
AWS
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IOT402

How to build connected microcontroller apps with FreeRTOS

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HALTER

This session’s target audience



Full stack IoT engineer



Embedded engineer



Embedded engineering manager

Agenda

Solution design and component selection

Application design and API selection

Operational design and maintenance



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General compute is not IoT

You can connect to AWS IoT Core from your laptop, but that is not IoT

Fit for purpose IoT devices provide:

- Lower costs
- Explicit peripheral use
- Smaller security footprints
- Power efficiencies
- State based operation and processing
- Deterministic controls

Connectivity module factors

Distance, weight, velocity, availability/mobility, energy, security, cost



5G and LTE

- ⊕ Distance
- ⊕ Weight
- ⊕ Velocity
- ⊕ Availability
- ⊜ Energy
- ⊕ Security
- ⊗ Cost



Wi-Fi

- ⊜ Distance
- ⊕ Weight
- ⊕ Velocity
- ≠ Availability
- ⊜ Energy
- ⊜ Security
- ⊕ Cost



Ethernet

- ⊗ Distance
- ⊕ Weight
- ⊕ Velocity
- ≠ Availability
- ⊕ Energy
- ⊗ Security
- ⊕ Cost



NB-IoT

- ⊕ Distance
- ⊜ Weight
- ⊜ Velocity
- ⊜ Availability
- ⊕ Energy
- ⊕ Security
- ⊜ Cost



Mesh

- ⊜ Distance
- ⊗ Weight
- ⊗ Velocity
- ≠ Availability
- ⊕ Energy
- ⊜ Security
- ⊕ Cost

⊕ good ⊜ ok ⊗ undesirable ≠ proprietary/immobile

Simplify and plan your IoT components

Simplify IoT development by choosing helpful components up front

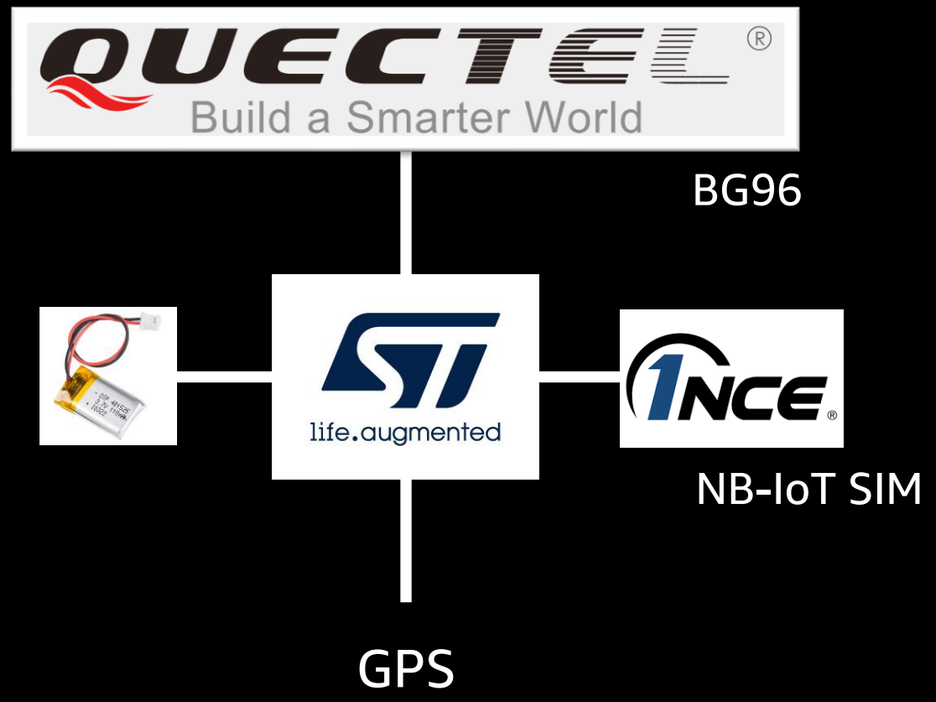
- Offload TCP through communication modules
- Offload cryptographic operations
- Choose microcontrollers with low power features

Piece together your prototyping board and breakouts with peripherals

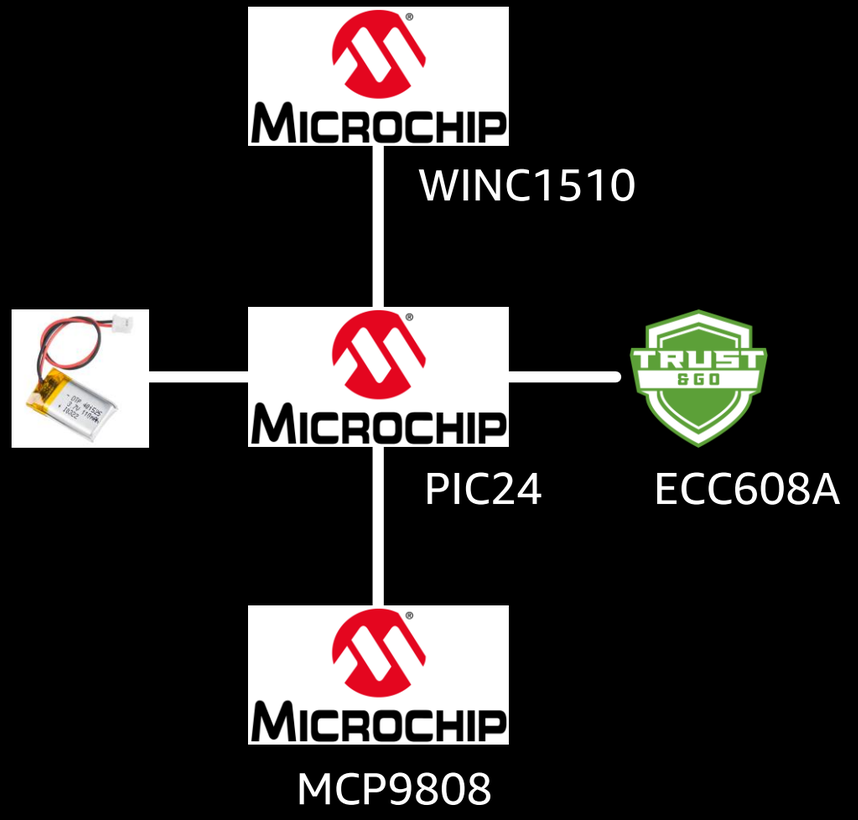
- Phase 1: use single boards that demonstrate vendor capabilities
- Phase 2: create a custom development board with chosen components
- Phase 3: production PCBA development

