Trusted Firmware M
YVR'18

Ashutosh Singh

Agenda

Introduction to PSA and Trusted Firmware M

High Level System Architecture

Overview of services

Use-case Scenarios

Getting Involved

Please feel free to interrupt during the course of this presentation!

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Overview –PSA and TFM

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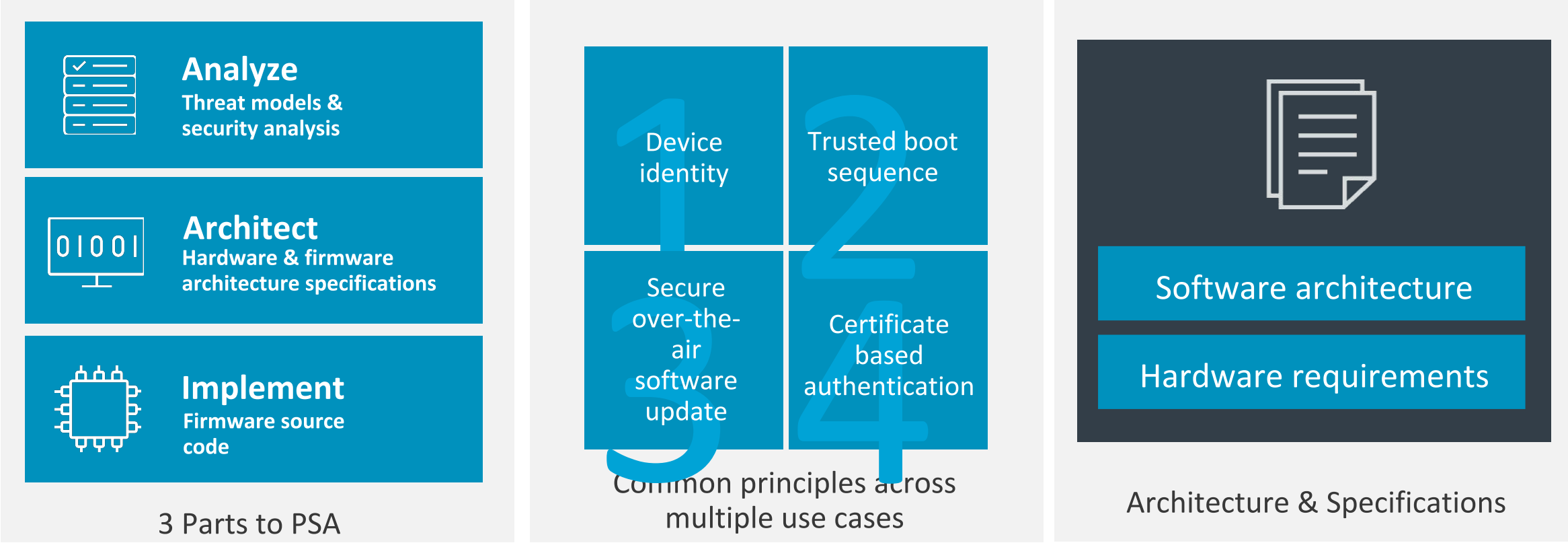
Platform Security Architecture



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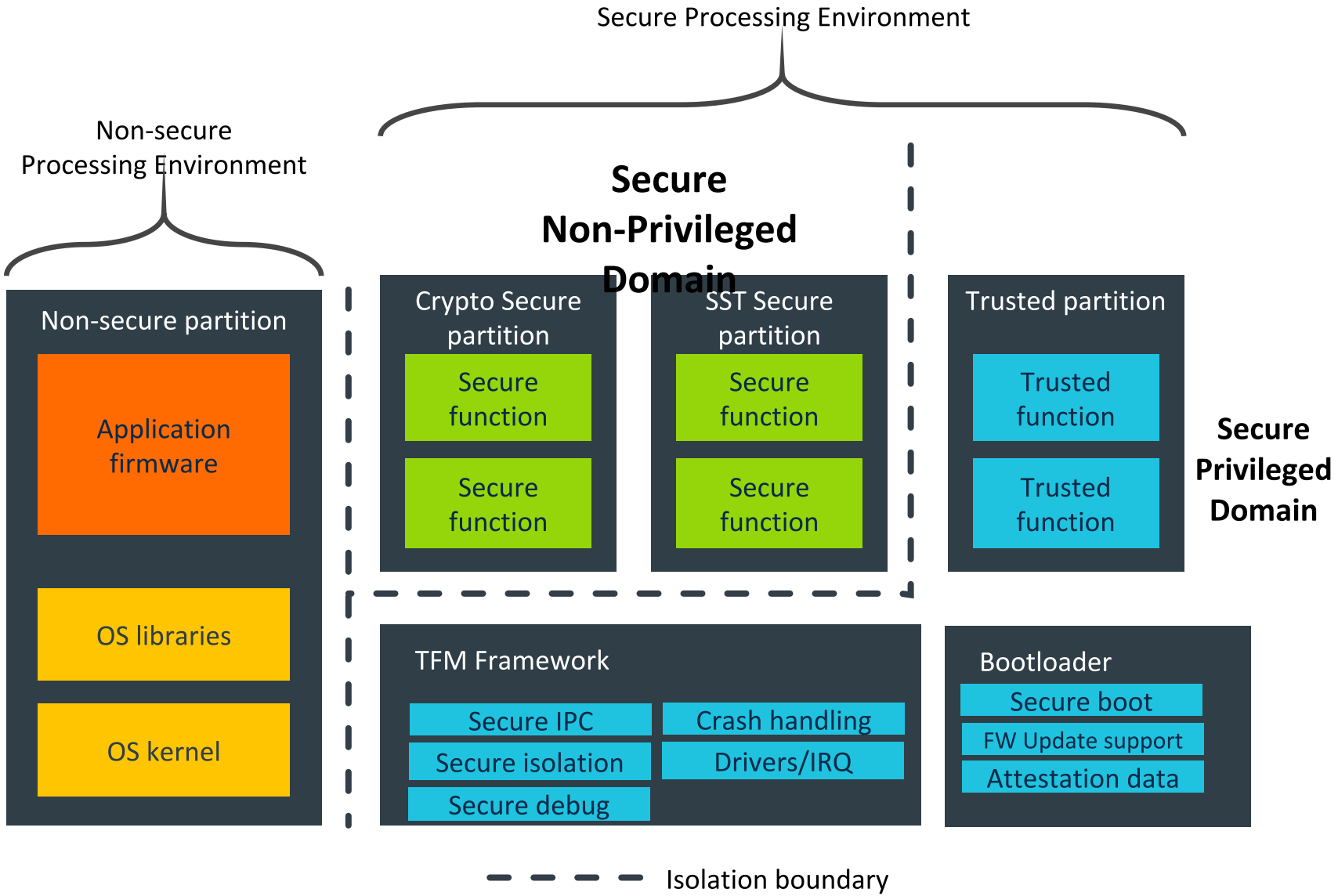
TF-M Overview

- Open source project
- PSA implementation for M class
- Secure Boot
- Secure Partition Management (SPM)
- Secure function call routing
- Isolation within SPE
- Secure Services
- NSPE API
- CMake based Build environment
- Test suite
- Documentation
- Infrastructure



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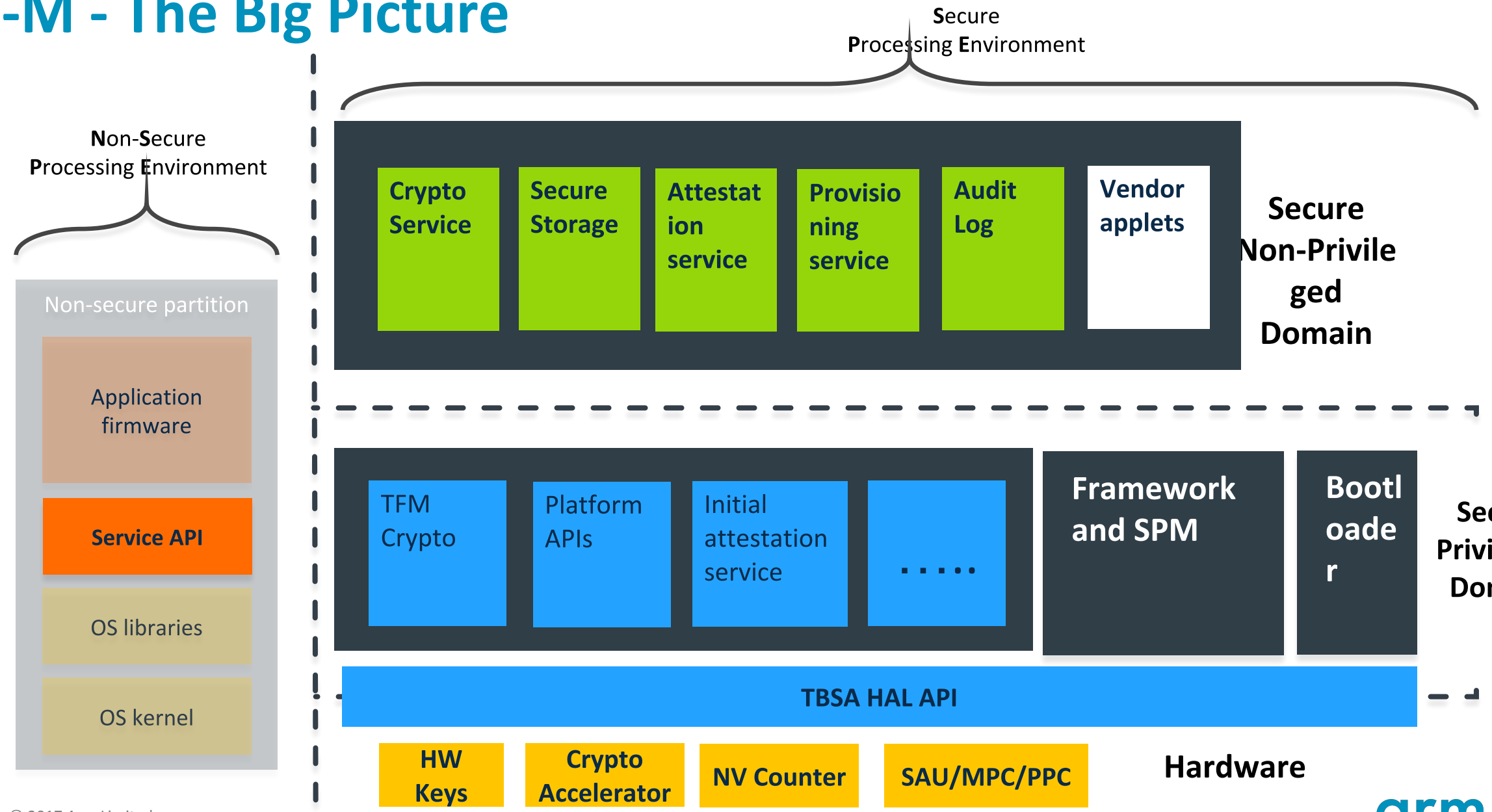
TF-M - The Big Picture



