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IOT311

Building connected vehicle and mobility platforms with AWS

Katja-Maja Kroedel

IoT Specialist Solutions Architect
AWS

Mike Tzamaloukas

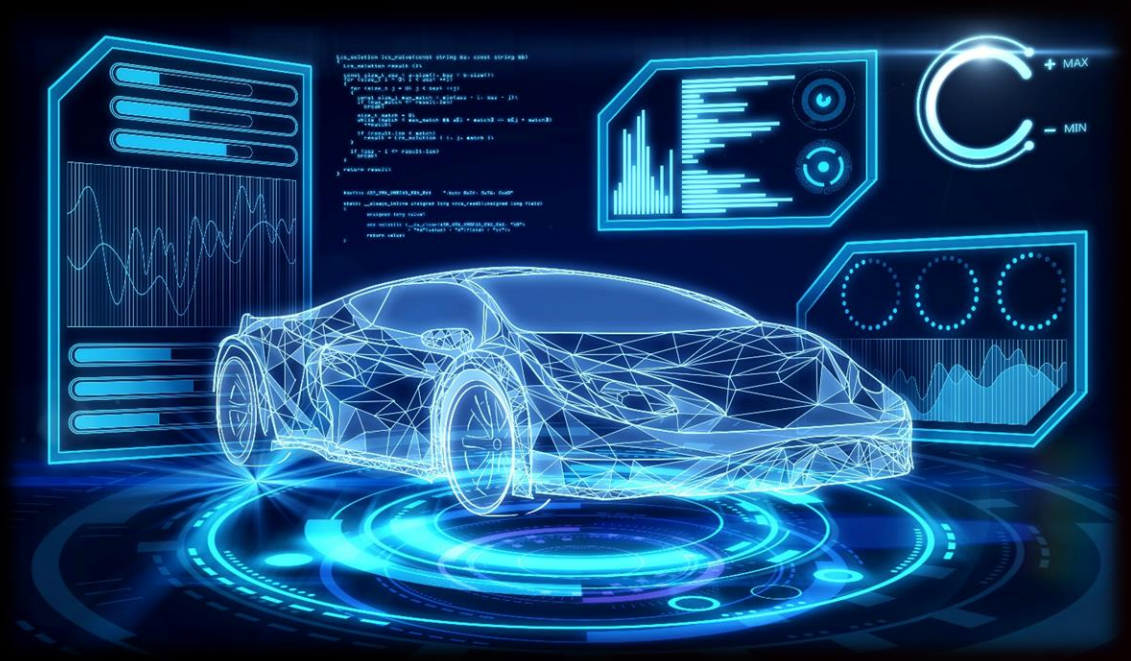
General Manager, IoT Automotive
AWS

Kevin Klinemeier

Chief Architect
Mercedes-Benz Research & Development North America, Inc.

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Connected vehicles: Challenges & opportunities



Automate vehicle **onboarding** and **testing**

Discover and collect **high volume of data**

Earn customer trust with **robustness**, **security**, and **privacy**

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Connected vehicle platform architectural layers

Cybersecurity protection

Applications layer
Business use cases, differentiation

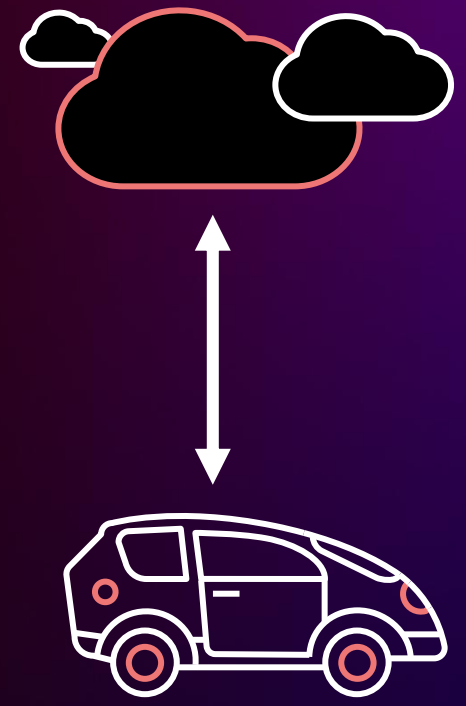
Operations layer
Monitoring, customer support, deployment

Software abstraction layer
Containers, CI/CD

Data abstraction layer
Model, select, collect

Connectivity layer
Secure connection from vehicle to cloud (MQTT, HTTPS)

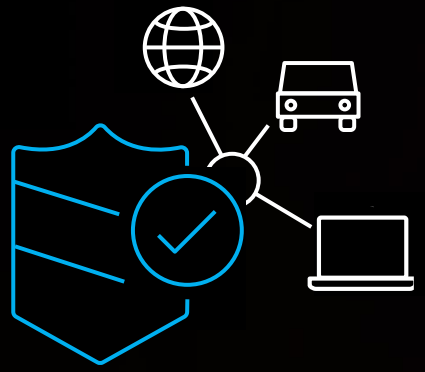
Device layer
Hardware abstraction, OS, device onboarding and management



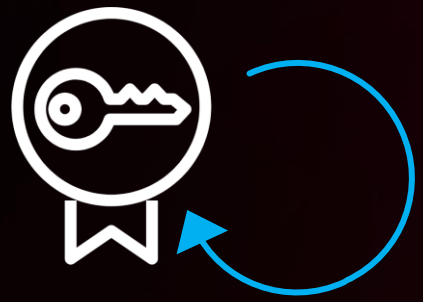
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AWS IoT Core enables large-scale connected vehicle workloads

