GOTO

Amsterdam 2018

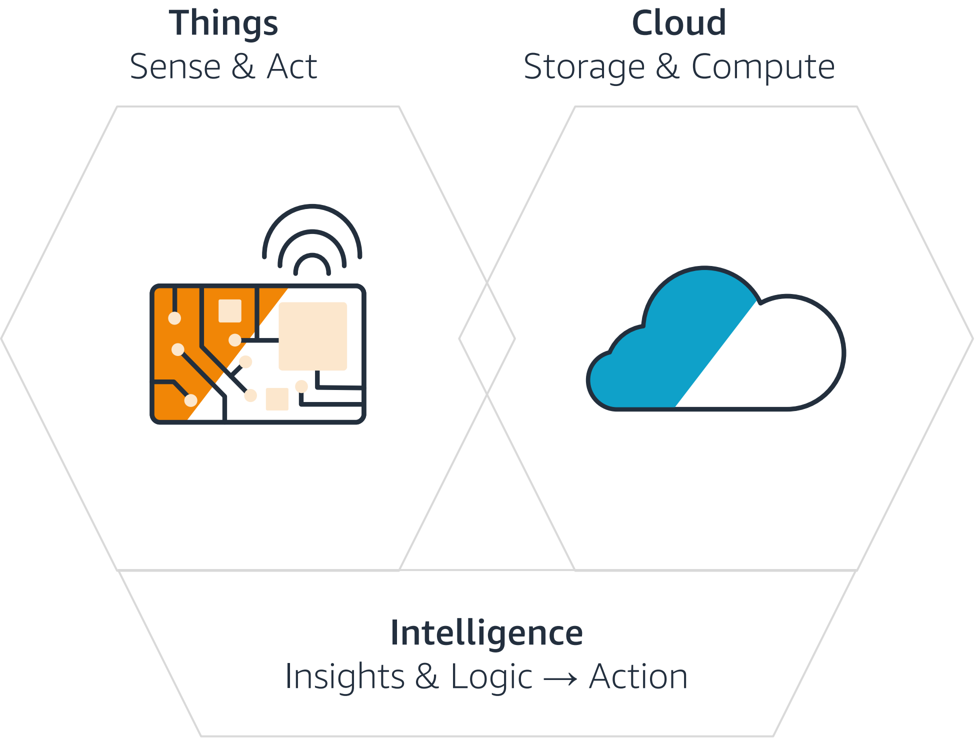
IoT Compute at the Edge with AWS Greengrass

Boaz Ziniman, Technical Evangelist – Amazon Web Service

@ziniman

boaz.ziniman.aws

Our Concept of IoT

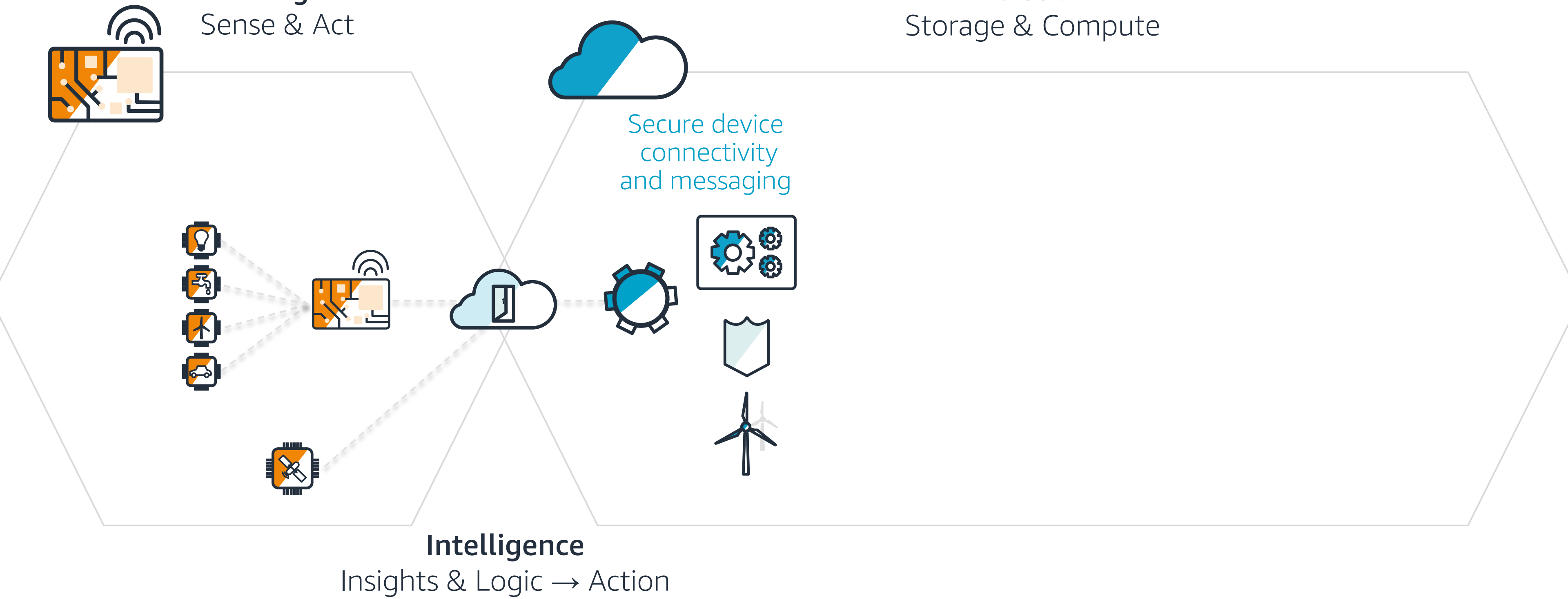


Things
Sense & Act

Cloud
Storage & Compute

Intelligence
Insights & Logic → Action

AWS IoT Architecture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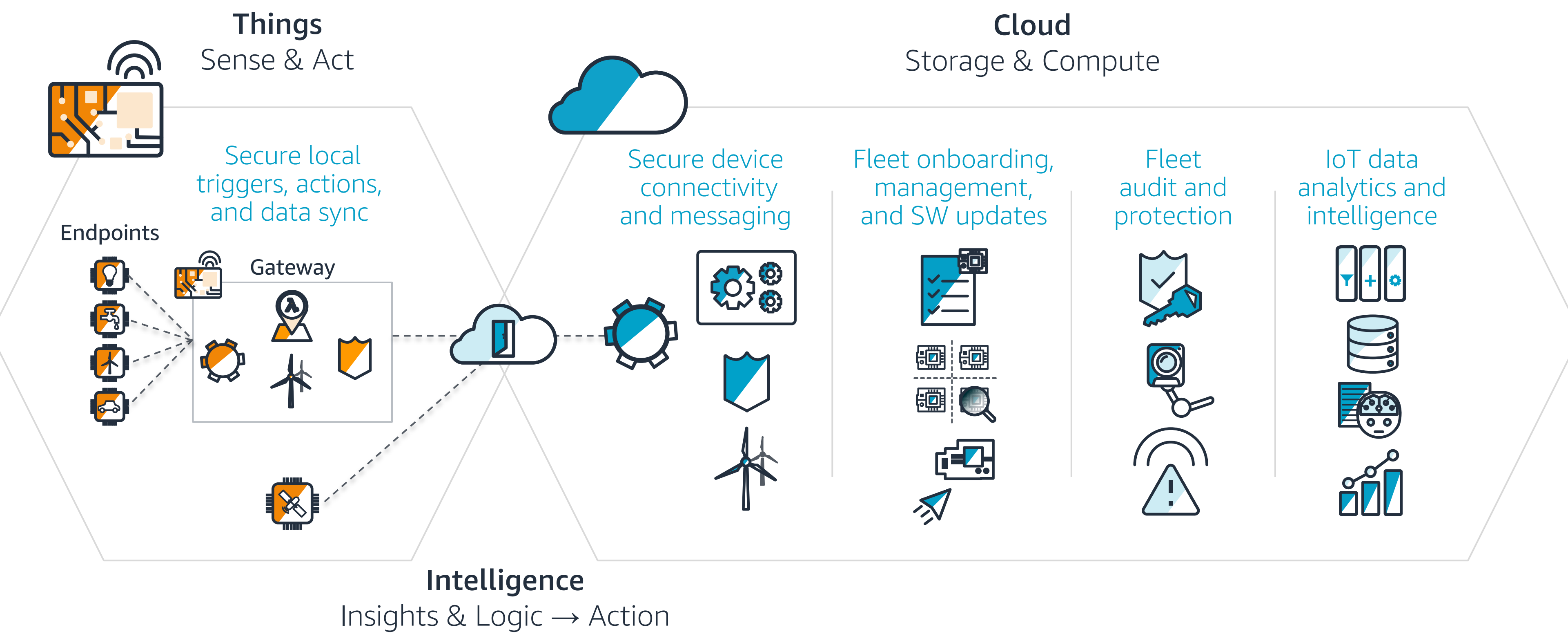
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Gateway
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Storage & Compute
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Fleet onboarding, management, and SW updates
Fleet audit and protection
IoT data analytics and intelligence
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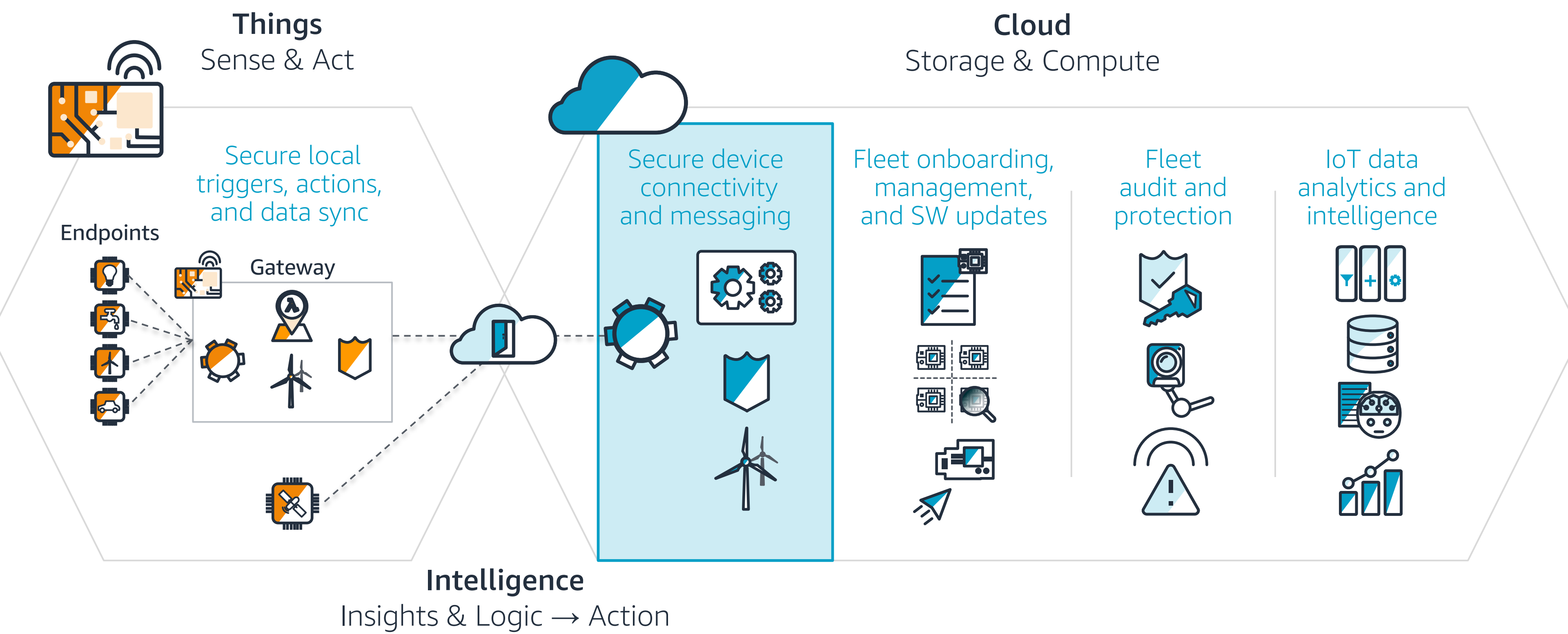

