mbed OS technical overview

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Challenges for IoT integration

IoT Device Platform

ARM mbed

IoT Device Applications

mbed Client Software

ARM Partner Silicon

mbed Device Connector

IoT Cloud Applications

Analytics and Rules Engines

App Management, Monitoring, Logging

Events, Streaming, Message Busses

VMs, Compute, Auto-scaling

Web Servers, Load Balancing

Databases, Caching, Storage, Archiving

Device Ecosystem

3rd Party Cloud Platforms & Services
mbed IoT Device Platform and ecosystem

- mbed Device Connector
  - A cloud service connecting a wide diversity of devices to any 3rd party cloud

- mbed Client
  - A device software library which enables any device to use mbed Device Connector services

- mbed OS and tools
  - An ARM Cortex-M Platform OS which provides a complete solution for security and connectivity in IoT devices.
  - mbed OS is pre-integrated with mbed Client

- mbed Ecosystem
  - A rapidly growing and vibrant ecosystem built around mbed products and services
mbed Device Connector and mbed Client
Platform OS requirements

- **Accelerate the development of IoT devices**
  - Integrate all the necessary software components needed for constrained IoT devices (MCUs)
  - Bring modern development methodologies and choice to MCUs to improve productivity
  - Provide OS functionality and APIs across many vendor solutions to enable choice

- **Accelerating the deployment of IoT devices**
  - Provide standardised connectivity to the cloud across different transports
  - Provide manageability from the cloud to open opportunities and reduce cost/risk

- **Develop and leverage an ecosystem**
  - Freely available and open source to remove barriers to entry and enable adoption
  - In collaboration with partners to provide maximum gearing of investment for everyone
  - The tools and web infrastructure to support an ecosystem and create network effects
mbed licensing, contributions and governance

- Licensing and delivery
  - Almost all code in mbed OS is open source under an Apache 2.0 license
  - Some components are only supplied to end developers under a permissive binary license
    https://www.mbed.com/en/licenses/permissive-binary-license/
  - mbed partners get access to full source code

- Contributions
  - mbed contributor license agreement
  - Submitted via pull requests
  - Code style guide (broadly K&R style)

- Governance
  - ARM is the lead maintainer for the core of mbed OS
  - mbed silicon partners are lead maintainers for their target specific drivers
  - mbed ecosystem partners are responsible for supporting their components
mbed OS 5
A platform operating system for the internet of things

Cortex-M RTOS Kernel
Portable Drivers
Integrated Security
IoT Connectivity
Development Tools
Management Services
Partner Ecosystem
Developer Community

https://partners.mbed.com
https://developer.mbed.com
mbed OS technical overview

- mbed OS Core
  - Consistent kernel and hardware abstraction providing application portability

- mbed Connectivity
  - Developer friendly APIs to increase productivity and portability
  - Wide choice of low level communication stack implementations and supported hardware

- mbed Security
  - Comprehensive lifecycle, communication and device security framework

- mbed Tools
  - Configuration, build, component management and testing
mbed OS Core

- Includes an RTOS Kernel
  - Built on the open source CMSIS-RTOS RTX
  - Established, widely used RTOS kernel
  - Very small kernel optimised for constrained memory devices
  - For more information, see www.keil.com/cmsis/rtx

- Includes peripheral driver APIs, consistent across devices
  - Start-up and environment initialisation
  - Memory maps and cross-toolchain support and integration
  - Driver APIs for all common peripherals, supported across all MCUs

- Application and component libraries can be built unchanged
  - Provides portability for developers and helps to deliver network effects
BLE

- BLE has huge potential beyond its current application areas
  - Trusted robust radio, low cost chips, roadmap to longer range and IP

- mbed OS has established BLE APIs, already used widely and successfully
  - Added support for RTOS, portability across different vendors
  - Examples demonstrating functionality e.g. Google Eddystone

- Expanding support for BLE across more platforms
  - Already supporting Cordio Radio IP, Nordic SoC, ST (transceiver)

See demo at:
Demo Friday : Beetle test chip, BLE and mbed OS demo
  Friday 12:10pm : Abhishek Pandit
WiFi