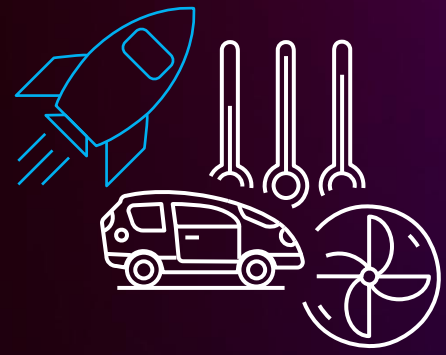
CONNECT, MANAGE, AND SCALE YOUR DEVICE FLEET EASILY AND RELIABLY



Connected vehicles device management



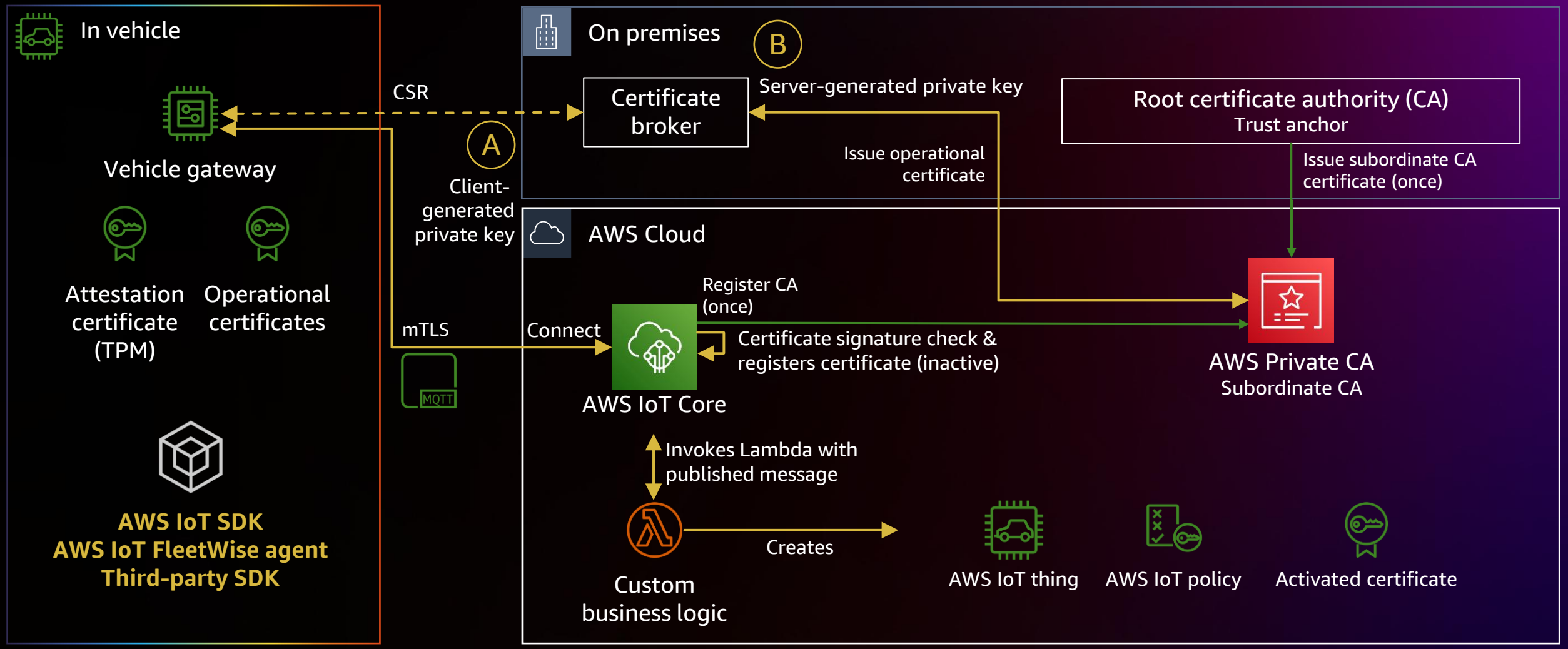
Connected vehicle device defender



AWS IoT Core launches native MQTT 5 support

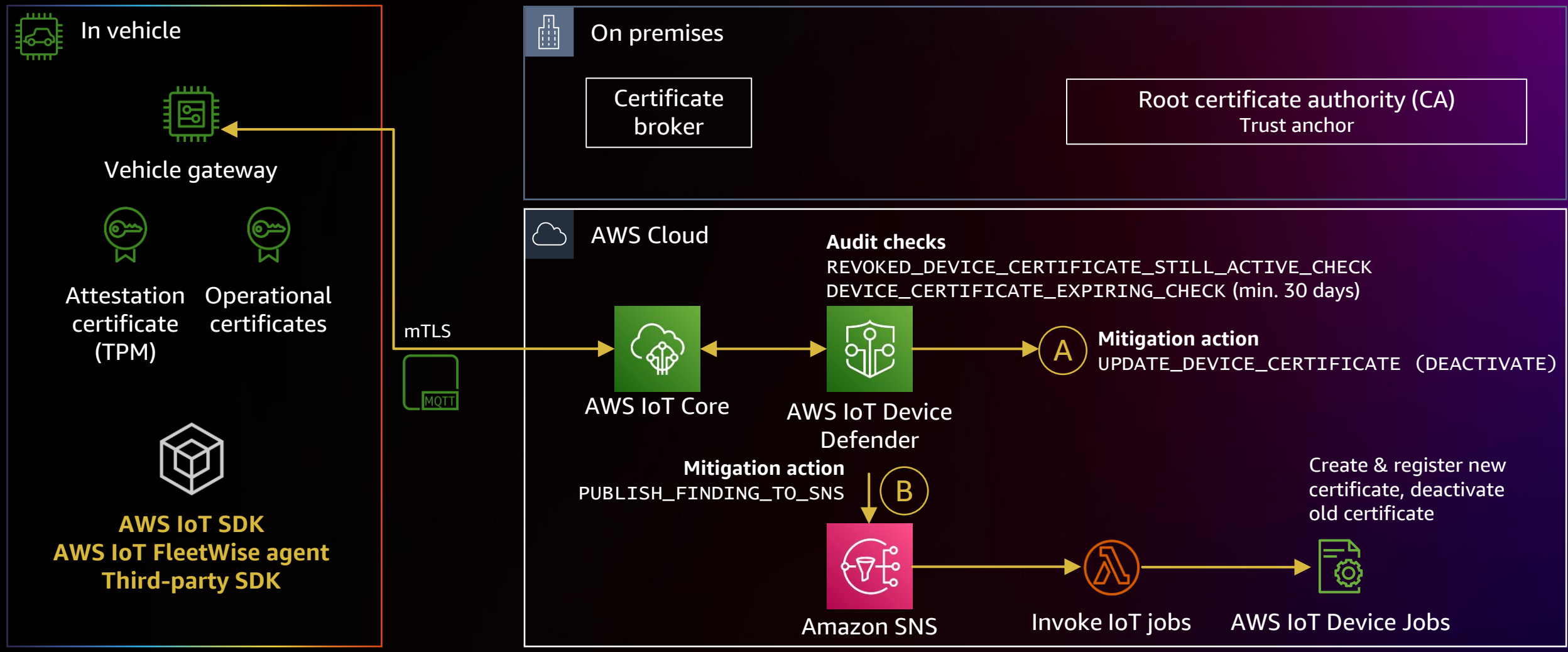
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Best practice: Securing ECU communication



