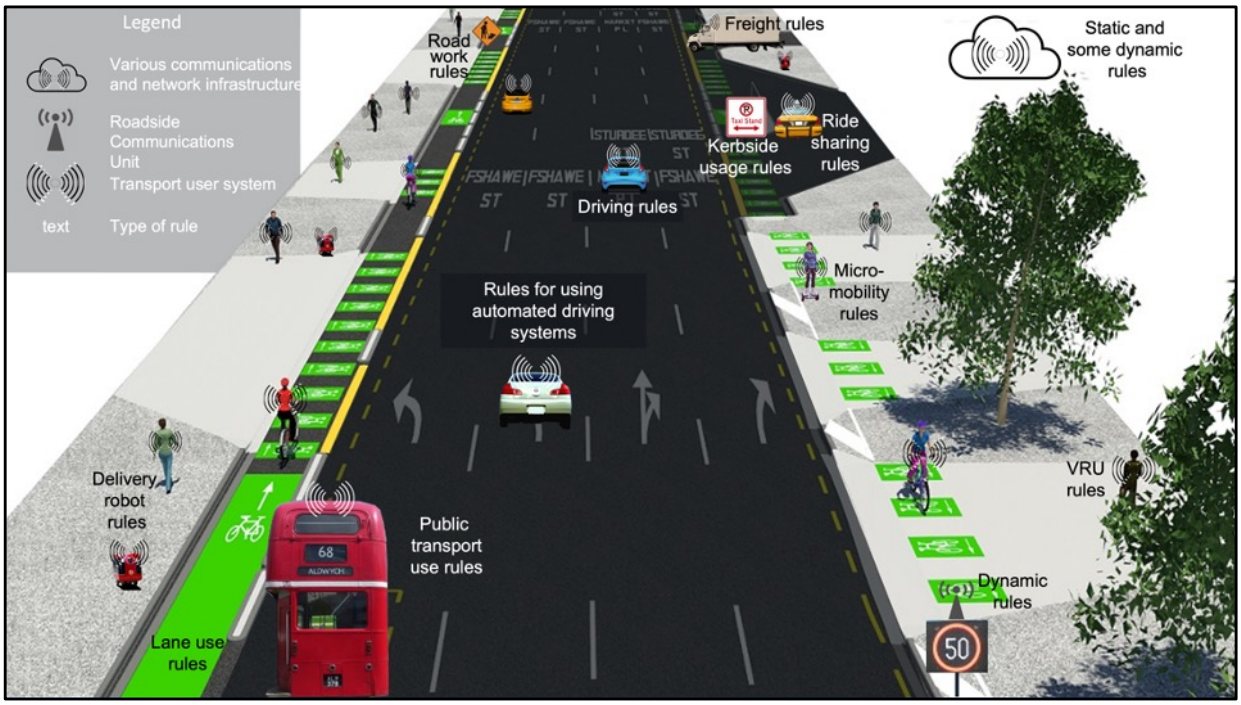
It is important to acknowledge that the materials developed to date represents a team effort. While there is a core editing group, as shown in the upper left, the concepts presented within this presentation already reflect valuable inputs from the review team shown on the right. In addition, the overall document is being prepared under the auspices of ISO/TC 204/WG 19, and especially its METR Drafting Team.



Before we begin, it is useful for everyone to understand the ground rules of our conversation. The development of the ConOps is intended to be a cooperative effort that reflects the input from stakeholders from different perspectives. To facilitate this process, the development team has prepared the workshops to gain feedback from stakeholders – but your feedback does not have to be limited to the topics presented.

The workshops are generally structured to present a topic and then gain feedback. Participants are welcome to voice their concerns during the workshop presentations, either verbally or using the chat window, but we request that verbal feedback is made when we are on discussion slides. We also recognize that our workshops are time limited and comments should be kept fairly concise. If major topics of discussion arise we can schedule additional meetings to focus on specific points, as needed. We have also established a discussion forum on the Github site to promote off-line conversations and encourage everyone to use the facility,

After we complete the workshops, we expect to prepare a draft ConOps early next year, and there will be ample opportunity for additional comments on the document once distributed.



METR is intended to support all transport user systems. This includes: vehicle systems (e.g., automated driving systems and driver support systems), sidewalk delivery robots, and other devices such as smartphones used by pedestrians and perhaps units on-board micromobility devices (e.g., e-scooter interfaces)

The information provided to these users would potentially include all rules related to using the transport facilities, such as (from top and proceeding clockwise) any special rules for freight delivery or for the operation of heavy vehicles, kerbside usage rules (e.g., bus stop, taxi stand), ride sharing rules (e.g., what forms of ride sharing are allowed), micromobility rules (e.g., are e-scooters allowed in cycle lanes), VRU rules (e.g., is the sidewalk closed to pedestrians), dynamic rules (e.g., variable speed limits, lane control signals), public transport use rules (e.g., does my ticket quality me for a transfer, what are the fare zones), lane use rules (e.g., bike only, bus only, HOV-2), delivery robot rules (e.g., what is the maximum speed for a delivery robot for this sidewalk), road work rules (e.g., speed limit for the work zone). METR is intended to be flexible enough to address all of the transport rules, these are just a few examples that demonstrate the breadth of the effort.

Importantly, in order to cover all rules, the scope must include rules that can change

or be imposed in a dynamic fashion. For example, temporary lane closures due to unplanned incidents and signal timing information need to be considered and handled in a trustworthy way, even when long-range communications may not be available. Thus, the full scope of METR will likely need to rely on both cloud based delivery mechanisms as well as local broadcast of exceptional data.