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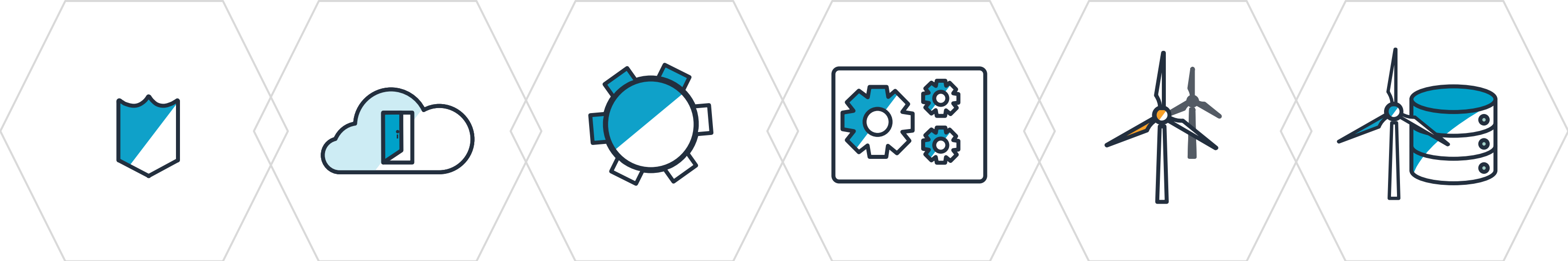
AWS IoT Core

Secure Device Connectivity and Messaging



Identity Service

Device Gateway

Message Broker

Rules Engine

Device Shadow

Registry

Benefits of AWS IoT

The AWS IoT Core platform enables you:

- To **securely connect** devices to the AWS Cloud and other devices **at scale**

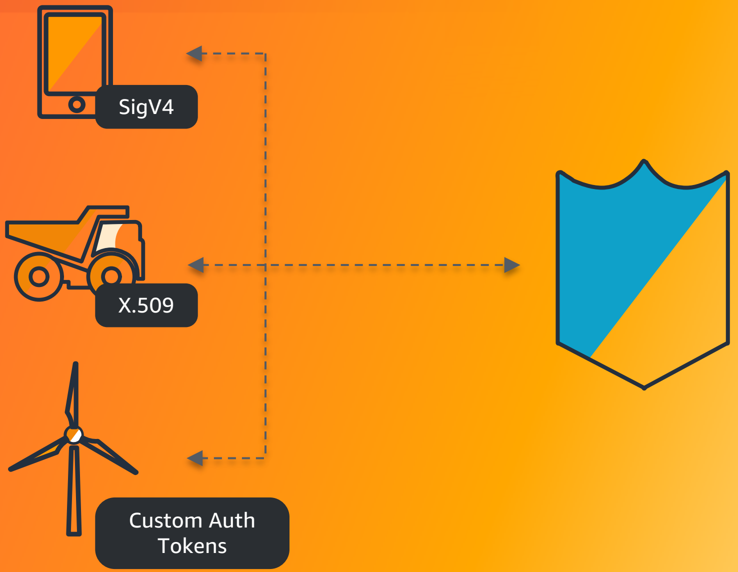
- To **route, process and act upon data** from these devices

- To **enable applications** to interact with devices even when they are offline

- To **fully integrate with other AWS service** to reason on top of the data (Analytics, Databases, AI, etc.)

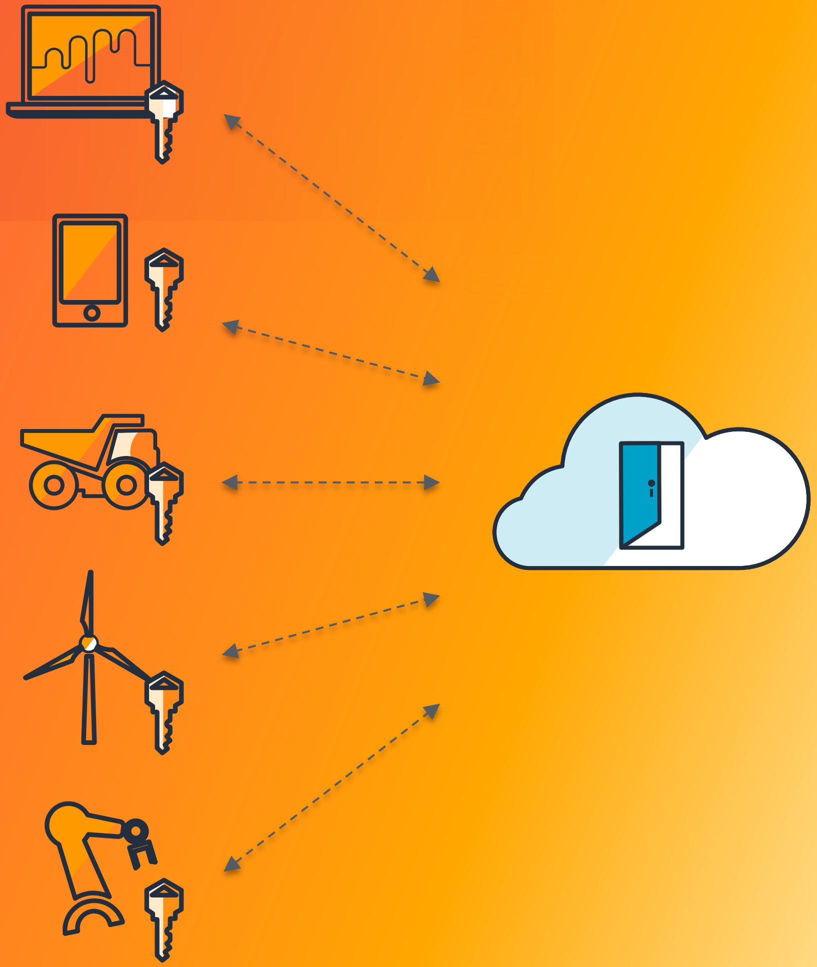
Identity Service

- Certificates
  - AWS or BYOC
- Manual or JITR
- IAM and AWS IoT policies
- Amazon Cognito
- Federated users



