

AMF302

# AWS re:INVENT

## Alexa, Where's My Car? A Test Drive of the AWS Connected Car Reference

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# Demonstration

Alexa, where is my car?

AWS Connected Vehicle Solution simulator

# Agenda

- Who is the AWS Solutions Team?
- Automotive Industry Solutions
- Automotive Industry Use Cases
- AWS Connected Vehicle Solution Reference Architecture
- The Edge and Ingestion
- Data Services
- Mobile Apps and AWS Connected Vehicle Solution

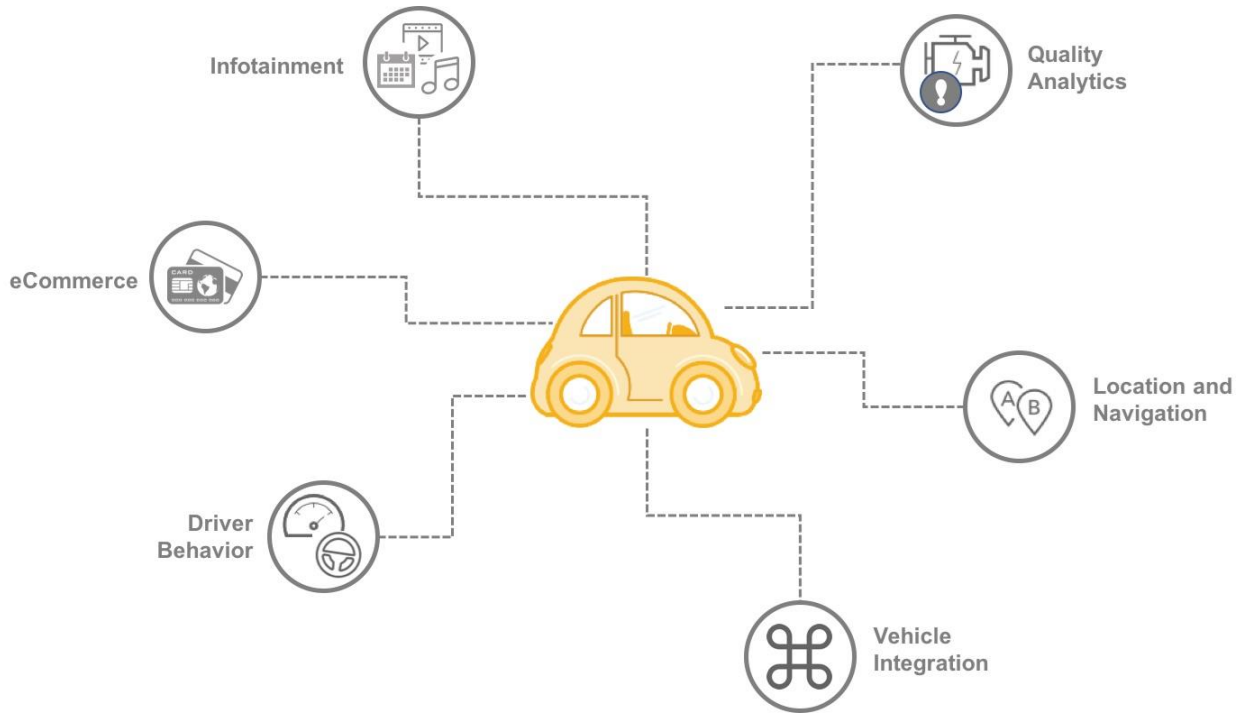
# AWS Solutions team

- Dedicated team of engineers and solutions architects
- Develop architectural best practices
- Create prescriptive guidance
- Provide detailed documentation
- Publish automated reference solutions

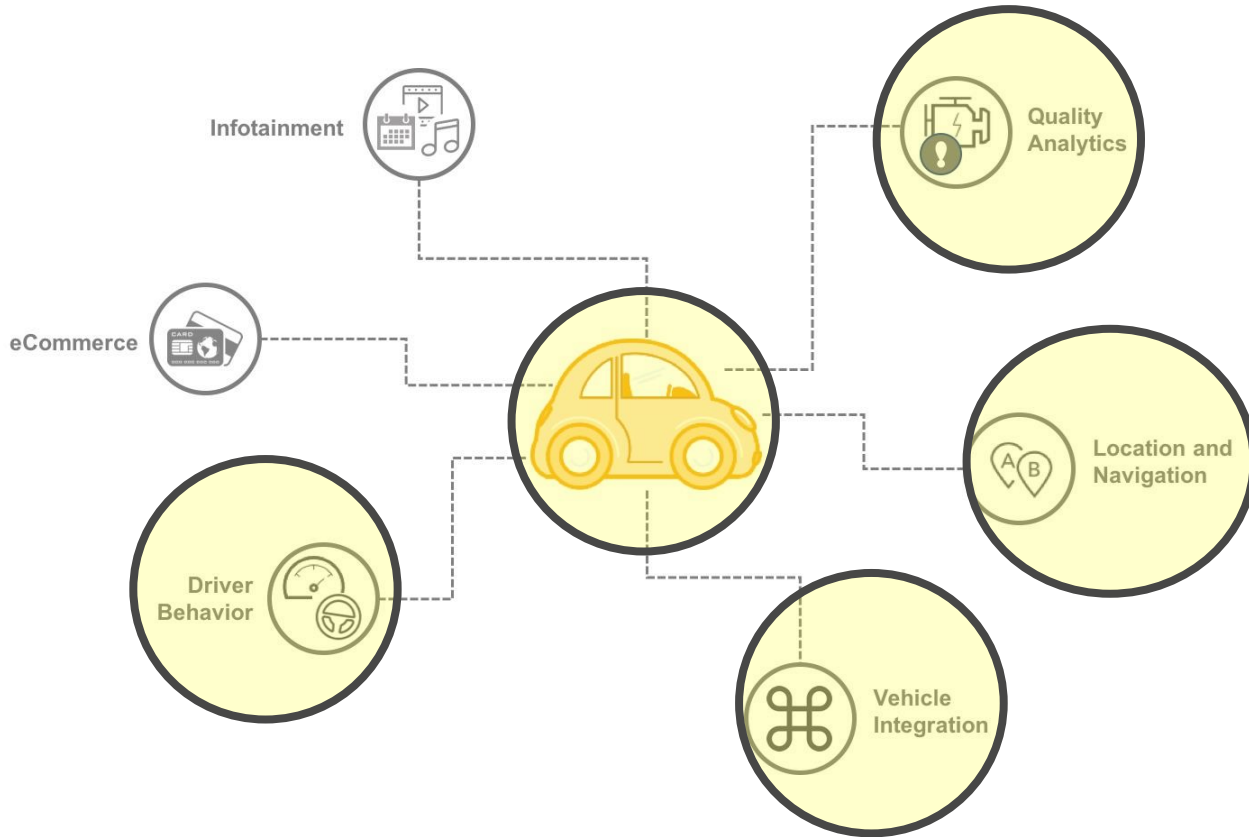


[\*https://aws.amazon.com/answers\*](https://aws.amazon.com/answers)