Component selection

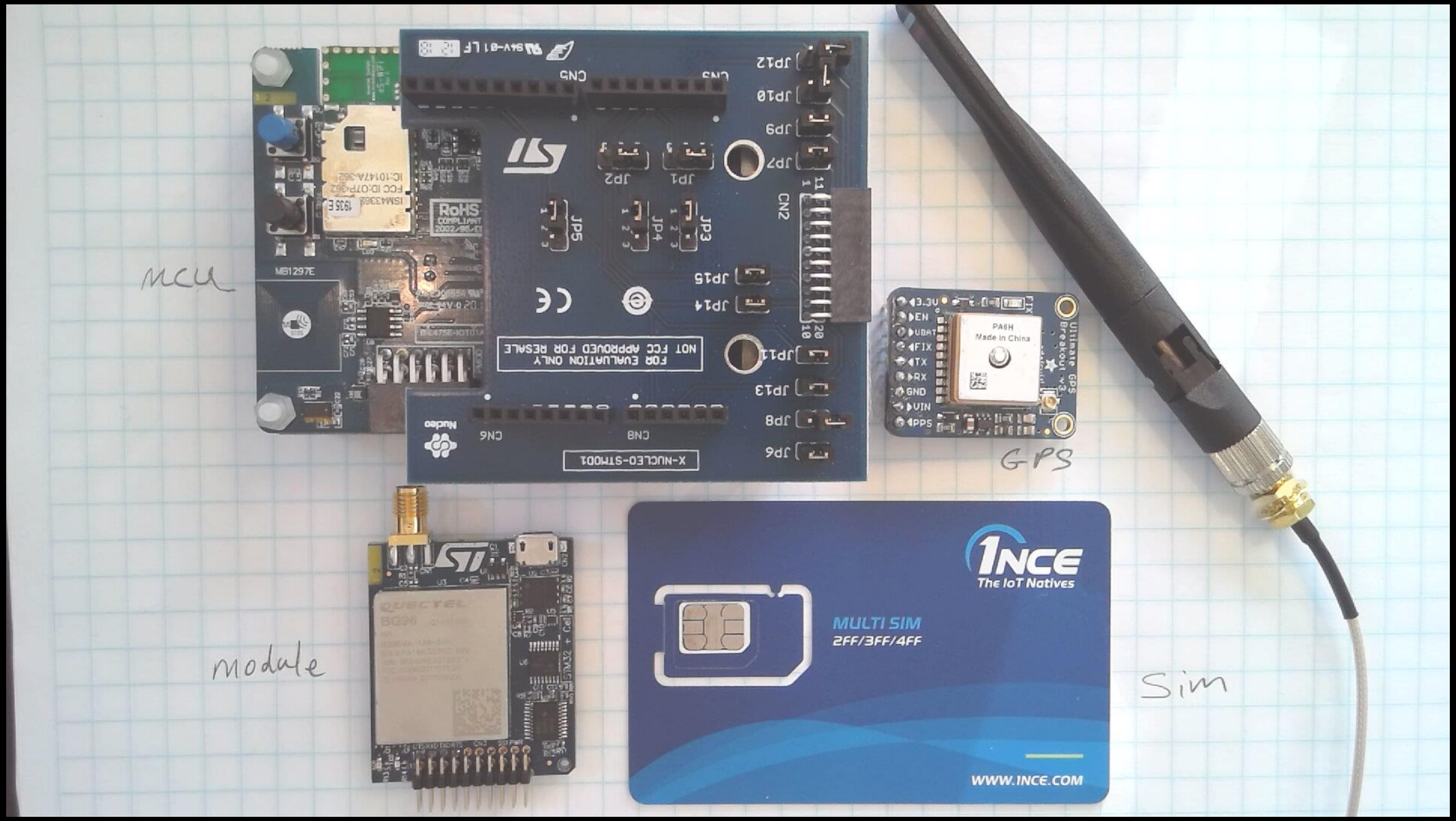
High mobility



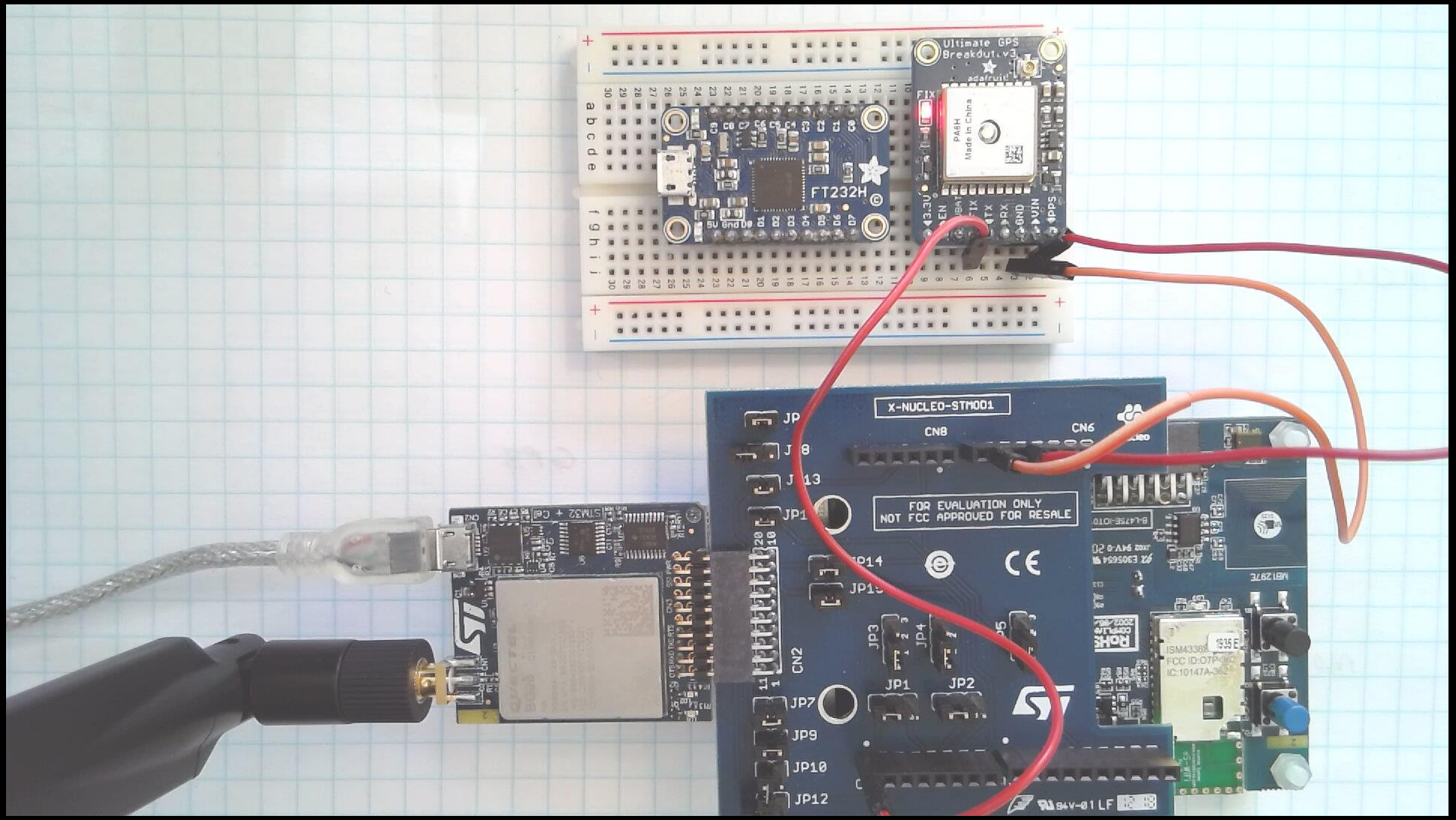
Limited mobility



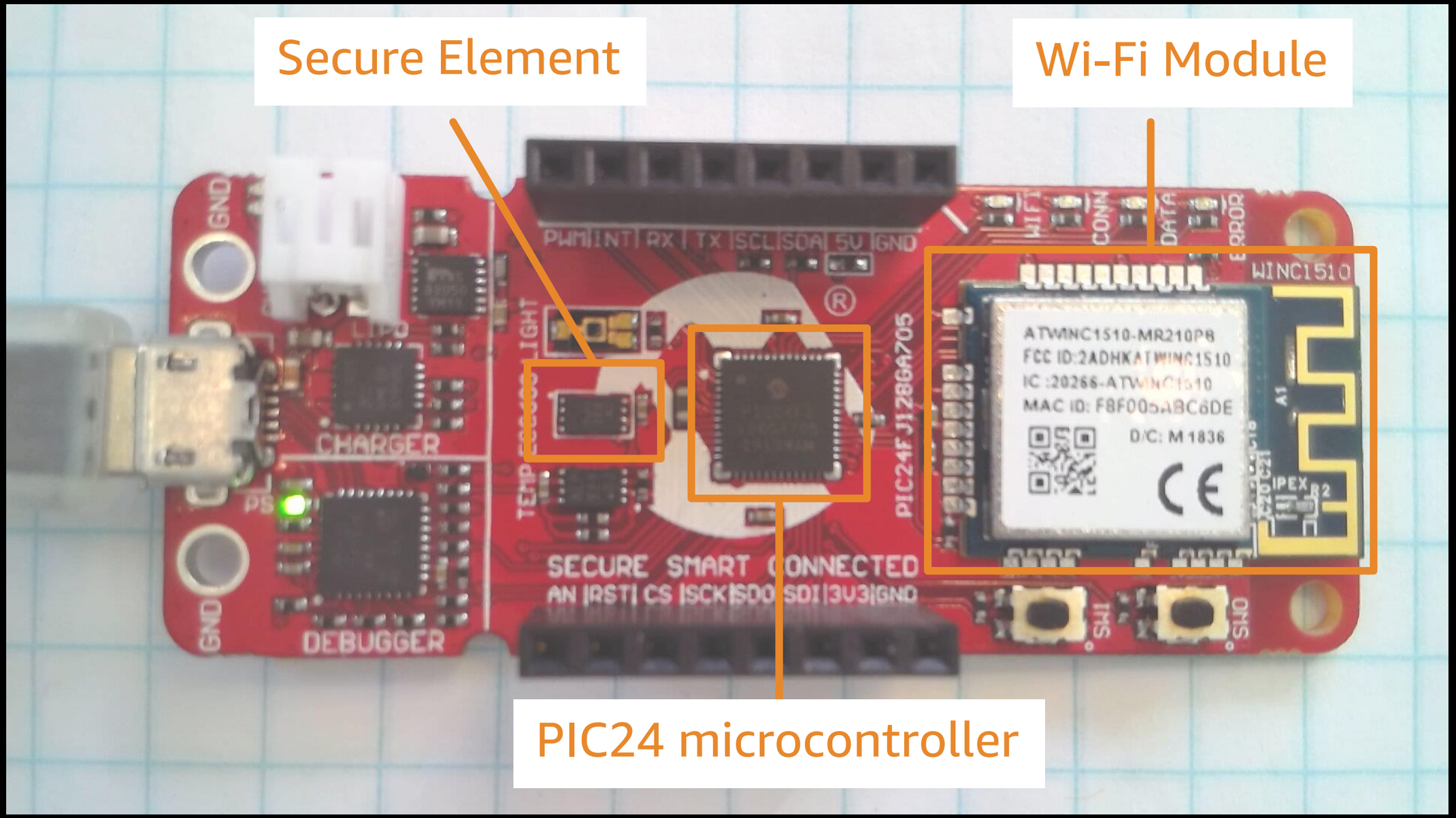
Hardware configuration, Cellular



Hardware configuration, Cellular



