CIRRUS BY PANASONIC V2X

Panasonic

Implementing Interoperable & Scalable Traffic Events

PREPARED BY

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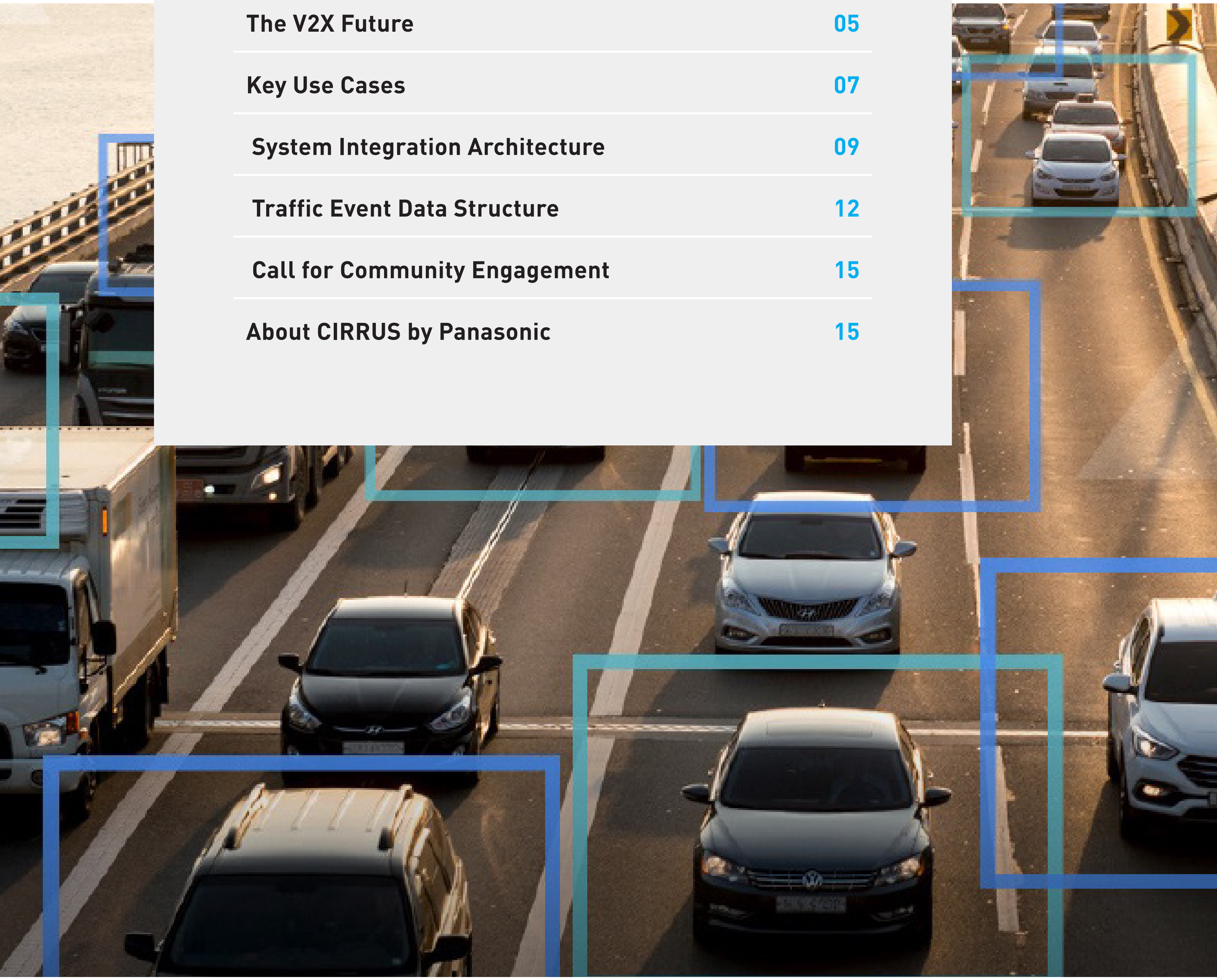


A Flexible Data Architecture for Interoperable and Scalable Traffic Events

Those of us in the transportation industry can already envision a safer, more automated version of our increasingly congested roadways: Commuters and freight vehicles smoothly zippering into construction merge zones while traffic signals automatically adjust to prioritize emergency vehicles. Behind the scenes, cloud-based software instantly processes billions of data points connected to vehicles, signals, weather, construction projects, and more.