# Automotive industry solutions



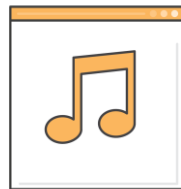
# Automotive industry solutions



# Automotive use cases

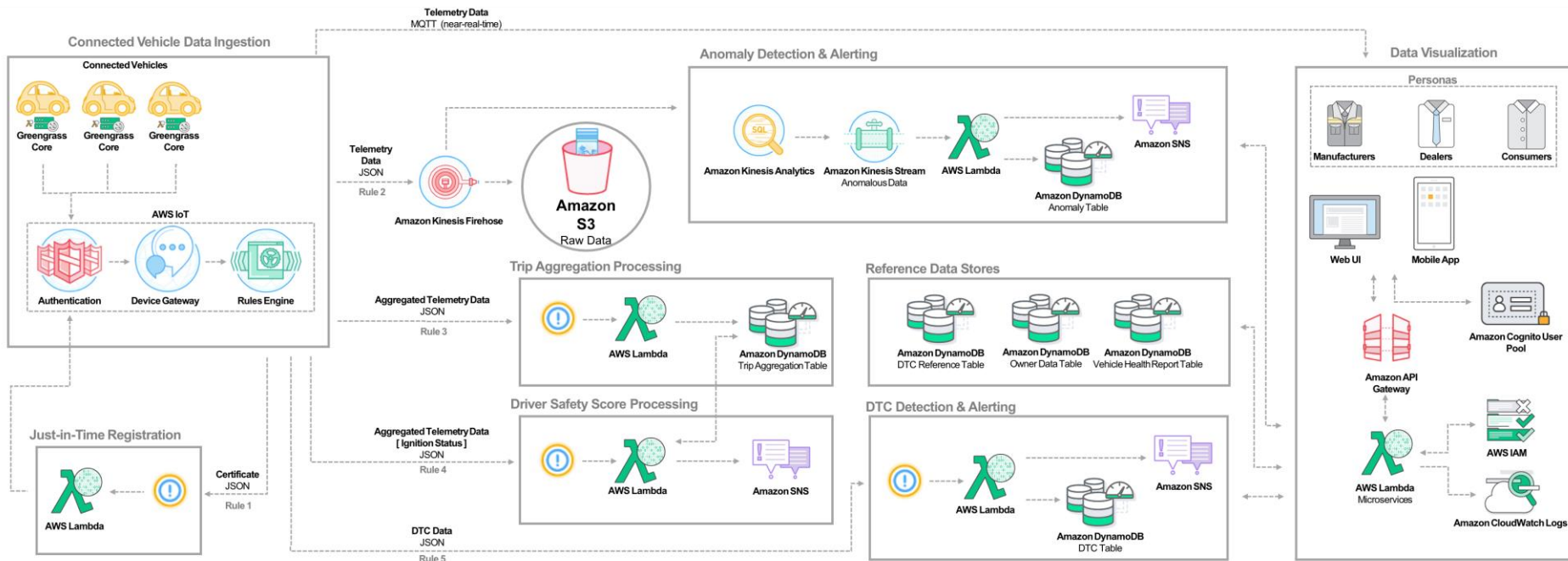
## Connected vehicle solution platform

- Secure data consumption
- Data analytics
- Vehicle health reports
- Anomaly detection
- Diagnostics alerts





# AWS Connected Vehicle Solution Reference Architecture





# AWS Connected Vehicle Solution Benefits

Eliminate undifferentiated heavy lifting and focus on creating compelling connected vehicle services

**Serverless**

**Managed**

**Microservice-based**

**Scalable**

**Event-driven**



No servers to administer or patch

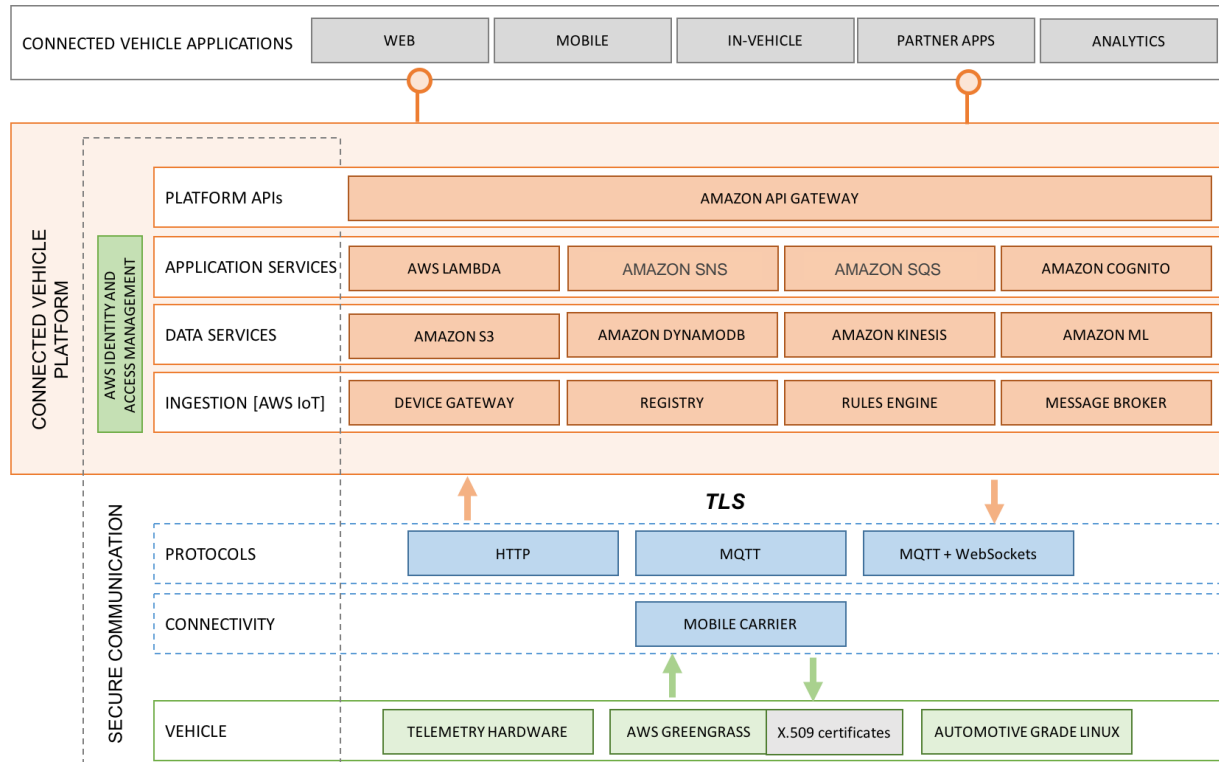


Flexible to capacity changes and requirements



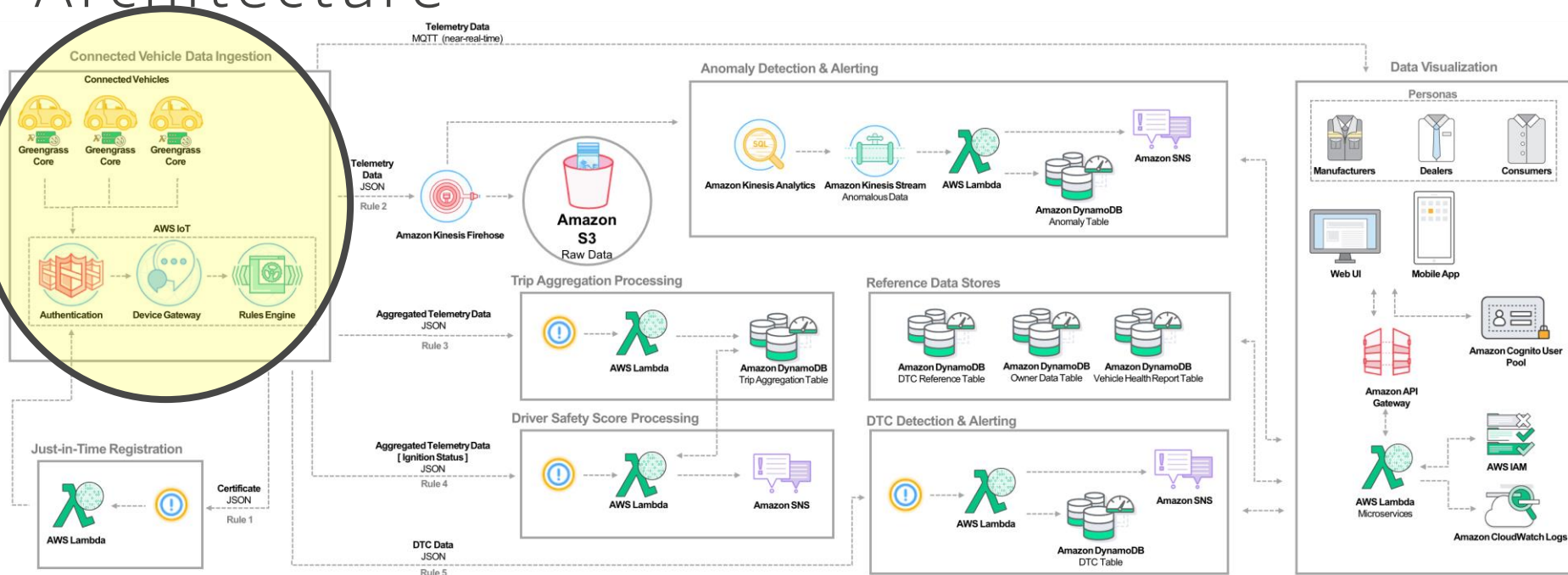
Minimal monthly spend

# AWS Connected Vehicle Solution Technology Stack



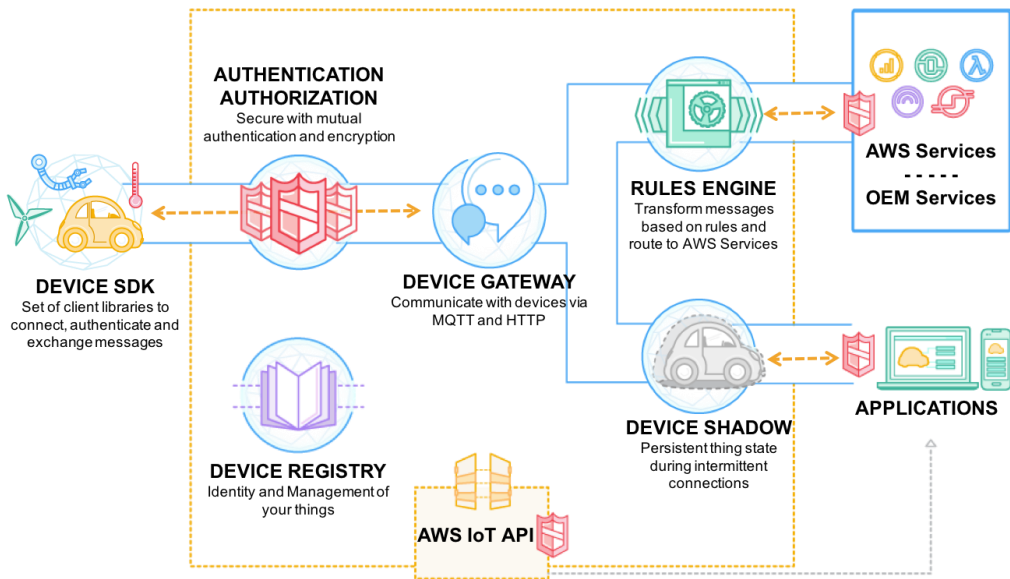
# The Edge and Ingestion—AWS Greengrass and AWS IoT