Hardware configuration, Wi-Fi



Key points for solution design and component selection

Prototyping boards help you get started quickly

Prototyping boards strongly favor specific vendors

Some more extensible than others

Extensibility allows you to try different peripherals

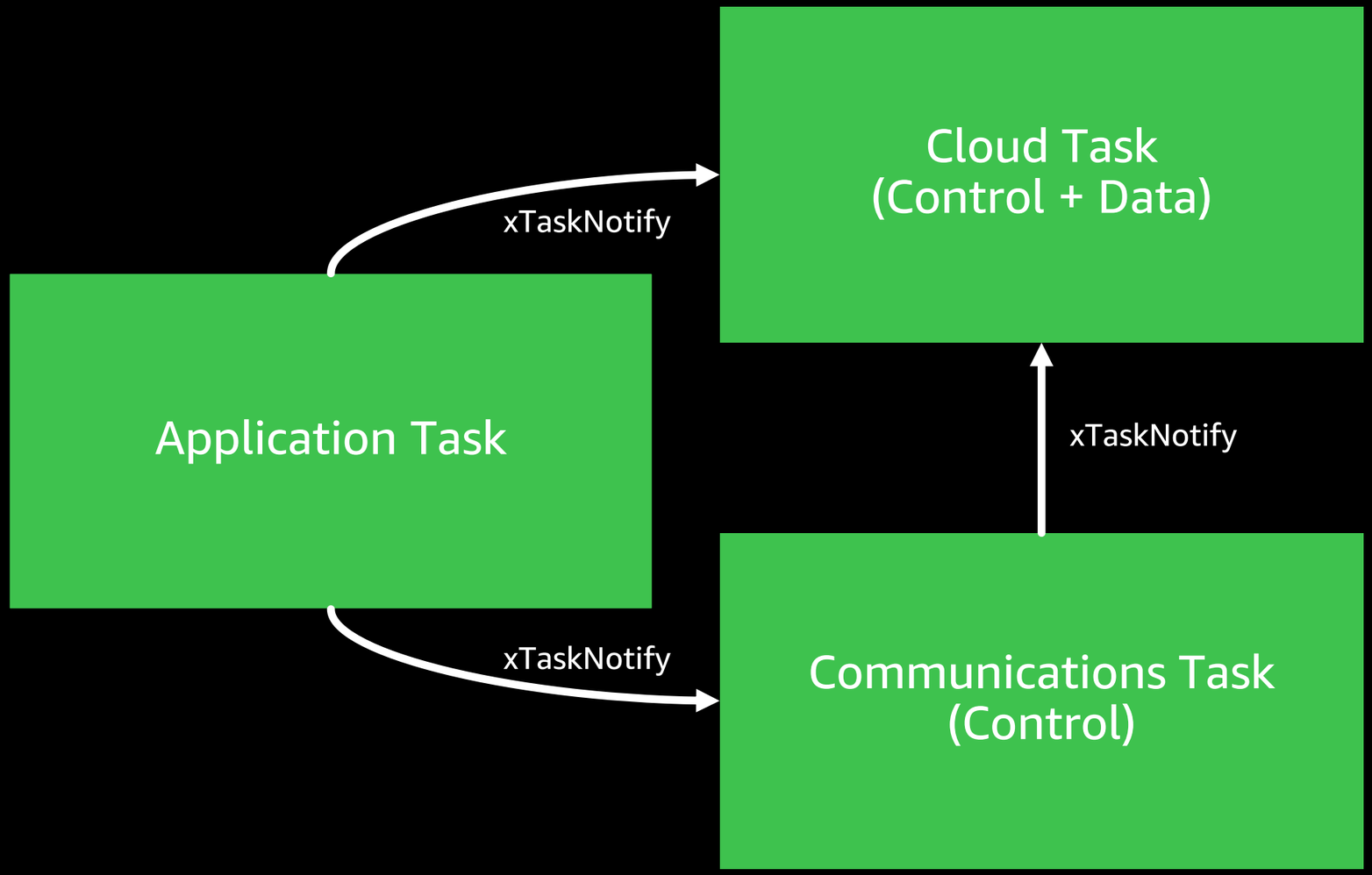
Organizing code for FreeRTOS



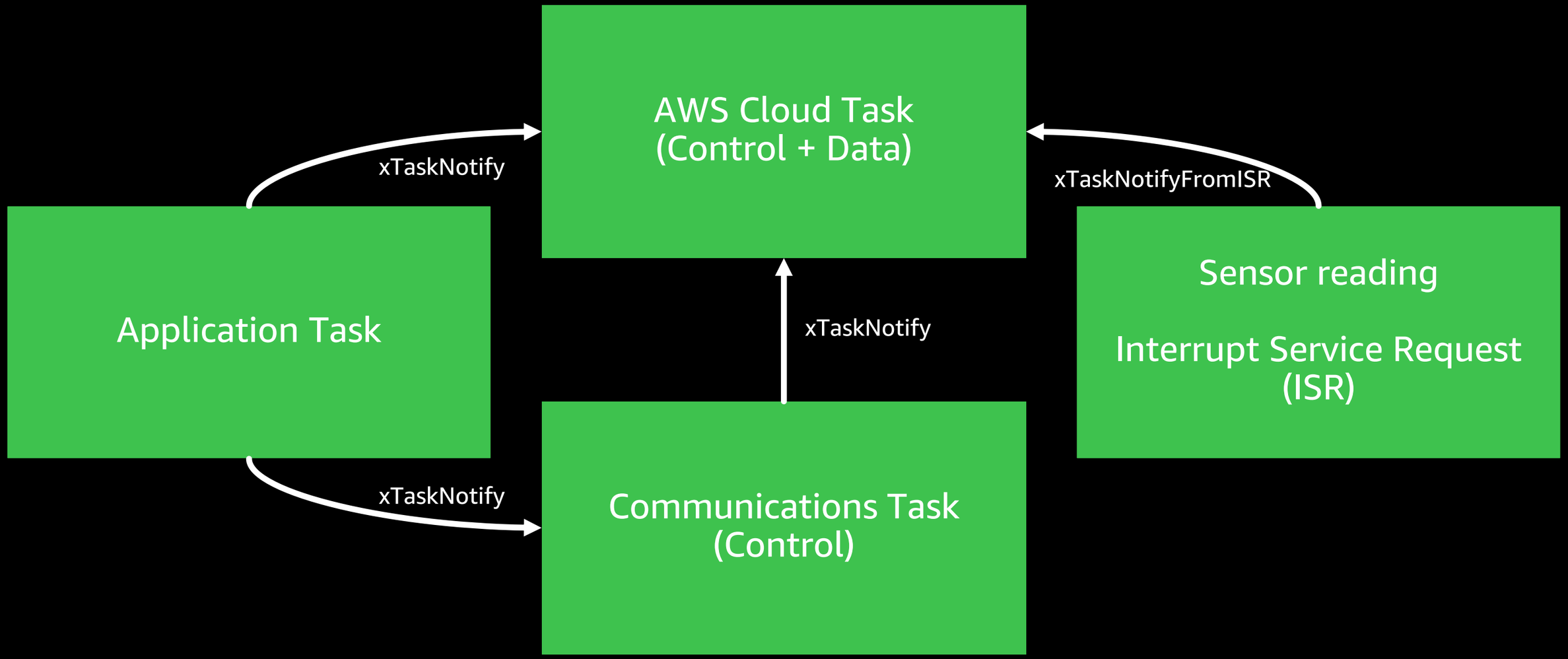
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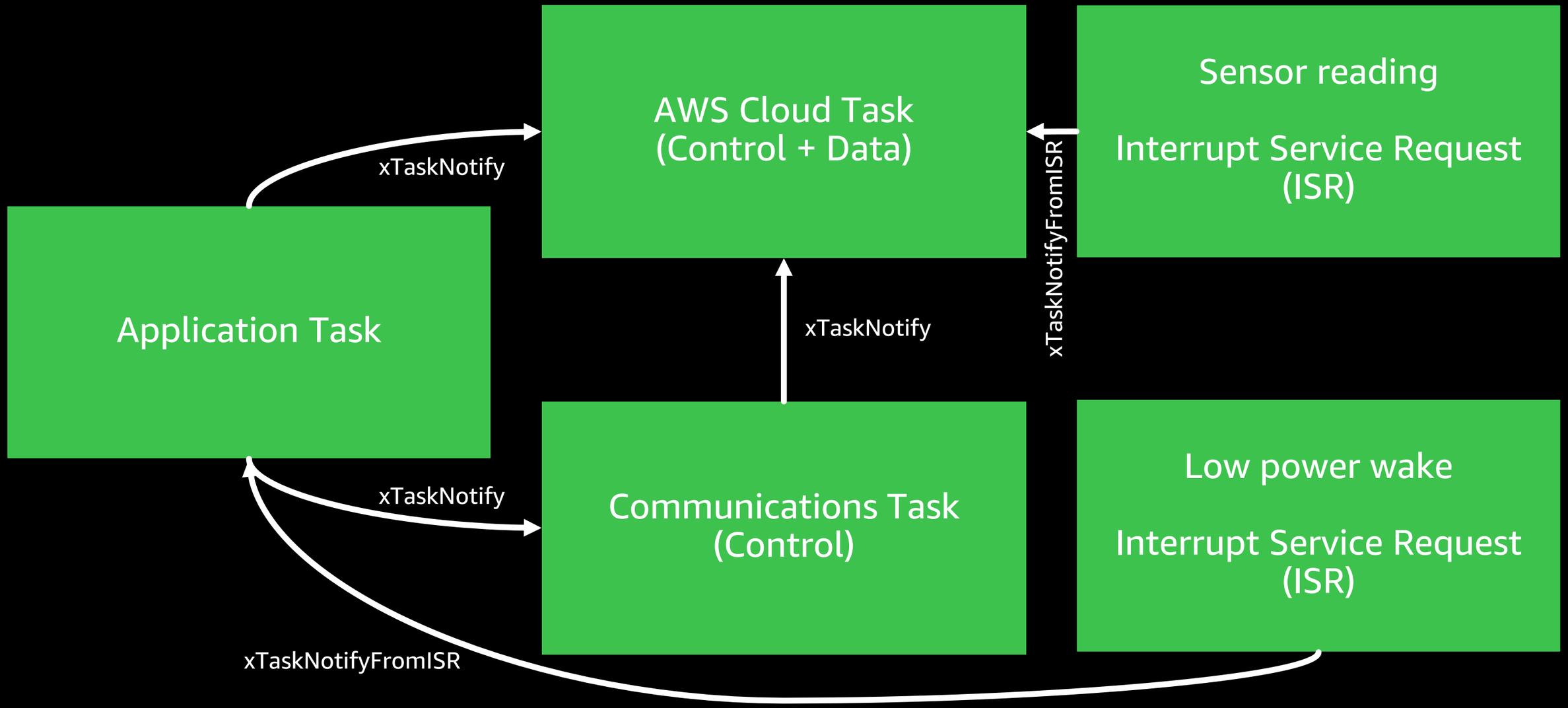
Create loosely coupled state machines



