Developing IoT endpoints with mbed Client

ARM

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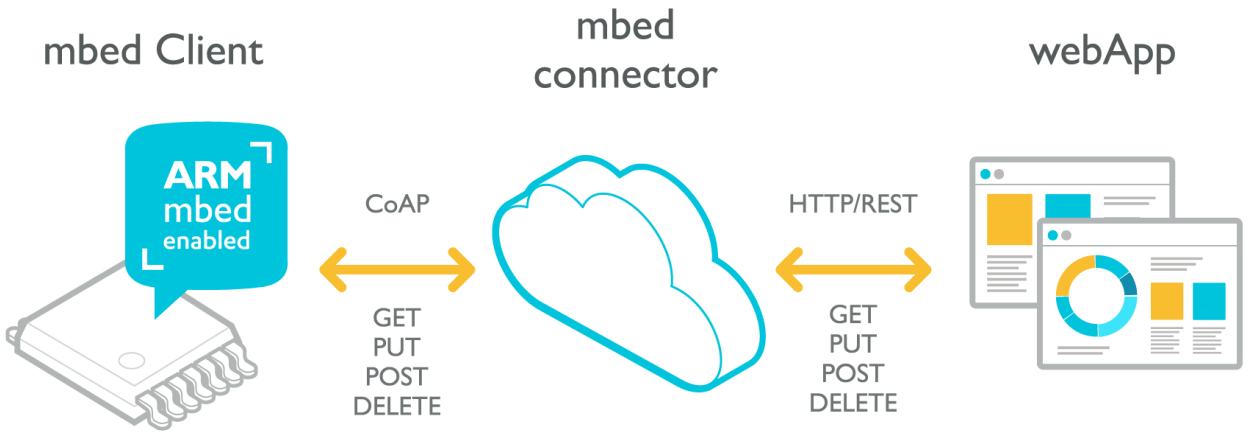
Agenda

- ARM mbed Client introduction
- Connecting endpoints with mbed Client
- Managing endpoints with mbed Client
- Maintaining energy efficiency
- End-to-end security with mbed Client
- Porting mbed Client to endpoints
- Summary

mbed Client introduction

mbed Client & mbed Connector

- mbed Client is an implementation of the LWM2M client, and the mbed Connector implements the LWM2M server
- mbed Client communicates with mbed Connector via CoAP messages
- mbed Connector interacts with Web services and apps using a REST API



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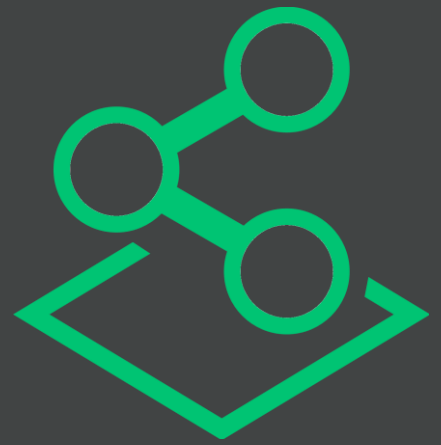
mbed Client scope

- mbed Client is a portable embedded software library that links IoT devices with mbed Device Connector, providing the infrastructure to connect endpoints with cloud apps

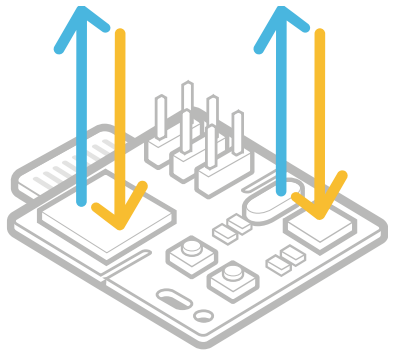
- mbed Client is provided free for IoT device manufacturers
  - A complete set of libraries
  - High level C++ API
  - Porting guidelines and examples
  - Apache 2.0 license