# AWS Connected Vehicle Solution Reference Architecture



# Communicate with vehicles in a secure way

Connect to AWS Services, secure data and interactions, process and act upon connected vehicle data



**Easily connect vehicles to the AWS cloud**

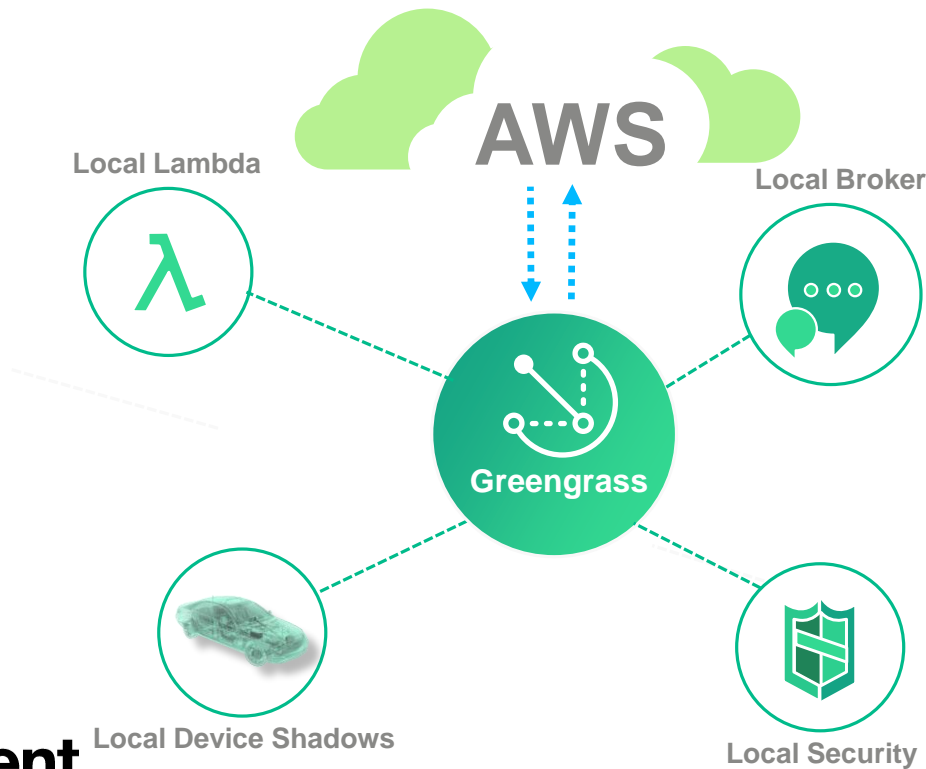
**Secure vehicle connections and data**

**Process and act upon telemetry with easy rule engine**

**Track vehicle metadata such as attributes and capabilities**

**SDK to easily and quickly connect vehicles**

# Act locally on the data generated from a connected vehicle



**Respond to local events quickly**

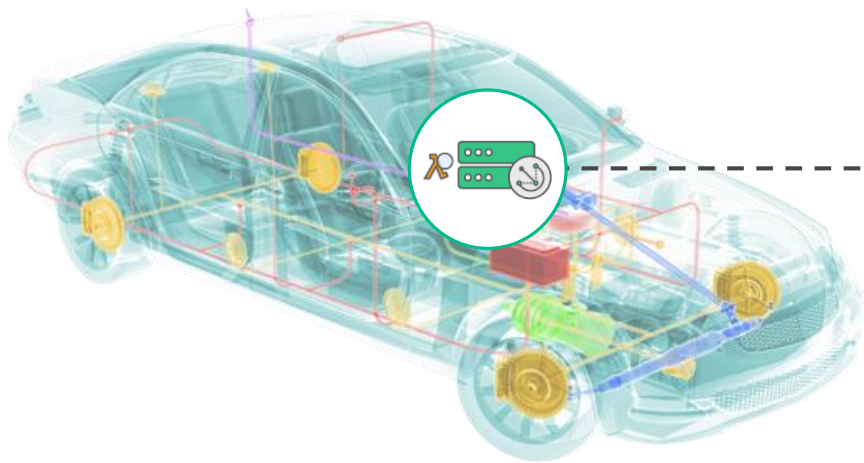
**Operate offline**

**Simplified device programming**

**Reduce the cost of running IoT applications**

# AWS Greengrass Requirements

Leverage AWS Greengrass on Linux-based vehicle operating systems



- Min 1 GHz compute; Min 128 MB RAM
- 4.4+ Linux kernel distributions
- C++ IoT device SDK
- MQTT protocol, pub/sub model  
Overlay OBD-II, UDS, or NGTP signals.
- x86 and ARM







# Greengrass components

- Greengrass group
  - Greengrass core
    - Installed on the edge
    - Where *platform* is either:
      - linux-armv7l
      - linux-x86-64
      - linux-aarch64
    - Where *version* is 1.0.0
    - Proxy for device to communicate with IoT endpoint – X.509 cert and private key needed
  - Device
    - IoT Thing
    - Private key and X.509 certificate used by the device to authenticate to the core
  - Subscriptions—routing table for messages between IoT and the device
  - Lambdas—define Lambda functions in AWS and have them run on the edge

# Console screenshot of Greengrass Subscription

## Subscriptions

[Add Subscription](#)

Source	Target	Topic	
 telemetry-T93UN88BGM85	 IoT Cloud	connectedcar/#	...
 IoT Cloud	 telemetry-T93UN88BGM85	connectedcar/alert/T93UN8...	...

# Connected vehicle solution MQTT channels

Message	Topic	Action	Description
OBD Telematics	connectedcar/telemetry/<VIN>	Publish	Vehicle sensor and telematic data
Vehicle Trip Info	connectedcar/trip/<VIN>	Publish	Aggregated trip data
Diagnostic Trouble Code	connectedcar/dtc/<VIN>	Publish	Diagnostic Trouble Code
Vehicle Provisioning	connectedcar/vehicle/<VIN>/provision	Publish	Connected Vehicle Provisioning Topic

# Connected vehicle solution MQTT channels

Message	Topic	Action	Description
Anomaly Alert	connectedcar/alert/<VIN>/anomaly	Subscribe	Anomaly Detection Alert
DTC Alert	connectedcar/alert/<VIN>/dtc	Subscribe	DTC Alert
Driver Score Alert	connectedcar/alert/<VIN>/driverscore	Subscribe	Driver Score Alert

# Rules engine rule—telematic data

## Description

[Edit](#)

Persistent storage of connected vehicle telematics data.

## Rule query statement

[Edit](#)

The source of the messages you want to process with this rule.

```
SELECT * FROM 'connectedcar/telemetry/#'
```

Using SQL version 2015-10-08

## Actions

Actions are what happens when a rule is triggered. [Learn more](#)



Send messages to an Amazon Kinesis Firehose ...

connected-vehicle-telemetry

[Remove](#)[Edit](#) [▶](#)[Add action](#)

# Rules engine rule—vehicle DTCs

## Description

[Edit](#)

Processing of DTC messages from the connected vehicle platform.

## Rule query statement

[Edit](#)

The source of the messages you want to process with this rule.

```
SELECT * FROM 'connectedcar/dtc/#'
```

Using SQL version 2015-10-08

## Actions

Actions are what happens when a rule is triggered. [Learn more](#)



Invoke a Lambda function passing the message...

cv-refarch-01-DtcServiceFunction-VQFUJDJSVIYO

[Remove](#)[Edit](#)[Add action](#)

# Rules engine rule—vehicle trip

## Description

[Edit](#)

Processing connected vehicle aggregated trip telematics.

## Rule query statement

[Edit](#)

The source of the messages you want to process with this rule.

```
SELECT * FROM 'connectedcar/trip/#'
```

Using SQL version 2015-10-08

## Actions

Actions are what happens when a rule is triggered. [Learn more](#)



Split message into multiple columns of a datab...