Example: basic telematics



Example: basic telematics and low power



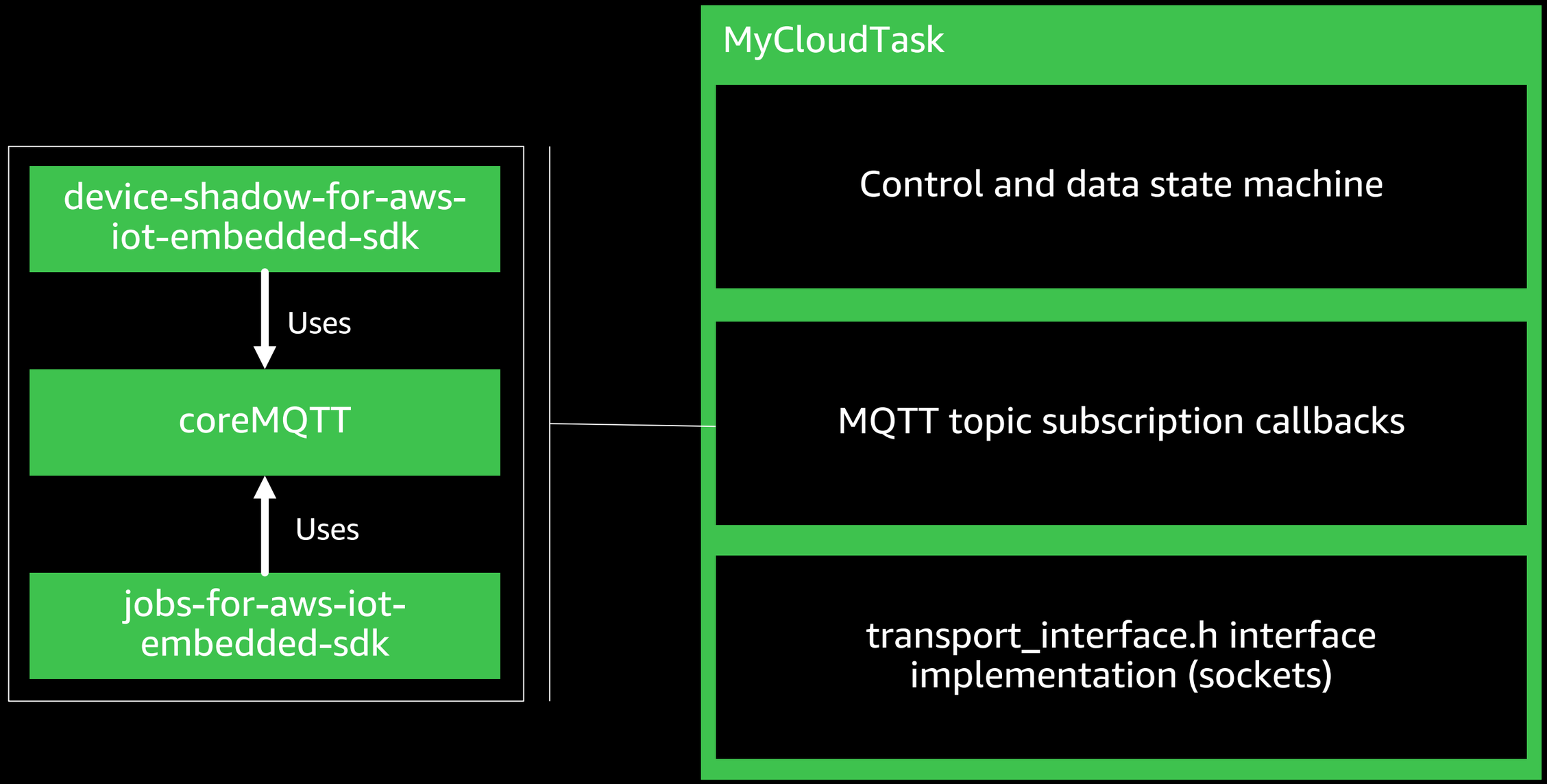
Libraries and the network interface

Core JSON	github.com/FreeRTOS/coreJSON
Core MQTT	github.com/FreeRTOS/coreMQTT
Core HTTP	github.com/FreeRTOS/coreHTTP
Core PKCS11	github.com/FreeRTOS/corePKCS11
Device Shadow	github.com/aws/device-shadow-for-aws-iot-embedded-sdk
Jobs	github.com/aws/jobs-for-aws-iot-embedded-sdk