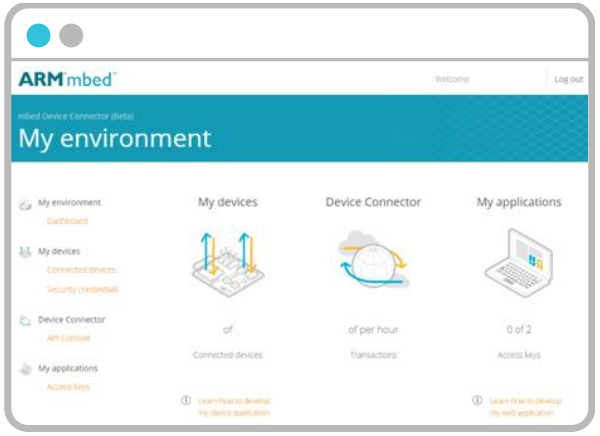
Connecting endpoints with mbed Client

mbed Device Connector: Making IoT scale

- mbed Device Connector eases development, management and scaling of IoT
- Available at connector.mbed.com – easy transition to commercial service providers



Build IoT Device



Connect your devices

Build application with example code

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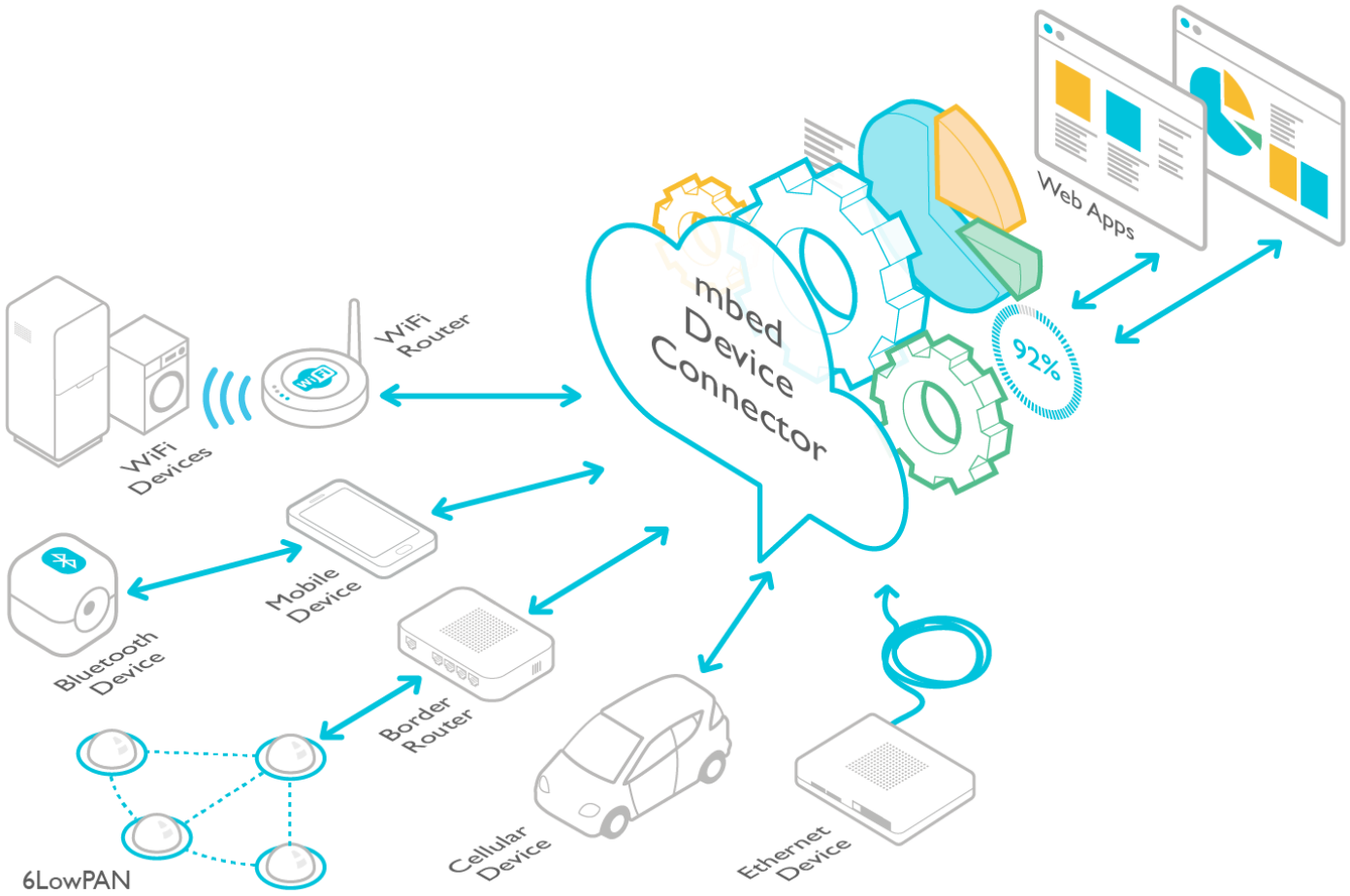
Bootstrapping IoT devices