But this dream depends on efficient data flow that can scale easily to incorporate new inputs we can't even imagine yet. That requires a data architecture designed for resilience. One that adapts when new data appears, and never becomes obsolete.

This is the mission of CIRRUS by Panasonic.

Sending relevant, timely, and accurate information to drivers is critical to improving roadway safety and making a dent in the **40,990 traffic fatalities** on US roadways in 2023 alone.

U.S. Department of Transportation

The V2X Future

Sending relevant, timely, and accurate information to drivers is critical to improving roadway safety and decreasing the 40,990 traffic fatalities on U.S. roadways in 2023 alone, according to the U.S. Department of Transportation.

Vehicle to everything (V2X) technologies provide an increasingly important, standards-based medium over which warnings can be shared to specific subsets of vehicles. Communications and traffic prioritization can be set for classification, geography, event type, and other filters to improve reach, awareness, and actionability of warnings. However, to deliver impact, V2X-based warnings require strategic development to avoid technology incompatibilities or becoming obsolete.

The CIRRUS team at Panasonic has been working with traffic event and warning data with our partners for over six years, and we have refined an optimized architecture that delivers value today while simultaneously preparing for scale to unlimited future event types. As our partners across the country look to develop new standards for these datasets such as the Federal Highway Administration's Managing Disruptions to Operations Data Exchange (MDODE), we share here our lessons learned to support implementation and scale across the industry.