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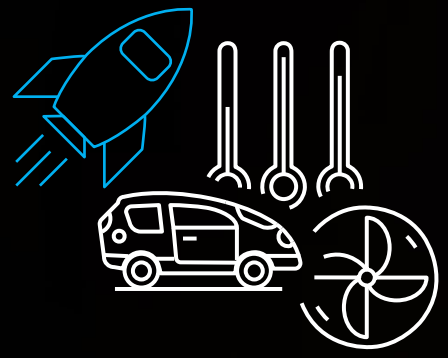
Best practice: Automate certificate rotation



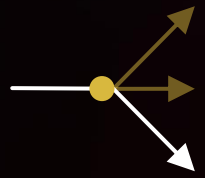
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AWS IoT Core: Native MQTT 5

New



AWS IoT Core launches native MQTT 5 support



Add **fault tolerance** and **redundancy** to your subscriber fleet through shared subscriptions



Implement **low-latency confirmation patterns** with request/response

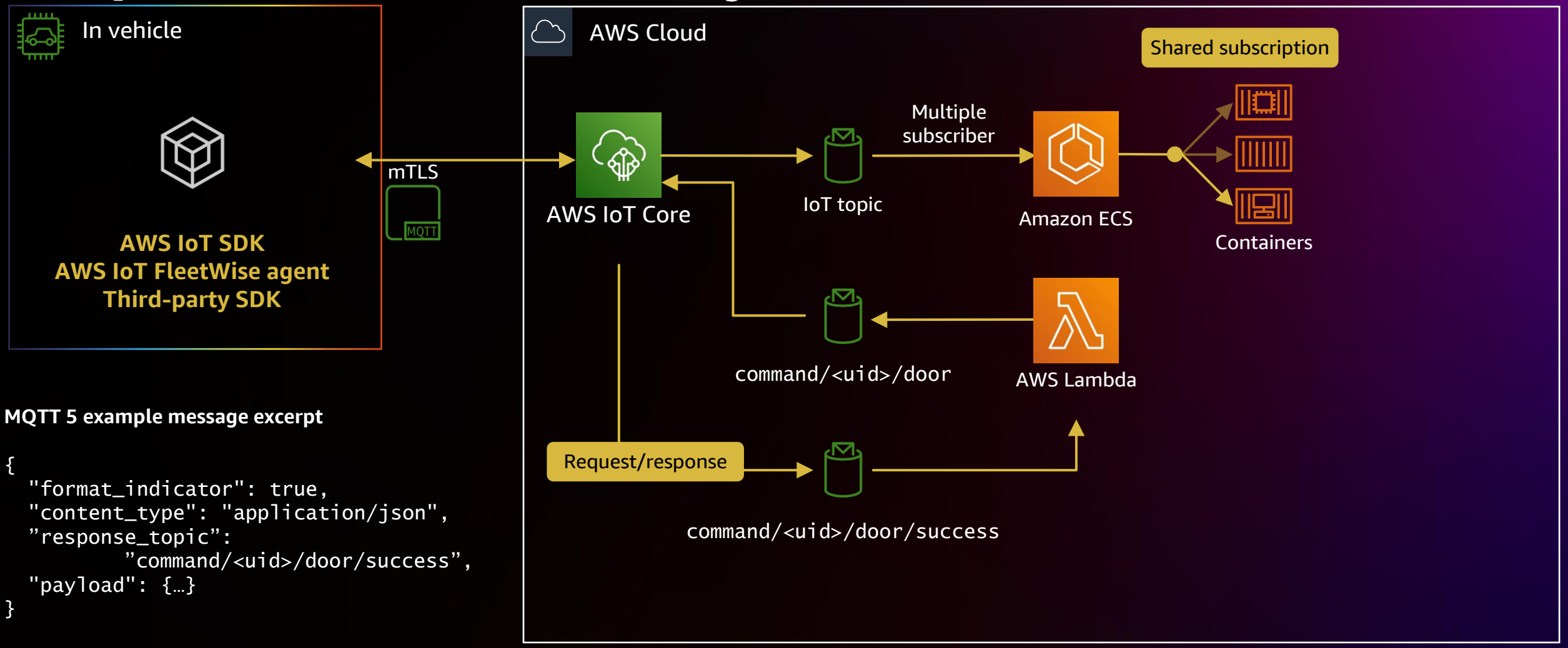


Optimize your **routing** using user properties

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Increase fault tolerance and implement low-latency confirmation

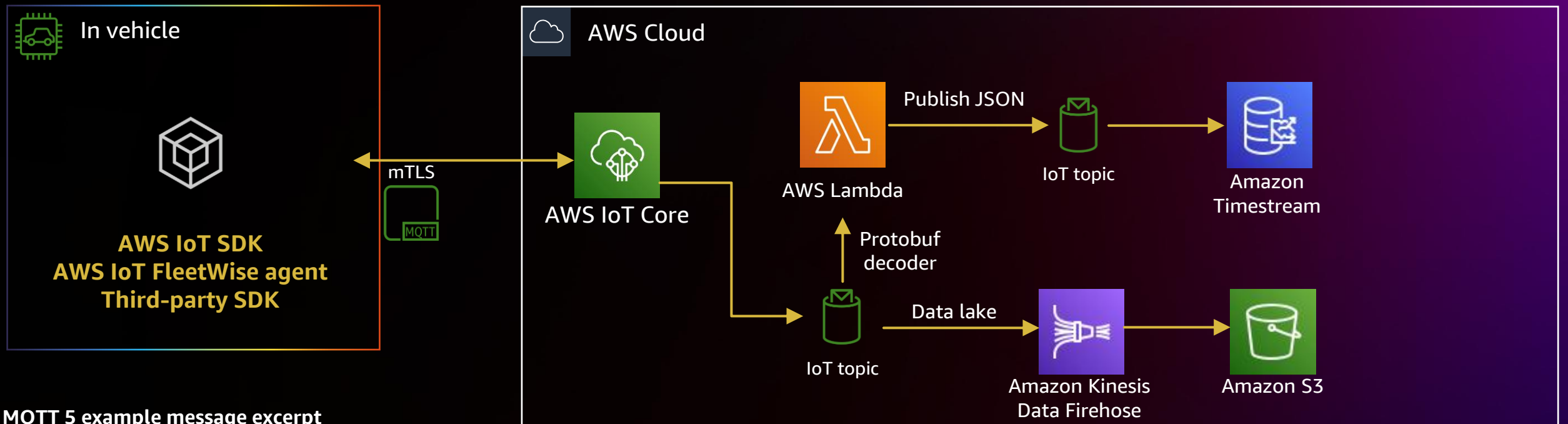


MQTT 5 example message excerpt

```
{
  "format_indicator": true,
  "content_type": "application/json",
  ”response_topic”:
          ”command/<uid>/door/success”,
  "payload": {…}
}
```