Secure Partition Manager and IPC

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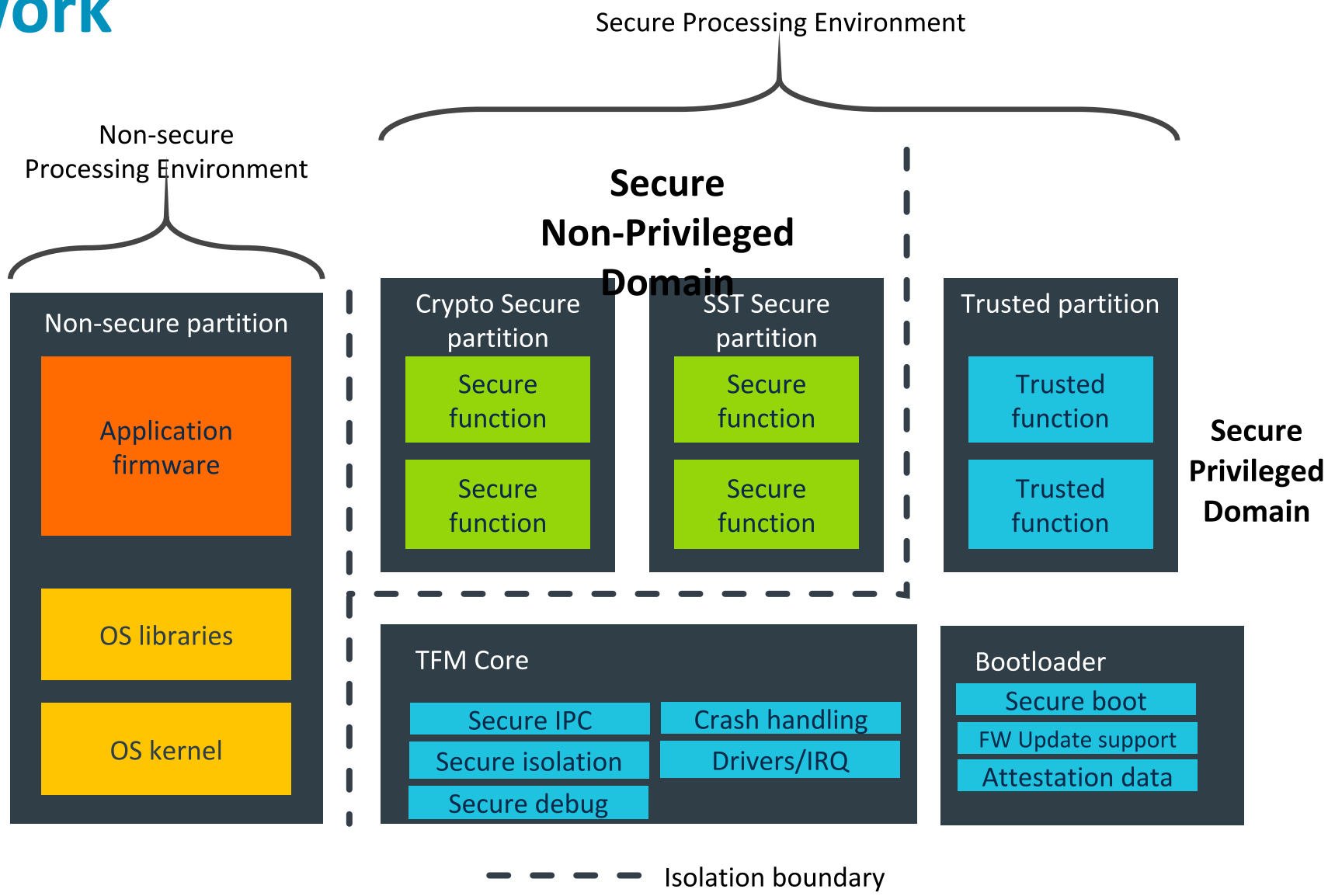
TF-M Core Framework

- Secure system init
- Secure Partition Management (SPM)
- Secure function call routing (IPC)
- Isolation within SPE
- NSPE API
- Build environment
- Test suite
- ...



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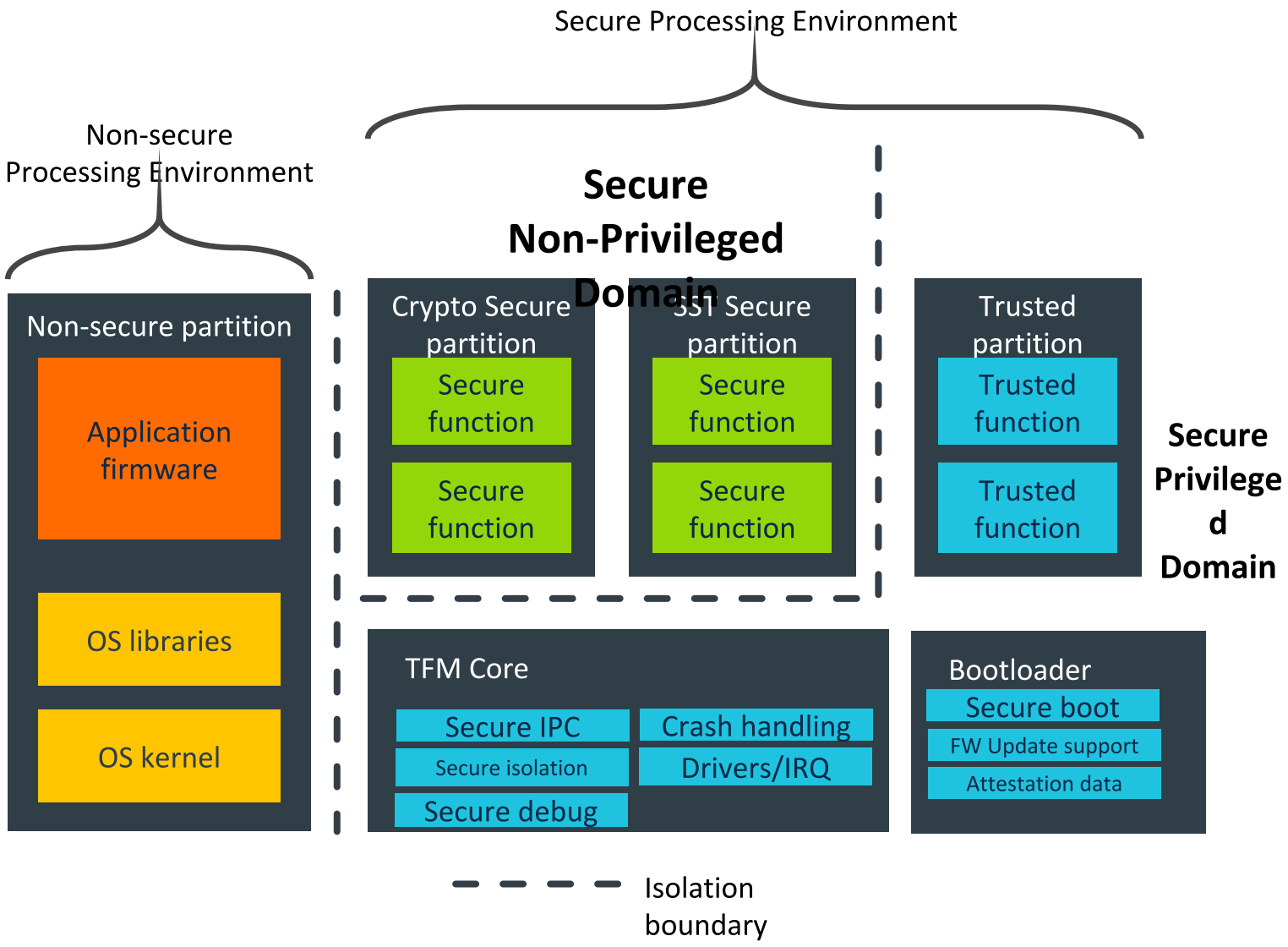
Framework Updates

- NS to S transition in thread mode
- Manifest based service definition
- IPC support (on a feature branch currently)
- Support for Trusted and Secure partitions
- GCC support
- Platform abstraction improvements
- ARMv8-m mainline and baseline supported