Static ODD Boundary

- What data does a vehicle need from METR to properly handle a static ODD boundary? (i.e., a boundary that is based on infrastructure characteristics rather than environmental and operation characteristics)
  - For example, does METR need to advertise the coverage areas and the types of information within each coverage area

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Our first question today deals with static ODD boundaries, such as those defined by physical infrastructure. What data do vehicles need for these boundaries?

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End of Motorway - https://upload.wikimedia.org/wikipedia/commons/thumb/c/c1/Mauritius_Road_Signs_-_Information_Sign_-_End_of_Motorway.svg/1024px-Mauritius_Road_Signs_-_Information_Sign_-_End_of_Motorway.svg.png
End Divided Highway - https://upload.wikimedia.org/wikipedia/commons/thumb/8/81/MUTCD_W6-2.svg/600px-MUTCD_W6-2.svg.png
Primitive Road - https://farm1.staticflickr.com/27/63123607_2c57ec04ff_z.jpg
Magic Roundabout - https://www.flickr.com/photos/robinhamman/27117099659

Implications of Boundary

- What is the operational scenario associated with a vehicle approaching a static ODD boundary that limits the vehicle's operation?
  - For example, does the ADS-equipped vehicle need to know where to park if the human driver does not respond?

ADS = Automated Driving System

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And what operational scenario do we need to consider within our ConOps?

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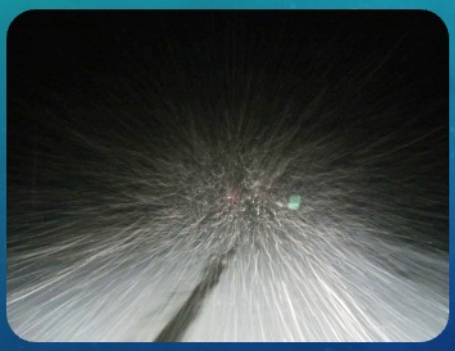
End Divided Highway - https://upload.wikimedia.org/wikipedia/commons/thumb/8/81/MUTCD_W6-2.svg/600px-MUTCD_W6-2.svg.png
Primitive Road - https://farm1.staticflickr.com/27/63123607_2c57ec04ff_z.jpg
Magic Roundabout - https://www.flickr.com/photos/robinhamman/27117099659

In addition to static ODD boundaries, there are dynamic ODD boundaries, in other words, under normal conditions an ADS-equipped vehicle might be able to drive the road, but at present there is some special condition that is outside the bounds of the ADS logic. What information does METR need to convey to ensure the safe operation when these conditions occur, if any?

Snow Blind - https://c2.staticflickr.com/8/7209/6802244796_c9fc9e3592_b.jpg
Rain - http://www.publicdomainpictures.net/pictures/60000/velka/dramatic-sky-while-driving.jpg

Implications of Boundary

- What is the operational scenario associated with a vehicle encountering a dynamic ODD boundary that limits the vehicle's operation?
  - For example, does the ADS-equipped vehicle need to know where to park if the human driver does not respond?



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And what should our ConOps describe as far as an operational scenario for this case?

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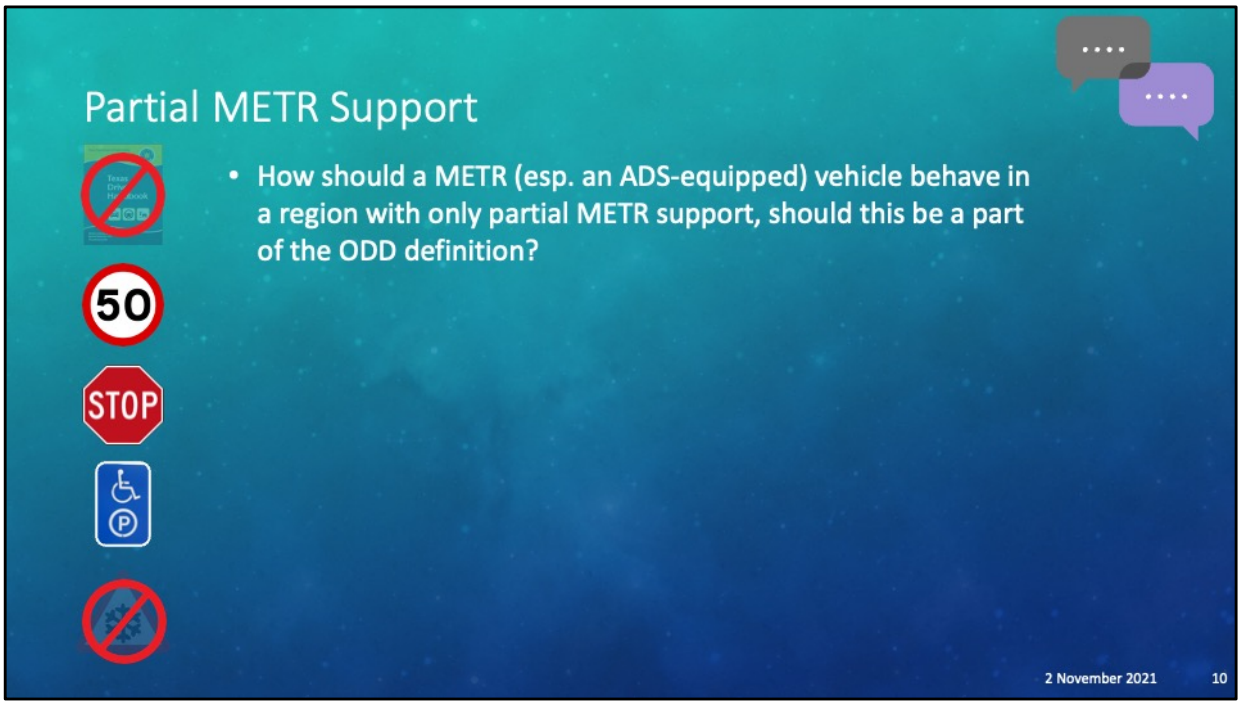
Rain - http://www.publicdomainpictures.net/pictures/60000/velka/dramatic-sky-while-driving.jpg