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Optimize message routing



MQTT 5 example message excerpt

```
{
  "format_indicator": true,
  "content_type": "application/x-protobuf",
  "user_properties": [
    {"service": "maintenance"},
  ],
  "payload": "<protobuf encoded message>"
}
```

IoT rule SQL example

```
SELECT encode(*, 'base64') AS payload,
       get_mqtt_property('content_type') as contentType,
       get_mqtt_property('format_indicator') as payloadFormatIndicator

WHERE get_mqtt_property('content_type') = "application/x-protobuf" AND
      get_user_properties('service') = "maintenance"
```

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Challenges with vehicle data



Data fragmentation

Unique data formats across vehicle models and components makes it challenging to generate fleet-wide insights



Data tsunami

Vast amounts of data from advanced sensors like cameras make it difficult and expensive to isolate the data signals you need in a sea of noise



Data delays

Data comes too late for users to quickly mitigate fleet-wide problems or provide customers with preventative maintenance

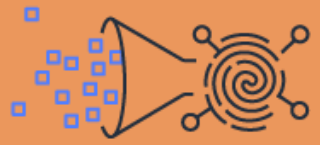
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Cloud-first architecture: From ETL to MSV



Extract



Transform



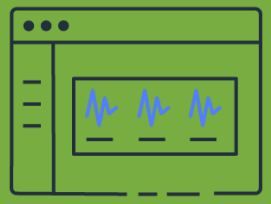
Load



Model



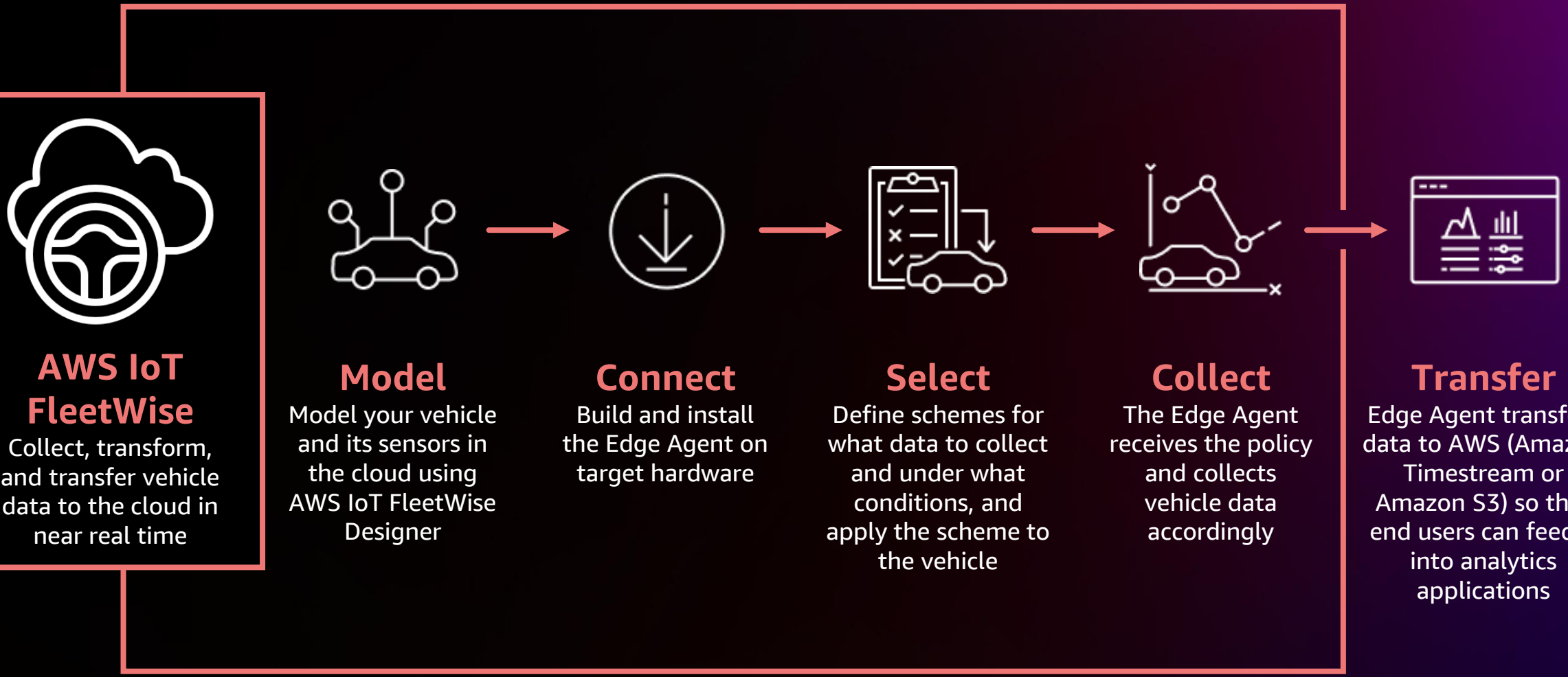
Select



View

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How AWS IoT FleetWise works



AWS IoT FleetWise

Collect, transform, and transfer vehicle data to the cloud in near real time

Model

Model your vehicle and its sensors in the cloud using AWS IoT FleetWise Designer

Connect

Build and install the Edge Agent on target hardware

Select

Define schemes for what data to collect and under what conditions, and apply the scheme to the vehicle