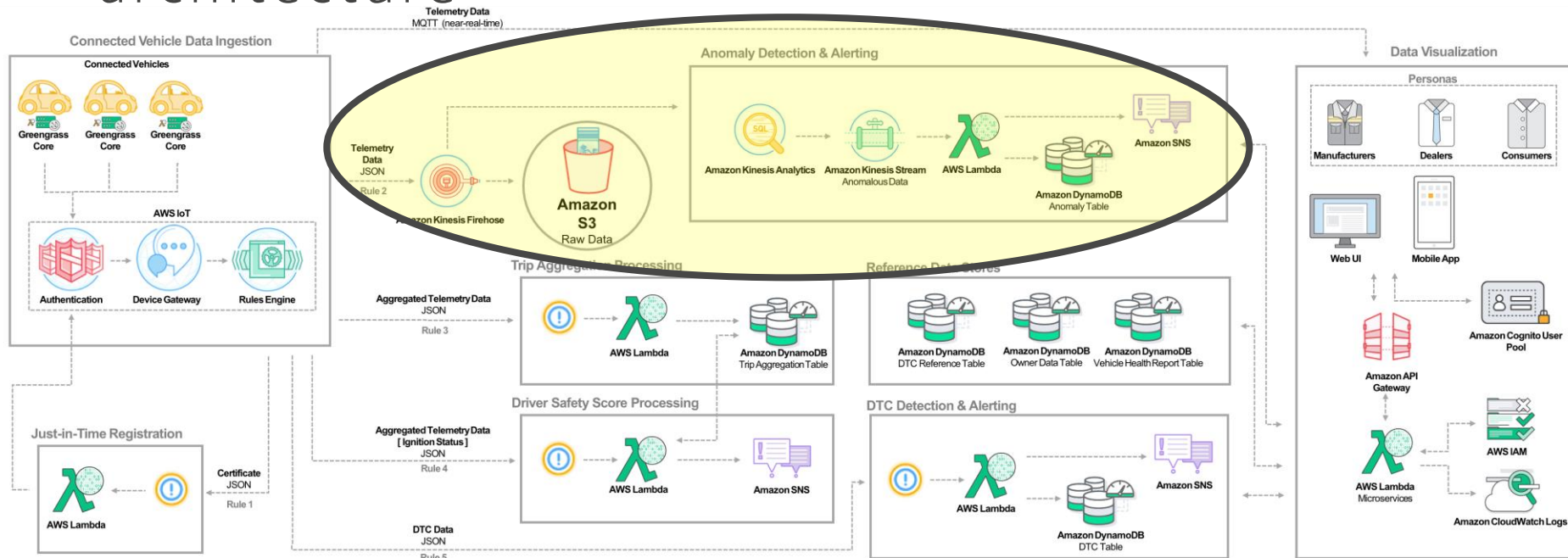
cv-refarch-01-VehicleTripTable-N9COBYAJ977R

[Remove](#)[Edit](#)[Add action](#)



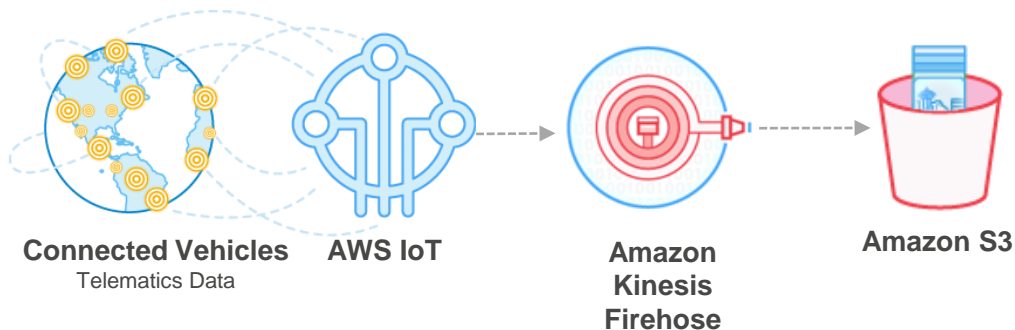
# Data services—Amazon S3, Amazon Kinesis, Amazon DynamoDB

# AWS Connected Vehicle Solution reference architecture



# Securely store connected vehicle data at scale

Store and retrieve any amount of vehicle data with a simple web service interface



**Deeply integrated with other AWS services**

**Secure vehicle data in flight and at rest**

**Store large amounts of vehicle data at a very low cost**

**Designed for up to 99.99% availability**

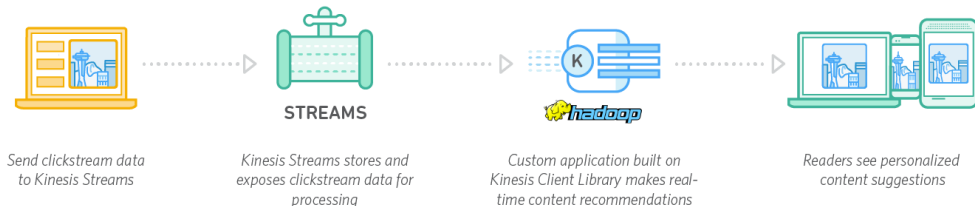
**Designed for durability of 99.999999999%**

# Kinesis Firehose to Amazon S3

<b>Delivery stream name*</b>	connected-vehicle-telemetry	<b>S3 buffer size (MB)*</b>	5
<b>Source</b>	Direct PUT	<b>S3 buffer interval (sec)*</b>	300
<b>S3 bucket</b>	<a href="#">connected-vehicle-data-us-east-1-193129100670</a>	<b>S3 Compression</b>	GZIP
<b>S3 prefix</b>	telemetry/	<b>S3 Encryption</b>	No Encryption
<b>IAM role*</b>	cv-refarch-01-TelemetricsDeliveryStreamRole-WQURB70BMW7X	<b>Status</b>	ACTIVE
<b>Data transformation*</b>	Disabled	<b>Error logging</b>	Enabled
<b>Source record backup*</b>	Disabled		

