

Webinar #2:

Connected Vehicle Data Ecosystem & Applications

Wednesday, August 2, 2023 | Kjeld Lindsted & Lauren Cordova

Panasonic Smart Mobility Office

Cirrus Platform Overview

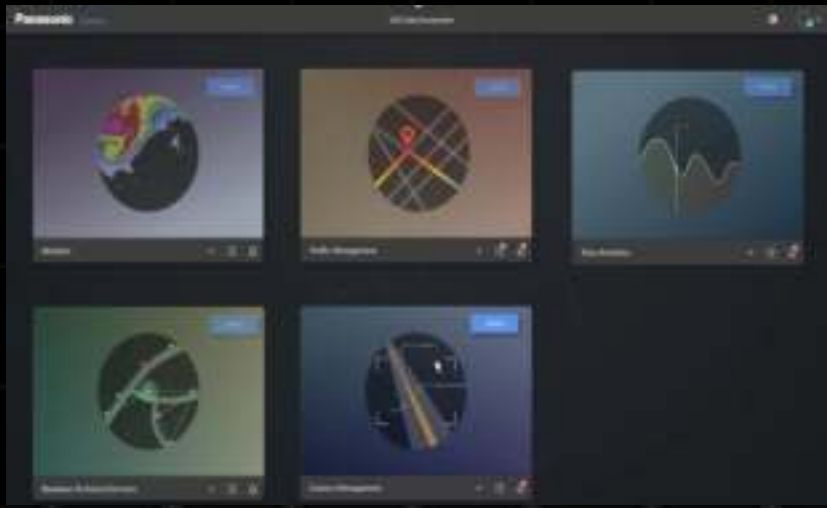
Kjeld Lindsted, Cirrus Product Manager
Panasonic Smart Mobility Office

Cirrus by Panasonic

Deployment Solutions



Cloud Platform



Cloud Platform Approach



+

Critical pipelines & infrastructure



+

Highly decoupled, asynchronous architecture



+

Serverless, event-driven design



+

Internet scale



+

Strong security-first approach, regardless of data type

Connected Vehicle Ecosystem Approach



V2X: A Common Mobility “Language”



*Work Zone Warning
Curve Speed Warning
Spot Weather Impact Warning
Crash Detection*

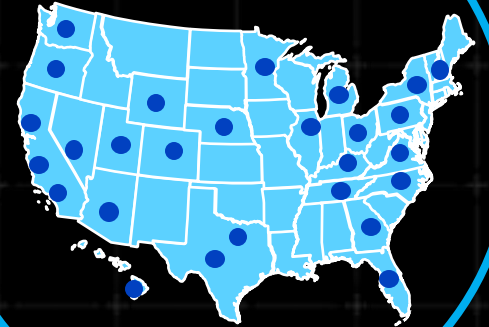


*Transit Signal Priority
Emergency Vehicle Preemption
Freight Signal Priority
Snowplow Preemption*



*Vulnerable Road User Alert
Red Light Violation Warning
Green Wave & Speed
Advisory
Collision Avoidance*