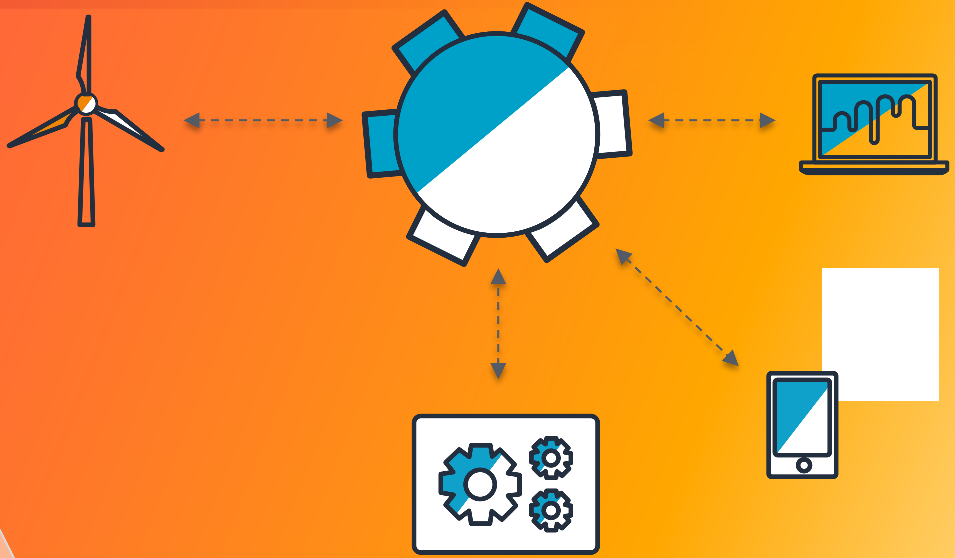
Device Gateway

- Long-lived connections
- MQTT, WebSockets, HTTP
- SigV4, X.509, and token-based authentication
- TLS 1.2



Message Broker

- MQTT-based routing
- Publish/Subscribe
- QoS 0/1
- Topics
  - Reserved ($aws/#)
  - Wildcards



Rules Engine

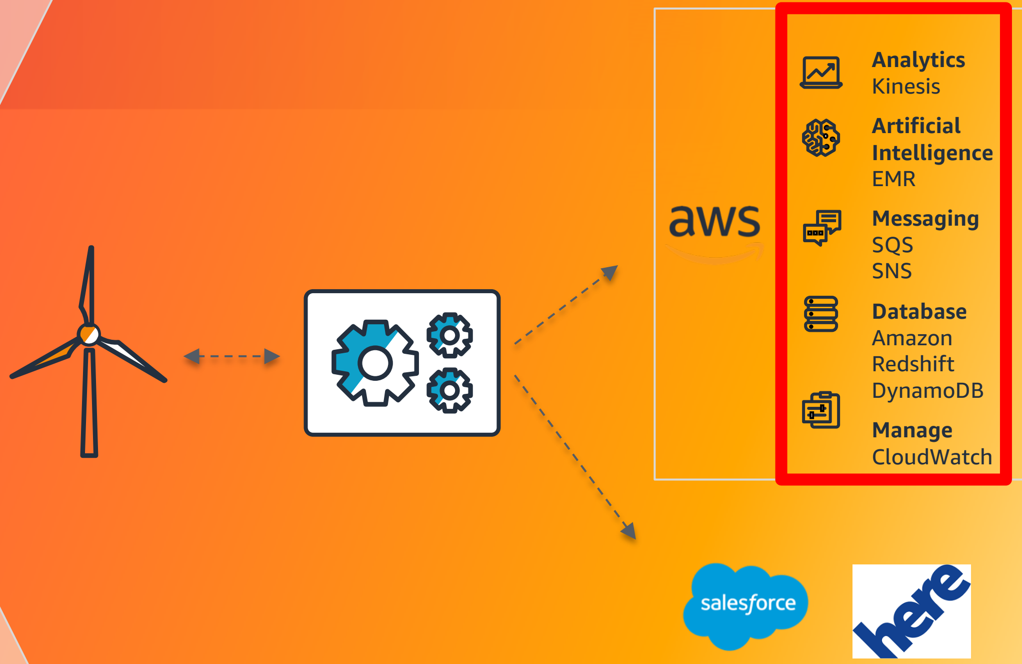
Data transformation and actions

- Query language

SELECT * from 'topic/structure'
WHERE temperature > 35

- Topics

- Republish
- ML



aws

Analytics
Kinesis

Artificial Intelligence
EMR

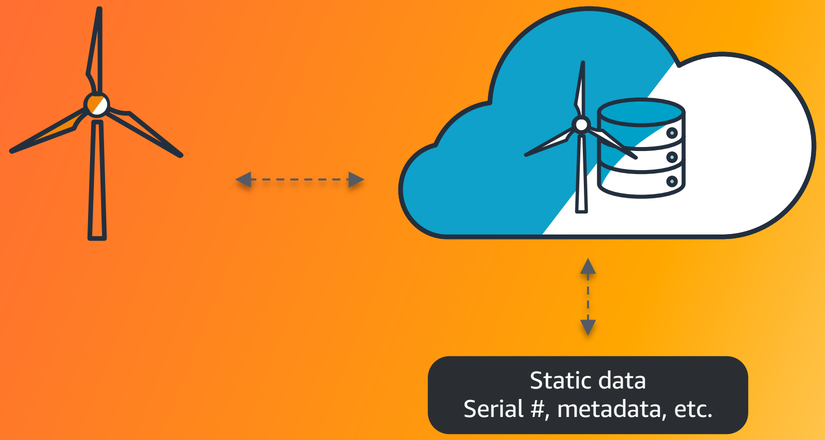
Messaging
SQS
SNS

Database
Amazon
Redshift
DynamoDB

Manage
CloudWatch

Registry

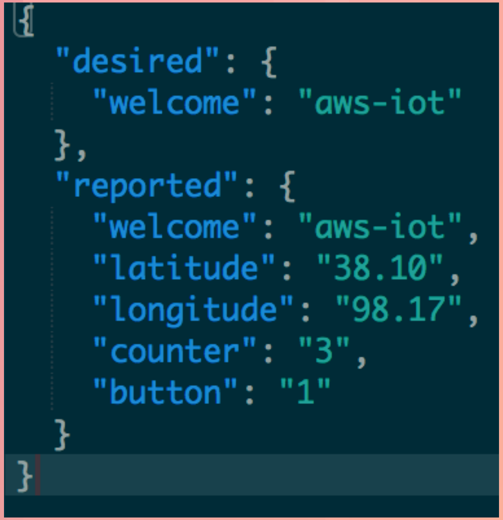
- Static device metadata
- ThingTypes
- Groups
- Jobs



Static data
Serial #, metadata, etc.

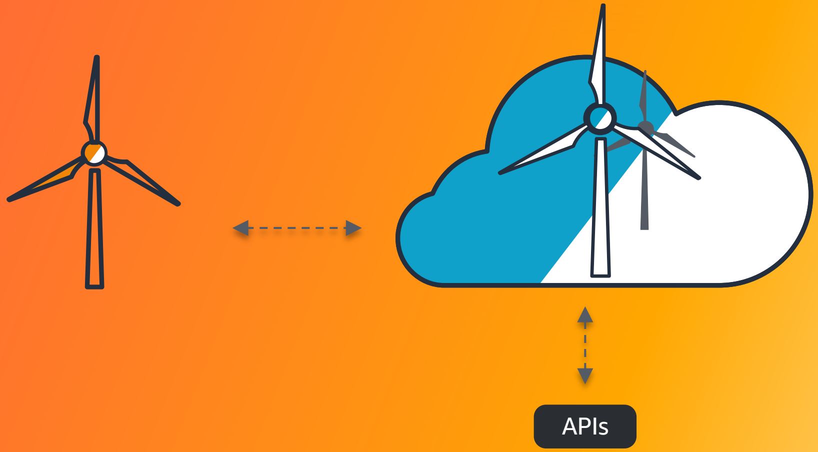
Device Shadow

- Representation of state
    - Reported
    - Desired

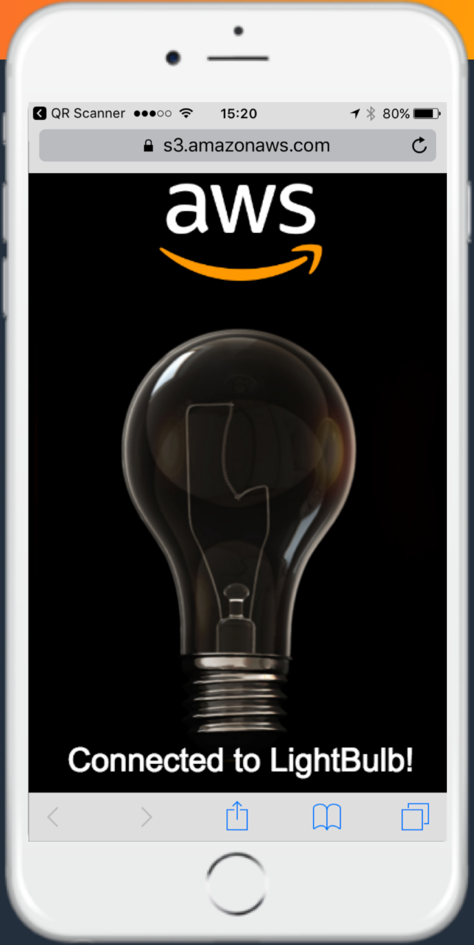


```
{
  "desired": {
    "welcome": "aws-iot"
  },
  "reported": {
    "welcome": "aws-iot",
    "latitude": "38.10",
    "longitude": "98.17",
    "counter": "3",
    "button": "1"
  }
}
```