# Act on connected vehicle information as it happens

## Capture, store, and analyze streaming connected vehicle telematic data



**Quickly load TBs per hour of streaming data**

**Perform real-time analytics on streaming vehicle data**

**Leverage multi-stage processing using specialized algorithms**

**Durable temporary storage for data in transit**

**Custom stream partitioning for finer control over scaling**

# Kinesis analytics



ConnectedVehicleAnomalyDetectionApp

## Input

**Source ARN:** arn:aws:firehose:us-east-1:193129100670:deliverystream/connected-vehicle-telemetry

**Role ARN:** arn:aws:iam::193129100670:role/cv-refarch-01-TelemetryAnalyticsRole-1AVHSVS28TZ1J

**Format:** JSON

## Output

**Destination ARN:** arn:aws:kinesis:us-east-1:193129100670:stream/cc-anomaly-stream

**Role ARN:** arn:aws:iam::193129100670:role/cv-refarch-01-TelemetryAnalyticsRole-1AVHSVS28TZ1J

**Format:** JSON



# Kinesis analytics application

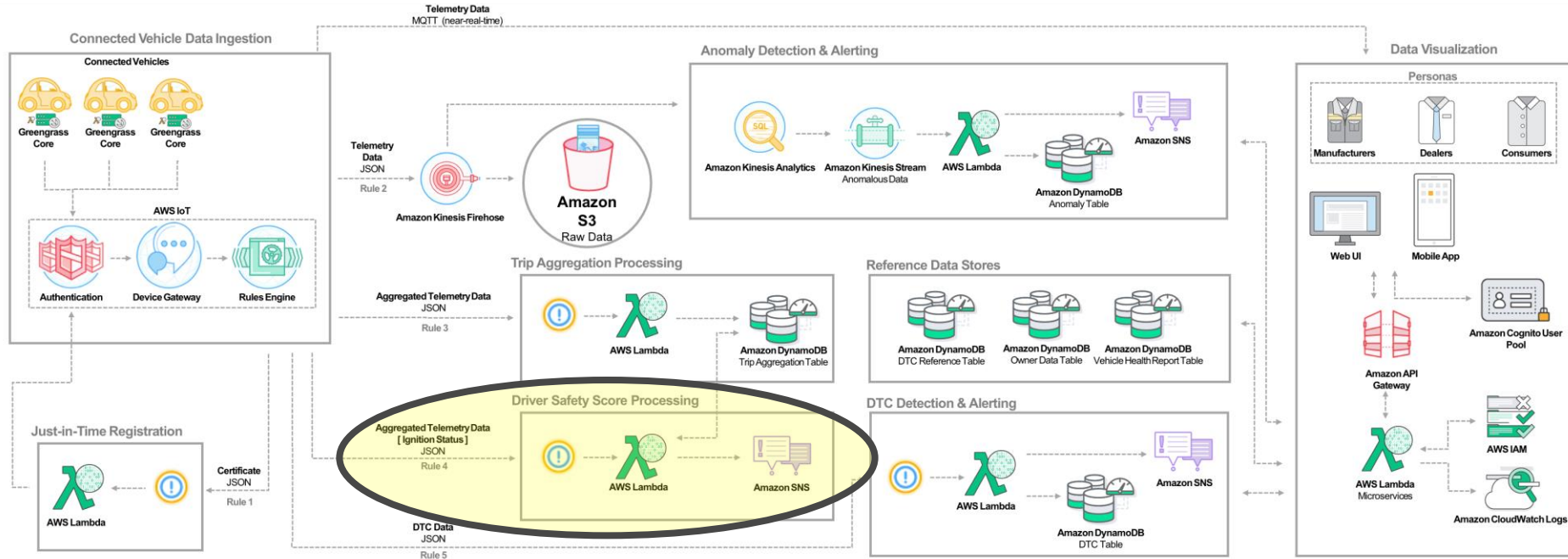
```
1 CREATE OR REPLACE STREAM "TEMP_STREAM" ("ts" TIMESTAMP,"oil_temp" DOUBLE,"trip_id" VARCHAR(64),"vin" VARCHAR(32),"ANOMALY_SCORE" DOUBLE);
2 CREATE OR REPLACE STREAM "ANOMALY_STREAM" ("ts" TIMESTAMP,"oil_temp" DOUBLE,"trip_id" VARCHAR(64),"vin" VARCHAR(32),"ANOMALY_SCORE" DOUBLE);
3 CREATE OR REPLACE STREAM "ANOMALY_OUTPUT_STREAM" ("ts" TIMESTAMP,"value" DOUBLE,"trip_id" VARCHAR(64),"vin" VARCHAR(32),"ANOMALY_SCORE" DOUBLE);
4 -- Option 1 - Compute an anomaly score for each oil temperature record in the input stream using unsupervised machine learning algorithm, Random Forest
5 --CREATE OR REPLACE PUMP "STREAM_PUMP" AS INSERT INTO "TEMP_STREAM" SELECT STREAM "ts","val", "trip_id", "vin", ANOMALY_SCORE FROM TABLE(RANDOM_CUT_FOREST("oil_temp", 250));
6 -- Option 2 - Compute an anomaly score for each oil temperature record in the input stream, where the anomaly is a simple diff between the observed and expected values
7 CREATE OR REPLACE PUMP "STREAM_PUMP" AS INSERT INTO "TEMP_STREAM" SELECT STREAM "ts","val", "trip_id", "vin", ("val"-250) as ANOMALY_SCORE FROM "TEMP_STREAM";
8 CREATE OR REPLACE PUMP "ANOMALY_STREAM_PUMP" AS INSERT INTO "ANOMALY_STREAM" SELECT STREAM * FROM "TEMP_STREAM";
9 CREATE OR REPLACE PUMP "OUTPUT_PUMP" AS INSERT INTO "ANOMALY_OUTPUT_STREAM" SELECT STREAM *, 'oil_temp' as telemetric, 250 as low_limit FROM "ANOMALY_STREAM";
10
```

[AWS Documentation](#) » [Amazon Kinesis Analytics](#) » [Developer Guide](#) » [Example Amazon Kinesis Analytics Applications](#) » [Examples: Advanced Analytics](#) » [Example: Detecting Data Anomalies on a Stream \(the RANDOM\\_CUT\\_FOREST Function\)](#)

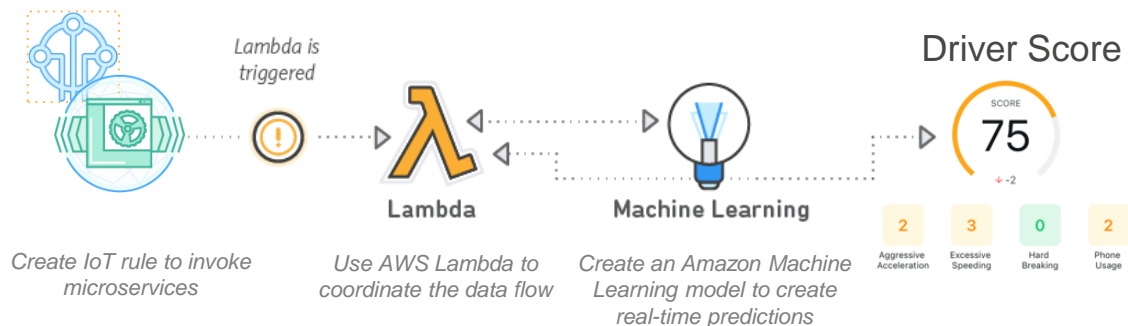
## Example: Detecting Data Anomalies on a Stream (the RANDOM\_CUT\_FOREST Function)



# AWS Connected Vehicle Solution



# Serve predictions in real time and at high throughput



**Find patterns in connected vehicle data**

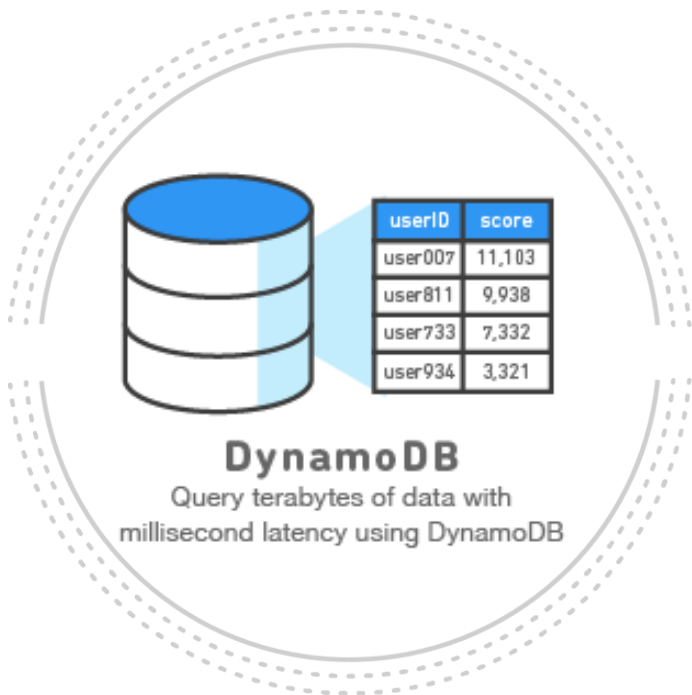
**APIs to generate billions of predictions for connected vehicle**

**Real-time predictions**

**Same proven, highly scalable, ML technology used for years by Amazon**

# Build for speed, build for scale

Consistent, single-digit millisecond latency NoSQL database for connected vehicle at any scale