V2X



Security through Standardization



Message
Authenticity

Allow messages only from trustworthy sources



Message
Authorization

Allow messages to only do authorized things



Message
Integrity

Allow messages only if not modified en route

Secure Driver/
Owner Identity



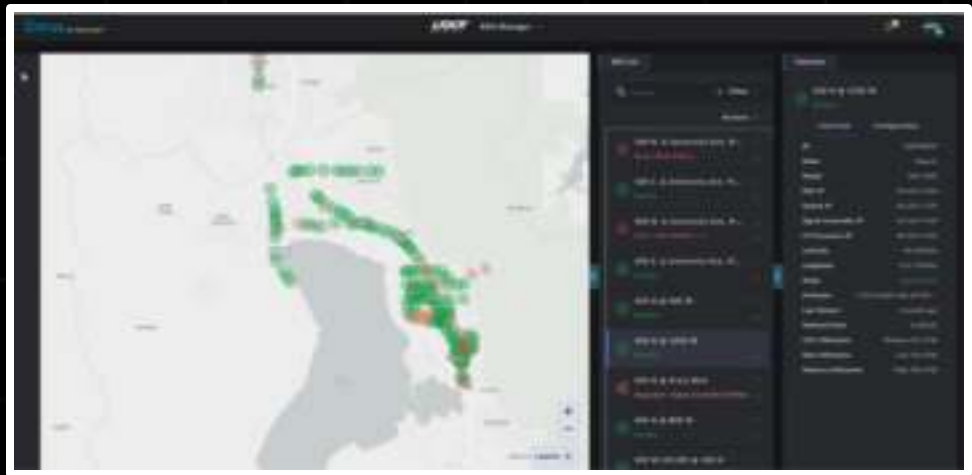
Secure Make/
Model/Year/VIN



Anonymize
Origin/
Destination



Cirrus V2X Applications



Sample Road Events Detected from BSMs



- **Hard Brake** (from vehicle acceleration/deceleration data)
- **Hazard Lights** (from vehicle light status data)
- **Rain** (from vehicle wiper and temperature sensor data)
- **Snow** (from vehicle wiper, temperature sensor, and traction control data)

Road Events are Detected from BSMs

The screenshot displays the UDOT Traffic Manager interface. On the left, a map of Utah shows a red location marker in the southern part of the state. On the right, a sidebar contains two panels: 'Alerts' and 'Events'. The 'Alerts' panel shows a 'Hard Braking' alert for vehicle ID 40-2076, with a 'Traveler Information Message' and a 'Send When Status Available' option. The 'Events' panel shows a list of 'Hard Braking' events for the same vehicle ID, with timestamps ranging from 3 to 4 minutes ago.

Alerts

1 message

Hard Braking
- 40-2076, No. 111-7141

Traveler Information Message
Traveler info not active. TIRs associated with this event.

[View All Time](#)

Details

- Number of Vehicles Reported: 1
- Send When Status Available: Off

Events Message Manager

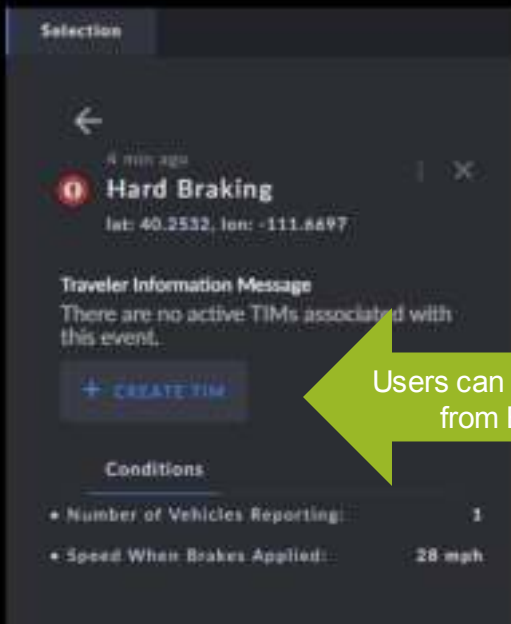
1 Item

Event: 3 Events

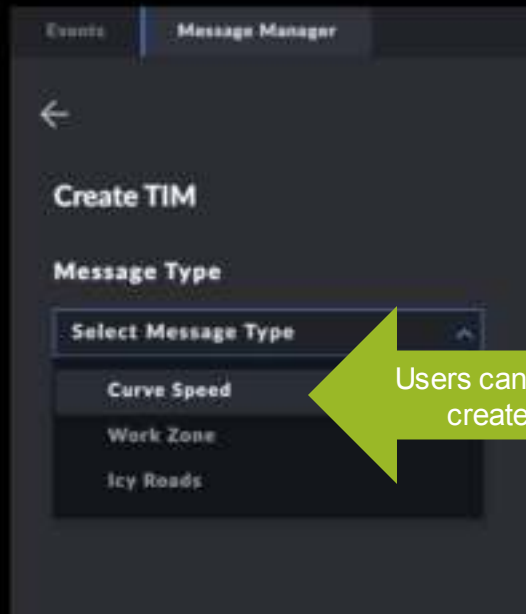
- 3 min ago
Hard Braking
- 40-2076, No. 111-7141
- 3 min ago
Hard Braking
- 40-2076, No. 111-7141
- 4 min ago
Hard Braking
- 40-2076, No. 111-4478