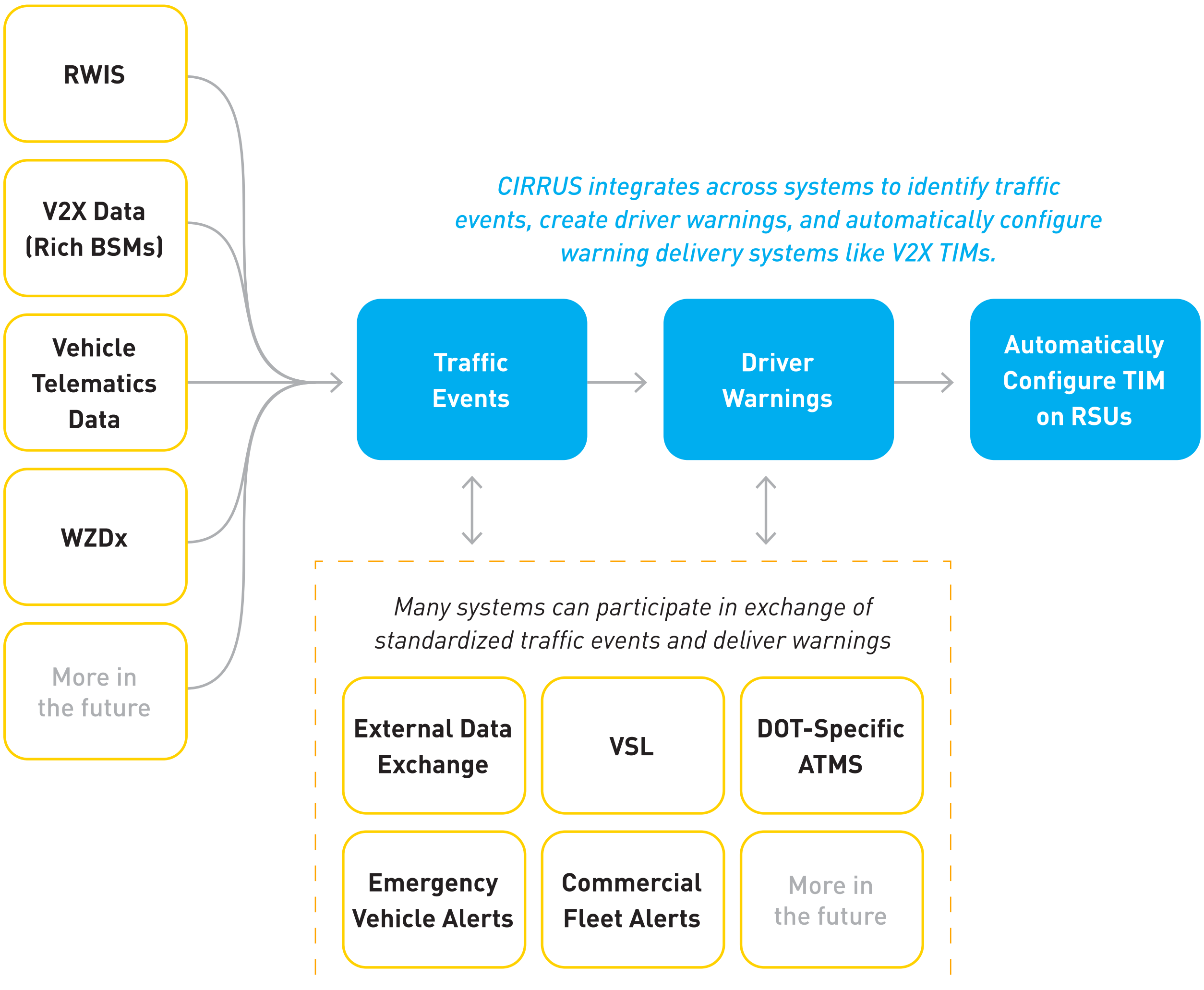
Key Use Cases

Given that there are many different types of traffic events impacting our roadways, we apply unique considerations to gathering data on each. Weather events, for example, consist of different data elements (areas of effect, event horizon) than vehicle-based events like a crash or stalled vehicle. Due to the different data collected, certain sensors or data sources may be optimized for event categories. For example, a construction event might be manually recorded vs. an automatically detected weather event.

Once traffic events are identified, a primary use case is to issue driver warnings to mitigate the event's impact on road safety and mobility. **Converting a traffic event into a driver warning requires several key considerations**:

+ The location of the event is most likely not the location of a desired warning because drivers need to be warned *before* they reach the event
+ How far in advance (and in what directions) to issue a warning may vary by location, event type, and regional regulations, among other things
+ Systems must be capable of seamlessly processing the interplay between different event types, such as a weather event that results in a crash
+ Multiple warnings must be prioritized so as not to overwhelm drivers

To handle these intricacies, Panasonic developed an architectural approach to events and warnings that fundamentally separates event detection from warning generation. This uncouples event input data from output requirements and provides the flexibility that a robust scalable system demands.



WZDx	Workzone Data Exchange	**TIM**	Traveler Information Message
ATMS	Advanced Traffic Management System	**BSM**	Basic Safety Message
RWIS	Road Weather Information Station	**RSU**	Roadside Unit
VSL	Variable Speed Limit		

Figure 1: Key components of the CIRRUS platform.

System Integration Architecture

As technology advances rapidly, traffic management systems will need to be flexible to accommodate new data streams and use cases that we can't envision today. Whatever hardware structure is in place, the underlying software must scale and adapt.

Recognizing this, CIRRUS was developed with integration points for scaling insights and impact through collaboration and partnership with many different industry initiatives. The traffic event feature manages all types of events in a common data structure and API.
See Figure 1.

Panasonic's traffic event architecture reflects two key assumptions:

+ **01** There is value in all event types being in a single, common data structure.

+ **02** We must accommodate an unknown number of data elements for both current and new event types, while minimizing breaking changes.