**Fast, consistent performance**

**Highly scalable**

**Fully managed**

**Fine-grained access control**

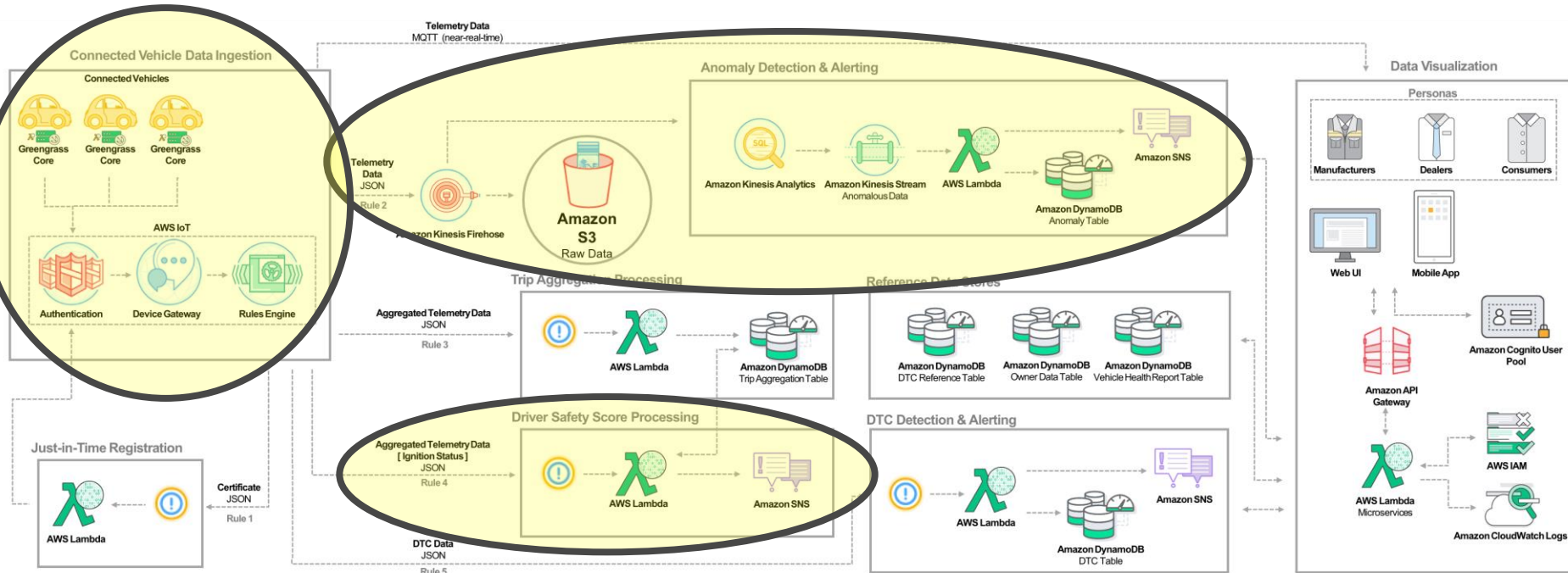
**Document & key-value structures**

**Event-driven programming**

# Amazon DynamoDB tables

Name ▲	Status ▼	Partition key ▼	Total read capacity ▼	Total write capacity ▼
cv-cloud-reference-arch-DtcTable-1N46O68HWVGFG	Active	dtc (String)	5	5
cv-cloud-reference-arch-HealthReportTable-BGB4NN0JPN7F	Active	vin (String)	2	2
cv-cloud-reference-arch-VehicleAnomalyTable-BZNNGVIRXLC4	Active	vin (String)	60	60
cv-cloud-reference-arch-VehicleDtcTable-1KFBIM1M5WV8H	Active	vin (String)	5	5
cv-cloud-reference-arch-VehicleOwnerTable-REUA7WNVCHA5	Active	owner_id (String)	32	32
cv-cloud-reference-arch-VehicleTripTable-12I9JFHR84I9J	Active	vin (String)	30	30

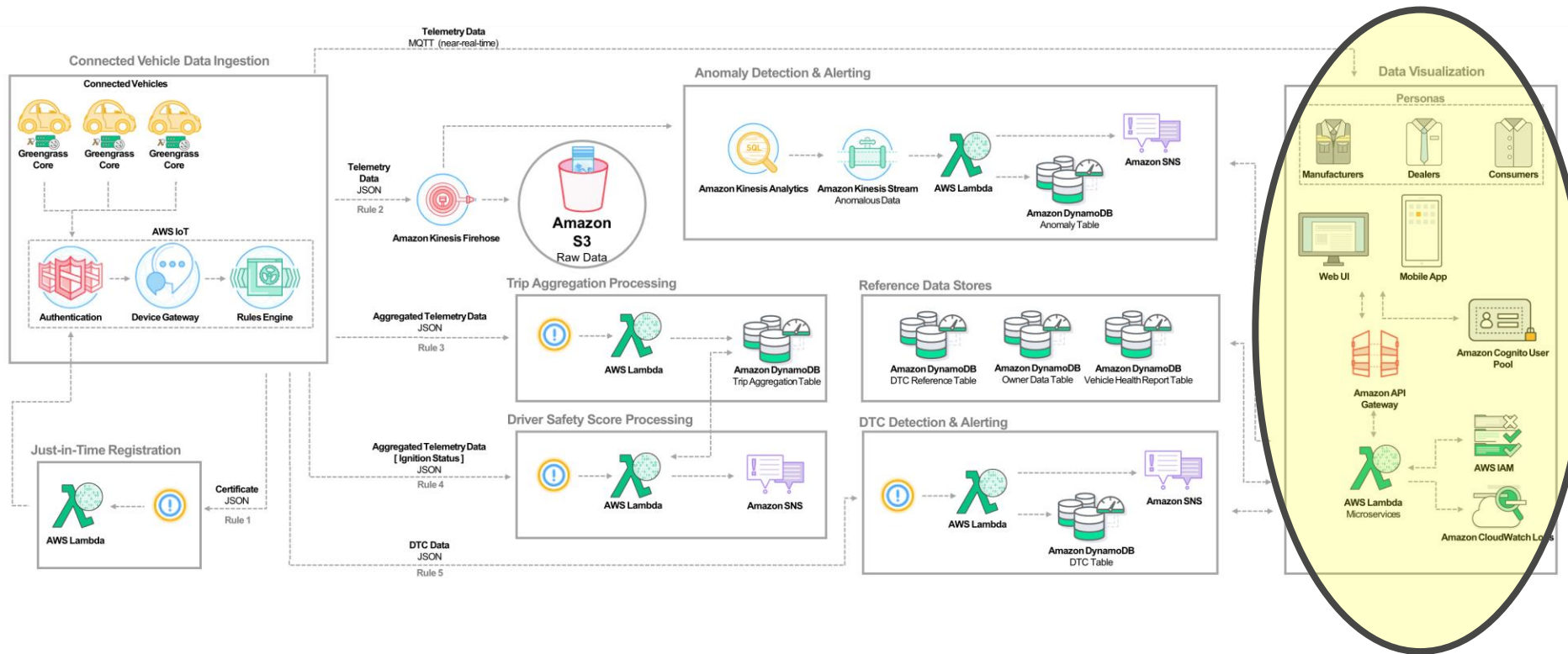
# AWS Connected Vehicle Solution



# Mobile Apps on AWS



# Connected vehicle reference architecture





# Creating an API with Amazon API Gateway



# Connected Vehicle API

- Generate documentation for developers
- Update documentation as new features are added
- Simultaneously run multiple API versions

## Connected Vehicle API

**Base URL:** /Prod, **Version:** 0.1.0

The Connected Vehicle platform is a collection of AWS cloud services, strategically combined to fuel innovation in the automotive industry. It provides fast and robust ingestion and highly reliable and durable storage of vehicle sensor data, simple and scalable big data services for analyzing the data, as well as global messaging and application services to connect with platform users.

**Schemes:** https

## Summary

### Tag: Vehicle

Operation	Description
<a href="#">GET /vehicles</a>	Retrieves list of user's vehicles
<a href="#">POST /vehicles</a>	Creates a new vehicle for an owner
<a href="#">GET /vehicles/{vin}</a>	Retrieves a user's vehicle

### Tag: Anomalies

Operation	Description
<a href="#">GET /vehicles/{vin}/anomalies</a>	Retrieves list of anomalies for vehicle
<a href="#">GET /vehicles/{vin}/anomalies/{anomaly_id}</a>	Retrieves an anomaly for vehicle
<a href="#">PUT /vehicles/{vin}/anomalies/{anomaly_id}/acknowledge</a>	Acknowledges an anomaly for vehicle

### Tag: DTG

# Mobile Companion App

- Separation of concerns
- Use the tools your team is familiar with
- Scale out to other application stacks

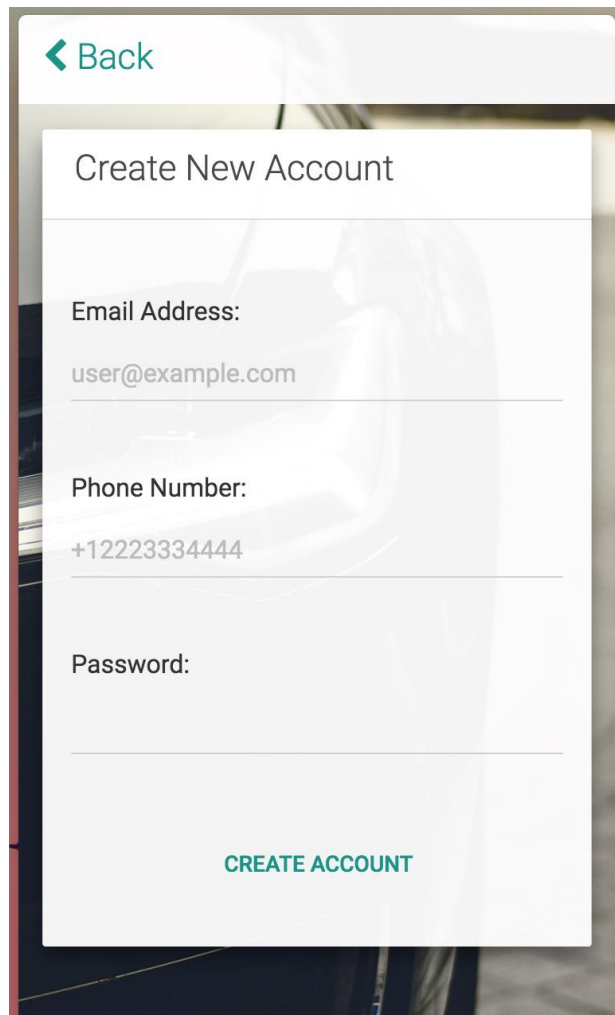
**HTML**



*Sass*

# Amazon Cognito

- Fully managed, secure user directory
- Set up user workflows in minutes
- Create your own UI or use a pre-built one

A screenshot of a mobile application interface for creating a new account. At the top left is a green back arrow and the word 'Back'. The title 'Create New Account' is centered at the top. Below it are three input fields: 'Email Address:' with the placeholder 'user@example.com', 'Phone Number:' with the placeholder '+12223334444', and 'Password:'. At the bottom right is a green button labeled 'CREATE ACCOUNT'. The background is a blurred image of a person's arm and hand.