Cirrus Warns Drivers About Events

Example TIMs



Users can create TIMs from Events

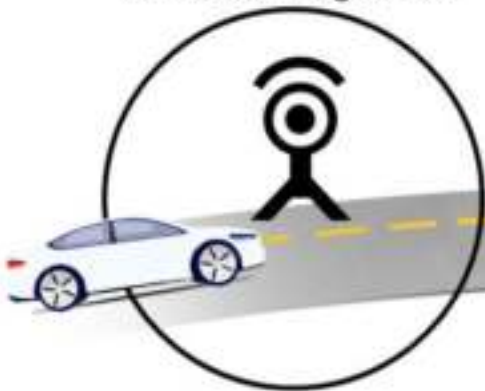


Users can manually create TIMs



TIMs can be deployed from any RSU

TIMs received only while vehicle is in range of RSE



TIMs are displayed in the vehicle when it reaches the designated location within the active window of time for the TIM



Data Deep Dive

Lauren Cordova, Head of Data Science & Analytics
Panasonic Smart Mobility Office



Utah BSM Data and Event Volumes in July 2023



Raw Data

322 Million Basic Safety Messages (BSMs)

39 GB of Basic Safety Messages (BSMs)

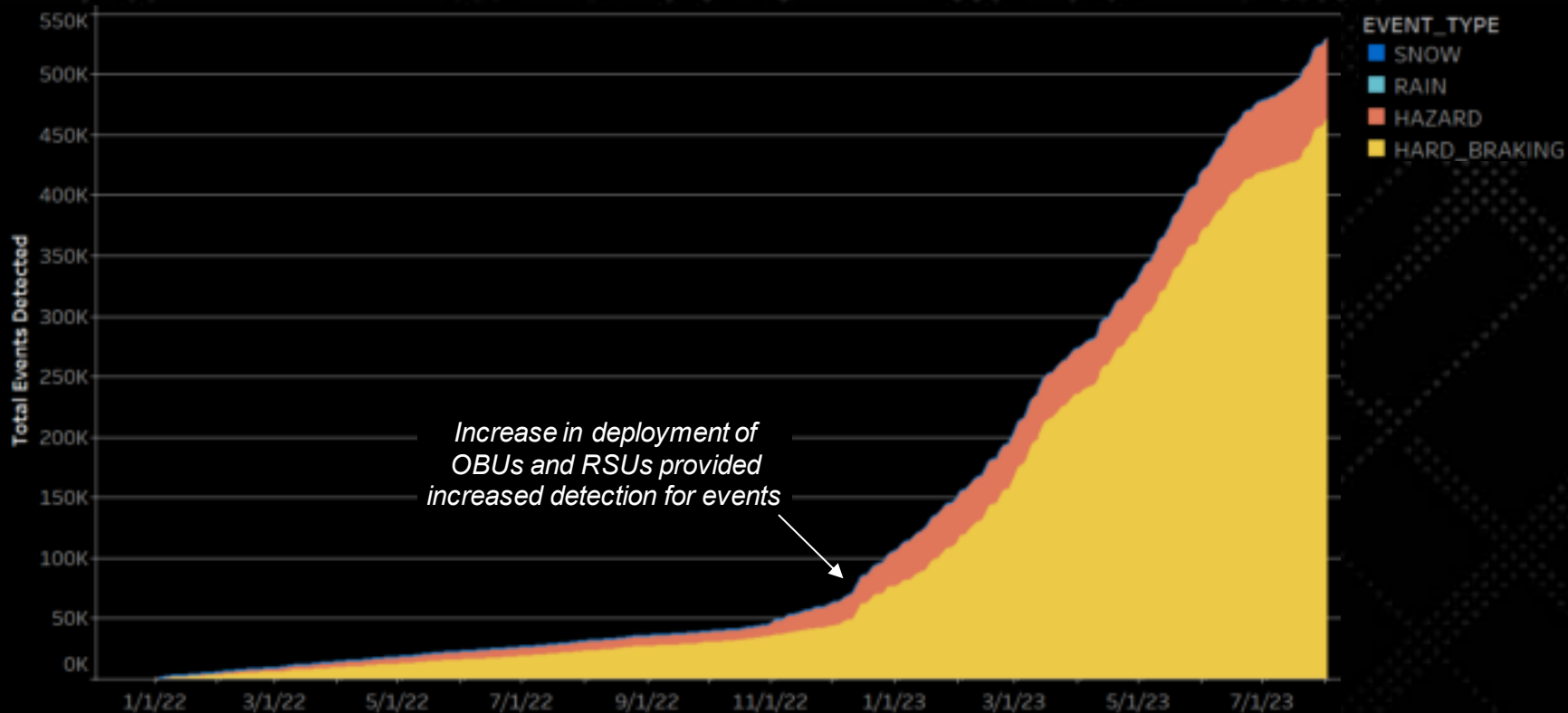


Insights

38,000 Hard Braking Events

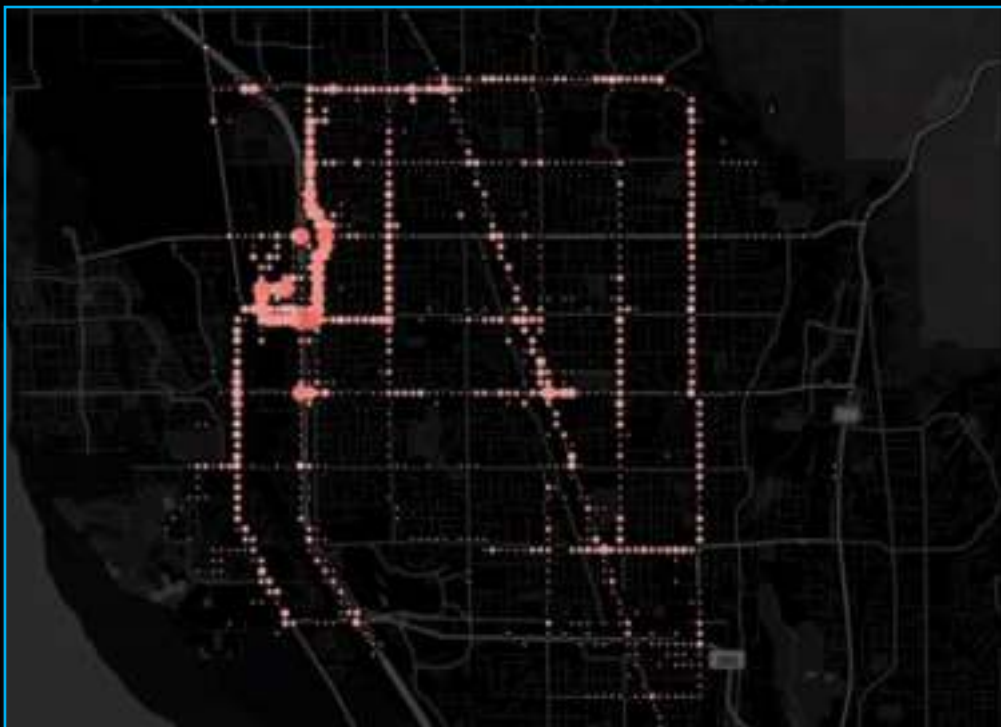
9,000 Hazard Light Events