- Application interaction

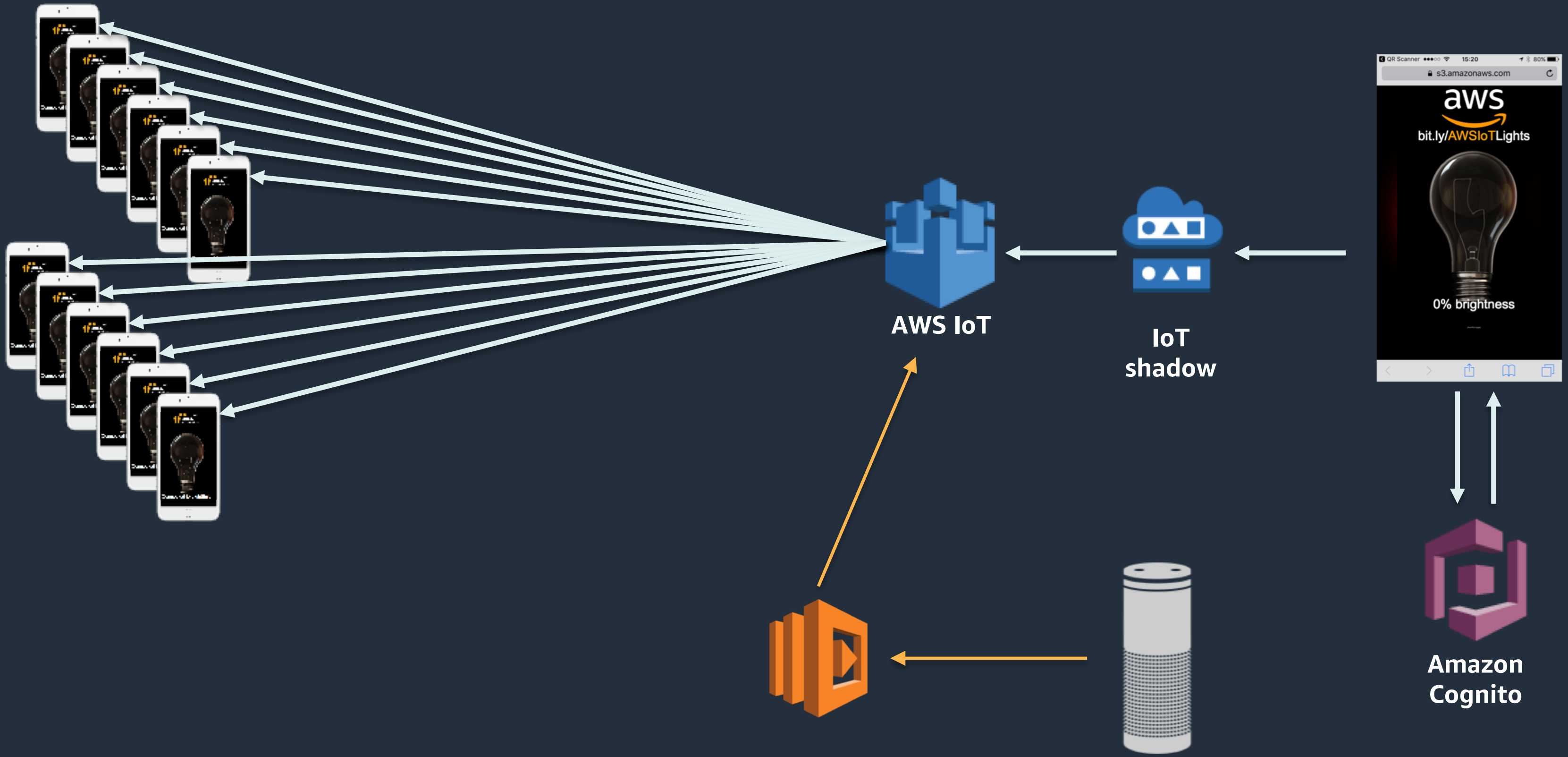


bit.ly/AWSIoTLights

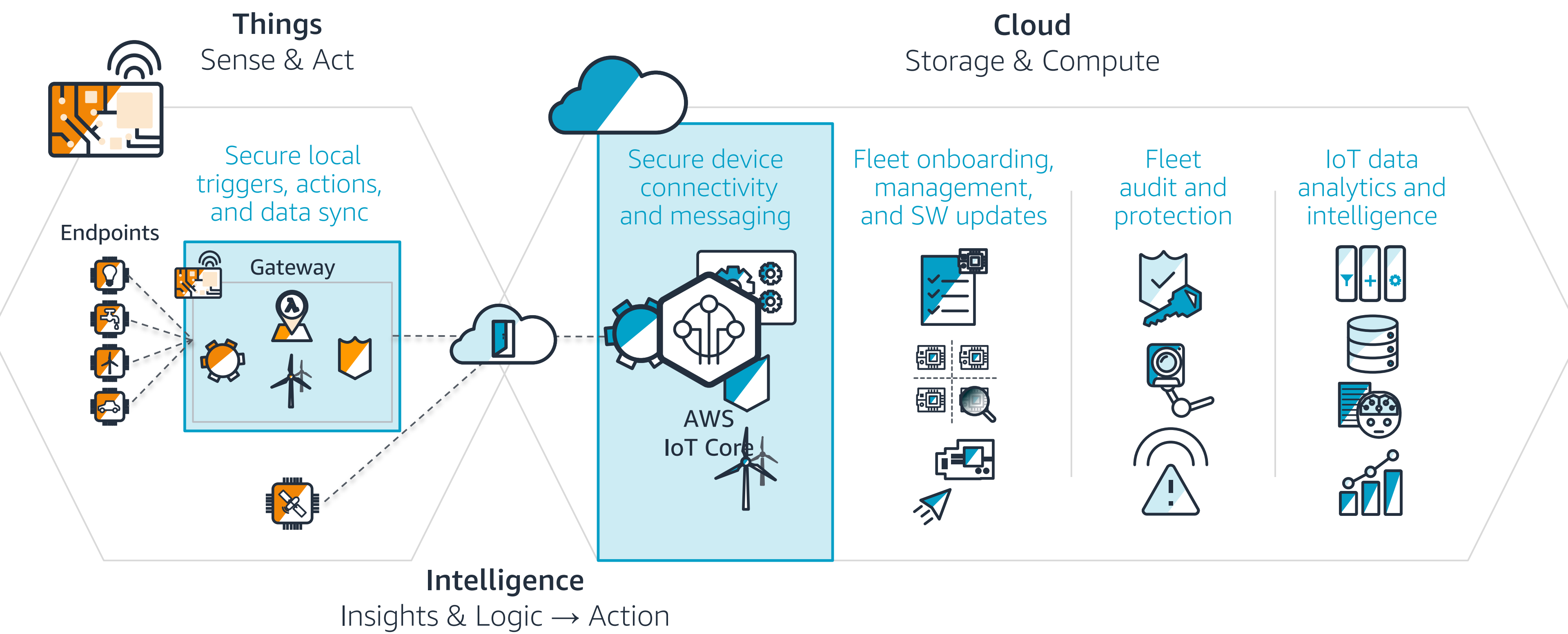


Connected to LightBulb!

Light bulb moment



AWS IoT Architecture



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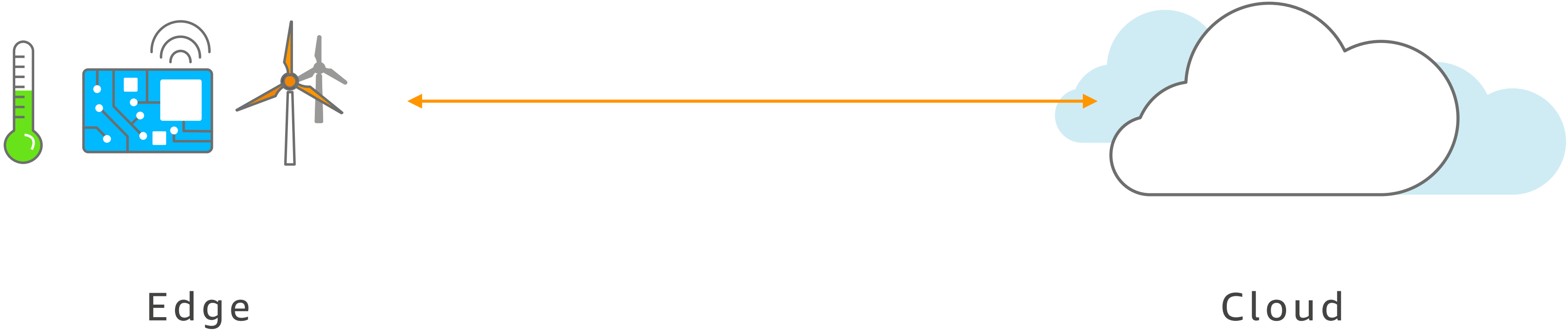
Where do I want to process data?



Where do I want to process data?