- Factory bootstrap according to OMA LWM2M standard
  - Create the keys in the webpage
  - Copy-and-paste them into the relevant file

- Bootstrapping of devices enables to configure a secure channel between device and mbed Device Connector

LWM2M data traffic

- Turn any device into an endpoint to use with mbed Device Connector
- Device initiated
  - IoT devices provide sensor readings and configuration information, to a cloud-based platform
- Service initiated
  - Actuators receive instructions from users routed via the cloud infrastructure



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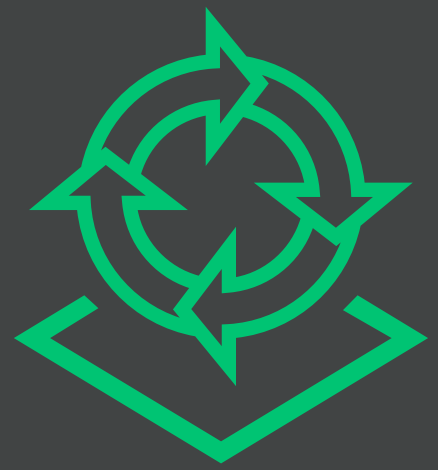


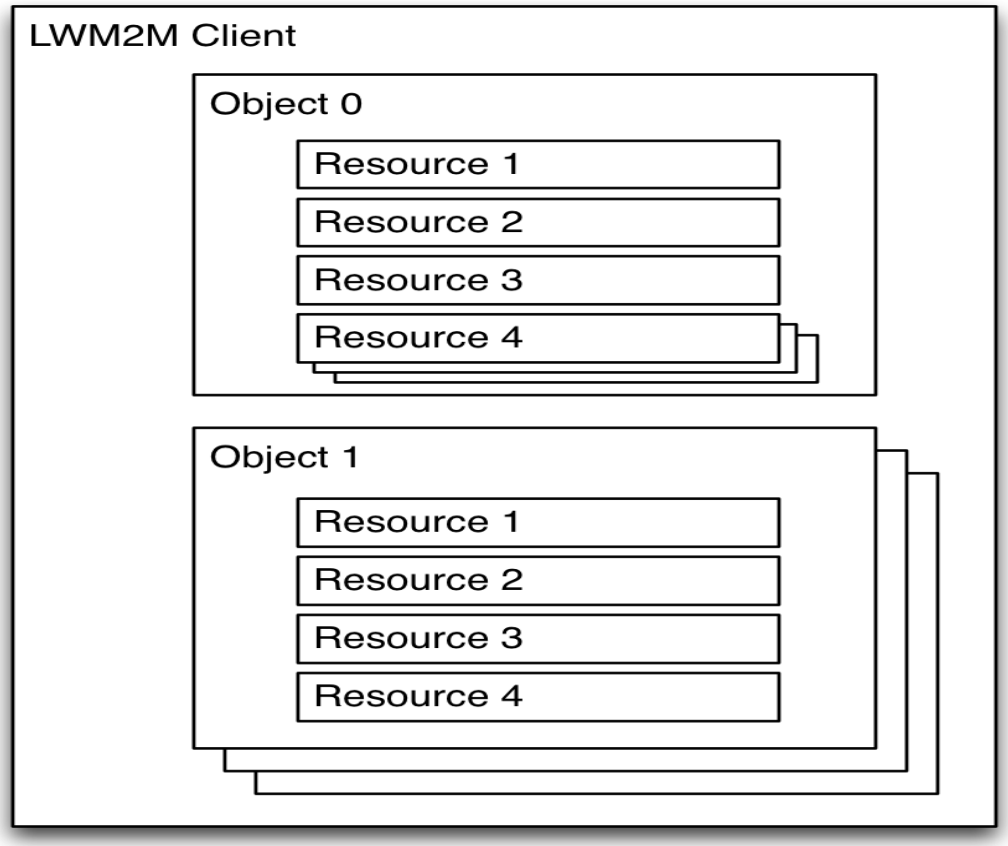
Managing endpoints with mbed Client

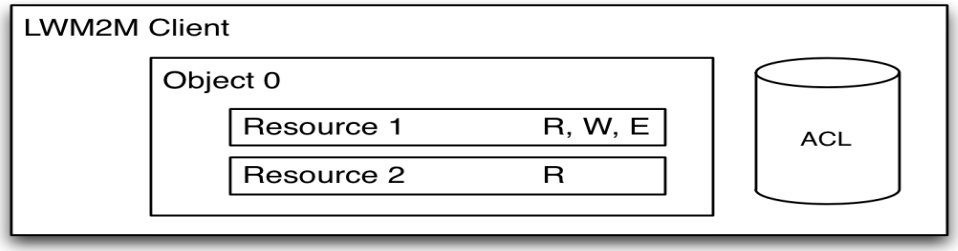
mbed Client interfaces for device management

- mbed Client allows full control and monitor of endpoint and applications
- Registration and deregistration
  - Register the Client and its Objects
- Device management and service enablement
  - Server access to Object or Resource
- Information reporting
  - Observe and get notifications of new Resource values

Object and Resource model

- Object & Resources can each can have Instances
- An Object is a collection of Resources
- A Resource is an atomic piece of information that can be read, written or executed
- Access control list (ACL) control access to objects accessed by LWM2M Servers