Utah Roadway Events Detected



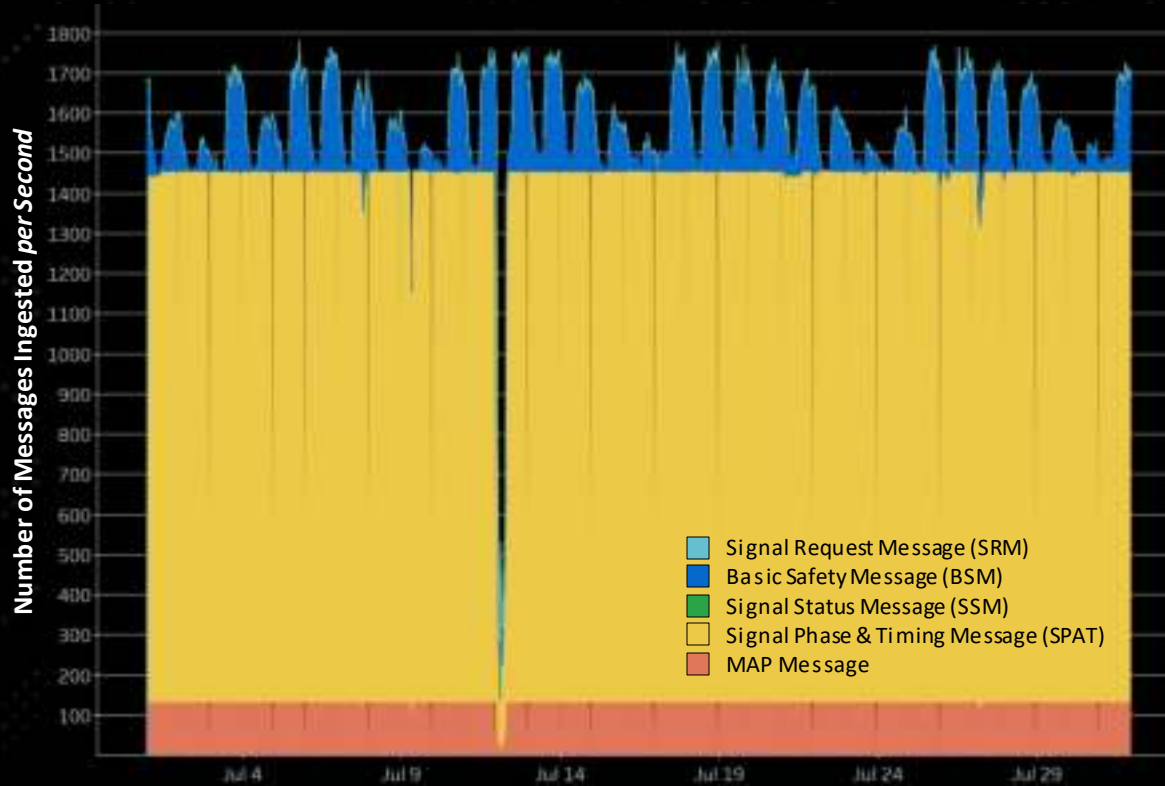
Increase in deployment of OBUs and RSUs provided increased detection for events

Hard Braking Example



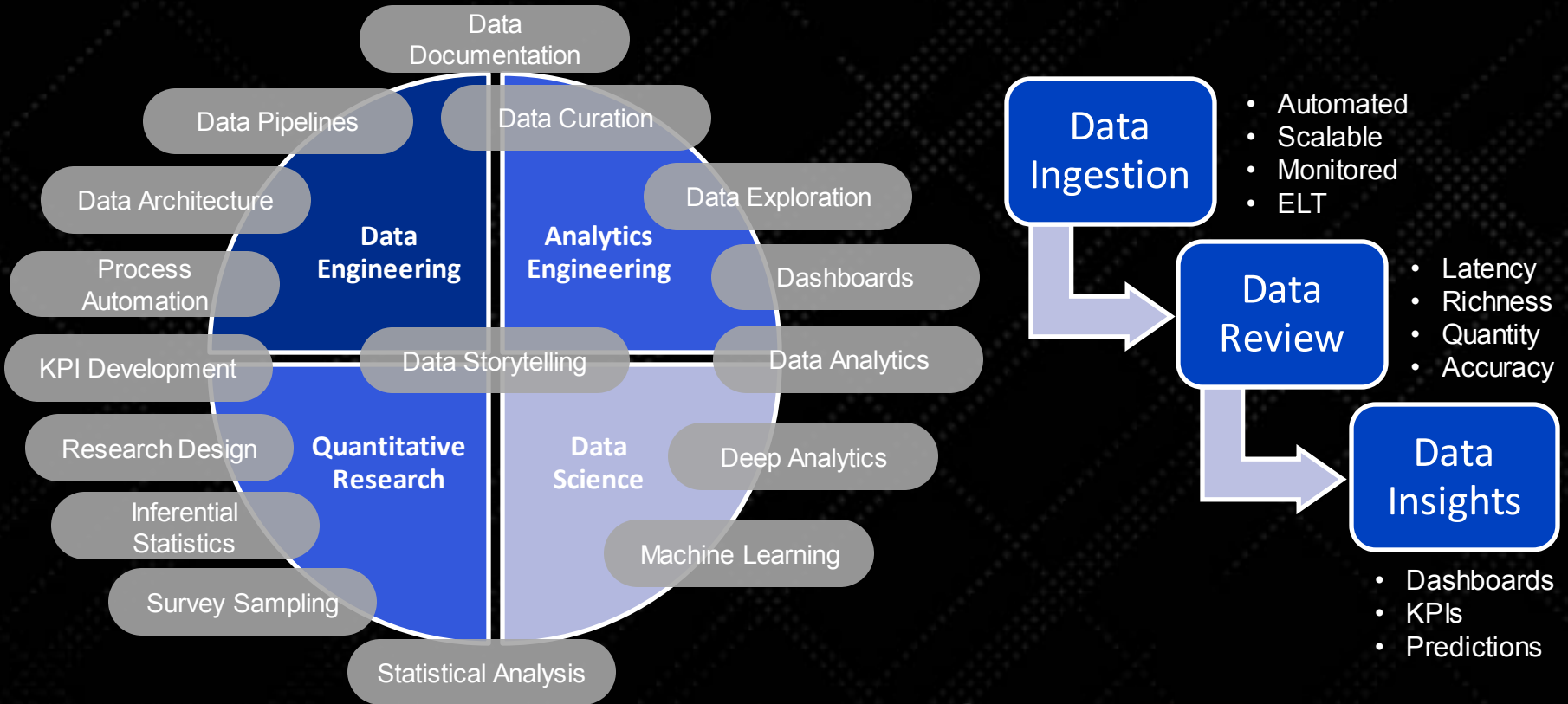
- The map to the left plays hard brake events in the UDOT V2X enclave by week in 2023
- Darker, larger circles represent locations with the most hard braking events detected