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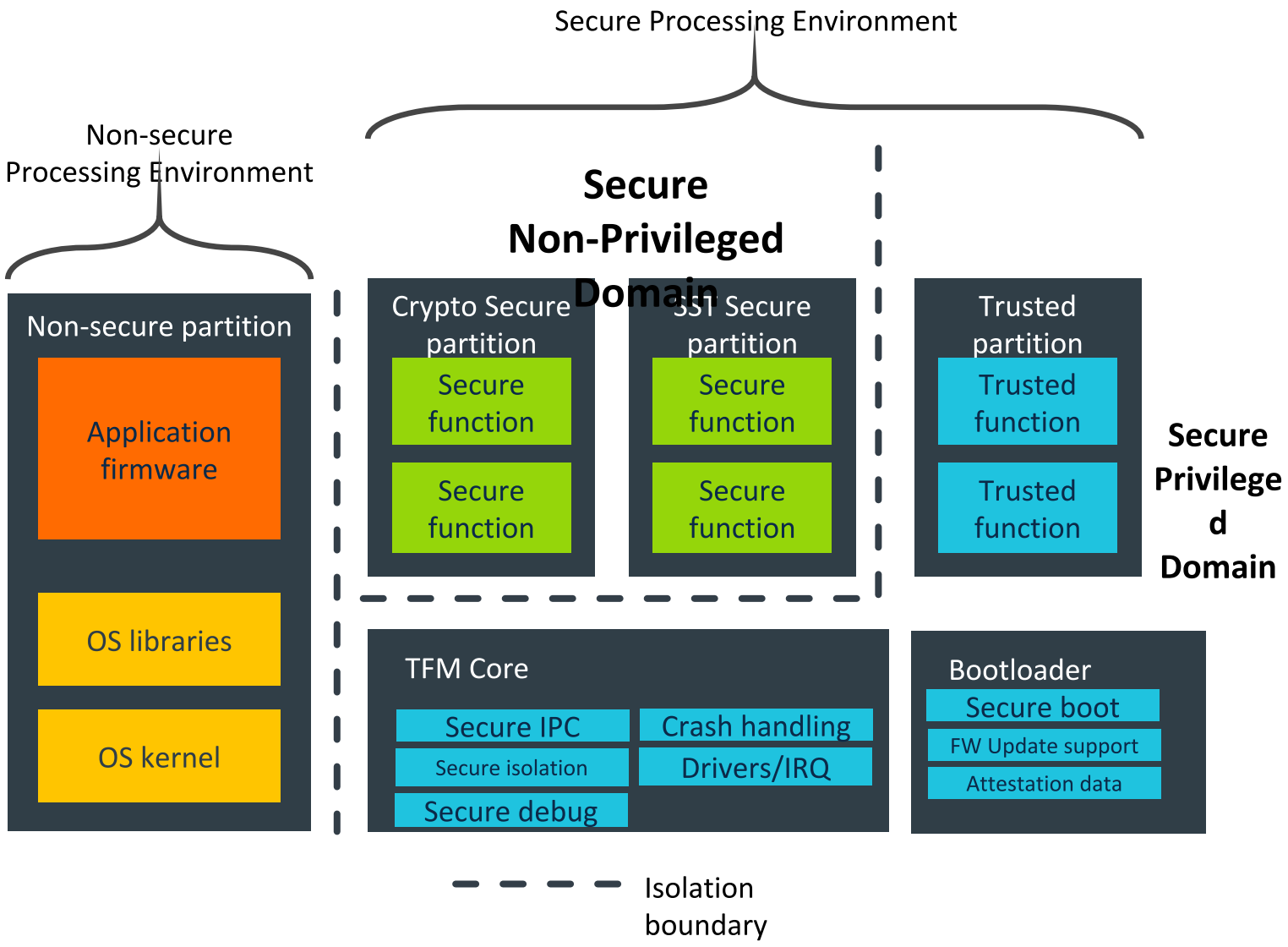
IPC

- Facilitates secure communication between-
  - SPE Services
  - NSPE to SPE services
- Services are written as daemons running in a while loop
- Calls from clients are sent as a message to partition
- Synchronous execution of Service's interrupt handling
- Blocking API calls



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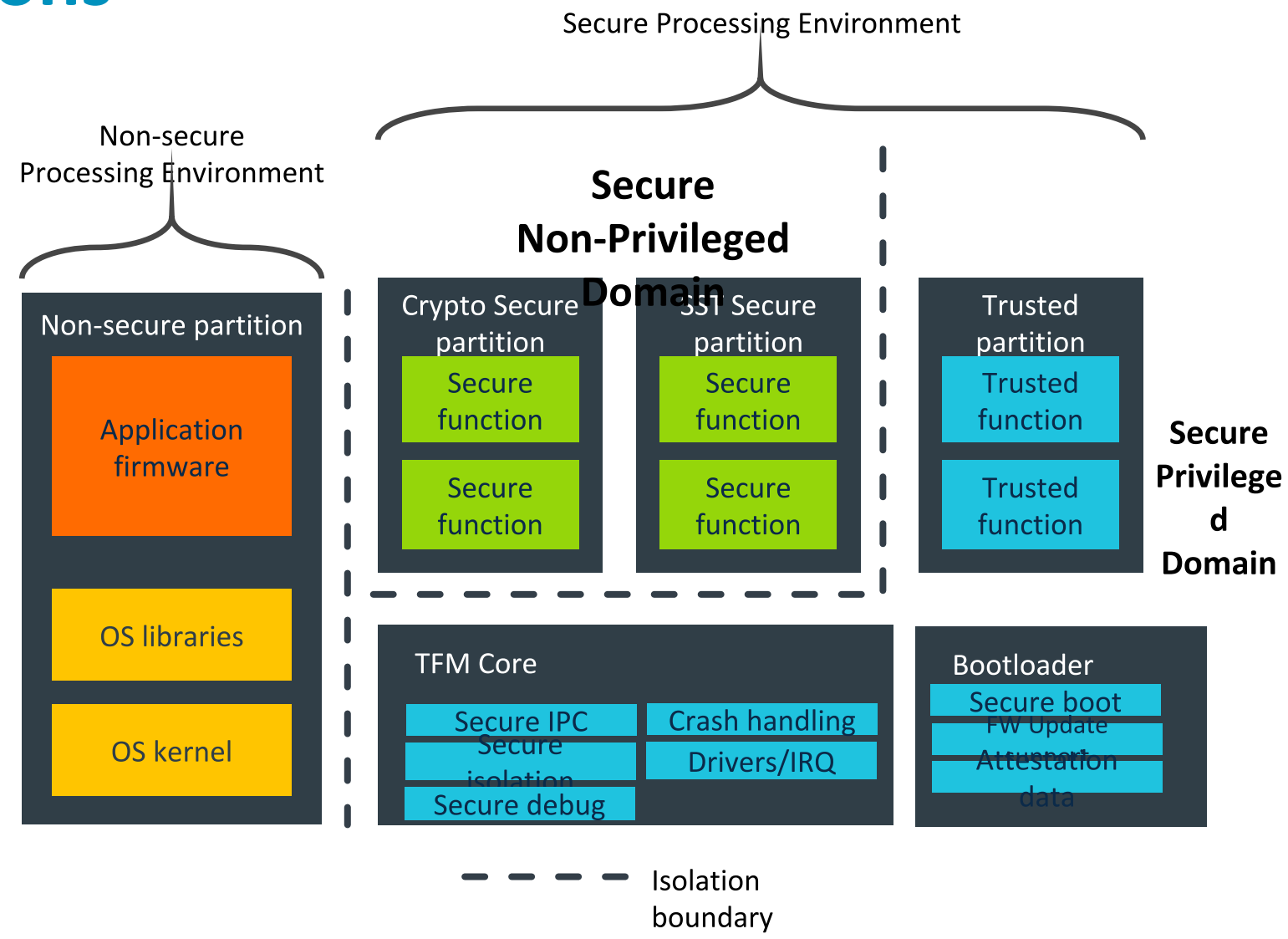
IPC Security Considerations

- IOVEC based communication

```
typedef struct psa_iovec {
    const void *base;
    size_t len;
} psa_invec;
```

- Integrity protection of iovecs
- Streamed buffer read/write
- Framework level memory bound check
- API based access to client memory
- MMIO regions per partition for peripheral usage isolation