Our next question deals with a scenario where a particular geographic region supports some METR data but not other data. Our assumption is that if a region claims support for any particular type of data (e.g., parking information), it must support ALL rules related to that type of data (e.g., default rules, static rules, and dynamic rules). How should METR convey that some types of rules are provided while others are not?

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50 - https://upload.wikimedia.org/wikipedia/commons/thumb/7/7b/Mauritius_Road_Signs_-_Prohibitory_Sign_-_Speed_limit_50.svg/600px-Mauritius_Road_Signs_-_Prohibitory_Sign_-_Speed_limit_50.svg.png
Texas Driver Handbook - http://dps.texas.gov/internetforms/forms/dl-7.pdf
Handicap - https://upload.wikimedia.org/wikipedia/commons/thumb/3/36/Handicap_parking_sign%2C_canada_2008.jpg/1200px-Handicap_parking_sign%2C_canada_2008.jpg
Snow Advisory -

https://upload.wikimedia.org/wikipedia/commons/thumb/3/38/UK_traffic_sign_554.2.svg/869px-UK_traffic_sign_554.2.svg.png
No - https://cdn.pixabay.com/photo/2012/04/24/12/29/no-symbol-39767_960_720.png

End of METR Coverage

- To what extent does METR need to provide warnings, especially to ADS-equipped vehicles, that you are approaching an area without METR coverage or with a lower level of conformance? (e.g., jurisdictions that do not have information entered, information is partially entered, system not (fully) operational)

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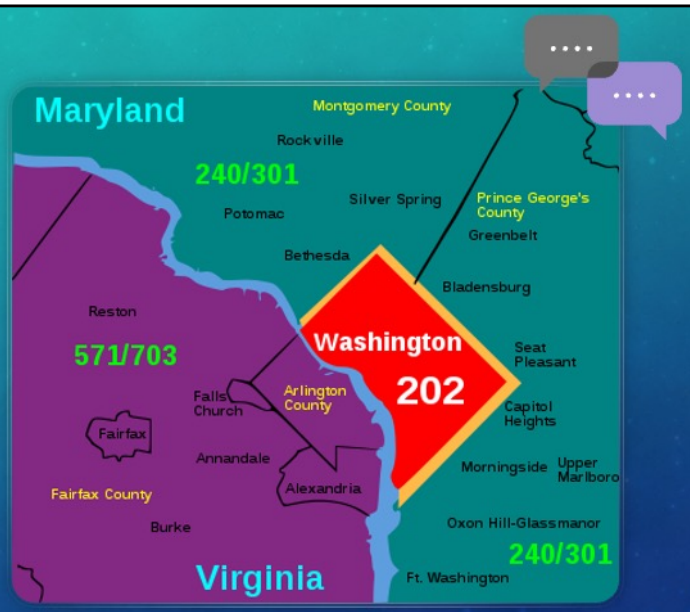
To what extent does METR need to indicate that coverage is ending or changing?

Exit 162 - https://en.wikipedia.org/wiki/Interstate_70_in_Utah#/media/File:I-70noservices1.jpg
Primitive Road - https://farm1.staticflickr.com/27/63123607_2c57ec04ff_z.jpg

Support Flows

- Does METR need to identify adjacent jurisdictions/METR download zones (e.g., when a user requests information for a jurisdiction or as a user nears a boundary)?



What support flows does METR need to provide so that a user system that is about to cross a regional boundary knows which disseminator to connect to?