Continuous Data Processing



- Connected Intersection messages sent continuously
 - SPAT at 10Hz
 - MAP at 1Hz
- Vehicle based messages sent when vehicles are present
 - BSMs at 10Hz
 - SRMs at 10Hz
 - SSMs at 10Hz
- Cirrus requirements for low latency ingestion and detection

Data Science & Analytics Team & Methodology



Data Science & Analytics Team & Methodology



Data Ingestion

- Automated
- Scalable
- Monitored
- ELT

Data Review

- Latency
- Richness
- Quantity
- Accuracy

Data Insights

- Dashboards
- KPIs
- Predictions

Overview of UDOT/Panasonic Data Community

Mission Statement

To advance innovation and collaboration with a diverse community of transportation experts through a curated data ecosystem.

Benefits

- Cloud Data Warehouse
- Curated & Documented Datasets
- Easy Accessibility
 - Web Based Query IDE
 - BI Tools (Tableau, Power BI, Looker, Spotfire etc.)
 - Microsoft Office Tools (Excel, Access)



Users

75+



Companies

16



Public Agencies

10



Universities

5

Data Community Instructions

Web Based Documentation Platform

Instructions are provided to connect to the available datasets via several common tools. However, there are numerous other software platforms capable of connecting with the same database server information. Data community members can reach out us if assistance is needed connecting with a different set of tools.

Instruction Guides

- [Connect to Snowflake \(Web\)](#)
- [Connect to Tableau](#)
- [Connect to DBeaver](#)
- [Connect to Excel](#)
- [Connect to Access](#)
- [Connect to Python](#)

Snowflake has several options to connect with Python to develop applications in Python using data in Snowflake. The detailed information can be found in Snowflake's official user guide page (<https://docs.snowflake.com/en/user-guide/python-connector.html>), and this tutorial is a demo for the Snowflake connector in Python with SQLAlchemy Toolkit (more details can be found in <https://docs.snowflake.com/en/user-guide/sqlalchemy.html>).

Install snowflake-sqlalchemy package for Snowflake connection

Snowflake SQLAlchemy is a dialect that runs on the top of the Snowflake Connector for Python and to set a bridge between the Snowflake database and the SQLAlchemy applications.

To install Snowflake SQLAlchemy, simply run this code below in the code block/command line:

```
pip install --upgrade snowflake-sqlalchemy
```

It then will automatically start the installation process, and install all necessary packages that required for snowflake-sqlalchemy.