- Support for integrated WiFi modules
  - Updated WiFi APIs coming in mbed OS 5.2
  - Working with partners to support WiFi chipsets and stacks

- Supports MAC and Network Processor integration
  - Flexibility in supported architectures

- Preferred modules include both WiFi+BLE
  - Enables use of BLE for side-band configuration and control
  - May be SoC or WiFi/BLE + MCU chipset
    - e.g. ODIN-W2 module based on chipset solution
Thread

- A secure wireless mesh network technology for home and beyond – analogous to Wi-Fi
  - Thread is a network and transport level stack
  - Thread can support multiple application layers

- Built on proven, existing internet technologies

- mbed Thread stack provides leading support built into mbed OS
LoRa

We invested early and have good support for LoRa in mbed

- 7 LoRa hardware devices already in platform/component database
- mbed LoRa examples imported 1000's times
- Planning to increase investment in LoRa with interested partners

Raising investment to be #1 LoRa development platform

- mbed OS 5.3: Standard mbed LoRa APIs, examples and showcase demos
- 2017: Services support, widespread deployment of low cost mbed Enabled modules
- Low-cost modules, support for operator "starter kits", events and demos
mbed uVisor

- A tiny, hypervisor/microkernel-like security kernel
- Creates and enforces secure isolation boundaries within the OS, between different parts of the system
- Enables secrets to be strongly protected against software and network-bourn attackers
- Efficient hardware enforcement through the memory protection unit (MPU) and TrustZone for v8-M

Discuss at:
LAS16-308 Mini Conference – Security Architecture for Cortex-M
Wednesday 12:10pm : Paul Bakker
mbed TLS

- mbed TLS enables cryptographic and SSL/TLS capabilities for use in embedded software
- mbed TLS is tightly integrated in to mbed OS
- Combined with the mbed uVisor, this provides comprehensive device and communication security for IoT products

Hear more at:
LAS16-203: Platform security architecture for embedded devices
Tuesday 10:10am : Mark Hambleton
Core Tools

- Support via free Command Line and Online IDE tools
  - Supports compilation, collaboration and test workflows
  - Easily select build for different Targets and Toolchains
  - Integrated with Distributed Version Control Systems
3rd Party Tool Support

- Working with tools partners for support in industry standard IDEs
- Software built and tested across different compilers
Test Tools

- **Greentea:**
  - This test suite provides a collection of tools that enable automated testing on mbed platforms

- **Related tools:**
  - CMSIS-DAP and DAPLink – Debug over standard SWD connections
  - USB enumeration and identification – To allow connection and discovery of hardware
  - Flash, reset and instrument testing for USB debug-enabled devices to enable test farms
  - Specific system testing e.g. BLE test suite
Continuous Integration Support

- Reporting in standard, human friendly, and Continuous Integration system formats:
  - Junit
  - XML/HTML
  - JSON

- Tools available as Python modules and command line interfaces
  - extendability
  - reuse
mbed Ecosystem
mbed OS partner ecosystem

- mbed OS runs on platforms from a wide range of MCU Partners
  - From Cortex-M0 to Cortex-M7. From general MCUs to IoT SoCs
- Other partners expand the platform in other ways
  - Incremental effort for each partner, network effects for all
- mbed OS 5.1 supported 40+ platforms at launch

Try them hands on at:
Board Games Night: mbed OS platforms tutorial

Wednesday 7pm : Paul Bakker
Join the mbed Partnership at mbed Connect 2016!

Santa Clara, October 24th

Meet over 800 developers building IoT of the future

Hands-on training

Exclusive partner insights

www.mbed.com/mbedConnect16
Summary

- **mbed OS**
  - A full functionality ARM Cortex-M IoT platform OS for use in production devices today
  - Free to use; open source; very broad platform support

- **mbed IoT Device Platform**
  - Device software for Cortex-A and Cortex-M end nodes
  - Connectivity to 3rd party clouds
  - Device management services for IoT deployments at scale

- **mbed Ecosystem**
  - Broad ecosystem of developers and companies building IoT at scale