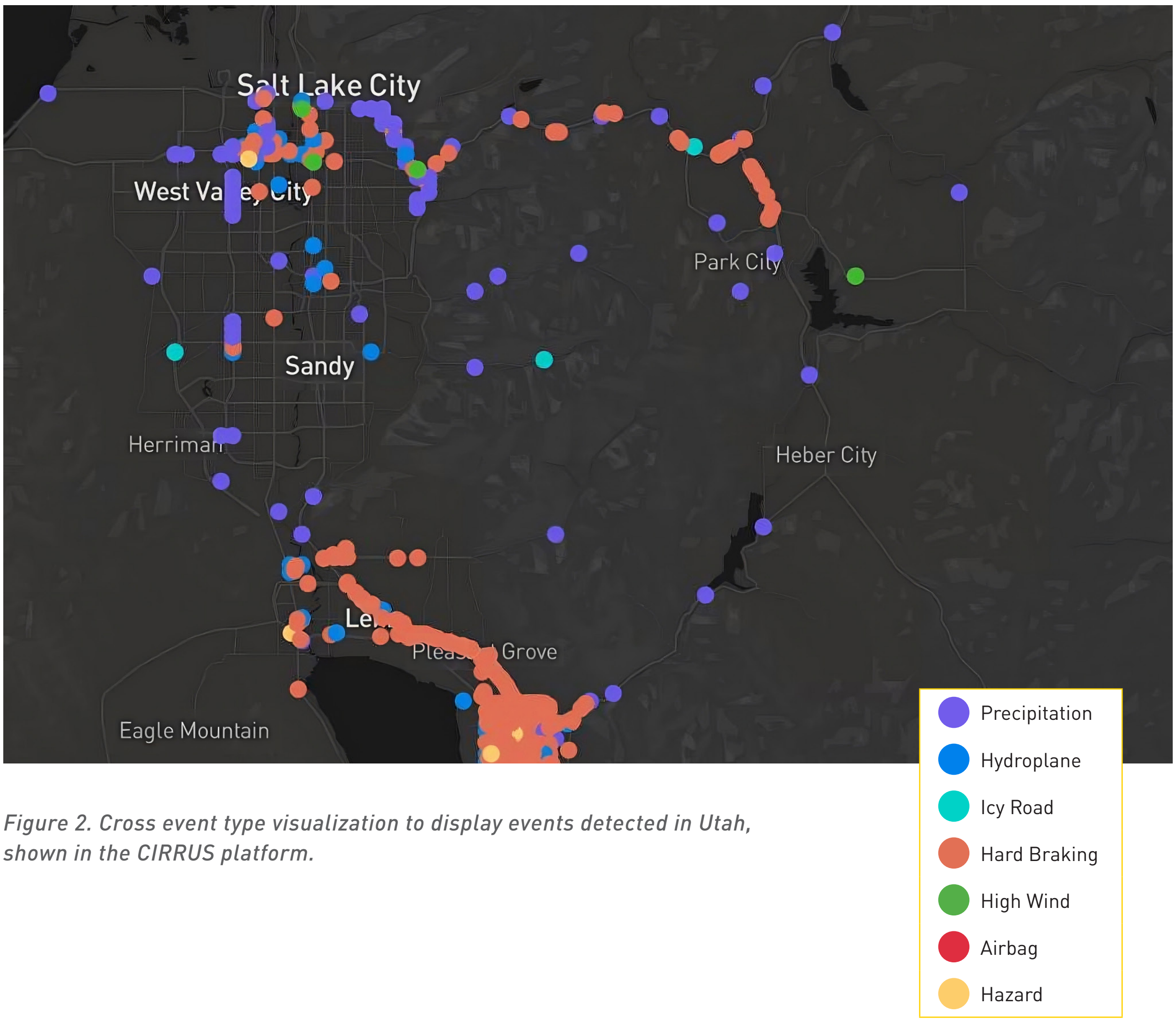


Figure 2. Cross event type visualization to display events detected in Utah, shown in the CIRRUS platform.

Going deeper on the first assumption, reporting all traffic events in a unified structure provides several benefits. For example, it makes the architecture fundamentally scalable. If a single structure can accommodate all types, then adding a new type in future doesn't break the architecture. J2540 (ITIS Phrase Lists) contains thousands of diverse potential event types, which supports future scale and accommodating new data types over time.

In addition, a consolidated event reporting structure facilitates cross-type analyses and use cases, as mentioned earlier. An operator who needs to know all events active in a location over a specific timeframe can reference a single output source. If there are multiple real-time events in a given location, those can easily be identified and prioritized for downstream applications like issuing driver warnings. ***See Figure 2.***

The second assumption addresses the tradeoffs in implementing for scale vs. customization. In this case, tailored data elements per event type could be one potential pain point. However, Panasonic has experimented with solutions to this dilemma and offers the following for consideration: a base architecture that scales across event types, with customizable metadata that may be extracted in downstream processing for more refined use cases as needed.

Traffic Event Data Structure

Capturing basic, raw data elements with freedom to expand customizable metadata is a task for data architecture. Panasonic proposes the below structure to support both scale and advanced analytics over time.