Law of Physics

Law of Economics

Law of the Land

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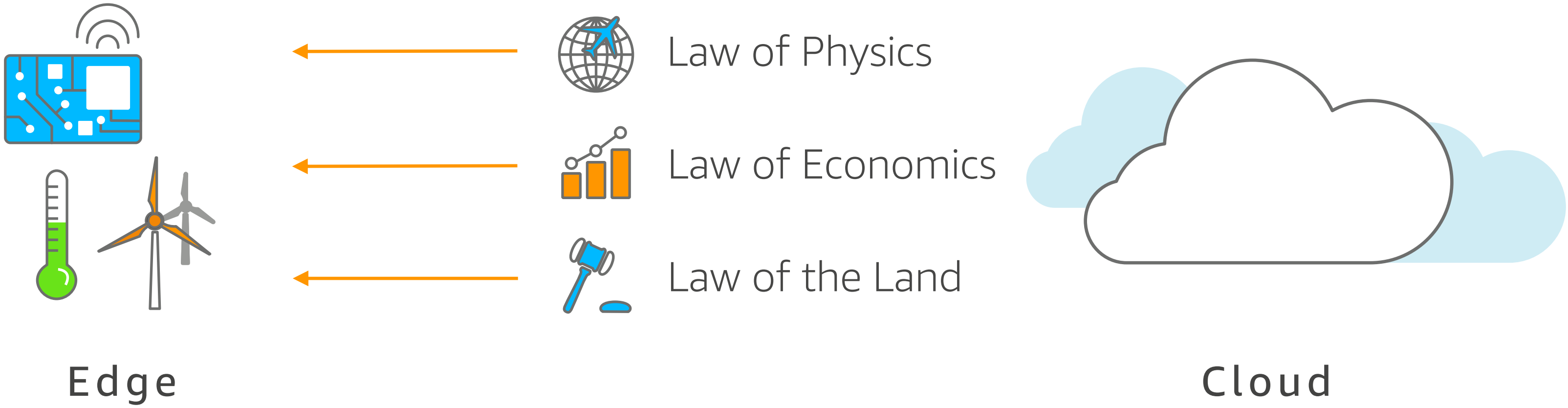

Law of Physics

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Law of the Land

Edge

Cloud

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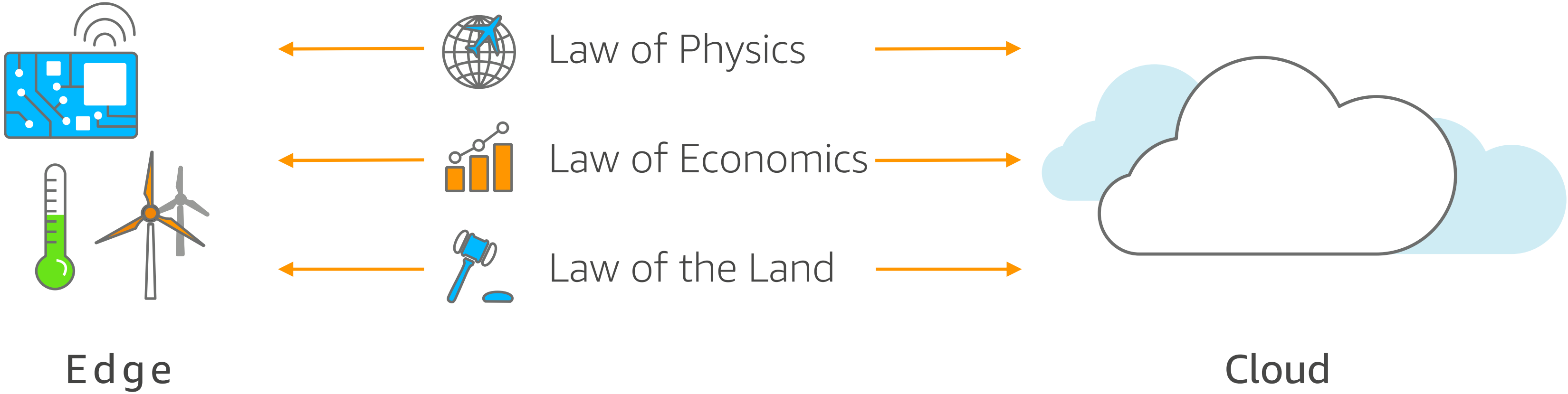

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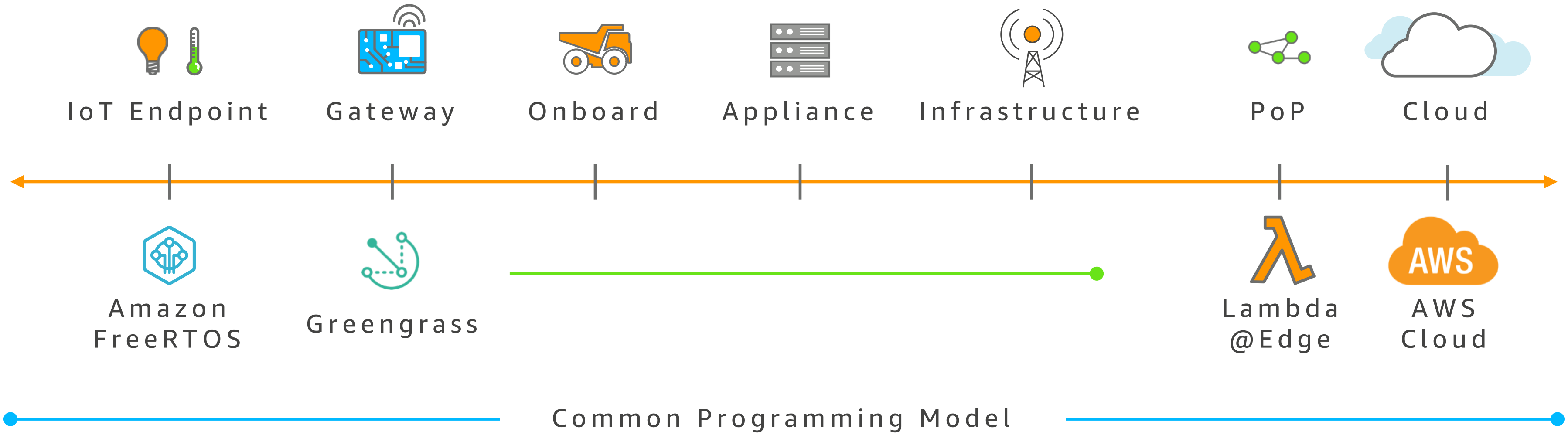


IoT Endpoint

Gateway

Onboard

Appliance

Infrastructure

PoP

Cloud

Amazon FreeRTOS

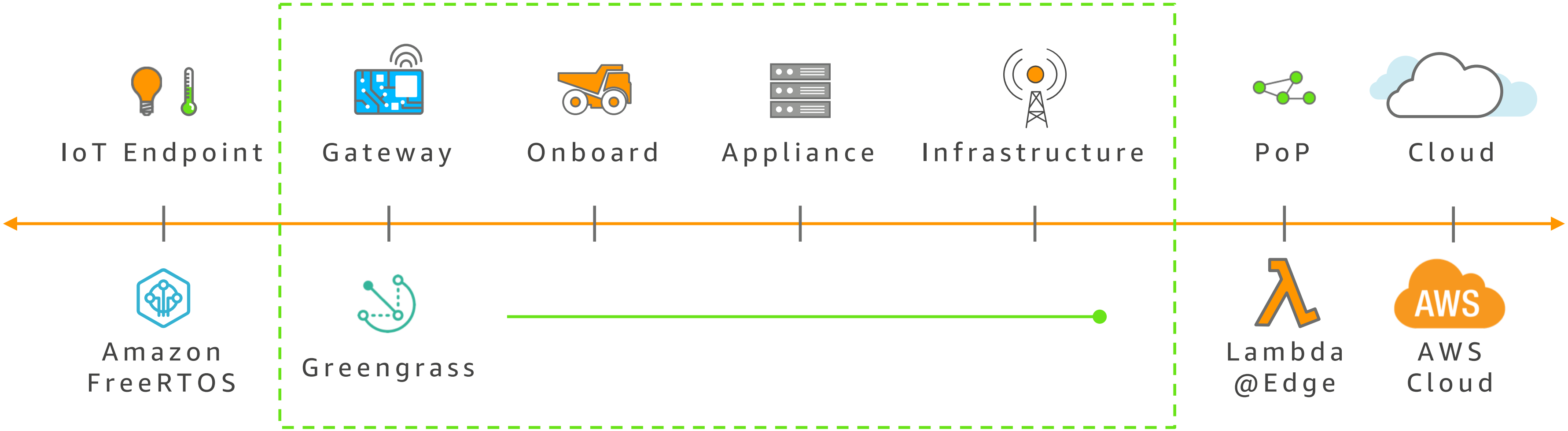
Greengrass

Lambda @Edge

AWS Cloud

Common Programming Model

Where do I want to process data?



You are here

Who is AWS Greengrass for?

Industrial Gateways

Consumer Electronics

Energy

Retail

Medical

Construction

Automotive

Infrastructure

Mining

Agriculture

Insurance

More...