Collect

The Edge Agent receives the policy and collects vehicle data accordingly

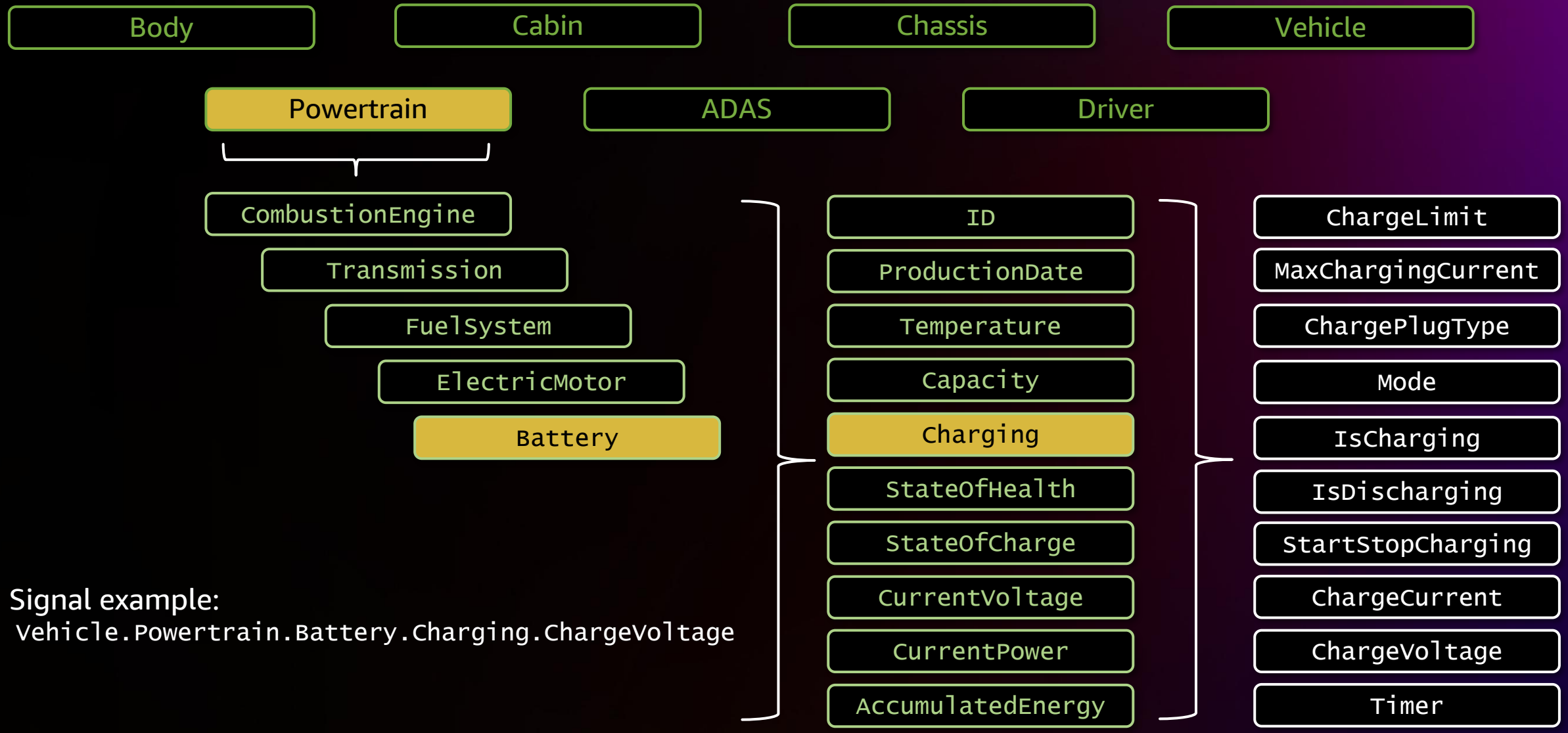
Transfer

Edge Agent transfers data to AWS (Amazon Timestream or Amazon S3) so that end users can feed it into analytics applications

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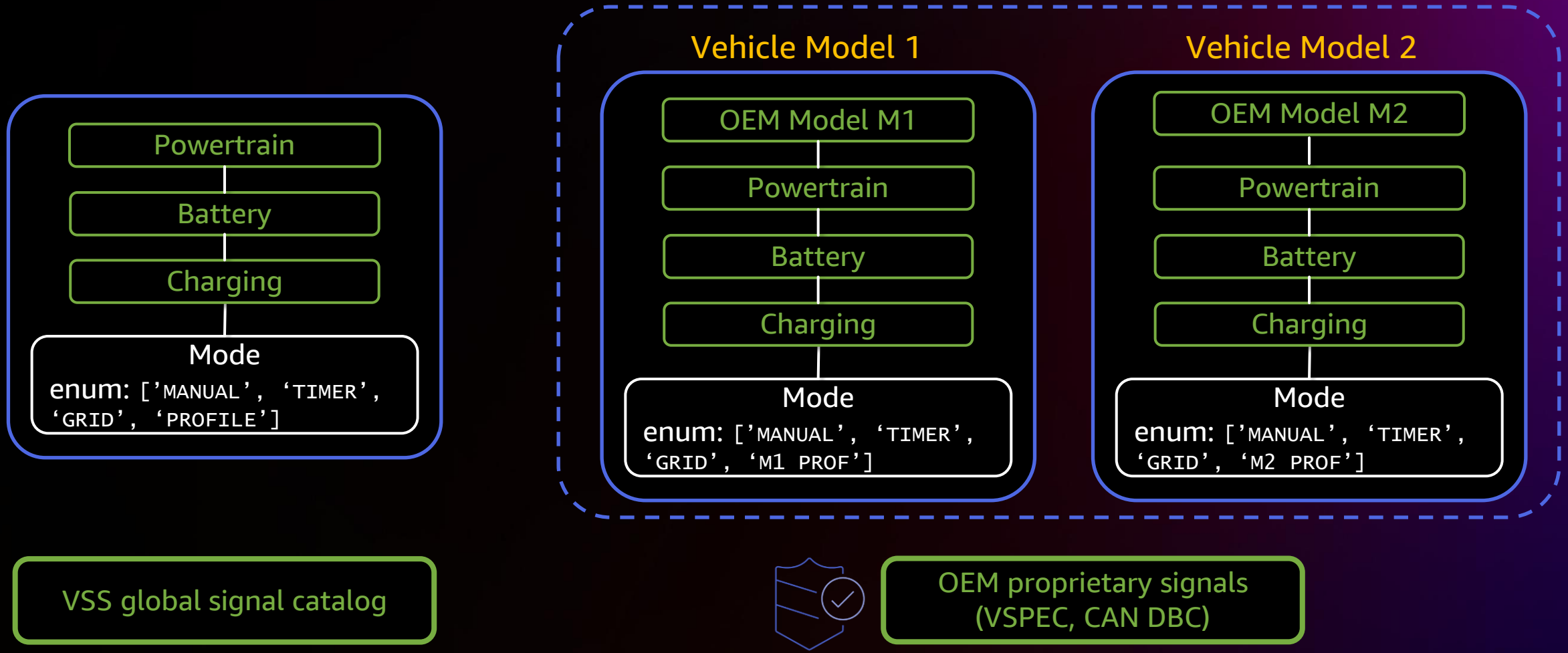
Modeling vehicle data with VSS