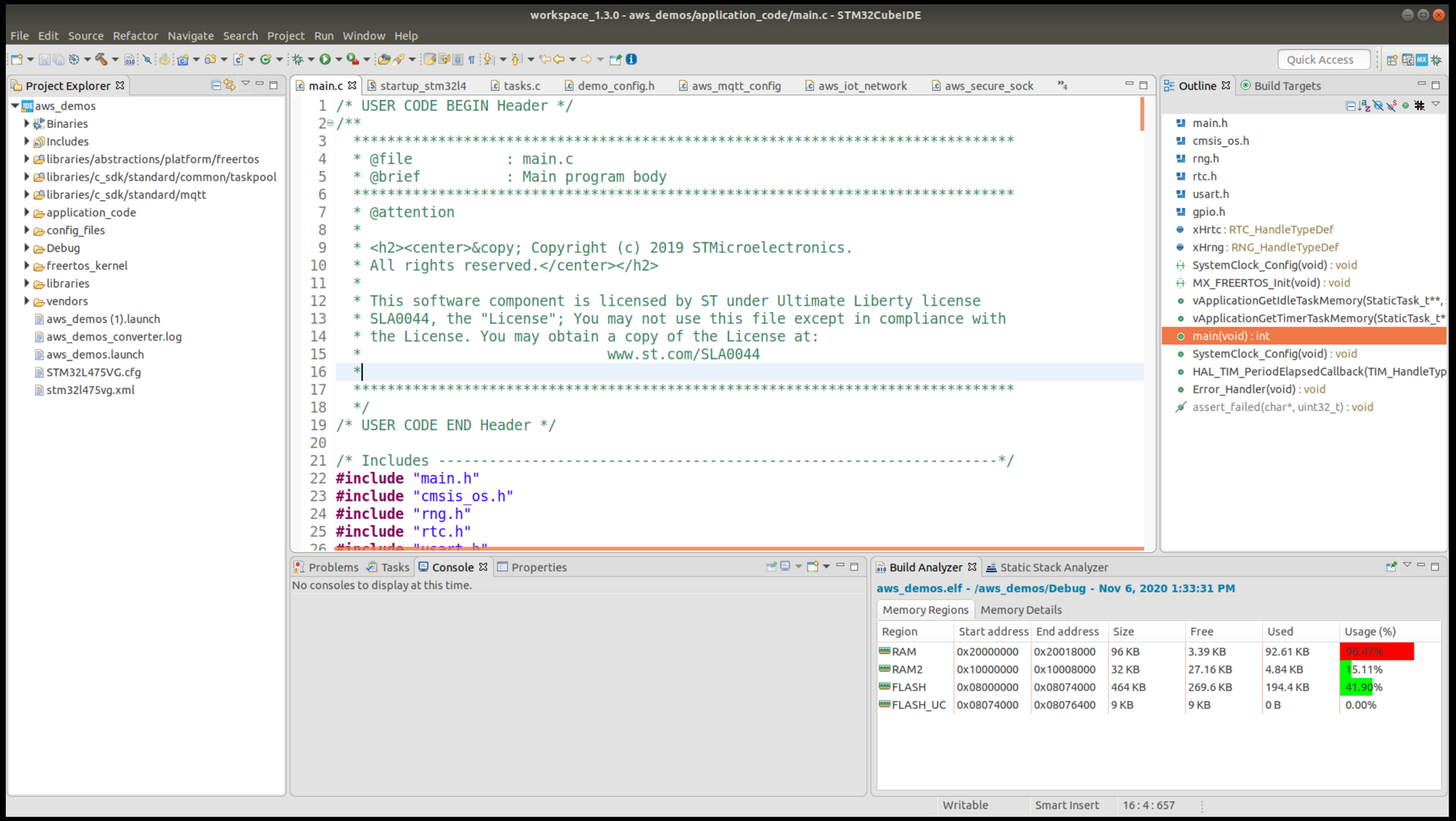
Cloud agnostic

AWS Cloud specific

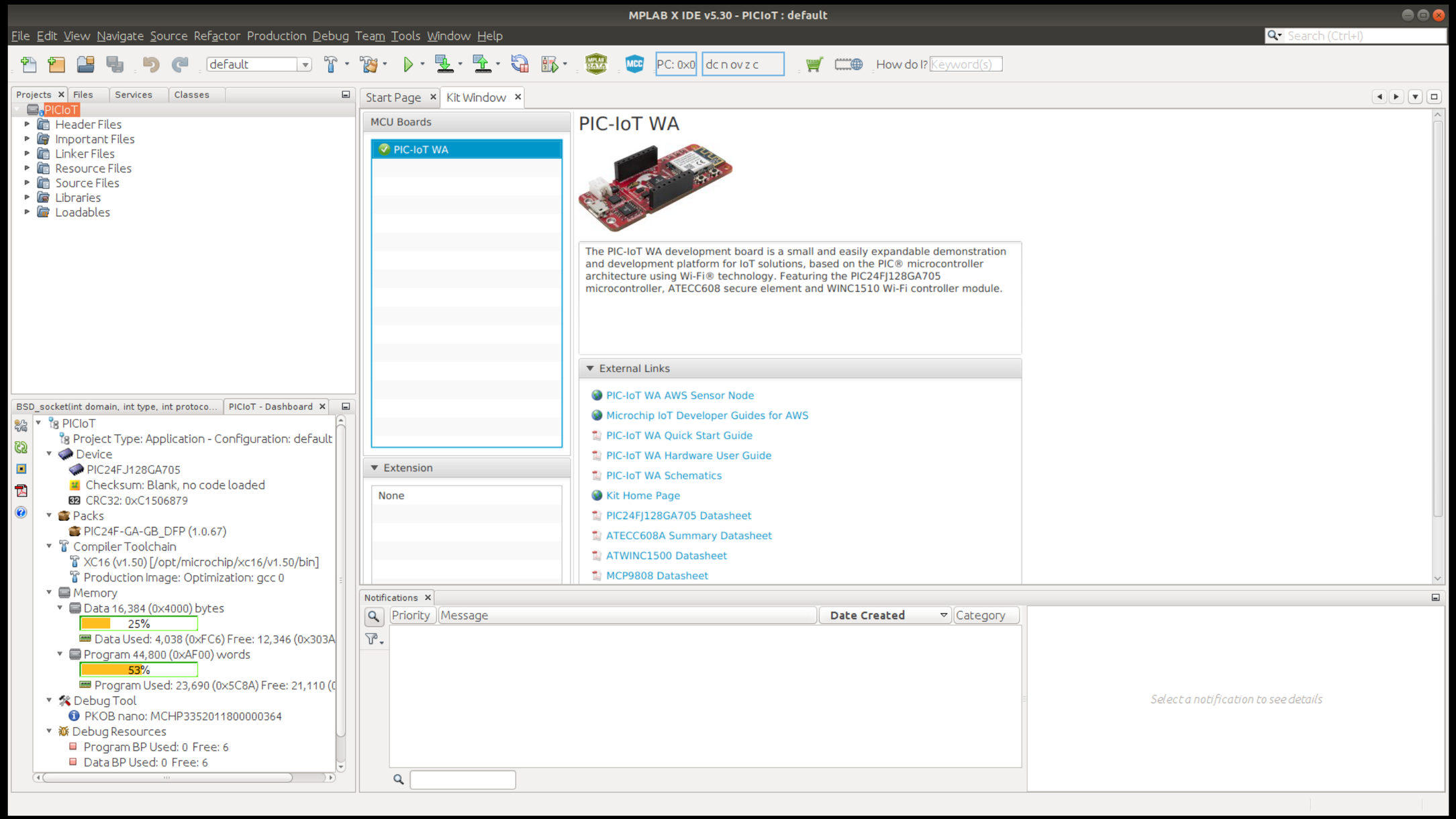
Integrating MQTT, Shadow, and Jobs



Development environment for STMicro



Development Environment for Microchip



Key points for organizing code

Component selection rarely matches the board so focus on software encapsulation

Use software tools that help you visualize Tasks, state, timing

Mitigate release delays with proper software encapsulation

Your IDE reflects and surfaces the specific value of silicon selection with differentiating tools