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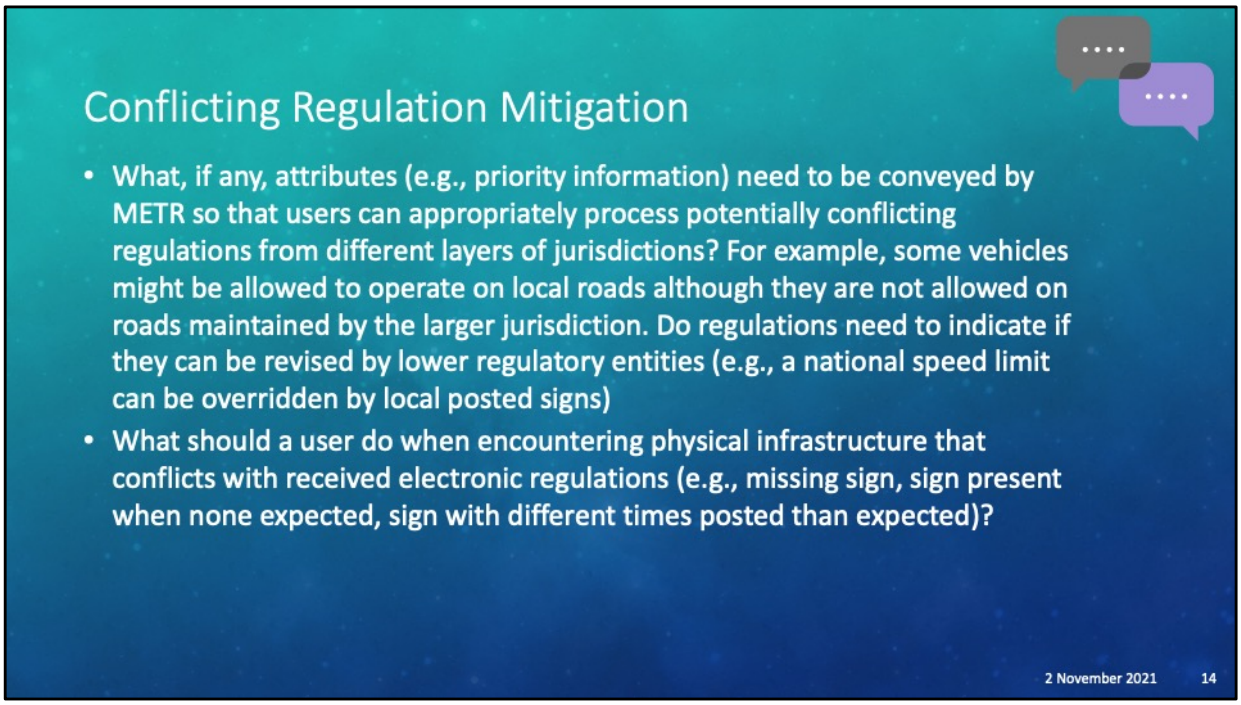
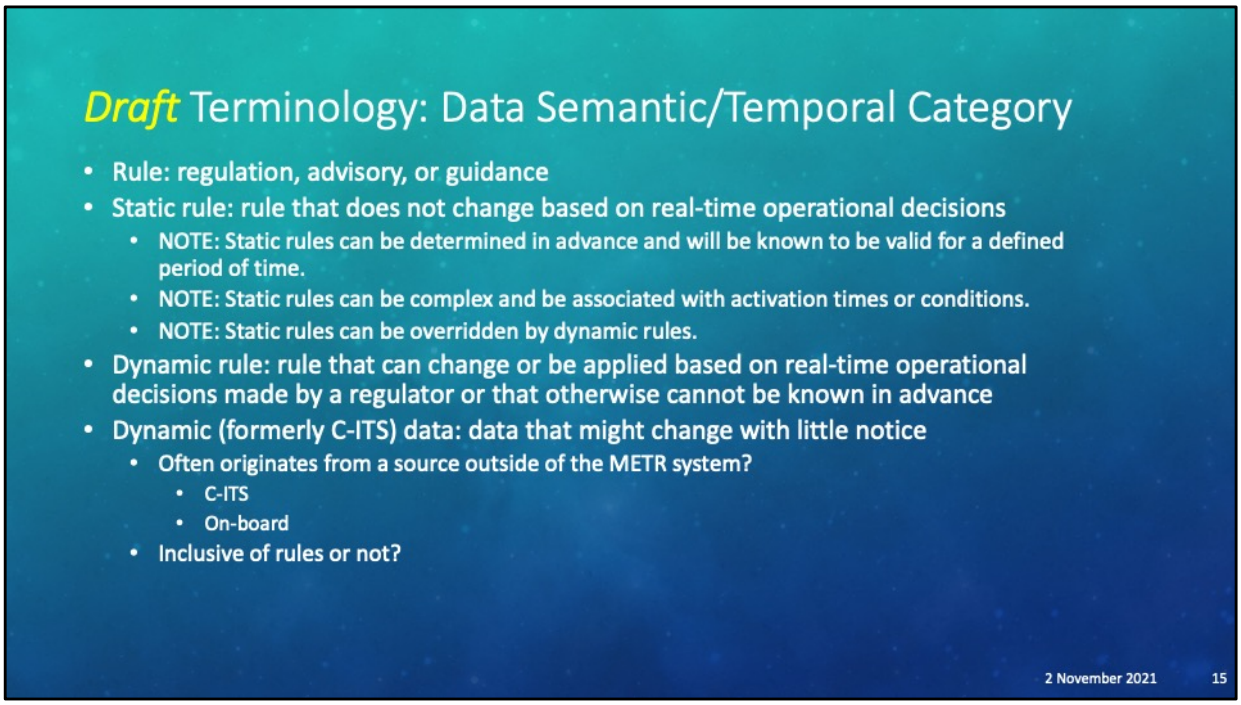
What should happen when a user system encounters an inconsistency in the received rules? Granted, this should be avoided, but in practice it is bound to occur at times and we should consider what a user system should do in this scenario.