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Secure Services

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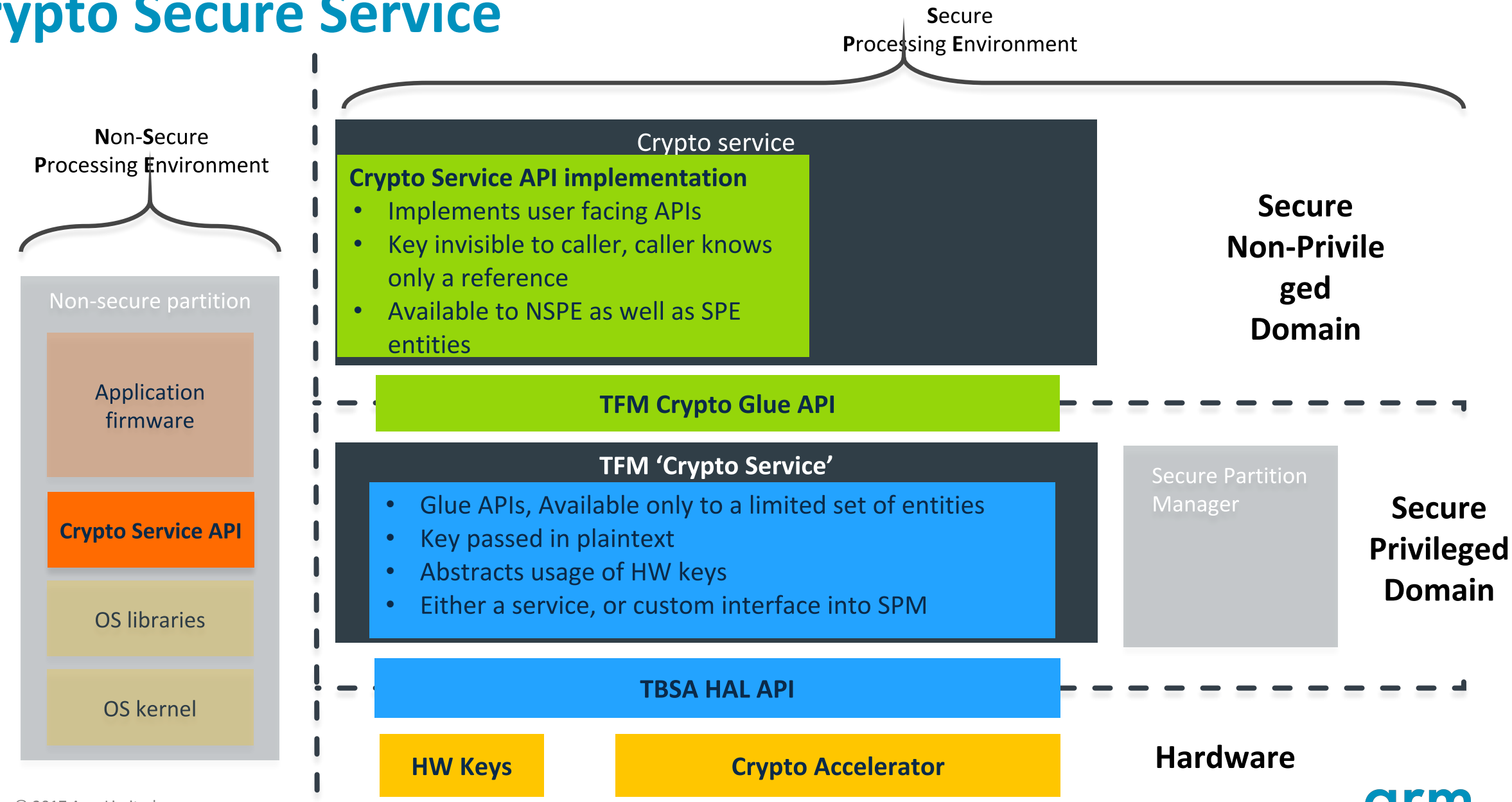
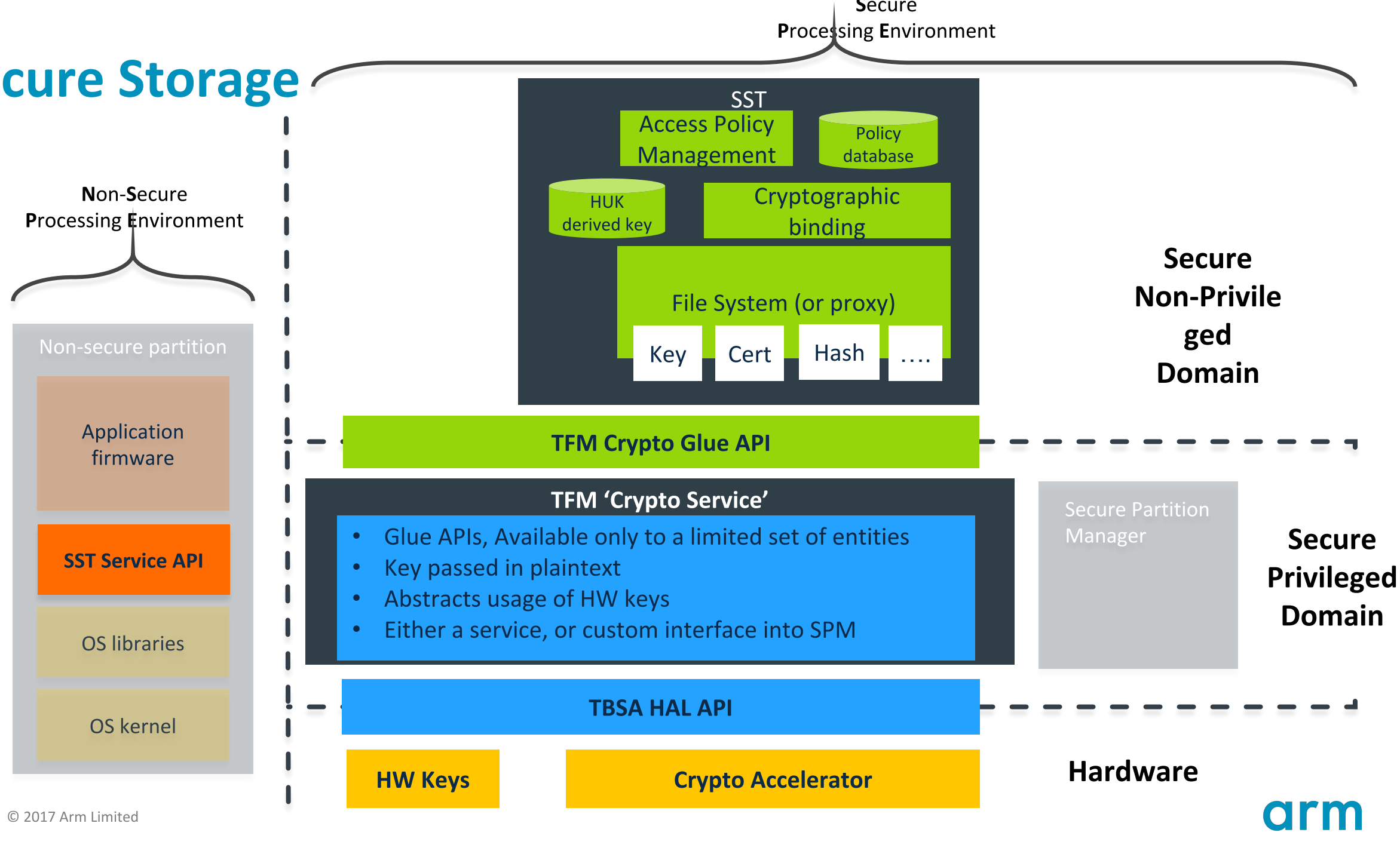
Crypto Secure Service



Secure Storage



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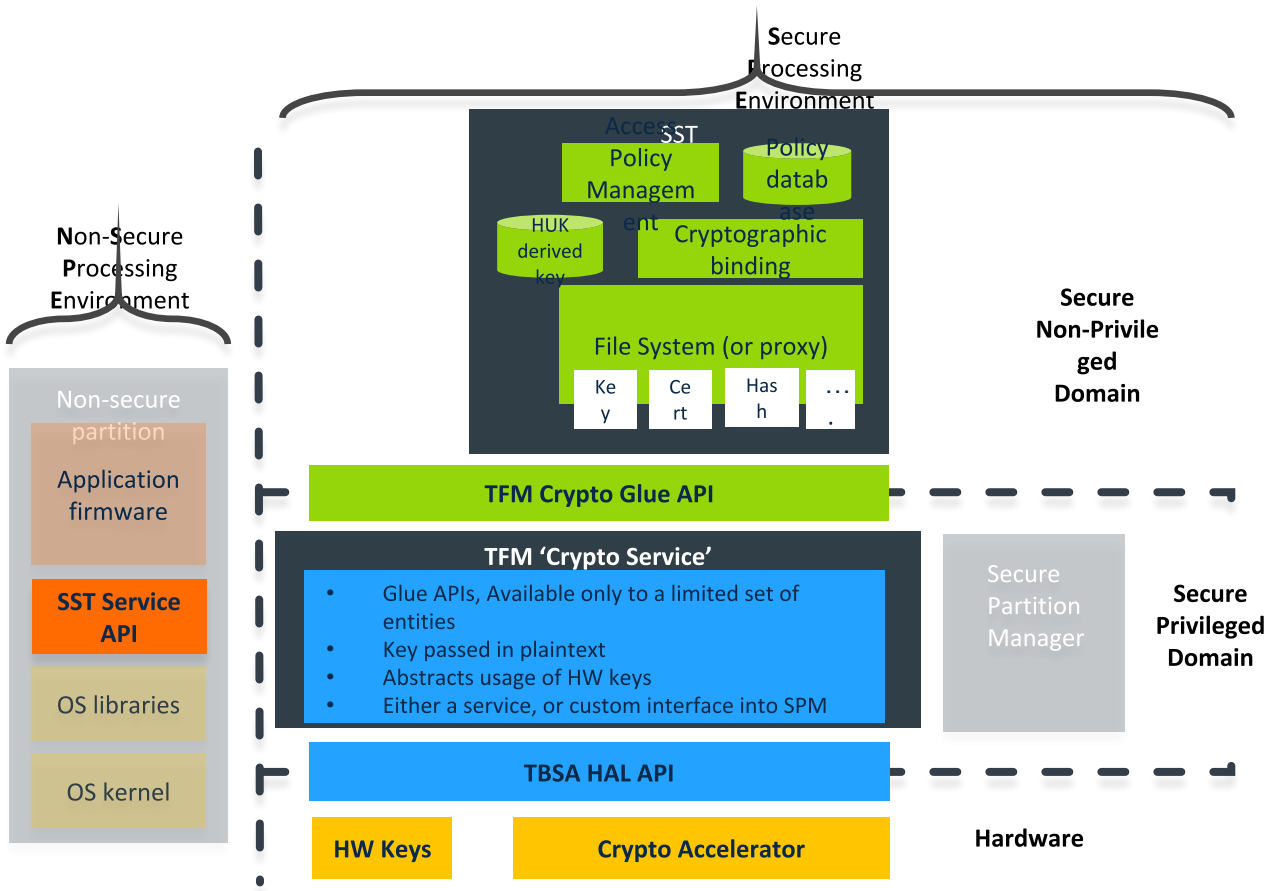
Secure Storage

- Protects Confidentiality, Integrity and availability of stored content
- Policy based access
- AES-GCM For AEAD
- Power failure safe operation
- Custom File System
- Rollback protection

New Stuff….