◀ Back

Create New Account

Email Address:  
user@example.com

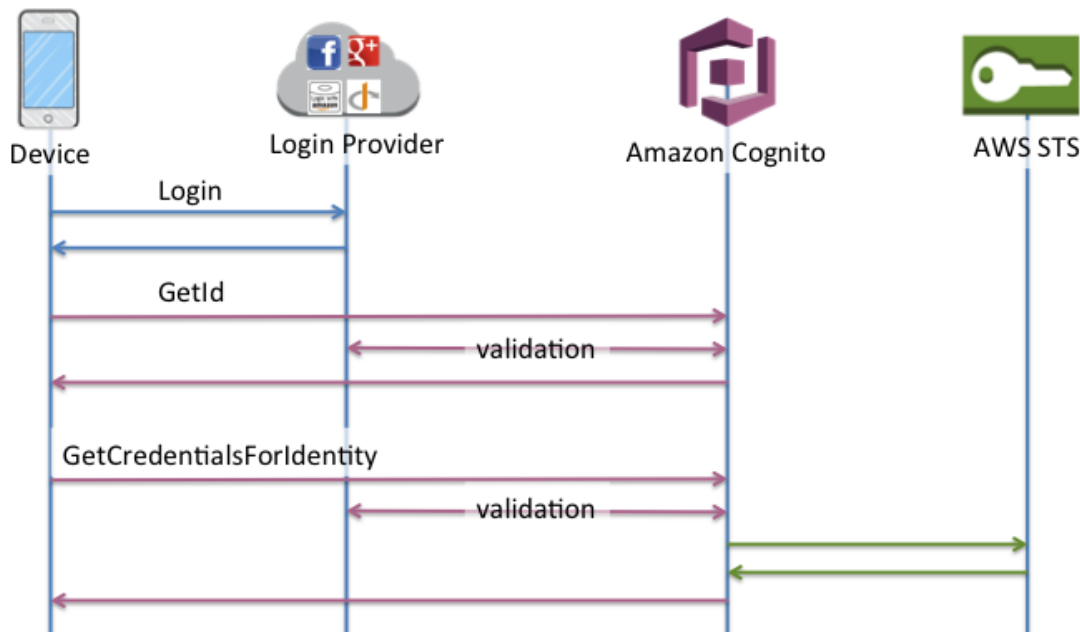
Phone Number:  
+12223334444

Password:

CREATE ACCOUNT




# Amazon Cognito Authentication

- Handshake with identity provider
- Validate against Amazon Cognito
- Get a user token
- Token is traded for access credentials



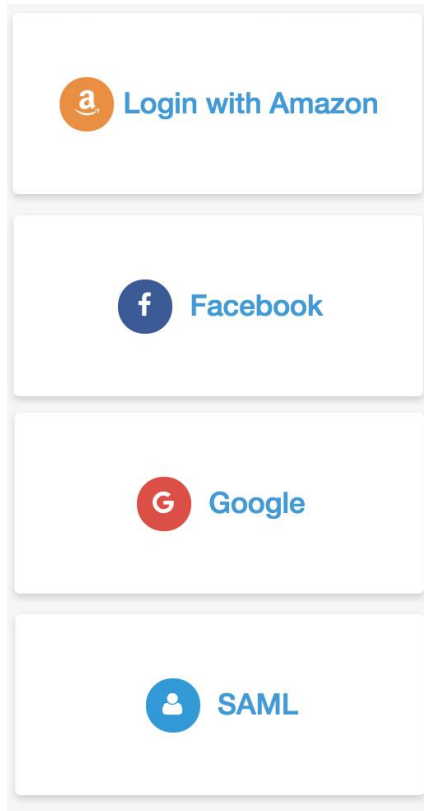
# Amazon Cognito User Pools

- Store user information
  - Email address
  - Phone number
- Enforce security policies
  - Password requirements
  - MFA

<b>Pool Id</b>	<REMOVED>	
<b>Pool ARN</b>	<REMOVED>	
<b>Estimated number of users</b>	1	
<b>Required attributes</b>	email, phone_number	
<b>Alias attributes</b>	email	
<b>Username attributes</b>	none	
<b>Custom attributes</b>	<a href="#">Choose custom attributes...</a>	
<b>Minimum password length</b>	8	
<b>Password policy</b>	uppercase letters, lowercase letters, numbers	
<b>User sign ups allowed?</b>	Users can sign themselves up	


# Amazon Cognito Identity Providers

- Allow users to log in with other services
- Unified user directory
- Single sign-on (SSO)




# Vehicles API

- Building blocks for architecture integration
  - CREATE
  - READ
  - UPDATE
  - DELETE

 Select Vehicle

My Test Vehicle



VIN:  
99TU44Q9BG9K0TWHX  
Fuel Remaining:  

99%

Register New Vehicle

Vehicle Nickname:

VIN:



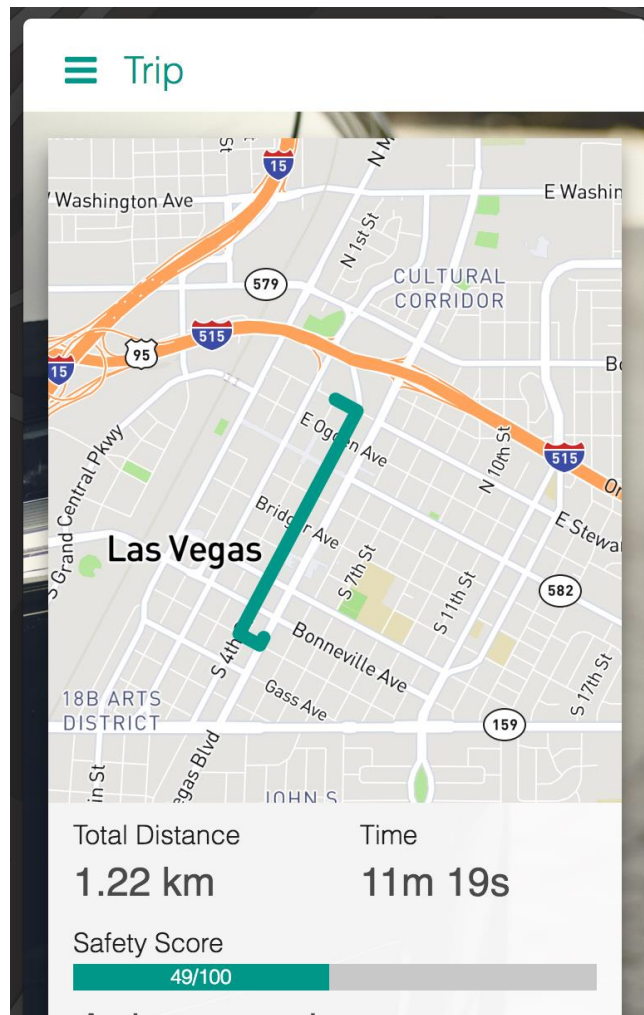
# Vehicle history

- Query past trips
- Mapbox integration
- Advanced data views



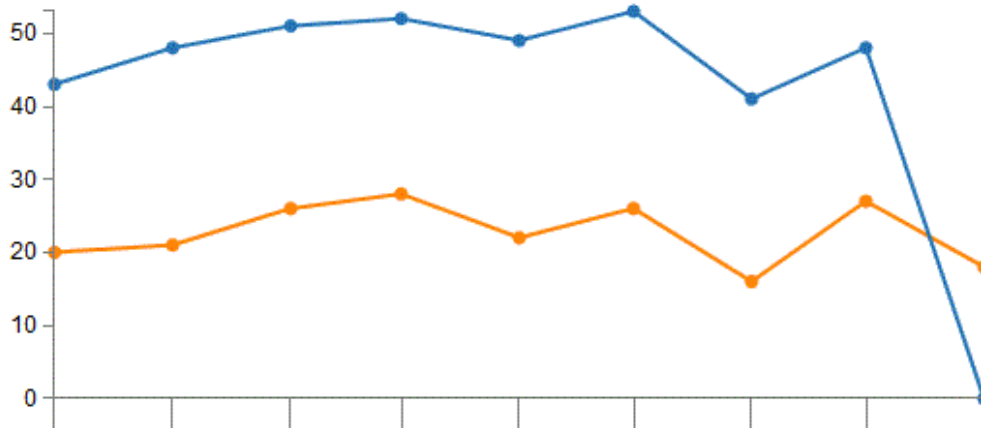
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# Historical data

- Show aggregated data over time
- .reduce() down to the data we want
- Plot data on a D3.js chart



# Push notifications with MQTT

- Diagnostic Trouble Codes (DTCs)
- Anomaly detection
- Trip completion
- Real-time dashboard data