If you experience an error while installing the snowflake-sqlalchemy connector execute the following command:

```
pip install (error packages) --upgrade
```

Data Dictionary

Web Based Documentation Platform

- Data Dictionary
- Universal Search Feature

TYPE	NAME	DESCRIPTION
enum	network_ip_address	The IP address assigned to the RSU at this location.
enum	id	Unique identifier for a TIM.
enum	event_id	An identifier related to an event.
enum	route_message_id	A unique identifier for a route message.
enum	rsu_id	Unique RSU identifier assigned by Onyx.
boolean	rsu_online_status	Returns TRUE or FALSE depending on whether an RSU successfully sent out a TIM. TRUE is successful and FALSE if not successful.
enum	status	The latest a TIM was generated in.
enum	announcement	The announcement a TIM was created in.

Overview

Traffic Information Messages (TIMs) are an [IEEE 802.11](#) defined message intended to provide alerts to drivers via V2X communications. TIMs are sent by RSUs, which are picked up by OBU's when in range of an RSU and then displayed via an HMI. When the vehicle reaches the location during the window of time defined for the TIM, the TIM view contains a record for every RSU that sent out a specific TIM; this is to say the view has one RSU and one TIM per row.

How TIMs Work

The inputs for a TIM are:

1. A sequence of ITS codes used to compose the advisory message.
2. A polyline path made of two or more (x,y)ord vertices used to define the advisory region.
3. A UTC start time and duration specifying the TIM effective time period.

All the data above is compiled into an LPMS blob and uploaded into an RSU via OBU-V2X. Once uploaded, the RSU will begin broadcasting the TIM (i.e. transmitting the blob) to all vehicles in range. Vehicles that receive the TIM store it locally in the OBU for later use (even if the vehicle drives out of range of the RSU that sent the TIM). If a vehicle ever enters an affected region (i.e. vehicle drives through a road delineated with a TIM polyline during the active time period, the TIM will fire and the ITS-coded message will be displayed in the vehicle's HMI. Notice that vehicles only store/remember TIMs while turned ON; once the vehicle is turned OFF the OBU forgets all TIMs.

TIMs received only while vehicle is in range of RSU

TIMs are displayed in the vehicle when it reaches the designated location within the active window of time for the TIM

Display TIM for each road section in this region from 8:00-9:00am

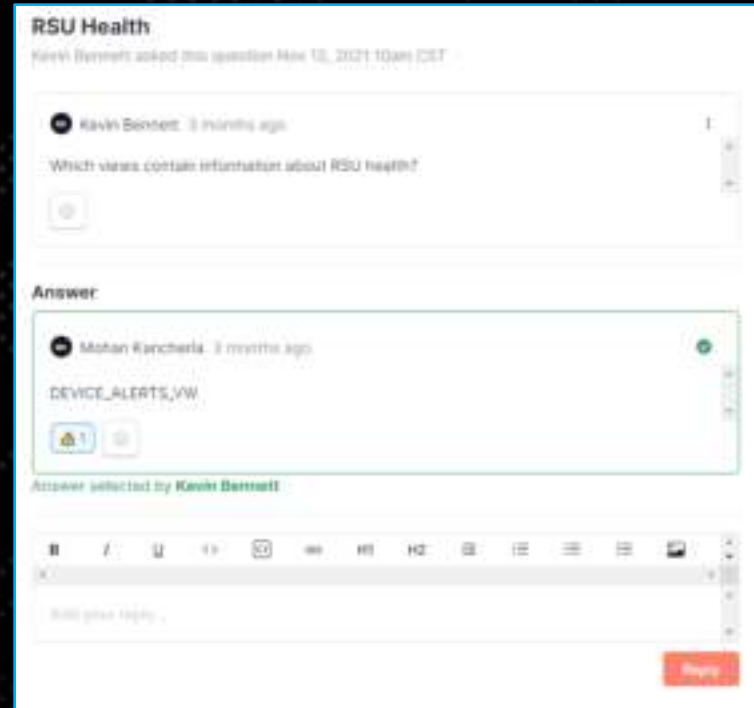
Data Community Support

If data community members experience any errors or need additional help connecting or understanding the data, there are two primary ways contact us for support:

- Dedicated support email: V2XSupport@us.panasonic.com
- Online Question Forum

Data Access Interest Form:

<https://app.s.martsheet.com/b/form/edfec6388a7046fdb1263d59acd2fa2b>



Thank You!