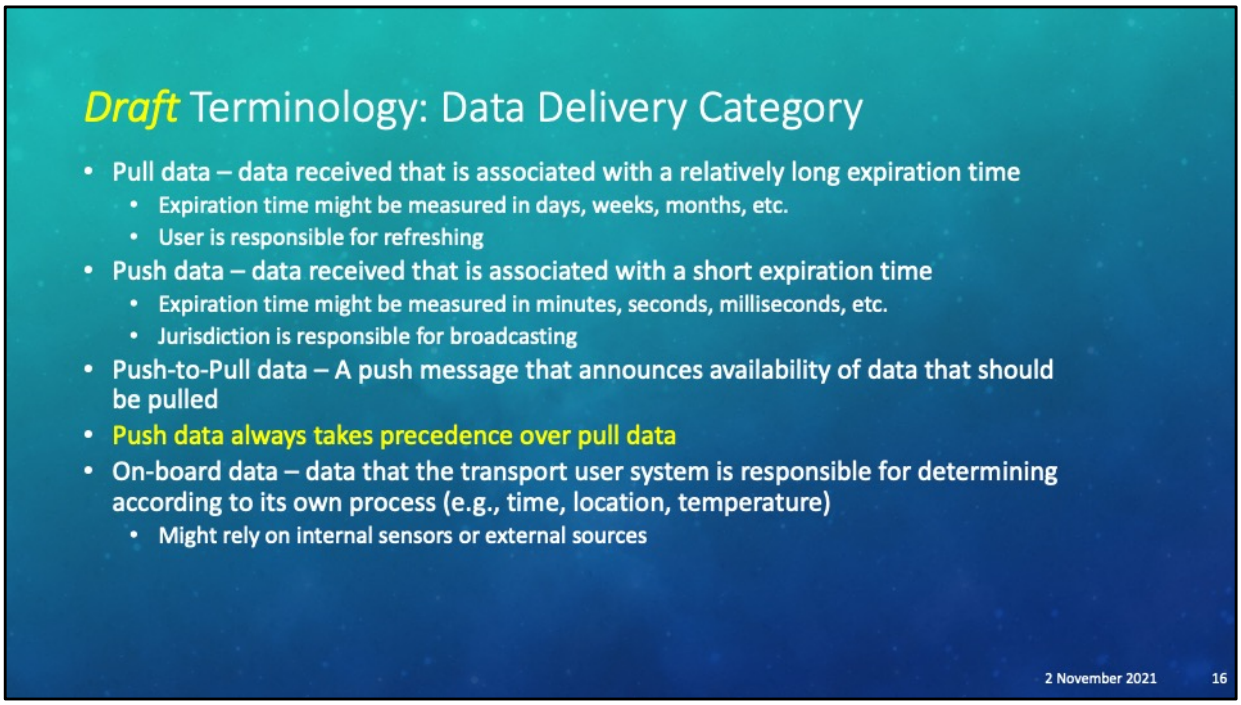
What information should each METR rule include so that user systems can determine the relative priority of rules. For example, default speed limits often have wording such that it is the defined speed limit unless otherwise posted. How should METR convey the concept of “unless otherwise posted”?

Likewise, what should the ConOps say about a user encountering a physical traffic control device that is inconsistent with the rules that it has received electronically. While this should be avoided, inconsistencies are bound to arise at times and we should consider what advice we should give and consider how these inconsistencies can be reported so that they can be resolved in a timely manner.



We now get into a set of term definitions. Our goal is to get feedback from the participants as to what terms and definitions we should use within the ConOps.

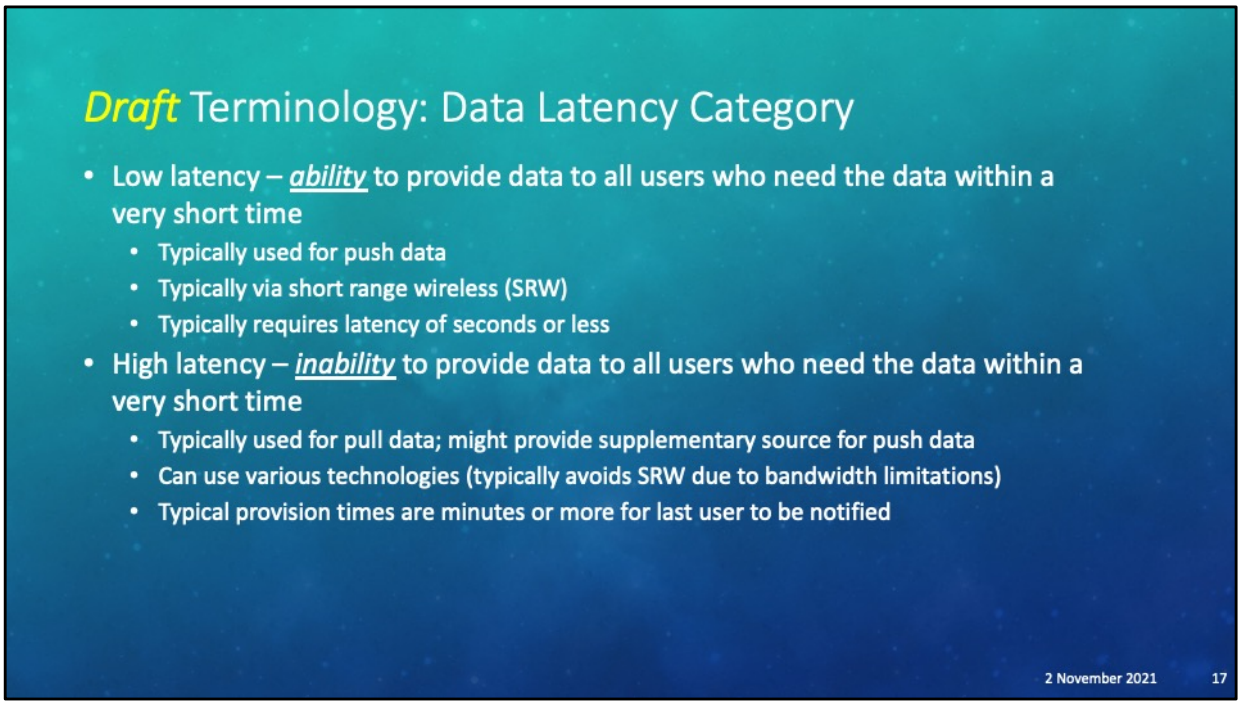
We propose that we will define a rule to be a general term that is used for a regulation, advisory, or guidance. Static rules are those that do not change based on real time conditions and dynamic rules do. Rules are a type of data and the state of rules (even static rules) might depend on the current vaues of other dynamic data. For example, there might be a rule to turn on headlights when it is raining. That would be a static rule, but the data about whether it is currently raining is dynamic data. Whether or not the speed limit is currently reduced is dependent upon that dynamic data.