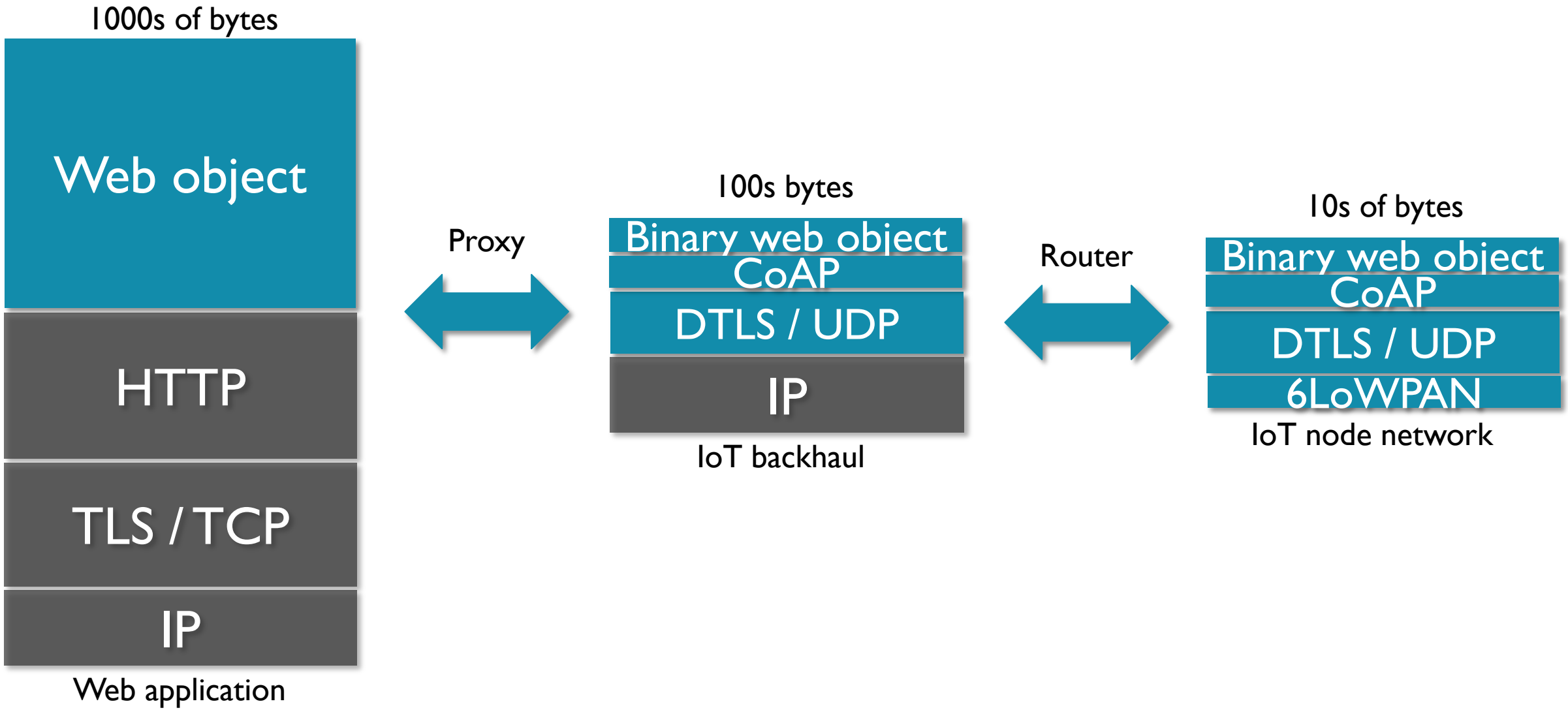


Maintaining energy efficiency

IoT energy constraints

- Power consumption is one of the key constraints for the IoT devices
- Use battery or energy harvesting source for power which further constraints hardware, software and the communication protocol usage
- Important to keep the device in sleep mode when not sensing or communicating data

From Web Applications to IoT Nodes



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Sleeping nodes & energy efficiency

- Easy to interact with devices that are always connected
- To save energy client registers to server in Queue Mode and goes offline
- Server queues operations when client is asleep
- Client uses the registration update message to inform server that it is awake and ready to receive messages
- Server conveys queued messages to client within a given time window

End-to-end security with mbed Client

mbed Client security

- LWM2M defines a strong security solution for authentication of the end points and data channel protection
- DTLS v1.2 security for all CoAP communication
- mbed Client uses X.509 certificates to authenticate DTLS keys
- Per Server and Object instance access control using ACL objects
- Bootstrapping for complete provisioning and key management

mbed TLS for mbed Client

- mbed TLS makes it easy for developers to include cryptographic and TLS/DTLS capabilities in their embedded products, with a minimal code footprint
- mbed Client provides an API to set up entropy and RNG functions for the underlying TLS to enhance robustness and security
- Full API documentation available
- Open Source under Apache 2.0 license at https://tls.mbed.org/
- Suitable for use on Cortex-M and Cortex-A targets

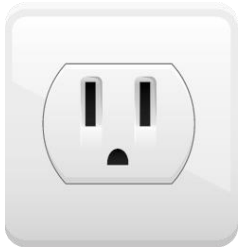
Porting mbed Client to endpoints

mbed Client scalability objectives

- Enable management of all connected devices within a single management system
- Support mbed Client porting across a wide spectrum of hardware platforms and embedded operating systems of a very fragmented IoT market
- Enable smooth and swift porting of mbed Client capabilities for ARM partners