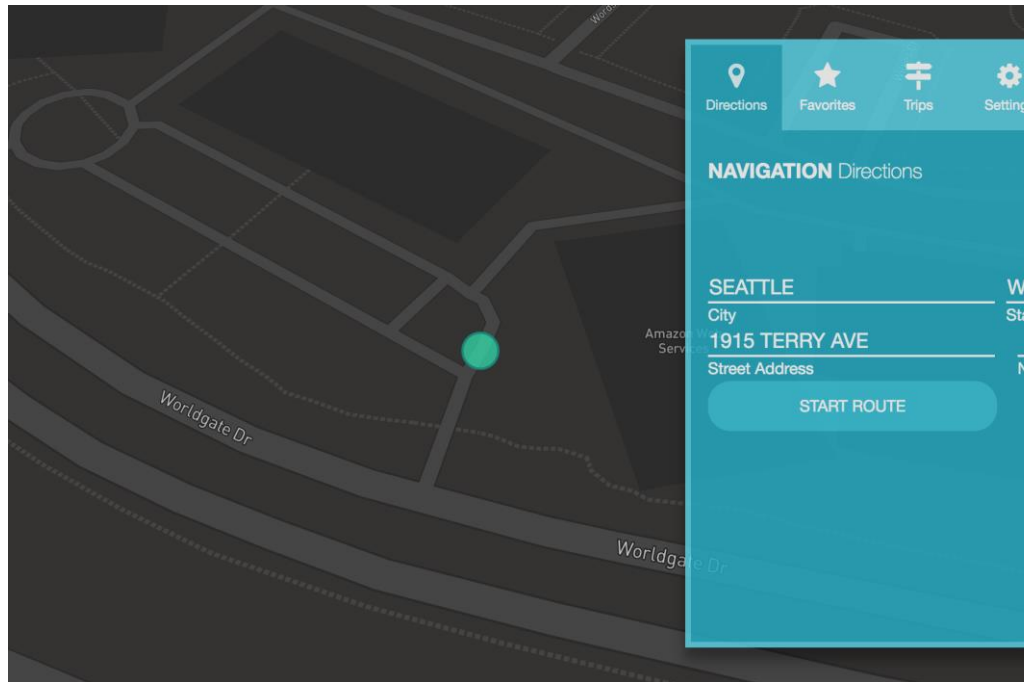
# Delivering data with MQTT topics

- Services publish to IoT
- Rules engine fans out the information to different MQTT topics
- Application is subscribed to those topics with AWS IoT SDK



# Real-time dashboard

- View real-time trip data delivered via MQTT topics
- Location data is fed into MapBox.js
- Update telemetry display as data streams in



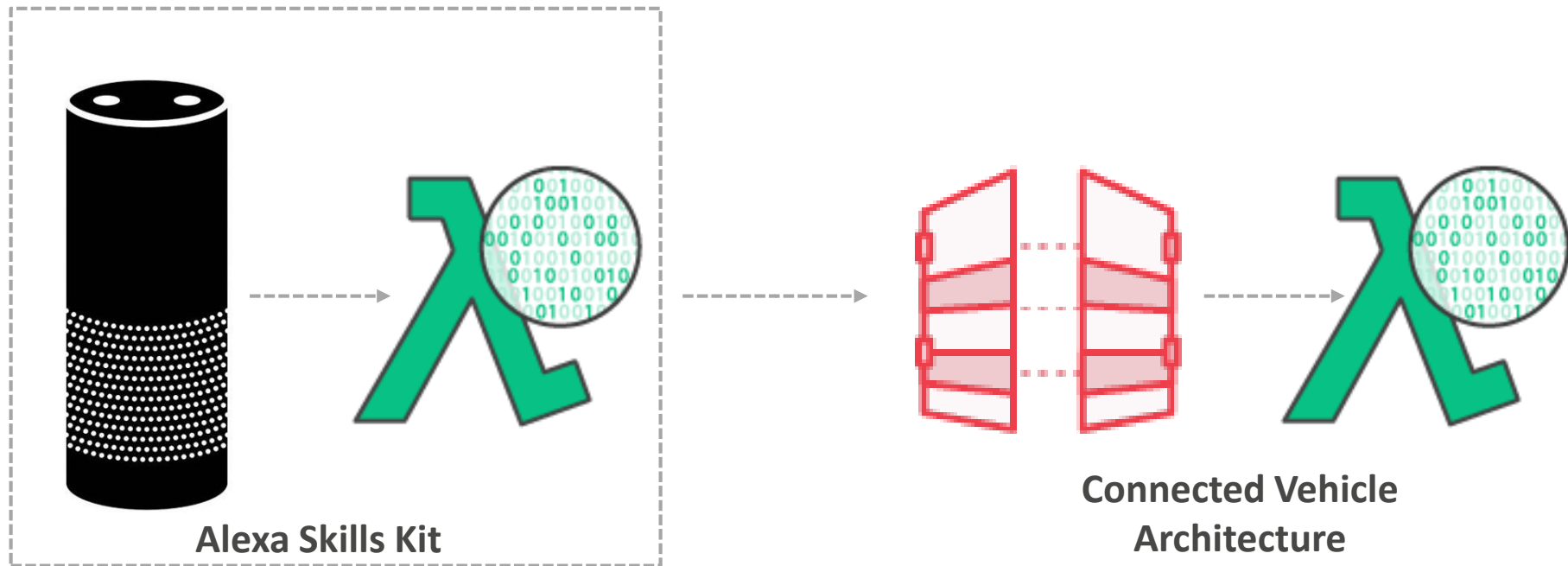
# Building an Alexa skill

# Why build an Alexa Skill?

- Reimagine your customer experience
- Over 10 million Alexa-powered devices sold



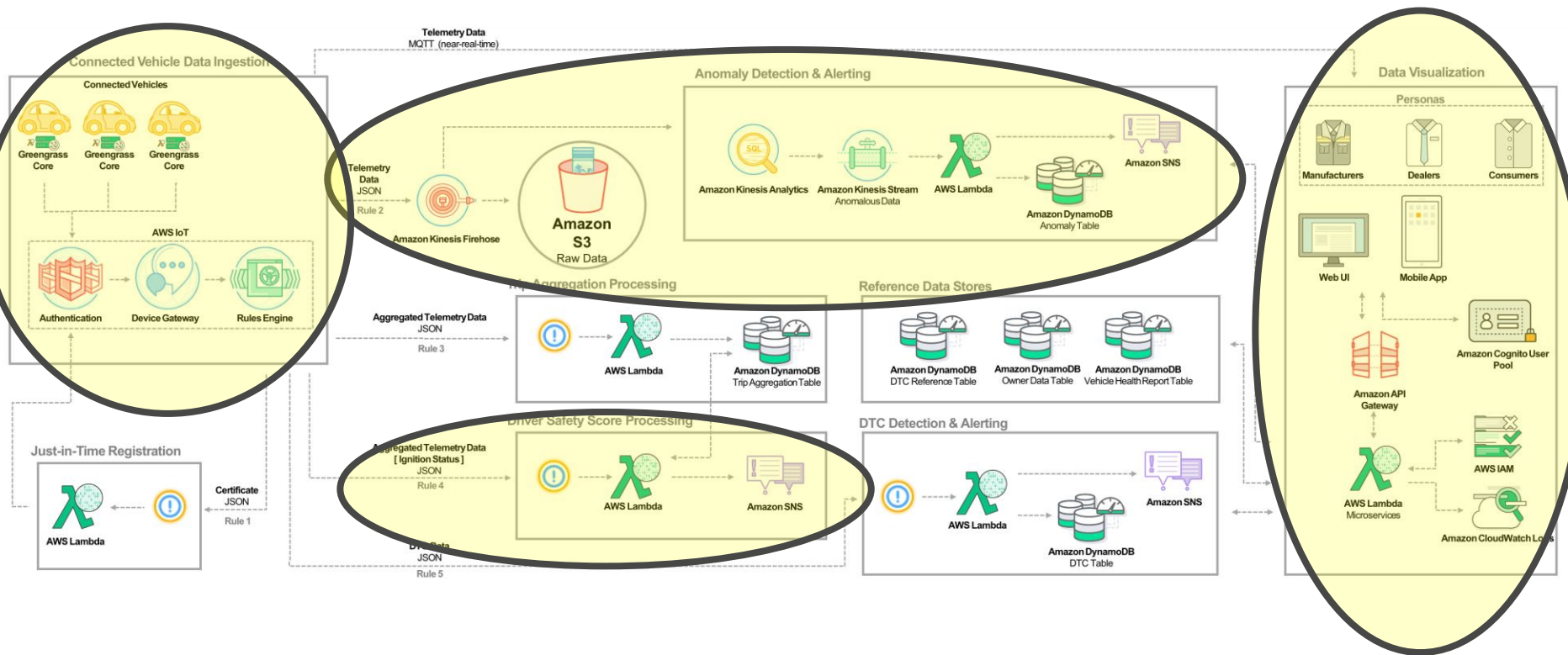
# Alexa skill architecture





# Summary

# What we've covered





# AWS re:Invent

Thank you!

AWS  
re:Invent

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