AWS Greengrass

Extend AWS IoT to the Edge

Local Messages and Triggers

Local message broker

Local Actions

Lambda functions

Data and State Sync

Local device shadows

Security

AWS-grade security

Local Resource Access

Lambda functions Interact with peripherals

Machine Learning Inference

Local execution of ML models

Protocol Adapters

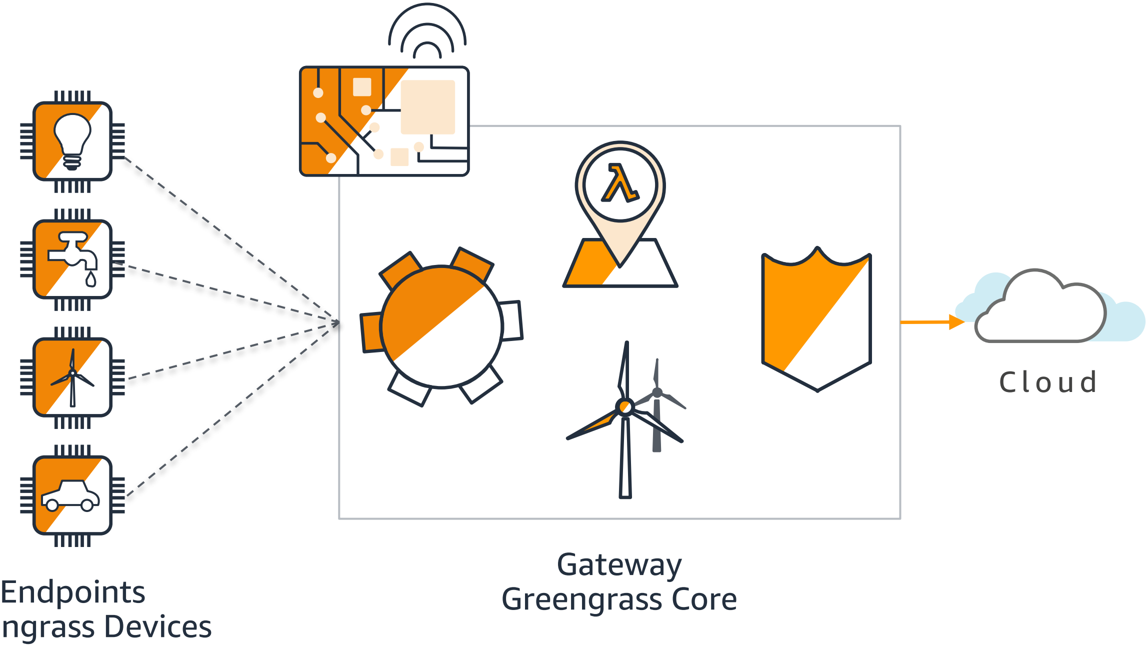
Easy integrations with local protocols

Over the Air Updates

Easily update AWS Greengrass core

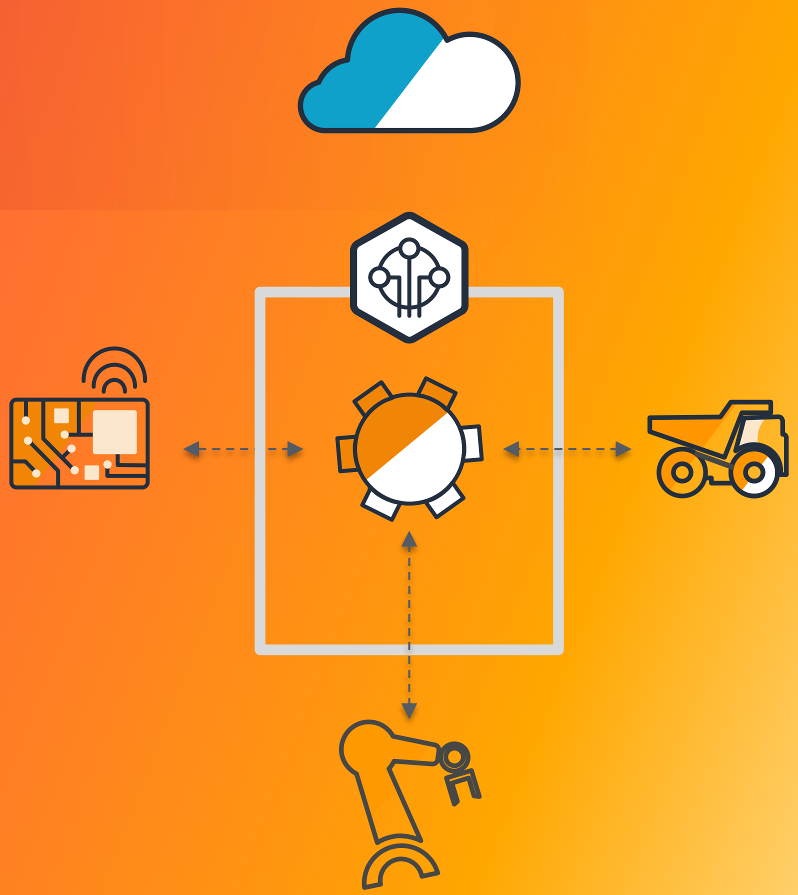
AWS Greengrass

- Software installed on a gateway
- Architectures:
  - x86_64
  - ARMv8
  - ARMv7l
- Linux bases:
  - Amazon Linux
  - Ubuntu 14.04 - 16.04
  - Raspbian Jessie
- Core and Device AWS IoT SDK



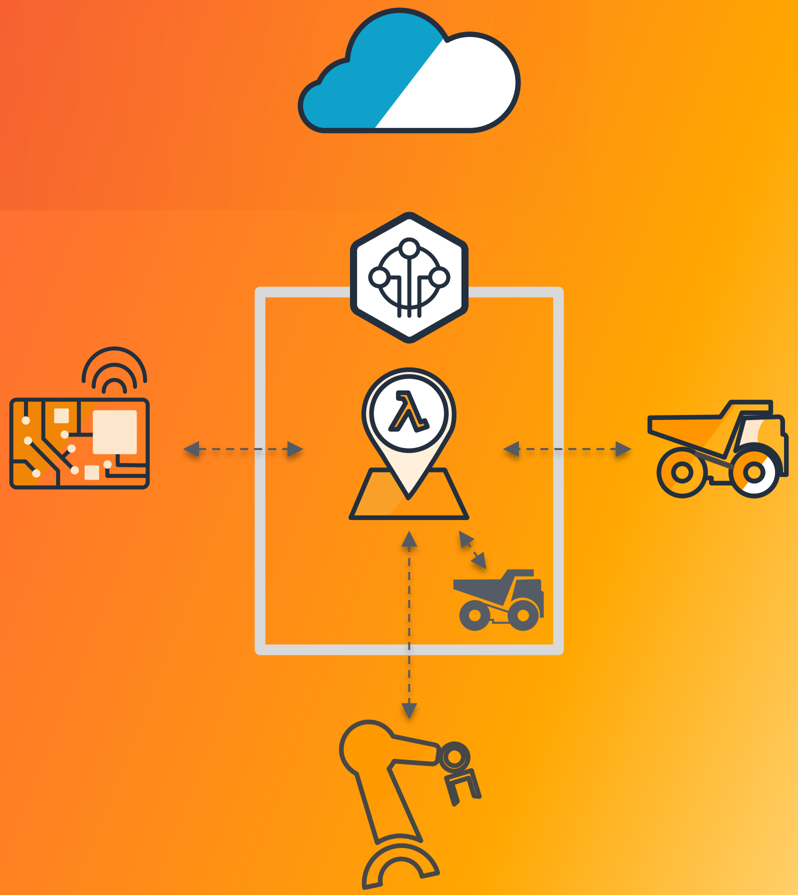
Local Messages and Triggers

- Extends the AWS IoT MQTT pub/sub messaging paradigm locally to the edge
- Allows AWS Lambda functions written in the cloud and deployed locally on the AWS Greengrass core to trigger and respond to events
- Enables offline command and control operations from the AWS Greengrass core and other devices that use the AWS IoT Device SDK



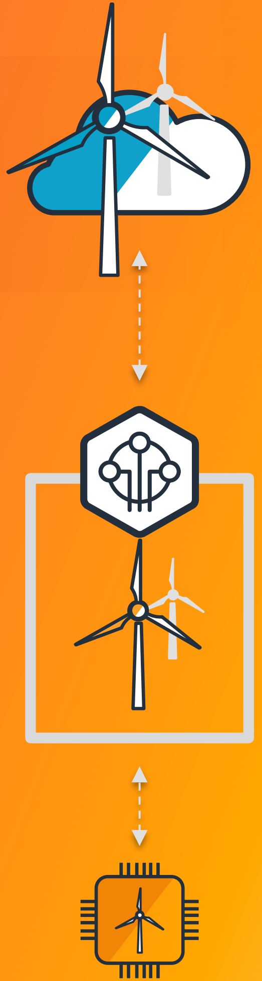
Local Actions

- With AWS Greengrass, you can write event-driven AWS Lambda functions in the cloud and deploy them locally
- AWS Greengrass runs AWS Lambda functions written in Python 2.7, Node.js, or Java
- Invoke AWS Lambda functions with messaging and shadow updates
- Offline actions and triggers, for example, that can detect low moisture in the soil and then trigger controls to spray more water inside a smart greenhouse



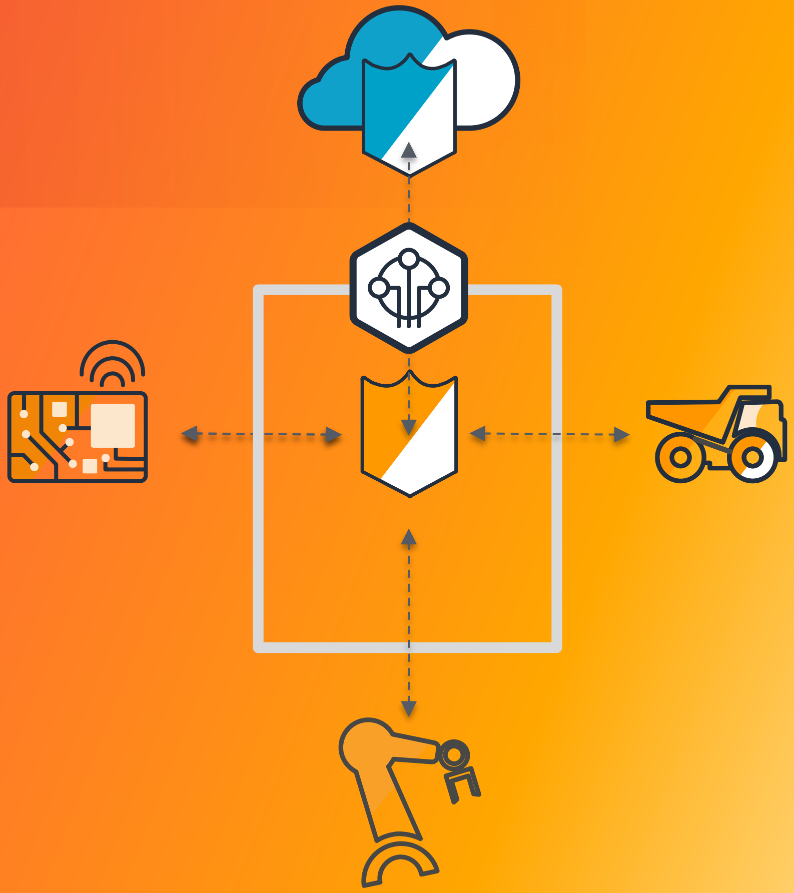
Data & State Sync

- Enables you to define a shadow state for a device as a JSON document in any logical manner - a single wind turbine, a wind farm, or a resource grid
- Allows shadow states to be local or synced to the cloud
- AWS Lambda functions running on the AWS Greengrass core can update shadow states through MQTT messages
  - For example, the AWS Greengrass core can update a tractor's shadow with continuous information on harvest quality, and a snapshot of the data can be synced to the cloud at the end of the day