Platform Abstraction Layer

mbed Client

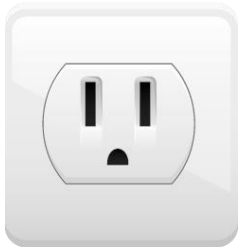


mbed OS

RTOS

Platform Abstraction Layer

New release

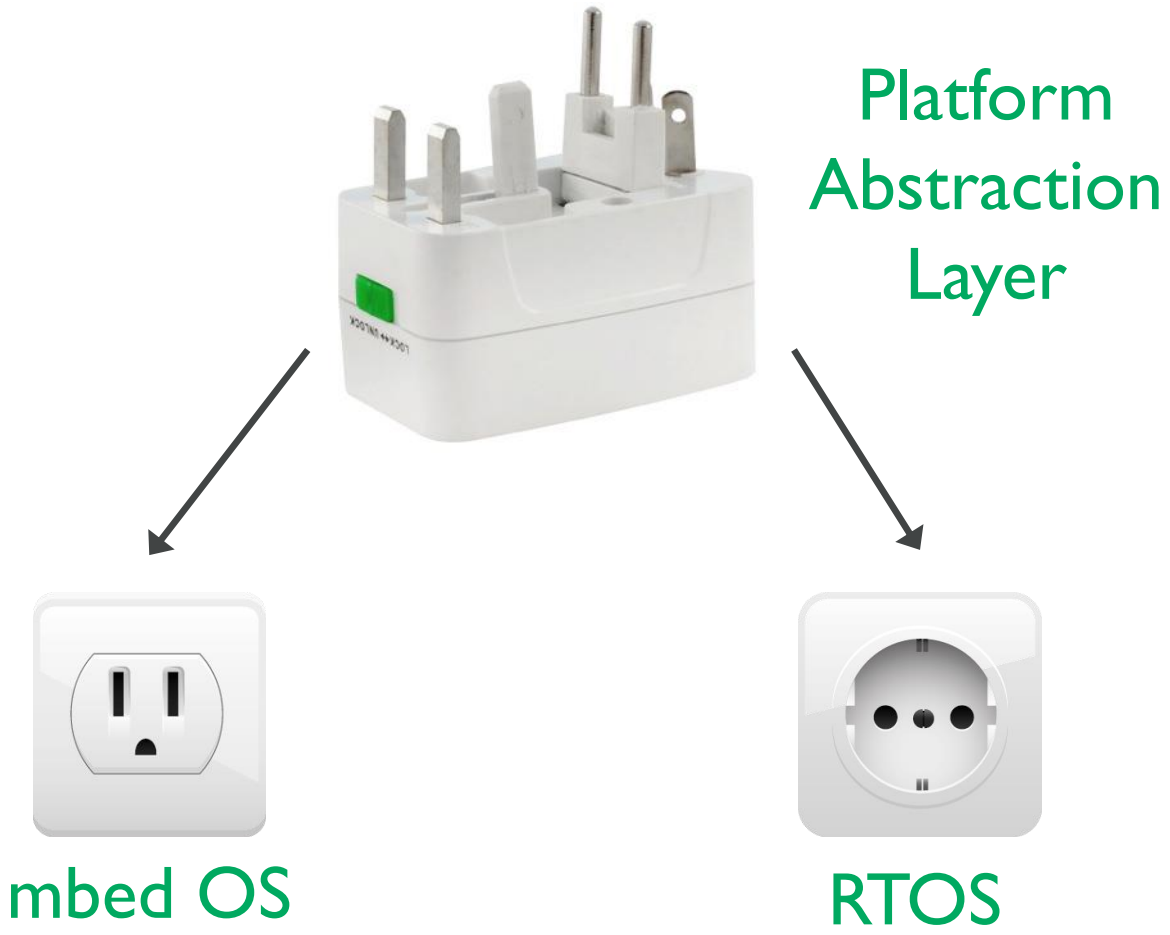


mbed OS

RTOS

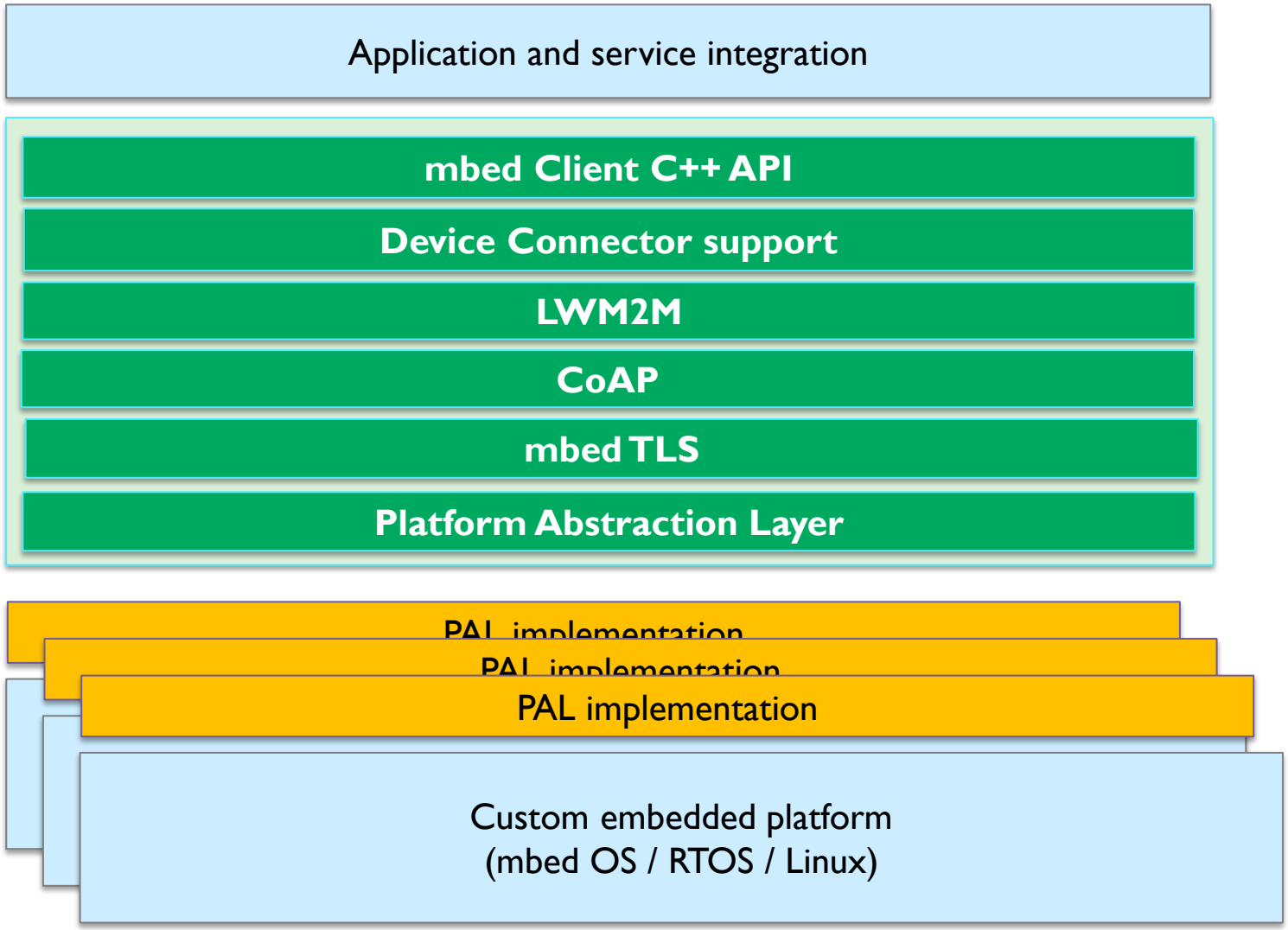
Platform Abstraction Layer

- Contain porting effort within a single layer of platform dependent interfaces, which can be implemented by partners



mbed Client library

- PAL interfaces include:
  - Threads
  - Synchronization objects
  - Kernel ticks, timers
  - Memory-pool
  - Message-queue
  - IP networking



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Summary

mbed Client

Connect

Addressing the complexity of reliably connecting high volumes of diverse devices across different networks

Management

Enabling scalability through interoperability across the supply chain

Productivity

Portable to any device allowing management of all connected devices on a single system and fast time to market

Efficiency

Optimized for constrained environments and sleepy nodes

Security

Trust through end-to-end security, by providing confidentiality, integrity and authentication

Useful links

- mbed Client libraries, example code, and documentation
  - https://docs.mbed.com/docs/mbed-client-guide/en/latest/
- mbed Client source code
  - https://github.com/ARMmbed/mbed-client/tree/master/source
- mbed Client example:
  - https://github.com/ARMmbed/mbed-client-quickstart
- ARM mbed developer site:
  - https://developer.mbed.org/
- OMA LWM2M object & resource registry
  - http://technical.openmobilealliance.org/Technical/technical-information/omna/lightweight-m2m-lwm2m-object-registry

Thank You!

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