First, codify the known fields required for any event type. Generally speaking, this will comprise a unique identifier, source, type, location, time (start/end), and version.

Next implement a customizable field that allows for metadata capture which may vary over time or by event type. If the data is captured at this level, downstream processing can parse out metadata elements for tailored analyses, such as analysis of weather specific events/fields, without requiring any changes to the upstream primary data structure. When faced with events that carry new metadata fields and new versions over time, the architecture deploys simple if/then logic statements to capture the new information. Users and downstream applications can then leverage the data without the hard limitations that generally apply to breaking changes.

Table 1: The CIRRUS Data Structure.

event_id TEXT
A system-generated unique ID for the event. The event_id can be used to locate all records associated with a single event, in the case events span multiple geographic regions or times (such as weather events).

source TEXT
This element reports the organization or source identifying the event.

event_type TEXT
The type of event detected (i.e. rain, snow, ice, hard braking, etc.).

geojson JSON

Contains a JSON data structure that represents a geographic element, such as a Point or a Polygon. A generic GeoJSON data structure is comprised of a 'type' field which indicates what kind of geographic element it represents, and a 'coordinates' field, which can be a 2 item list containing long/lat coordinates for a Point element, or a list of 2 item lists of long/lat coordinates which form a Polygon.

event_metadata JSON

This element is a JSON field that provides metadata relevant to the event_type, source, and version. ***This may vary over time and is available for customization as new data elements are desired***. Because new or changing key/value pairs in this JSON structure may be implemented without a top level architecture change, this field is key to unlocking efficient scale.

start_tmstp_utc TIMESTAMP

This is the UTC timestamp when the event record (e.g. the event at this location) was first detected by the source. In the case where an event is updated, this timestamp would indicate when the update became active. For example, if a weather event occurred and an estimated end time was initially provided, but then subsequent data indicated the event would persist for a longer or shorter duration, an update record may be sent with later or earlier end_tmstp_utc, and this start_tmstp_utc would be the timestamp of the effective change to the end timestamp.

end_tmstp_utc TIMESTAMP

This is the UTC timestamp when the event record (e.g. the event at this location) is estimated to expire. All events should be sent with an estimated time to live, but updates can be made based on new data that either extends or ends early the event record. Note that TIMs cannot be created without a duration, which this data element facilitates.

version TEXT

The version of the logic reporting the event, which may be used in historical analyses to parse data elements or evaluate effectiveness of updates to the logic over time, among other use cases.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Call for Community Engagement