- PSA API, crypto property binding
- Rollback protection
- Key diversification (under review)
- File system abstraction (under review)



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Audit Log

- Mitigation against repudiation
- Confidentiality/Integrity/Authenticity protested log of system's security critical events
- Use-case defined log entries
- Facilitates secure retrieval of logs by server

Bootloader

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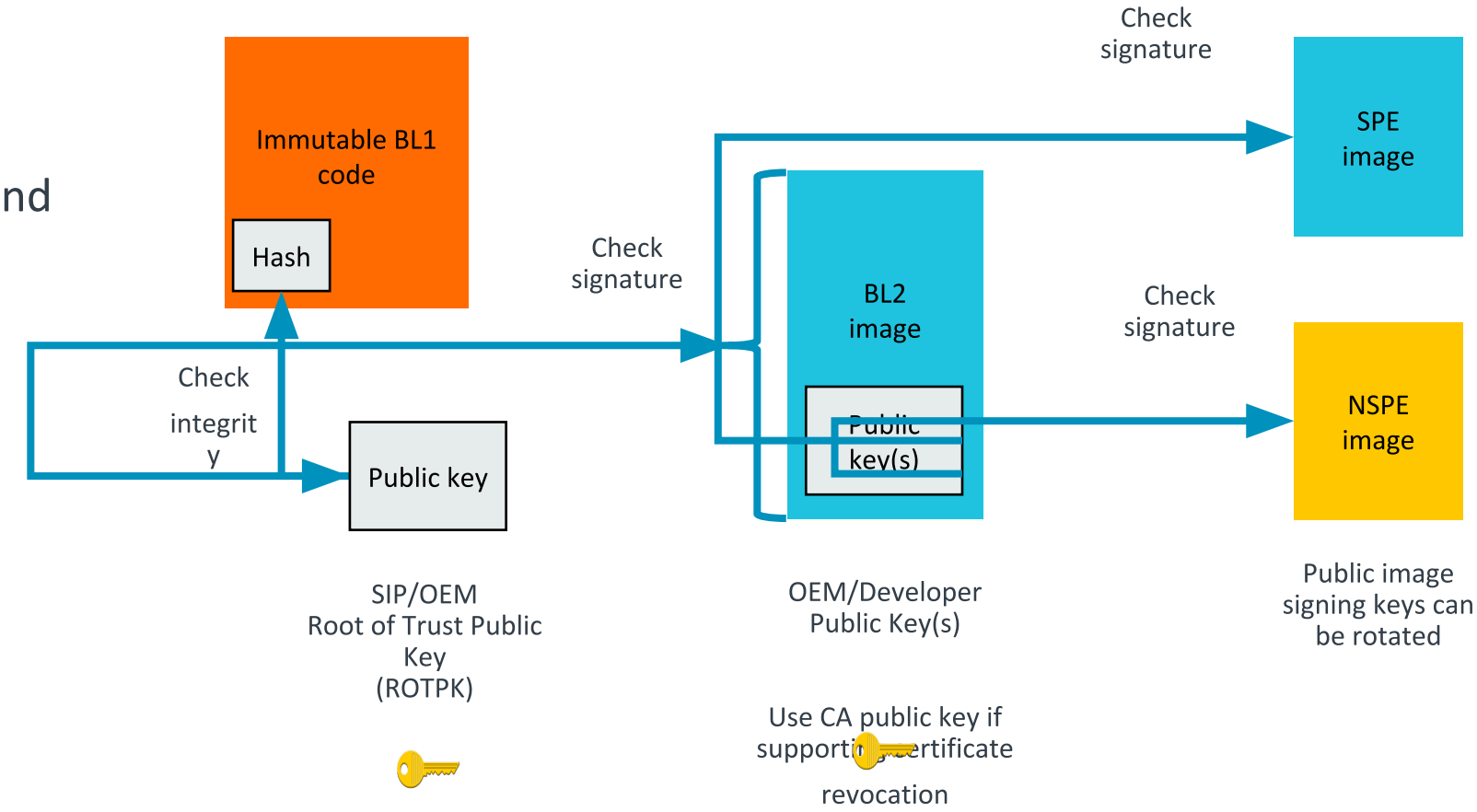
Bootloader

- SPE and NSPE image combined and signed
- SHA256, RSA-2048
- Firmware update support
- Attestation token collection
- Support for execution from RAM



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Usecase Scenarios

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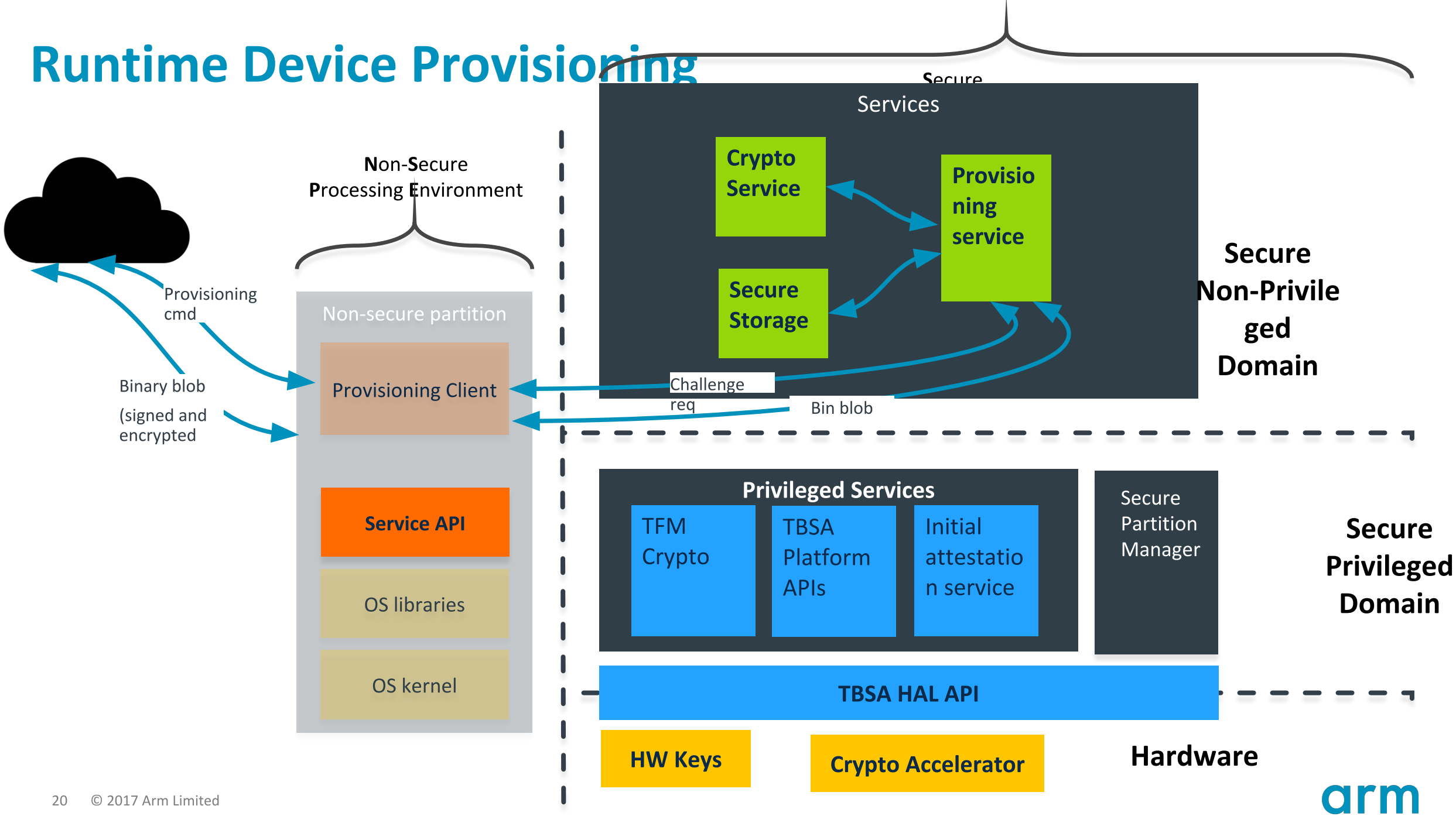
Runtime Device Provisioning