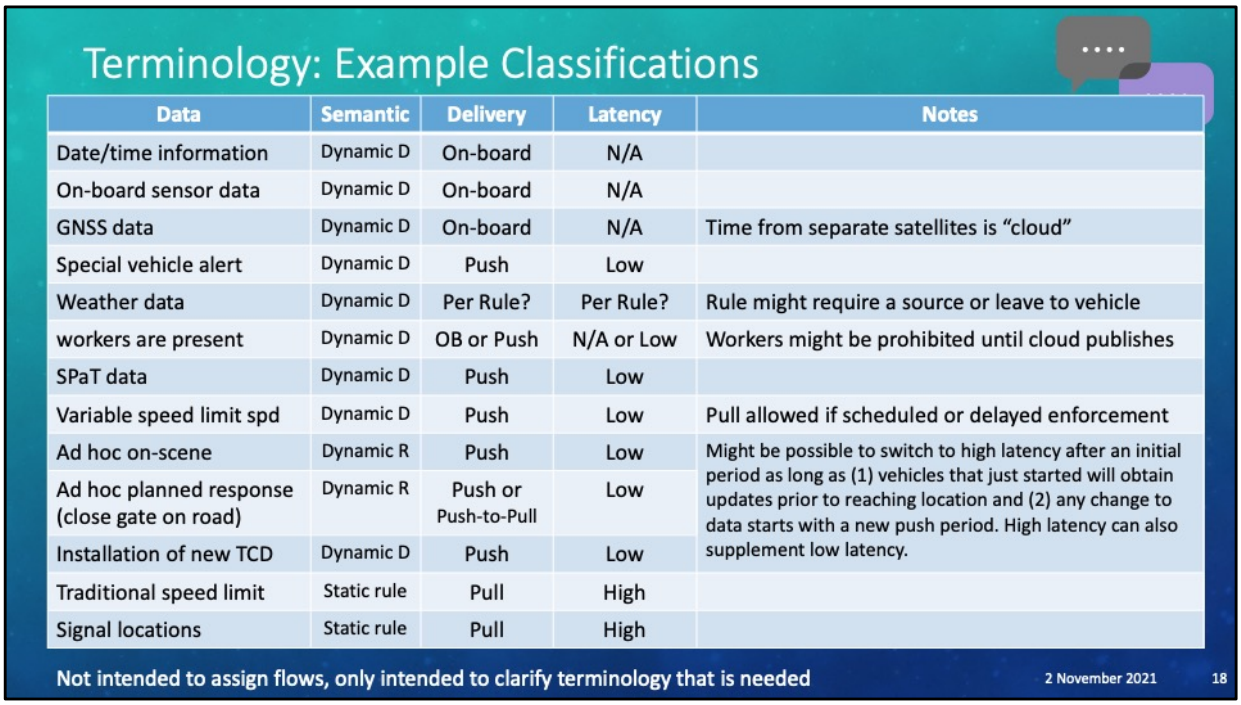
We also talk about data from other perspectives. One such perspective is whether it is the user system's responsibility to pull the data or whether it is the regulator's responsibility to push the data to the user. These roles are formally defined to be based on whether the data is expected to have a long expiry time or short expiry time (i.e., how long before data that was previously downloaded can no longer be considered valid). Data with short expiration times (e.g., signal timing states, variable speed limits) need to be pushed (often in localized areas) in order to prevent a massive load of requests from users to their disseminators.

There is also a possibility of "push-to-pull" data, this is where the regulator informs a user that new data is available that needs to be pulled. This is particularly useful when the amount of data that needs to be sent might exceeed local push capabilities (e.g., data capacities).

In general, push data is assumed to always take precedence over pull data as it is the latest data received and very possibly reflects a change in states and is more recent. A final scenario is data that is not exchanged outside of the user system at all but is determined on-board (e.g., using on-board sensors). We propose to call this "on-board data"



A final perspective that is considered is the communications technology and how quickly data is needed. For example, how long of a time lag is allowed between it is known that a rule will change to the time that all affected users must be notified. Typically, this is similar to the concept of push and pull but rather than considering how often the rule changes we are looking at notification times.