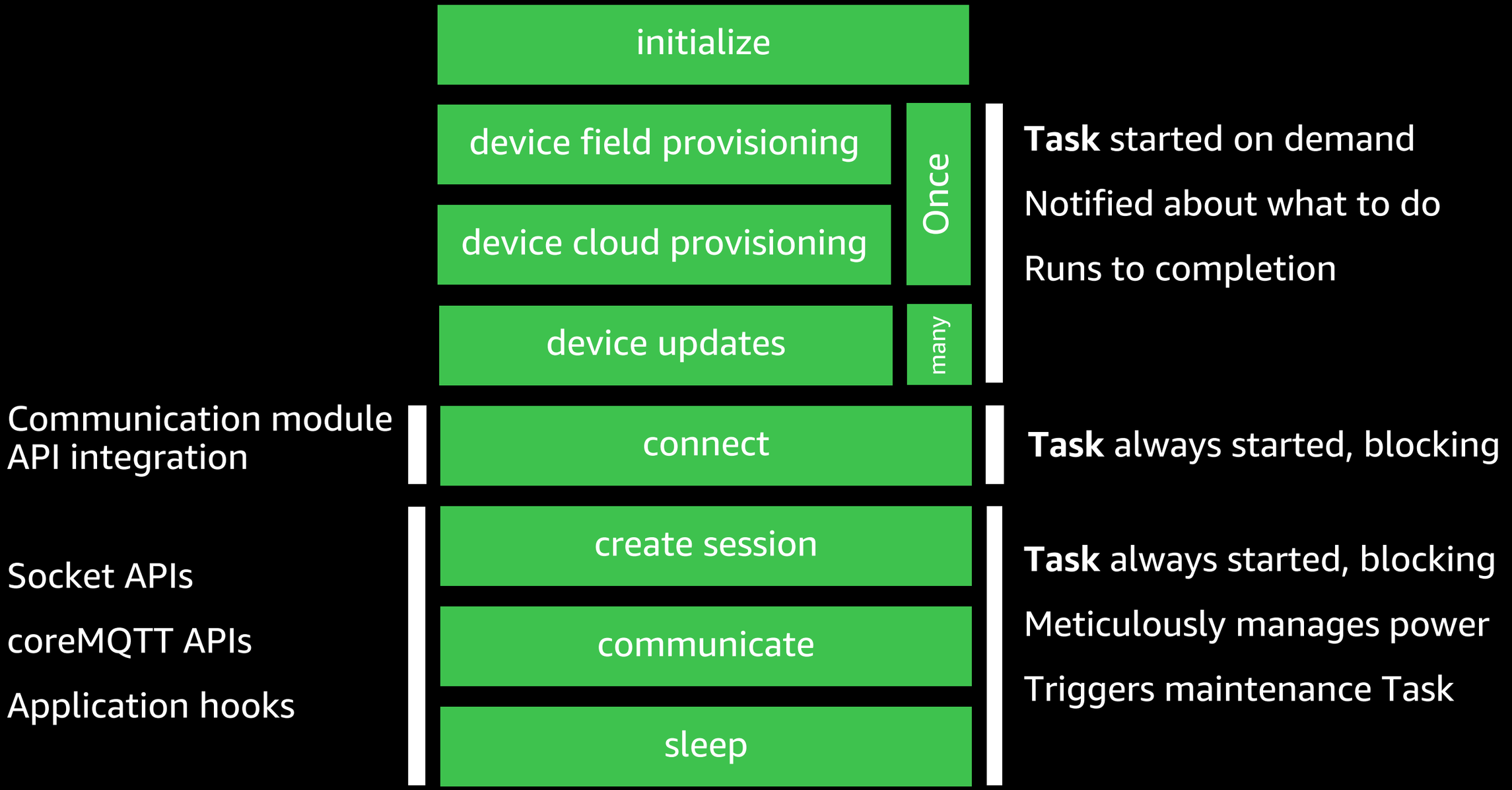
Stitching and running



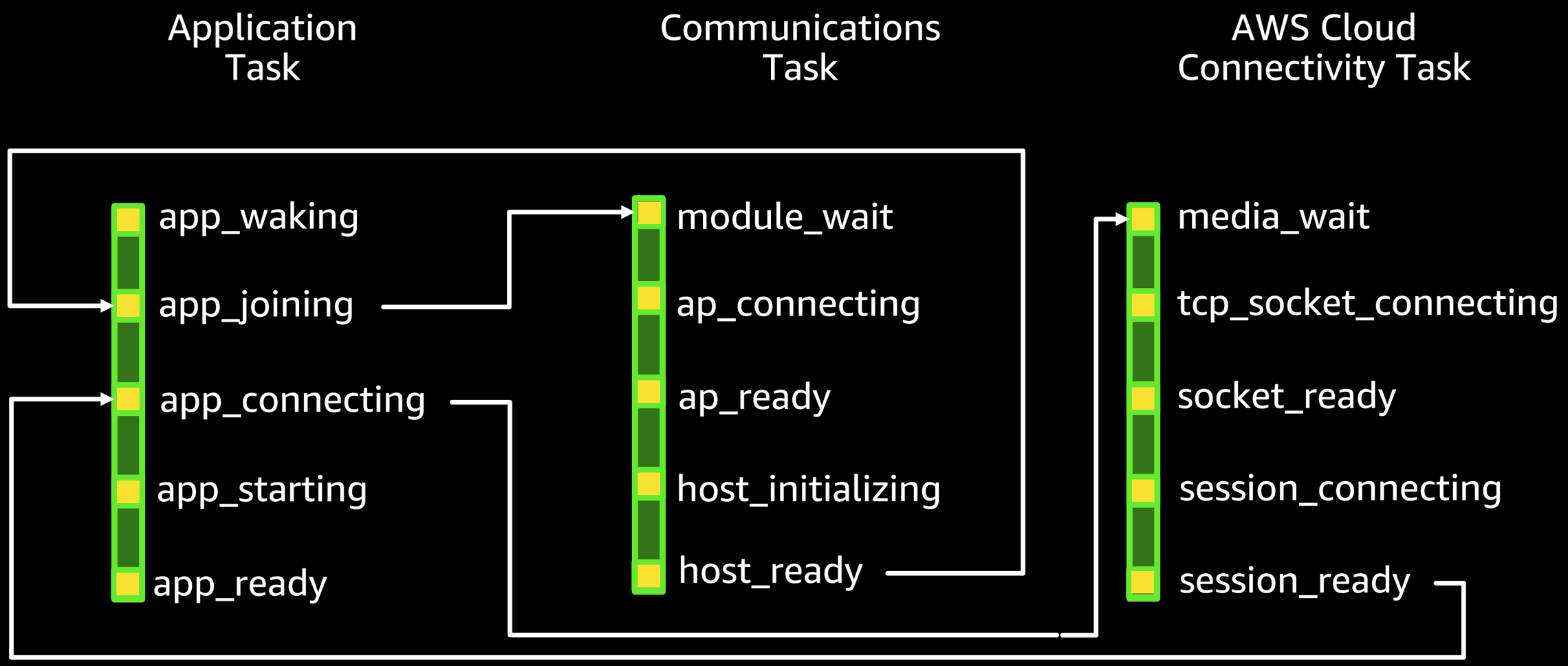
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Define your state machines and stitch



Demonstration application states



Perform functional and integration tests

Perform functional tests

- Use Device Advisor for AWS IoT Core for device-to-cloud testing

Evaluate how your Tasks behave with partner logging tools

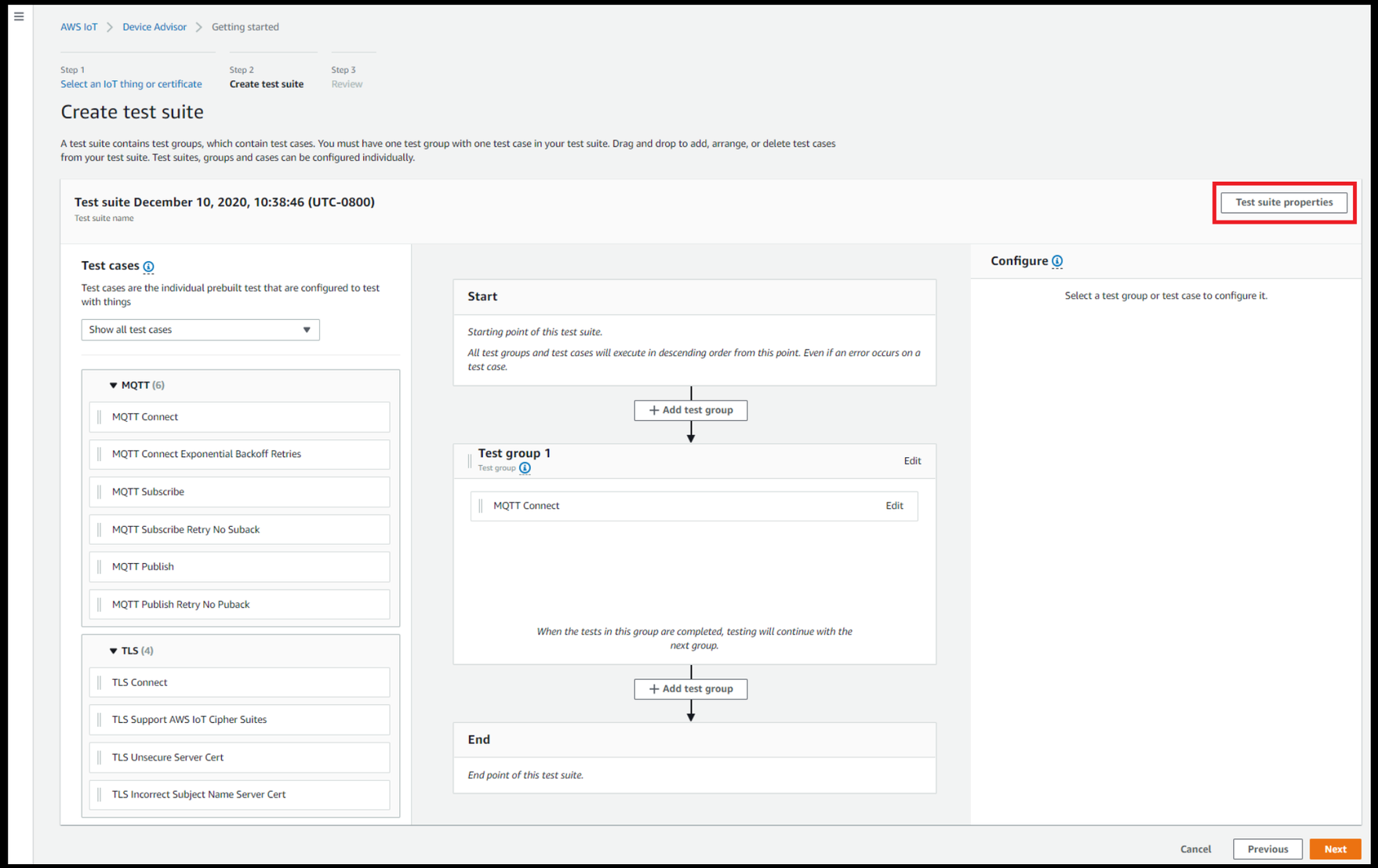
- Percepio DevAlert

Perform integration tests in the field

- Test range, jitter, temperature, other environmental factors
- Consider how to log data when evaluating tests