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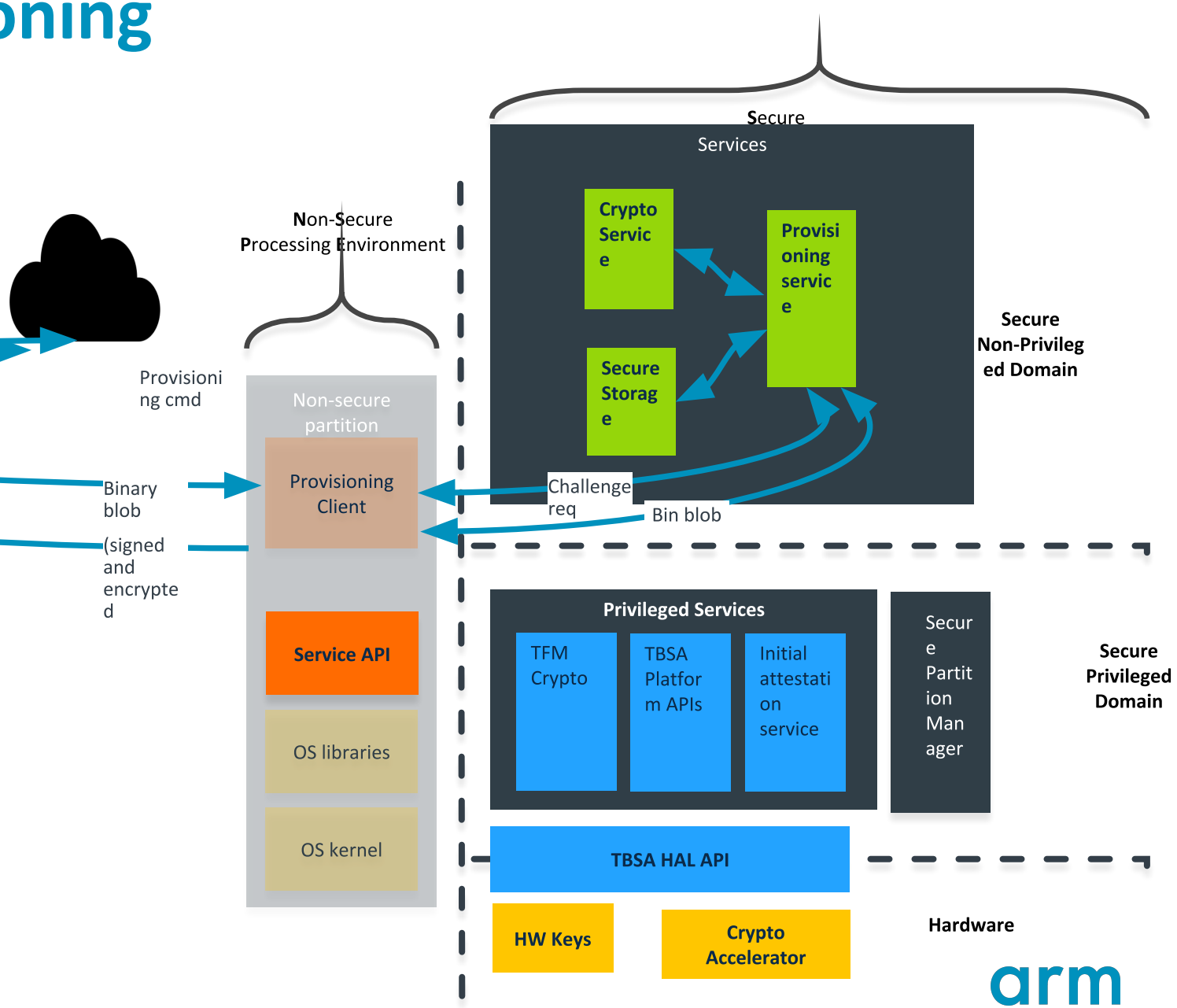
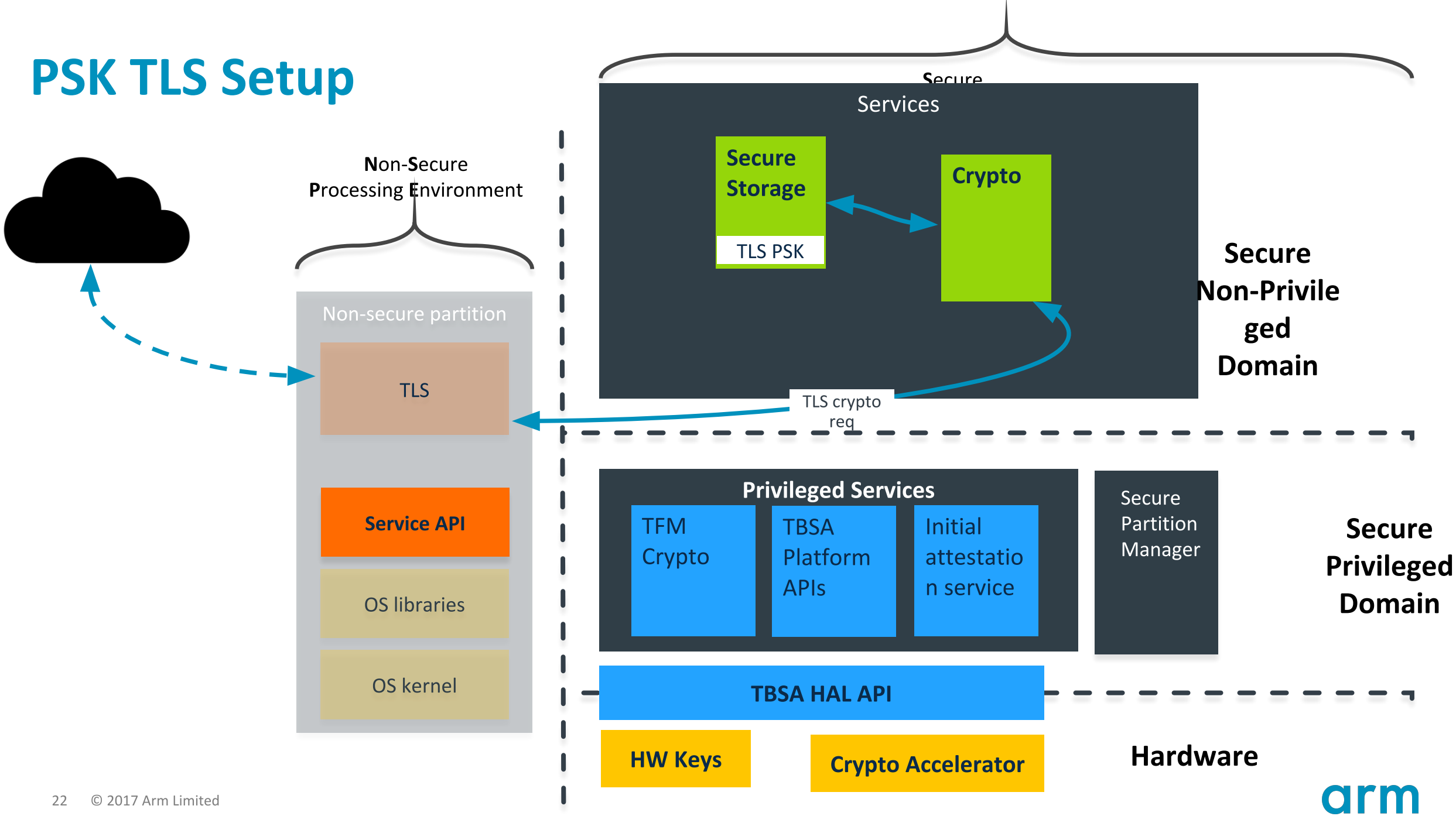
Runtime Device Provisioning

- Server sends provisioning cmd
- Provisioning client requests a challenge from provisioning service
- Server signs and encrypts the provisioning data(includes challenge)
- Provisioning service authenticates and decrypts the provisioning data
- Provisioning data is programmed in secure storage
- Flush crypto cache (key slots)

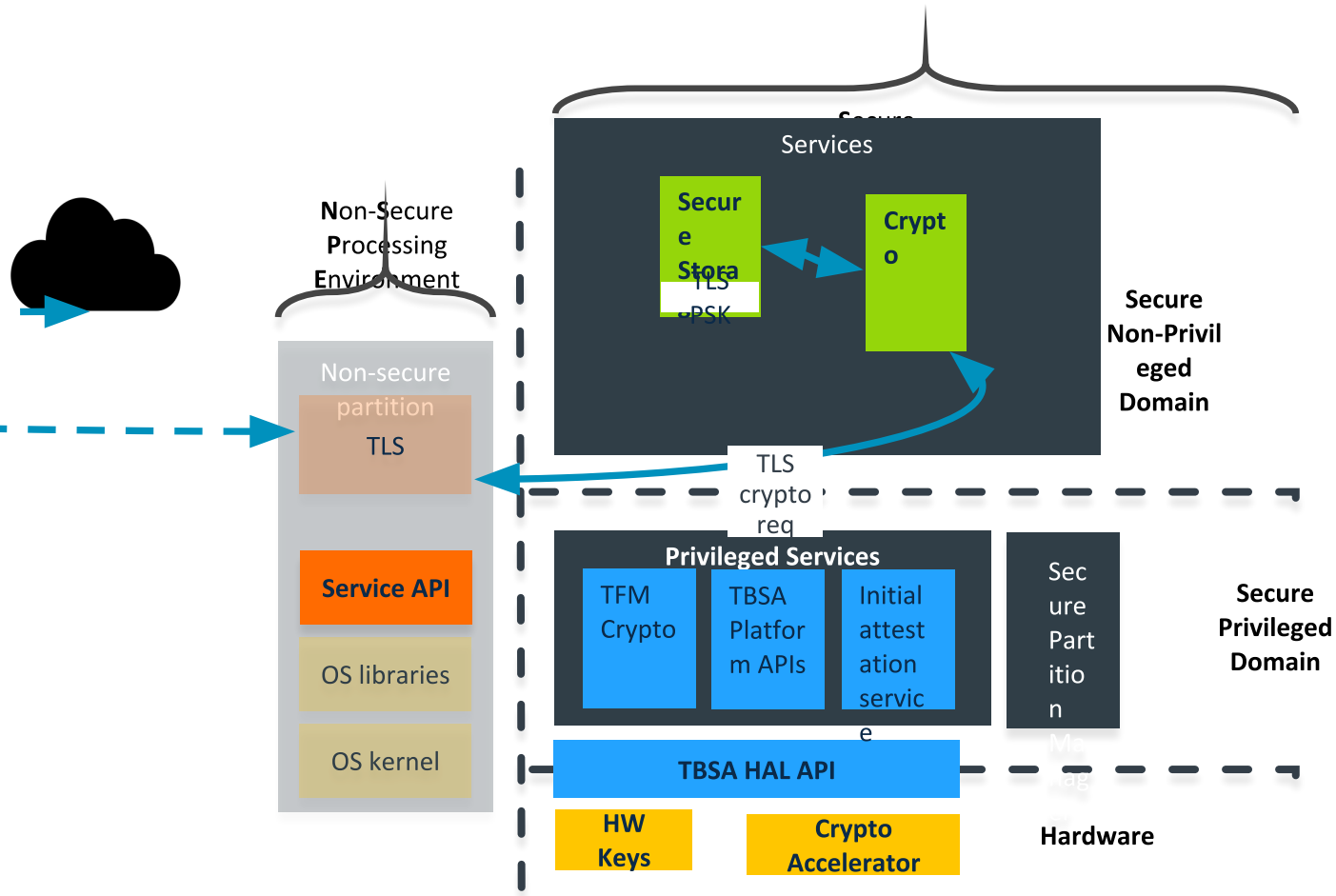


PSK TLS Setup



PSK TLS

- Server or device initiates the TLS protocol
- TLS lib on device requests Crypto for enc/dec/hash
- Crypto fetches the TLS key from secure storage
- Crypto performs the requested cryptographic operation
- Result is returned back to NSPE world
- Key never leaves secure world