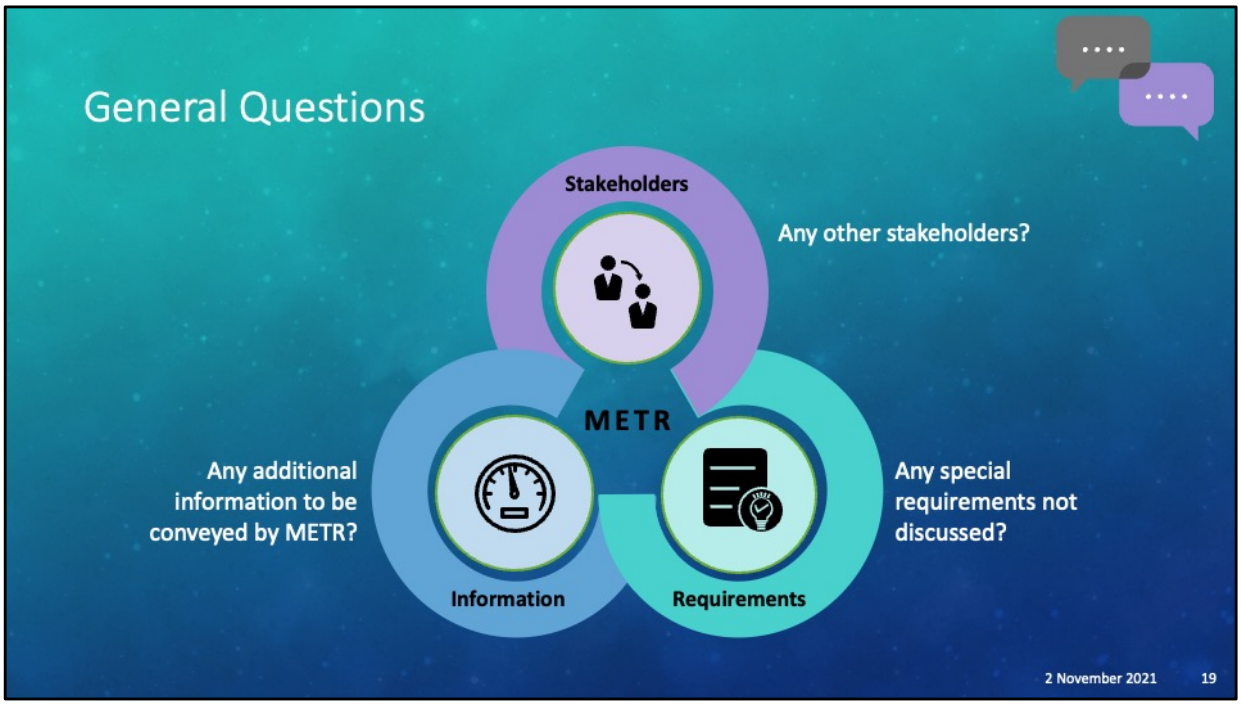
Terminology: Example Classifications

Data	Semantic	Delivery	Latency	Notes
Date/time information	Dynamic D	On-board	N/A	
On-board sensor data	Dynamic D	On-board	N/A	
GNSS data	Dynamic D	On-board	N/A	Time from separate satellites is "cloud"
Special vehicle alert	Dynamic D	Push	Low	
Weather data	Dynamic D	Per Rule?	Per Rule?	Rule might require a source or leave to vehicle
workers are present	Dynamic D	OB or Push	N/A or Low	Workers might be prohibited until cloud publishes
SPaT data	Dynamic D	Push	Low	
Variable speed limit spd	Dynamic D	Push	Low	Pull allowed if scheduled or delayed enforcement
Ad hoc on-scene	Dynamic R	Push	Low	Might be possible to switch to high latency after an initial period as long as (1) vehicles that just started will obtain updates prior to reaching location and (2) any change to data starts with a new push period. High latency can also supplement low latency.
Ad hoc planned response (close gate on road)	Dynamic R	Push or Push-to-Pull	Low	
Installation of new TCD	Dynamic D	Push	Low	
Traditional speed limit	Static rule	Pull	High	
Signal locations	Static rule	Pull	High	

Not intended to assign flows, only intended to clarify terminology that is needed

Finally, we look at a variety of scenarios to determine which terms are appropriate and which terms are needed. For example, do we need to define both push/pull data and low/high latency data – or are those terms always paired with each other? Is there ever a case where low-latency data depend solely on pull processes?

Note, this table is not attempting to assign flows to specific domains; it is merely attempting to describe the typical assignments and to get us thinking about what combination of terms might occur.



Finally, have we missed anything in our analysis? Are there other stakeholders that we need to engage; other topics that we need to cover?