Signal example:
`Vehicle.Powertrain.Battery.Charging.ChargeVoltage`

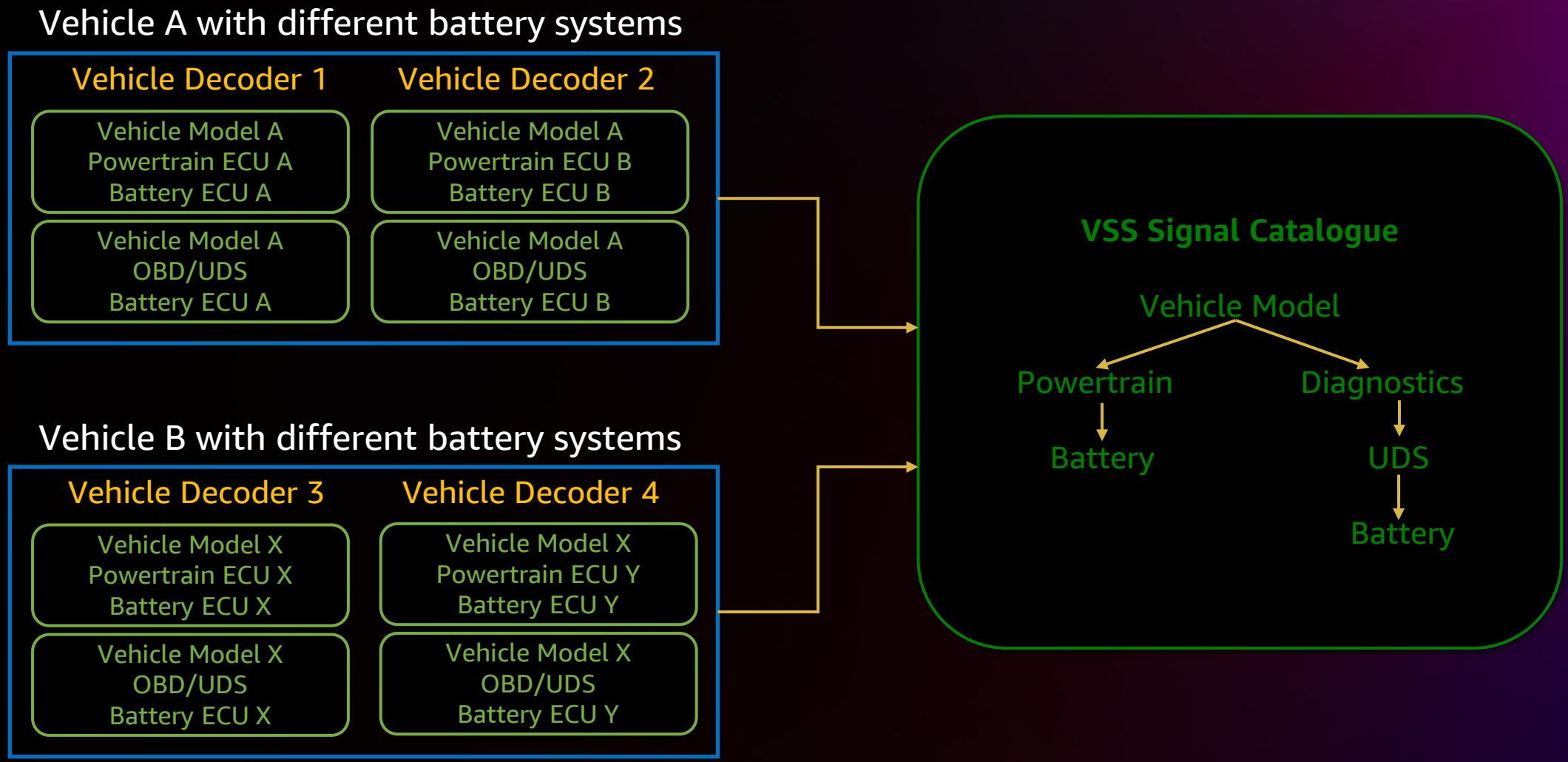
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Securely mapping private signals to a global signal catalog



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Working with multiple model decoders



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Easy and flexible data collection



QA engineer/vehicle ops

Create campaign

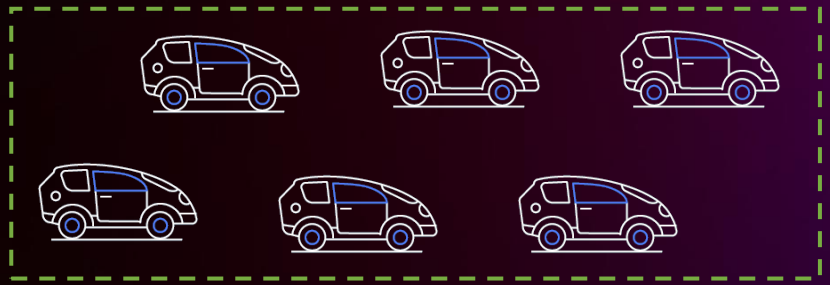
Select vehicle fleet

Data collection campaign

Name, ARN



Fleet X: All 2020 electric vehicles in North America



```
Battery_Data_1:
{
  Vehicle.Powertrain.Battery.Charging.ChargeVoltage,
  Vehicle.Powertrain.Battery.Charging.ChargeCurrent,
  Vehicle.Powertrain.Battery.Charging.IsCharging,
  Vehicle.Powertrain.Battery.Charging.IsDischarging,
  Vehicle.Powertrain.Battery.Charging.Temperature
}
mode: heartbeat,
sample: 100msec,
duration: 10sec
```