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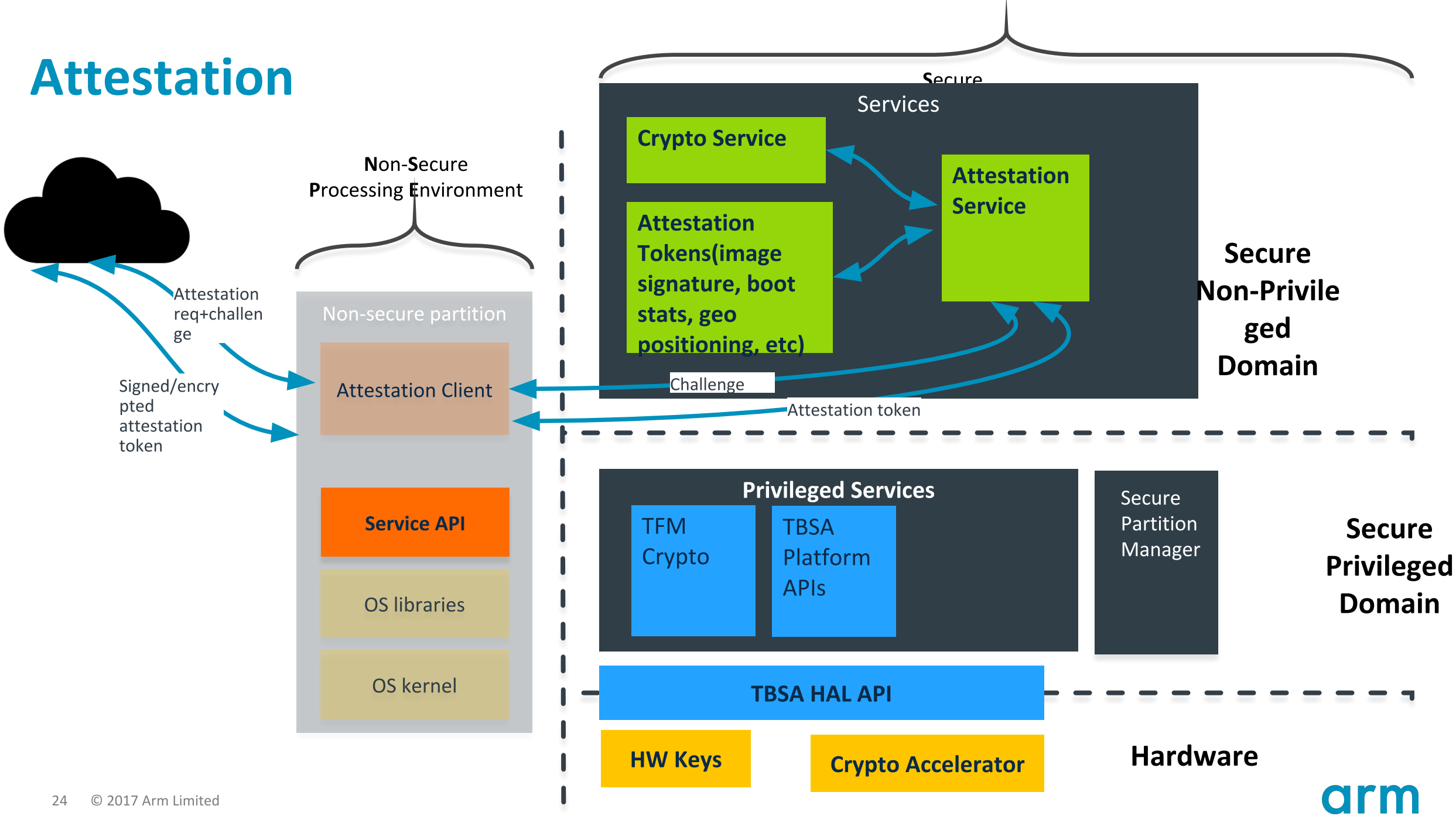
Attestation



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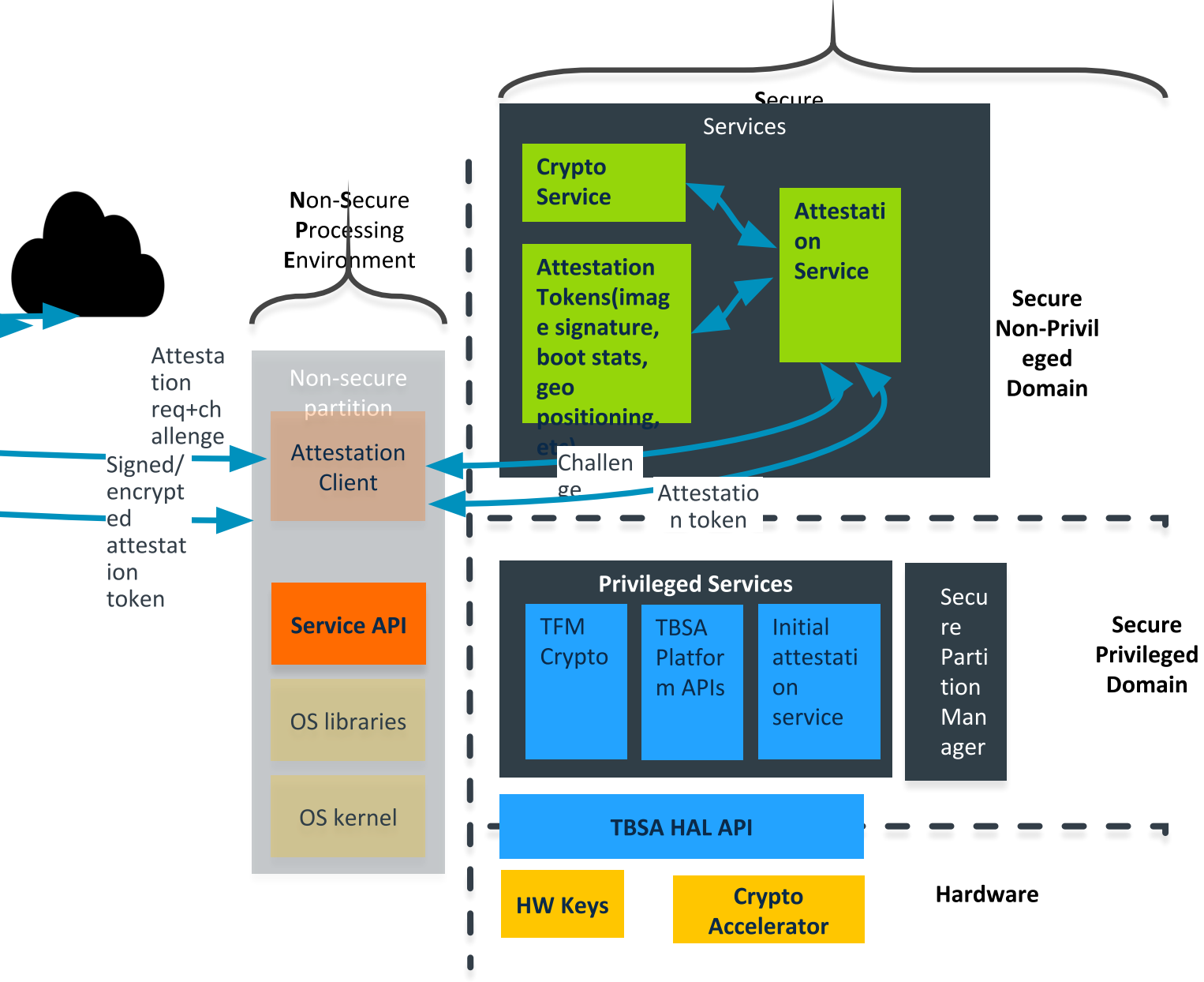
Attestation

- Service to securely collect and provide the device measurements-
  - Boot measurements
  - Image signature(s)
  - Device identity
  - Geographical location
  - Vendor data
- Server sends attestation request with a challenge
- Att service signs/encrypts the data alongwith challenge
- NSPE client returns the attestation blob to server



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Getting Involved

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How to get involved

Trusted Firmware Website

- https://www.trustedfirmware.org/index.html

TF-M codebases

- https://git.trustedfirmware.org/

TF-M Dev Team @ Connect HKG18

- Abhishek Pandit
- Ashutosh Singh

Get in touch

- Come round LITE hacking room
- Schedule a meeting via hkg18.pathable.com

More info on developer.arm.com

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Looking Ahead

- Add support for IPC in all the services
- Secure interrupt handling
- TFM-M scheduler
- Crypto service enhancements to support asymmetric crypto
- Attestations Service
- Provisioning Service
- Platform HAL standardization
- Threat Modelling

Questions?

- BoF: IOT Security with Arm OSS – 10:00 - 10:55, 18 September 2018
- Trusted Firmware - Project Updates - 16:00 - 16:55, 18 September 2018
- Open CI for Trusted Firmware - 12:00 - 12:25, 18 September 2018

Thank You!
Danke!
Merci!
谢谢!
ありがとう!
Gracias!
Kiitos!
감사합니다
धन्यवाद

Backup Slides

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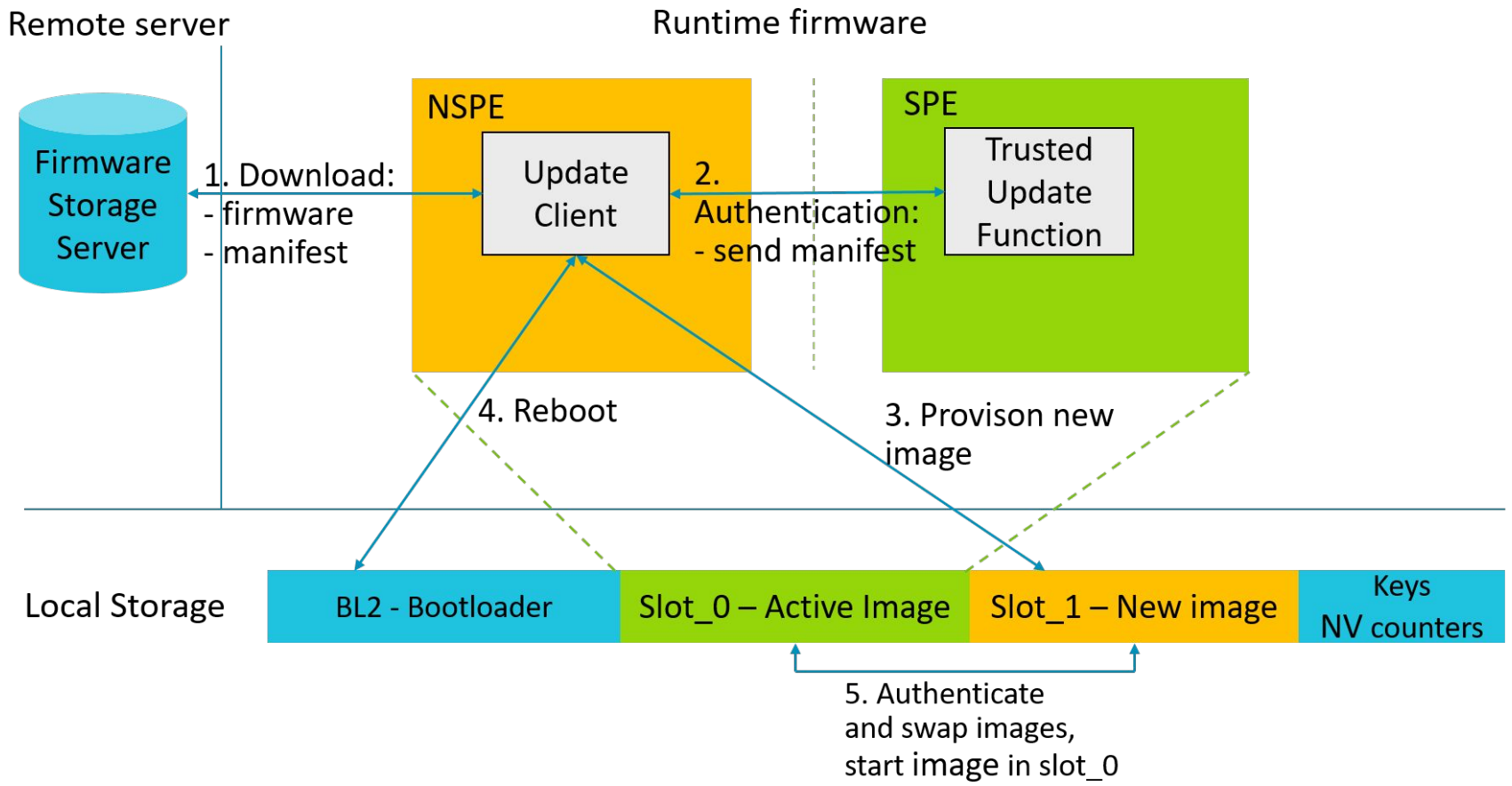
Firmware upgrade