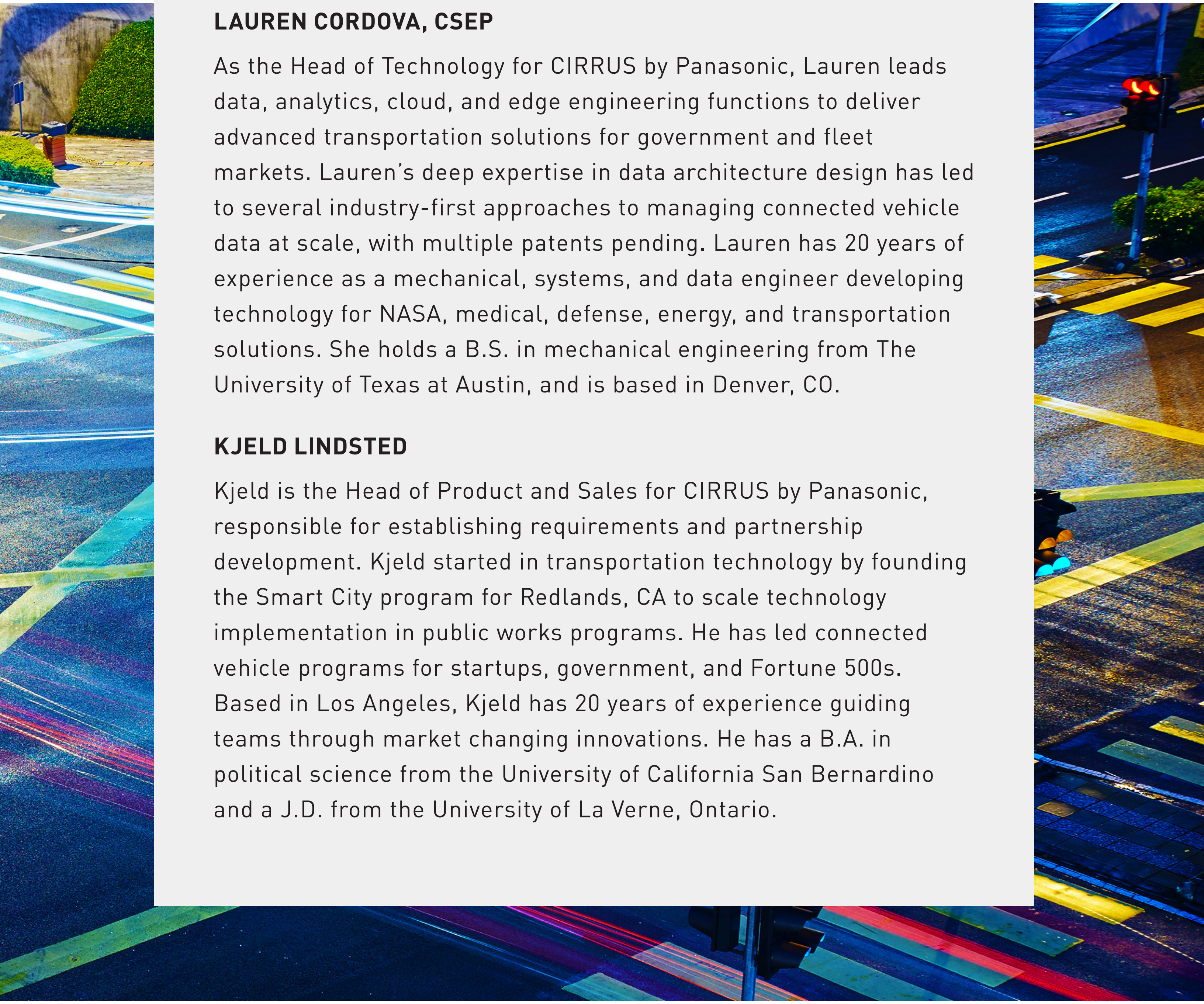
CIRRUS by Panasonic has deployed its architecture in multiple partnership applications, most notably with the Utah Department of Transportation (UDOT). UDOT has created a data community where users can access this data and provide feedback. CIRRUS believes this extensible, optimized architecture will provide value today and many years into the future through scale and expansion, and we welcome all user input as we continue to improve.

We invite others to join the movement to advance traffic event detection and analysis, and smooth impacts for everyone on the road. To join the community conversation and access the data, please visit https://mobility.na.panasonic.com/contact.

About CIRRUS by Panasonic

CIRRUS by Panasonic is a division of the Panasonic Corporation of North America's Smart Mobility Office. The CIRRUS platform enables instant and safe communication between vehicles, infrastructure, intersections, and the operations teams who manage them.

Formed in 2017, CIRRUS offers connected vehicle data and applications at scale and in the cloud. Our data collection and insights platform allows us to deliver unique intersection-specific insights, including data interaction replay (time travel). We incorporate input from edge devices, external systems, and cloud products for a scalable, complete, end-to-end solution. Learn more at https://mobility.na.panasonic.com/cirrus.



About the Authors

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As the Head of Technology for CIRRUS by Panasonic, Lauren leads data, analytics, cloud, and edge engineering functions to deliver advanced transportation solutions for government and fleet markets. Lauren's deep expertise in data architecture design has led to several industry-first approaches to managing connected vehicle data at scale, with multiple patents pending. Lauren has 20 years of experience as a mechanical, systems, and data engineer developing technology for NASA, medical, defense, energy, and transportation solutions. She holds a B.S. in mechanical engineering from The University of Texas at Austin, and is based in Denver, CO.

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Kjeld is the Head of Product and Sales for CIRRUS by Panasonic, responsible for establishing requirements and partnership development. Kjeld started in transportation technology by founding the Smart City program for Redlands, CA to scale technology implementation in public works programs. He has led connected vehicle programs for startups, government, and Fortune 500s. Based in Los Angeles, Kjeld has 20 years of experience guiding teams through market changing innovations. He has a B.A. in political science from the University of California San Bernardino and a J.D. from the University of La Verne, Ontario.