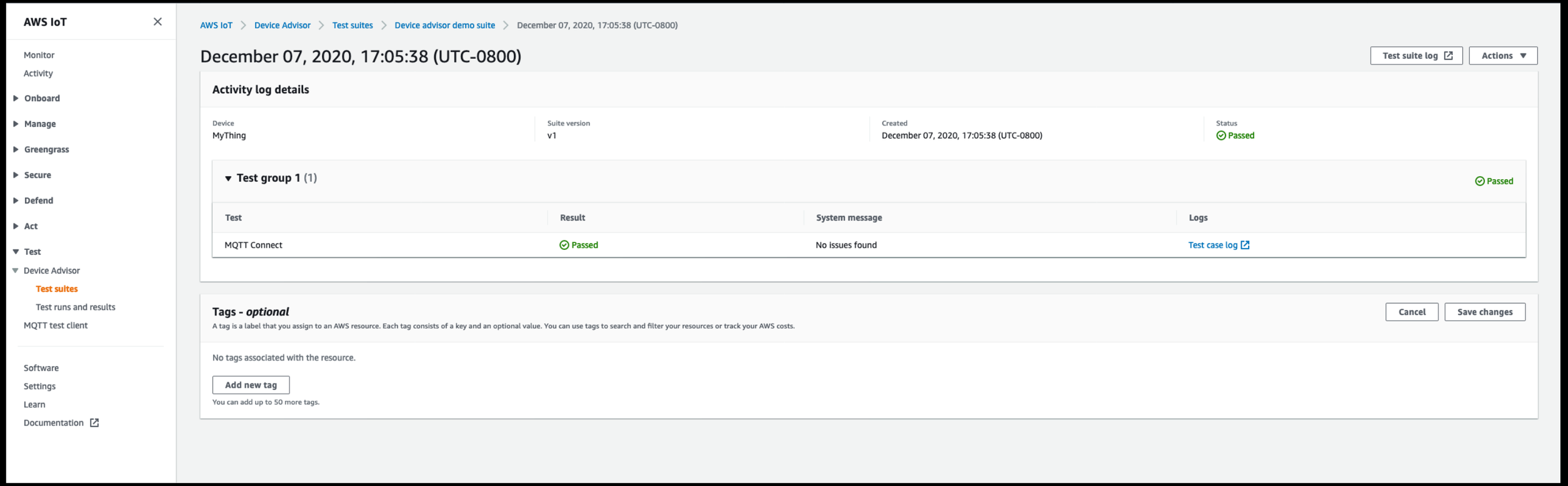
Defining a test suite

DEVICE ADVISOR FOR AWS IOT CORE



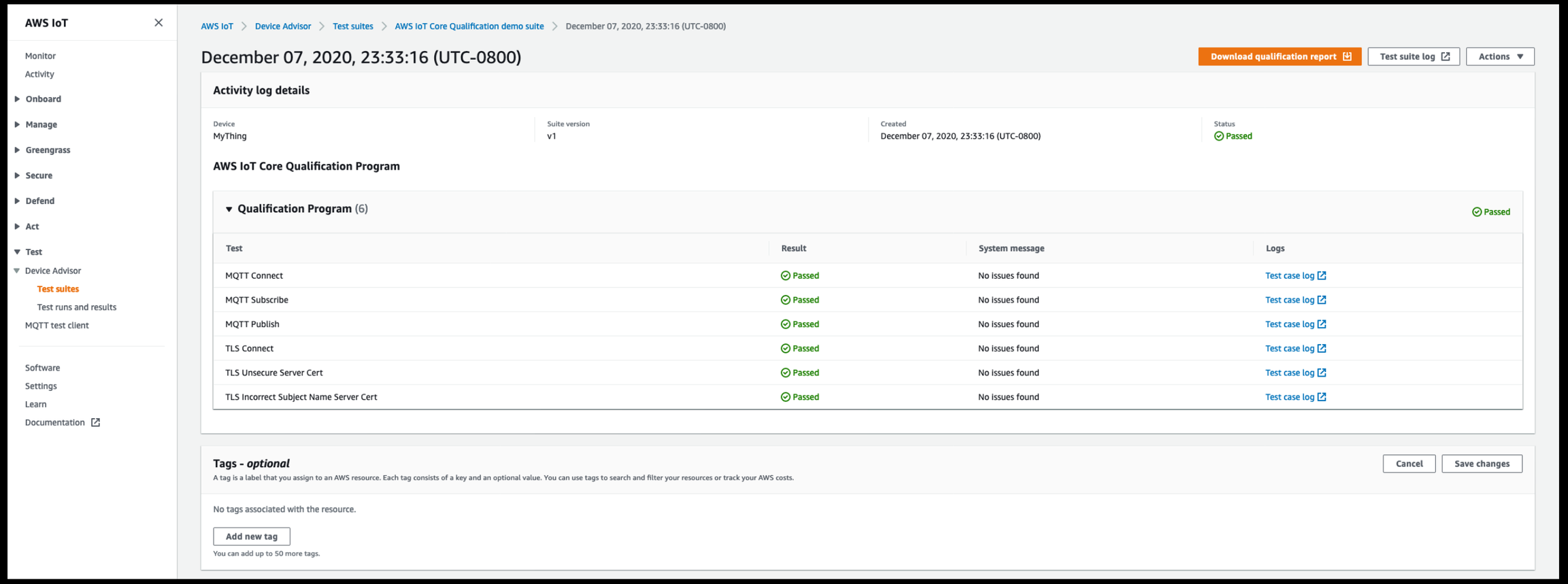
Invoking a test suite

DEVICE ADVISOR FOR AWS IOT CORE



Viewing the detail results of the test suite

DEVICE ADVISOR FOR AWS IOT CORE



Key points for stitching and running

Simplify your field provisioning strategy early

Communications peripherals consume lots of power, use them wisely

Deep sleep capabilities paired with FreeRTOS win the IoT

Build robust Tasks and callbacks to deal with environmental hazards

Confirming functions with Device Advisor for AWS IoT Core narrows problem resolution

Recap

Choose communications peripherals based on environment and range

Simplify security with fit-for-purpose components

Separate concerns across FreeRTOS Tasks

Streamline inter-task communications with Task Notifications

Reduce memory needs with the new AWS IoT Device SDK for Embedded C

Call to action

Visit FreeRTOS.org for everything FreeRTOS
Integrate Device Advisor for AWS IoT Core to improve quality
Browse the AWS Partner Device Catalog to choose development kits

Have fun and go build!



Woodside

NEW FEATURE

Woodside Energy is a petroleum exploration company and largest operator of **Oil and Gas** production in Australia

Use FreeRTOS LTS to create **intelligent sensors and devices** that gather plant data and securely send to the AWS cloud

Optimize production and predictive maintenance capability by monitoring operations 24/7

Thank you!

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