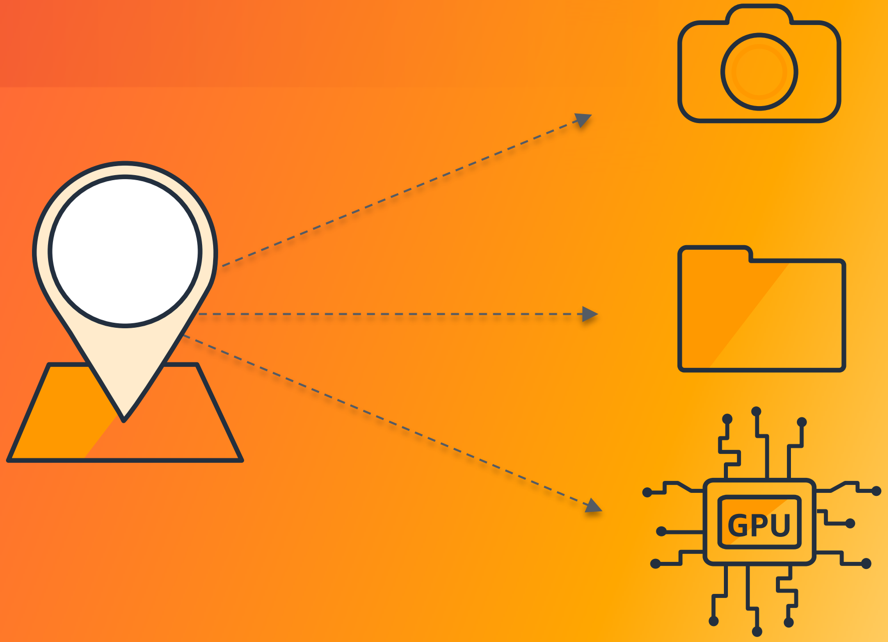
Security

- Supports TLS mutual authentication, both locally and with the cloud
- Certificates on your devices can be associated to SigV4 credentials in the cloud
- Through AWS Lambda running on the AWS Greengrass core, you can easily call any AWS service running in the cloud



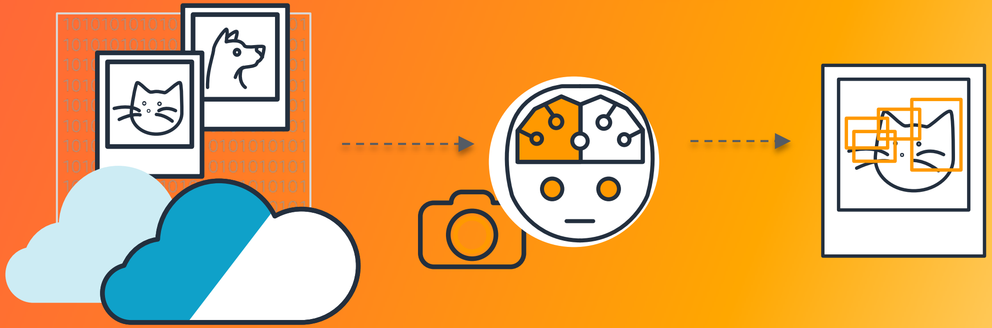
Local Resource Access

- Allows AWS Lambda to access local resources on a device
- GPIO can be accessed to process sensor and actuator data
- AWS Lambda can take advantage of the local file system on your operating system
- AWS Lambda can use GPUs for hardware acceleration for machine learning



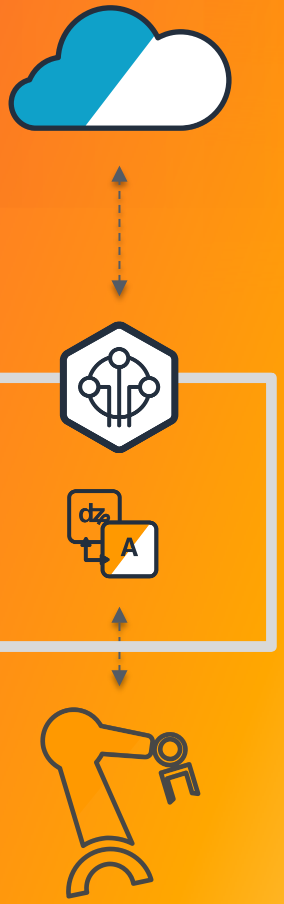
Machine Learning Inference

- Train models in the cloud using Amazon SageMaker or another service using Amazon EC2
- ML Inference works with Apache MXNet and TensorFlow
- Transfer your trained models onto your AWS Greengrass device to make predictions based on local data
- ML Inference gives you access to hardware accelerators such as GPUs on your devices



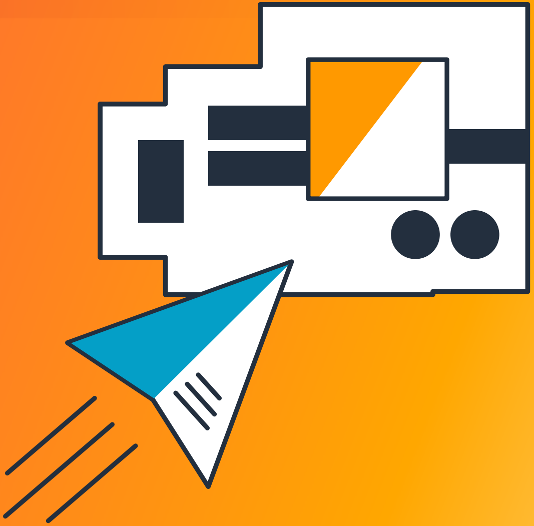
Protocol Adapter for OPC-UA

- Allows for industrial machines to participate in the AWS Greengrass programming paradigm
- Brings the robust AWS Greengrass security model to industrial devices that communicate through an OPC-UA server
- Supports certificate-based authentication with industrial OPC-UA servers
- Fully customizable framework to fit other industrial protocols
- Example: an industrial PLC on a machine can send telemetry data to an AWS Greengrass core that, in turn, controls other machines



Over-the-air Updates

- Remotely update an AWS Greengrass core device with the latest AWS Greengrass software, security updates, bug fixes, and features
- Enables bulk updates of many AWS Greengrass core devices at once
- Updates are fail-safe: Any breaking change triggers an automatic revert
- Status of updates can be tracked from the AWS IoT console