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Data storage in Amazon Timestream

eventId	vehicleName	campaignName	measure_name	measure_value	time
123	mycar1	Battery_Data_1	ChargeVoltage	180	2022-10-10 10:20:30
234	mycar1	Battery_Data_1	ChargeCurrent	24	2022-10-10 10:20:30
345	mycar1	Battery_Data_1	IsCharging	0	2022-10-10 10:20:30
456	mycar1	Battery_Data_1	IsDischarging	1	2022-10-10 10:20:30
567	mycar1	Battery_Data_1	Temperature	88	2022-10-10 10:20:30

```
SELECT * FROM IoTFleetWiseDB."newVehicleDataTable"
WHERE vehicleName='mycar1'
  AND campaignName='Battery_Data_1'
  AND measure_name='ChargeCurrent'
  AND measure_value < 5)
```

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Data visualization in Amazon Managed Grafana



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Electric vehicle (EV) battery use cases

- Fault and warning monitoring
- Performance degradation
- Anomaly detection – e.g., fire risk
- Vehicle range estimation
- Governance – carbon credits
- Charge optimization/fast charge
- Residual battery lifecycle and resell value
- Test and simulation for failure prediction

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Mercedes-Benz Research & Development North America

Kevin Klinemeier
Chief Architect – Cloud Foundation

Mercedes-Benz

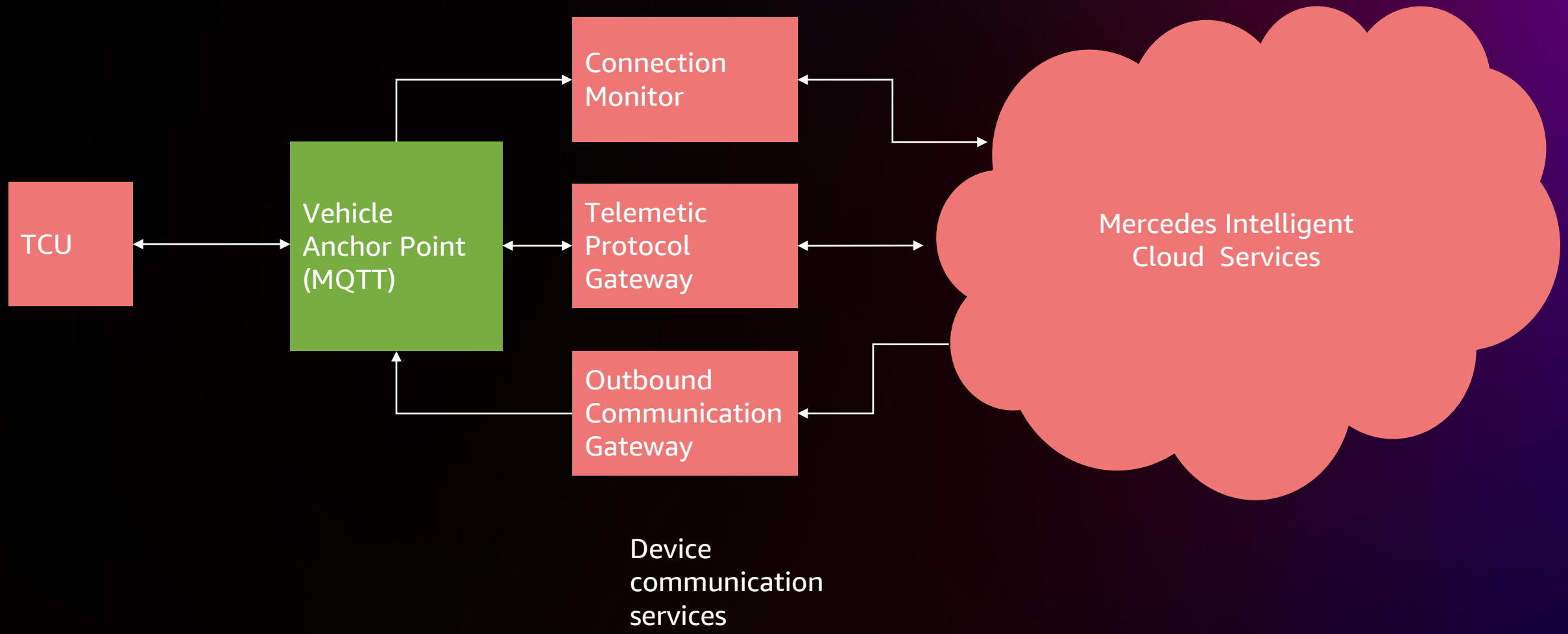
New MQTT broker architecture: Reasons & motivation

- Reduced complexity
- Use of managed services
- Cost reduction
- In housing of operational support and new development
- Move to serverless architecture
- Laying the groundwork for future cloud-native expansions

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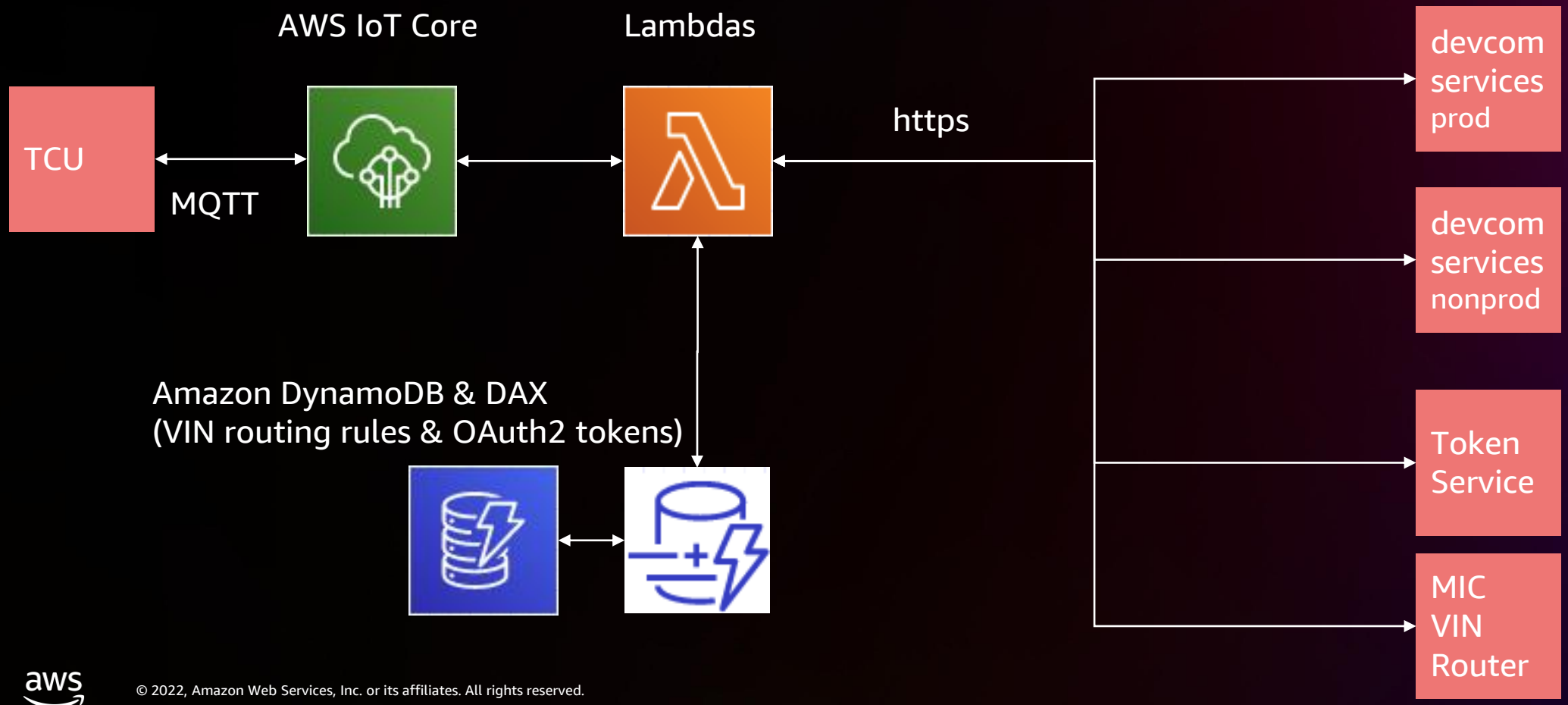
TCU communication overview