NEXT STEPS
2 November 2021
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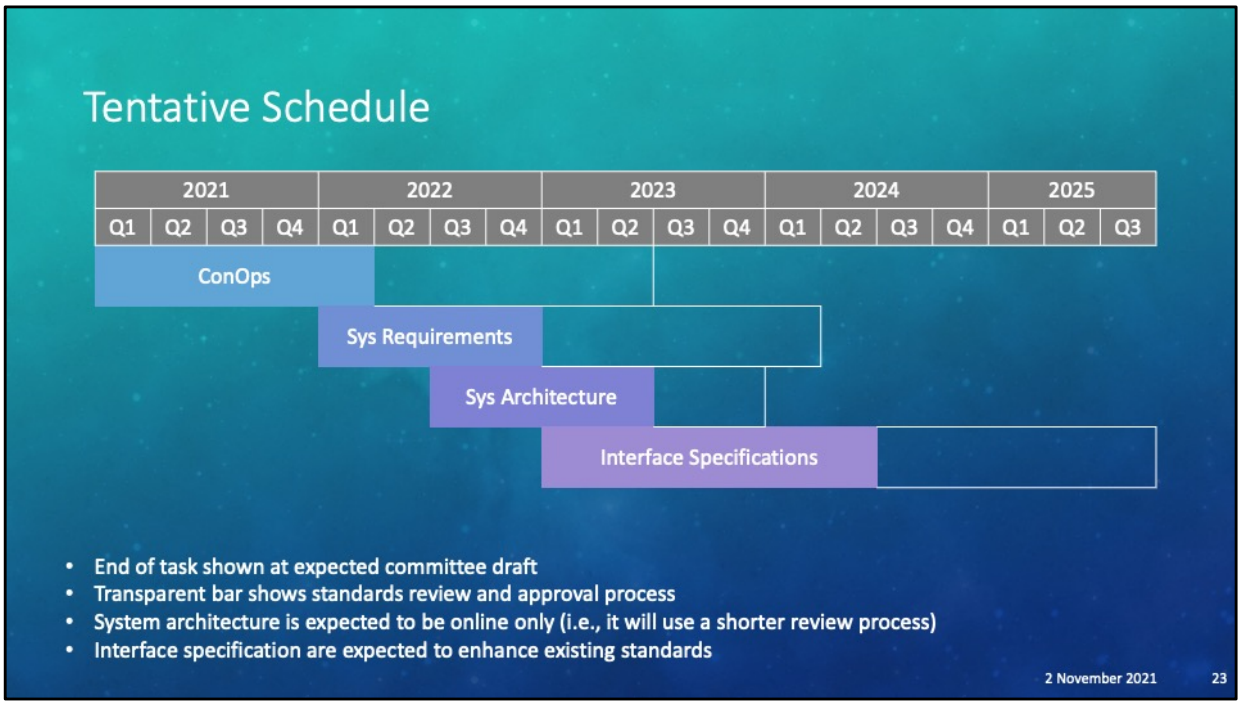
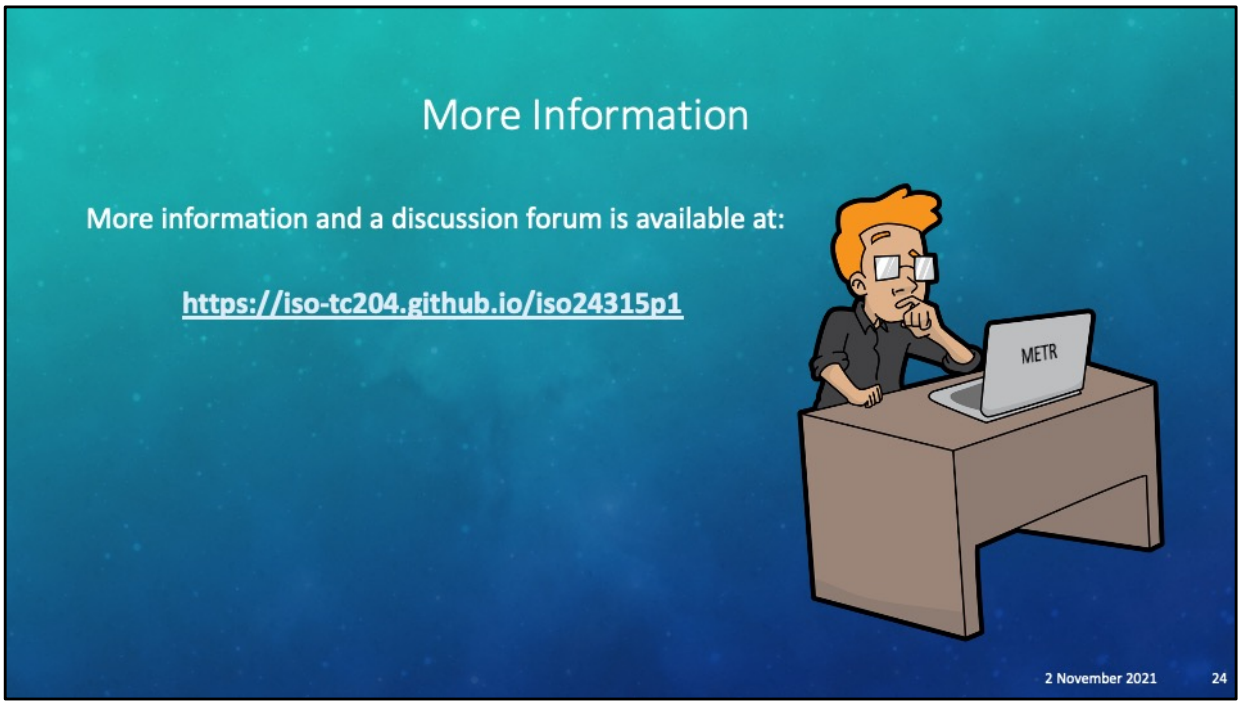
We've now completed 6 of our 12 workshops; we are half way through. Our next workshop will focus on campus governance.

The workshop will focus on the topics shown on this slide



As a reminder our current expected timeline is shown here. We hope to have a ConOps draft in early 2022, whereupon it will start the standardization process (of multiple reviews prior to standardization)



More information about the project and the latest developments will be posted on our GitHub site. This will include a PDF of weekly presentation files to be posted after our meetings each week.

https://upload.wikimedia.org/wikipedia/commons/thumb/2/24/Cartoon_Guy_In_Deep_Thought_Using_A_Computer.svg/1200px-Cartoon_Guy_In_Deep_Thought_Using_A_Computer.svg.png