Greengrass Momentum

accenture
acer
Aricent
Ayla
BCG Digital Ventures
brains

Bright Wolf
BROADCOM
BSQUARE
CANONICAL
ctp Cloud Technology Partners
DELPHI

DENSO Crafting the Core
enel
intel
INTERNET OF THINGS IOT
lenovo
LUXOFT

machineshop
MONGOOSE OS
NOKIA
NVIDIA.
PENTAIR
QNAP

QUALCOMM
RaspberryPi
resin.io
RioTinto
Saguna
SAMSUNG

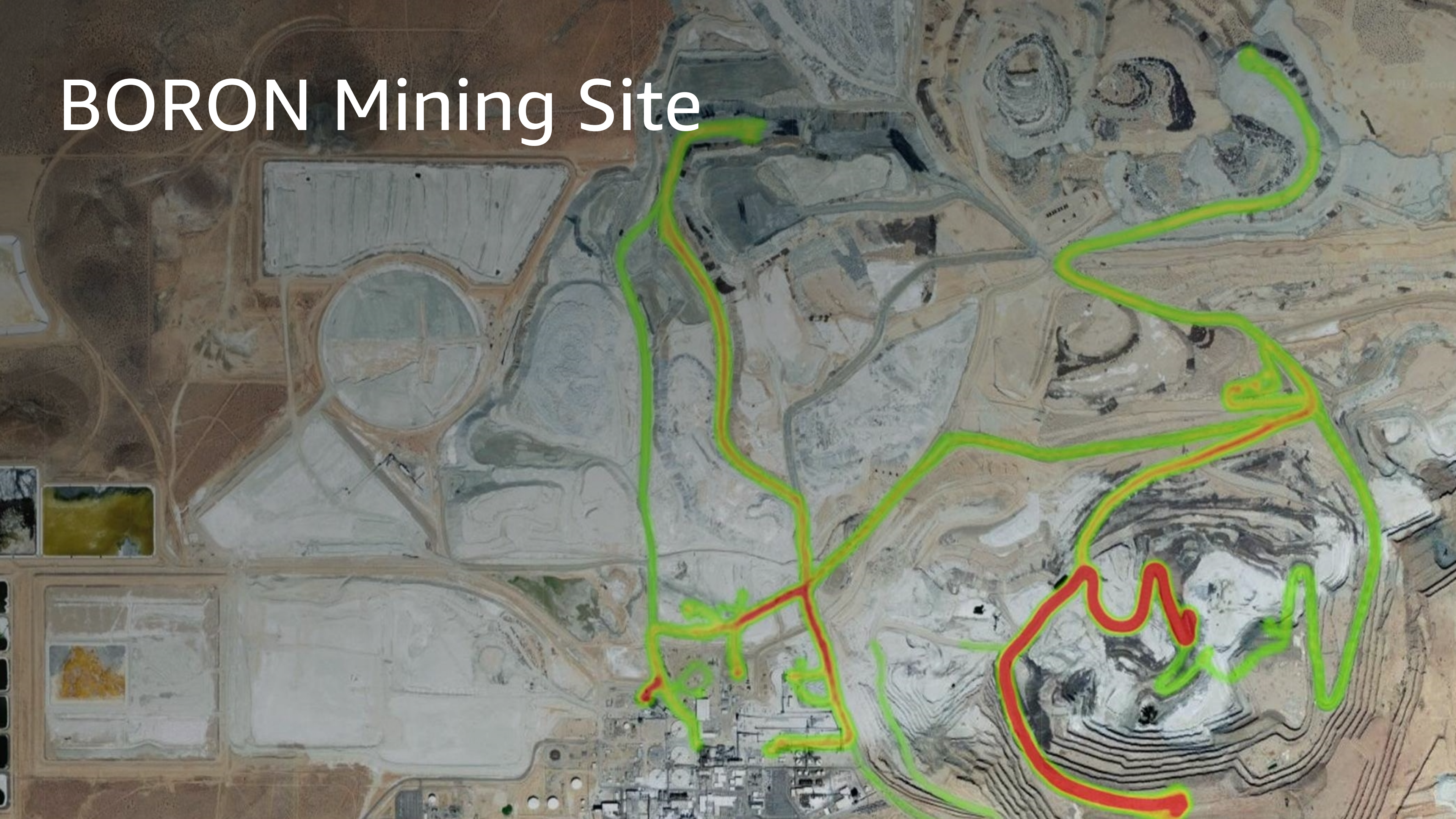
solstice
SONY
StanleyBlack&Decker
ST life.augmented
technicolor
ThunderSoft

TELUS
trek10
Visteon
vmware
WARBY PARKER
wistron

YANMAR
amazon
annapurnalabs an amazon company
AWS Snowball Edge

Rio Tinto

BORON Mining Site



AWS Greengrass - Benefits

Respond quickly to local events

Operate offline

Simplified device programming

Reduce the cost of IoT applications

AWS-grade security

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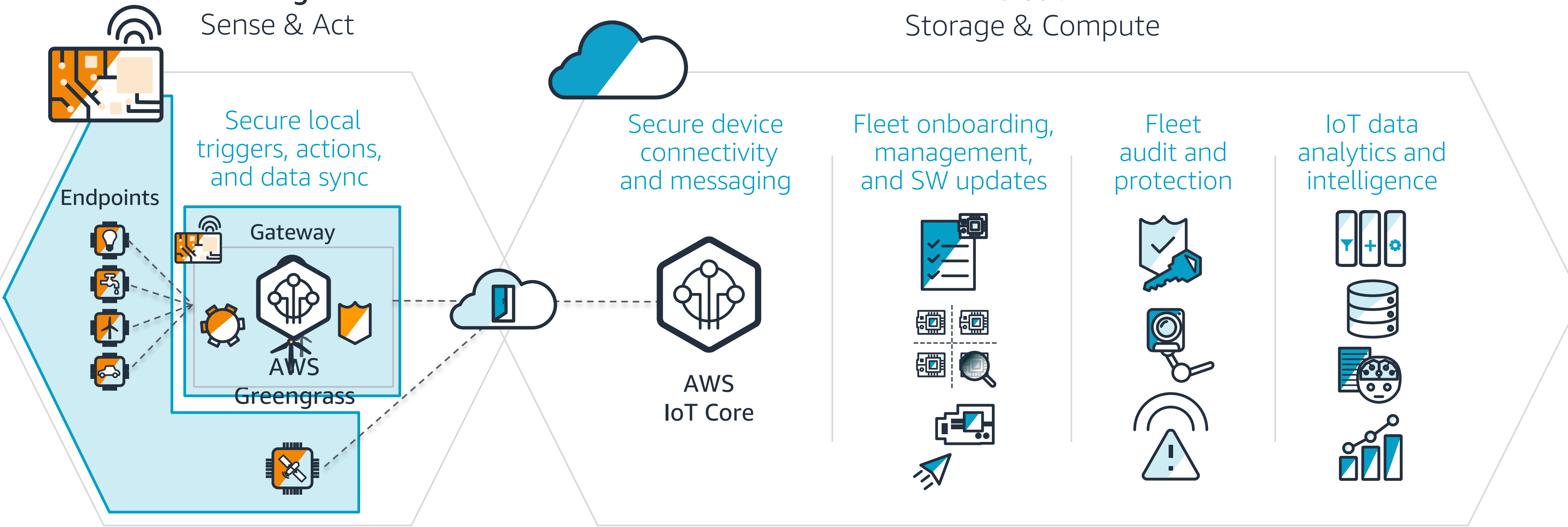

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Amazon FreeRTOS

IoT Microcontroller OS

Based on FreeRTOS kernel

Local Connectivity Libraries
AWS Greengrass

Cloud Connectivity Libraries
AWS IoT Core

Security Connectivity Libraries

OTA Beta &
Code Signing

WARBY PARKER

- Offer designer eyewear
- Started as online business and moved to physical stores
- Use data from the stores and the web to inform product decisions

Design a physical retail experience to be as data rich as the digital experience

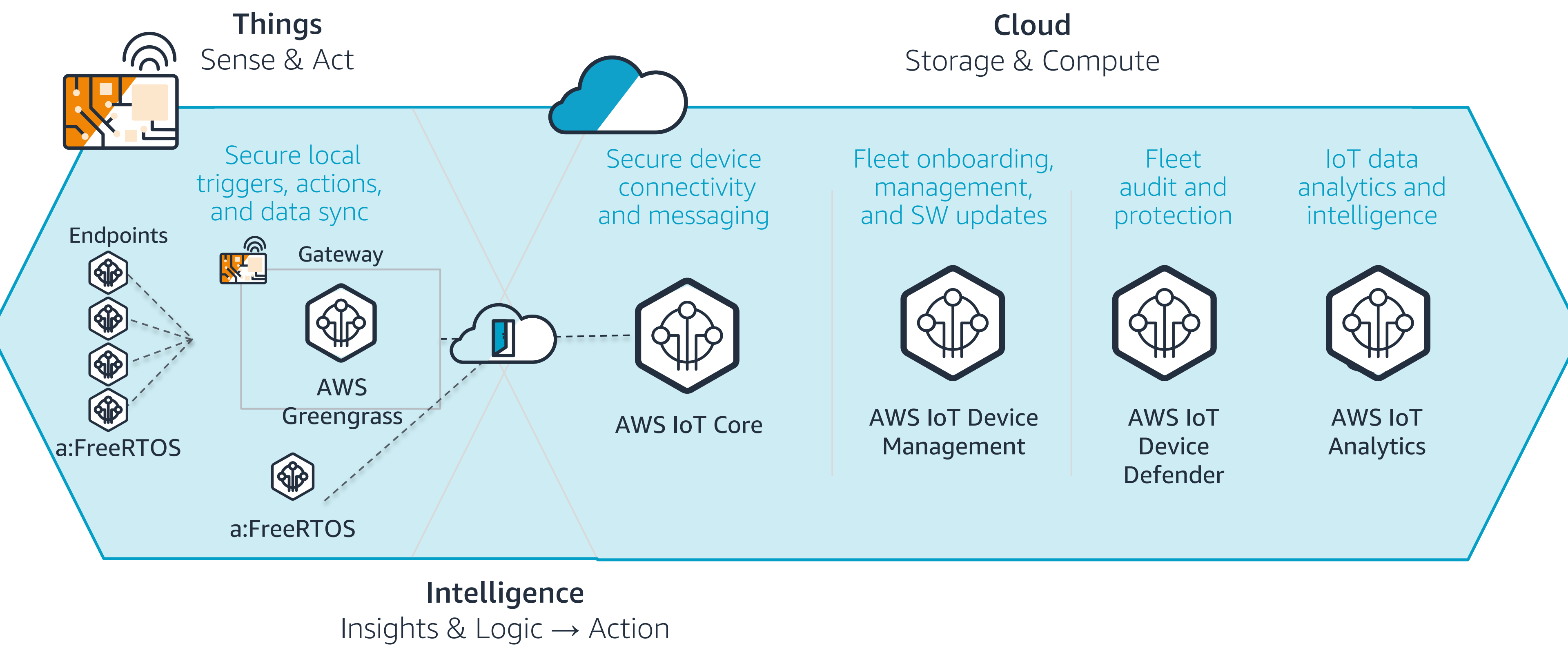
Online	In Store
Unique Visitors	Foot traffic
Click streams	Stay zones
Add-to-carts	Product interactions

With Greengrass, they can process and act upon in-store data more easily.

Already love using Lambda in the Cloud

Greengrass makes it easy to apply this paradigm in our stores

AWS IoT Architecture



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