OVERVIEW



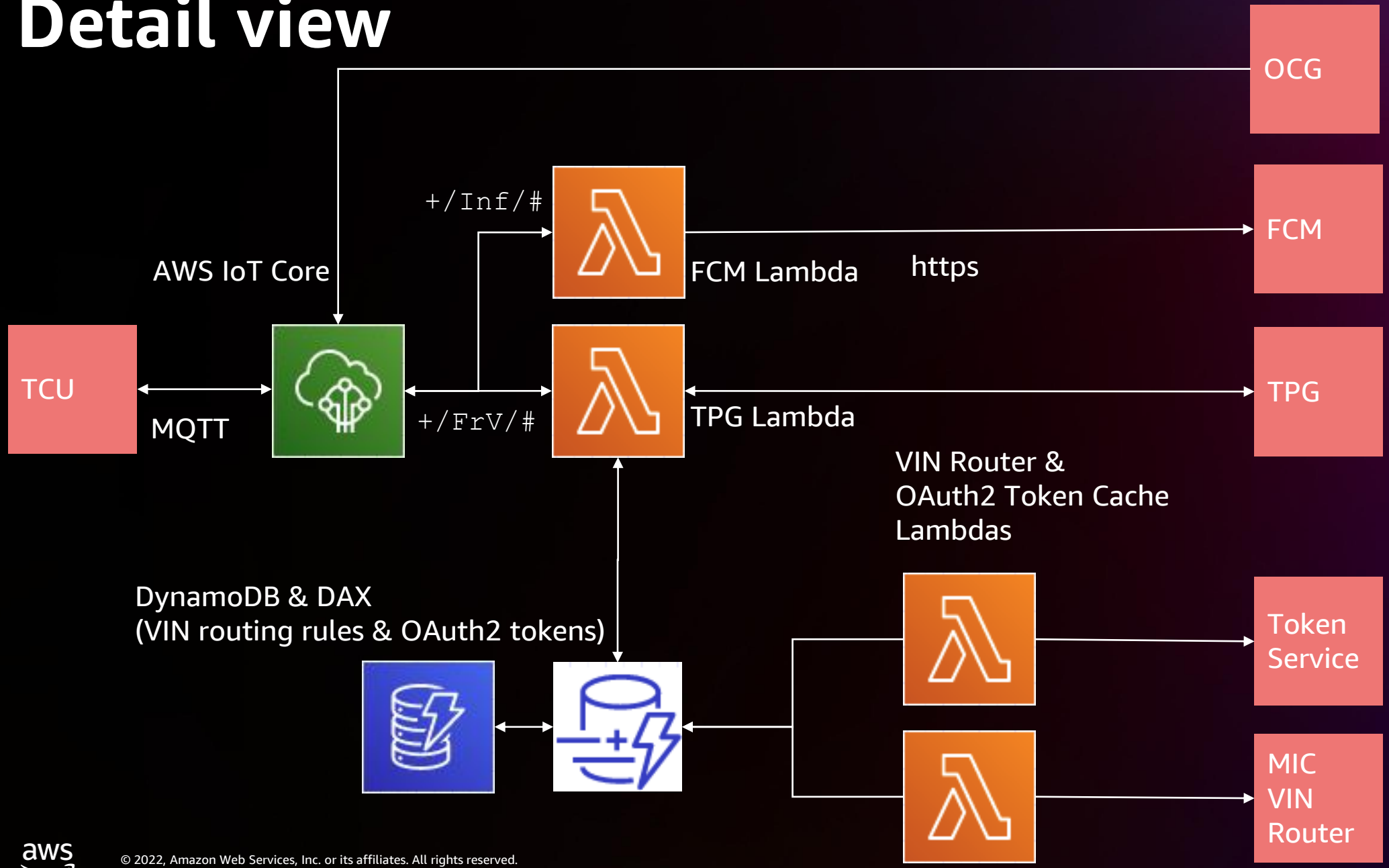
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AWS IoT Core – Overview per Region



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Detail view



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Future expansion potential

- Better per-vehicle analysis
  - Integration with in-house debug/trace tools
  - On-demand live view of MQTT traffic
- Streaming architecture
  - Early separation of messaging types (telemetry data vs. customer commands)
  - Traffic shadowing for testing/prototyping
  - Easier standard-based integration of e.g., Amazon Kinesis, Amazon Kinesis Data Firehose, …
- Multi-cloud support
  - Seamless service migration between clouds

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Thank you!

Katja-Maja Kroedel
kkroedel@amazon.com

Mike Tzamaloukas
mtz@amazon.com

Kevin Klinemeier
kevin.klinemeier@mercedes-benz.com



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