- Update client downloads the FW
- Bootloader validates the new image
- Swap the images
- Peform BIST in runtime and mark SPE and NSPE as ‘safe’
- If not, revert back



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ARMv8-M TrustZone overview

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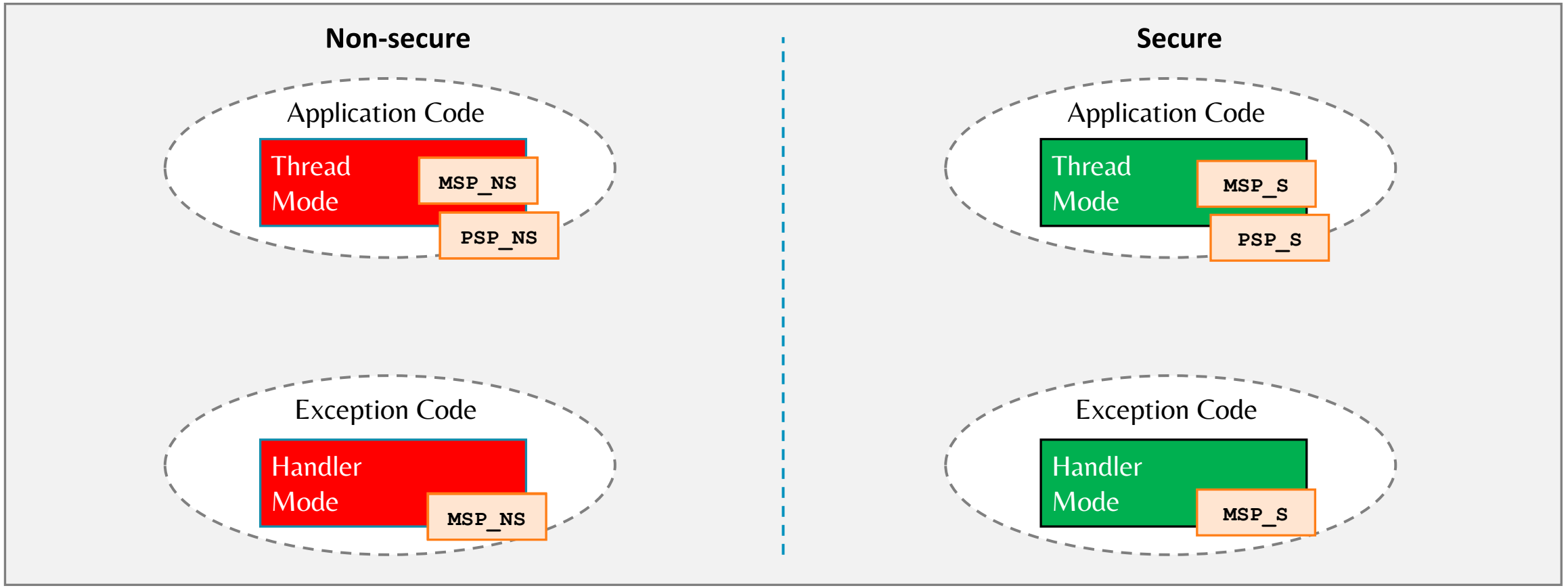
ARMv8-M Secure and Non-secure states



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ARMv8-M additional states

Existing Handler and Thread Modes mirrored with Secure and Non-secure States

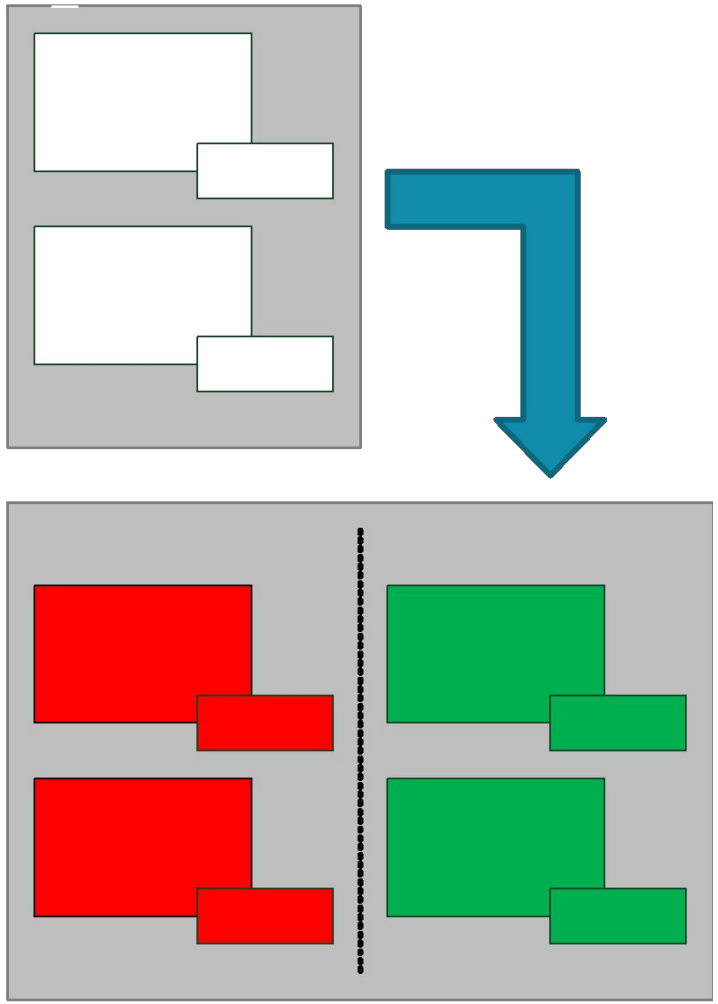
Secure and Non-Secure code run on a single CPU

Secure state for trusted code

- New Secure stack pointers for robust operation
  - MSP and PSP → MSP_NS, PSP_NS, MSP_S and PSP_S

Dedicated resources

- Separate memory protection units for S and NS
- Private SysTick timer for each state
- Secure side can configure target domain of interrupts



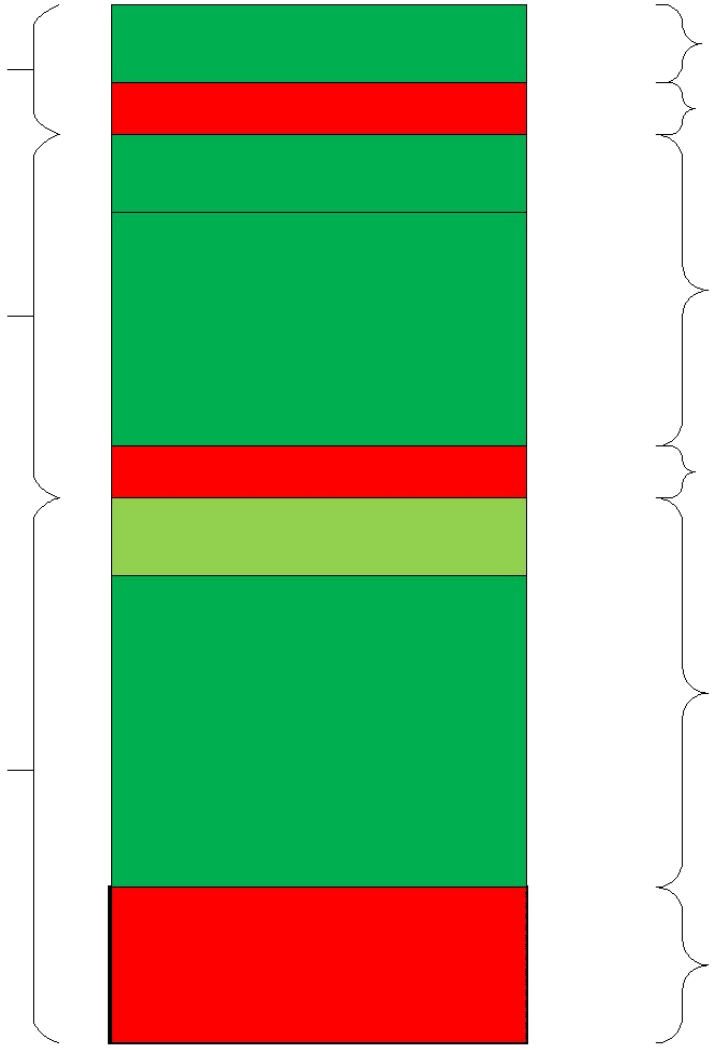
Secure Partitions: Address space layout/permissions

PSA level 1

SPE/NSPE isolation provided by v8M TrustZone (SAU, IDAU, MPC, PPC)

Partition Manager

- creates/maintains database of SPs
- sets up isolation boundaries
- prepares execution context for secure function
- keeps track of partition states



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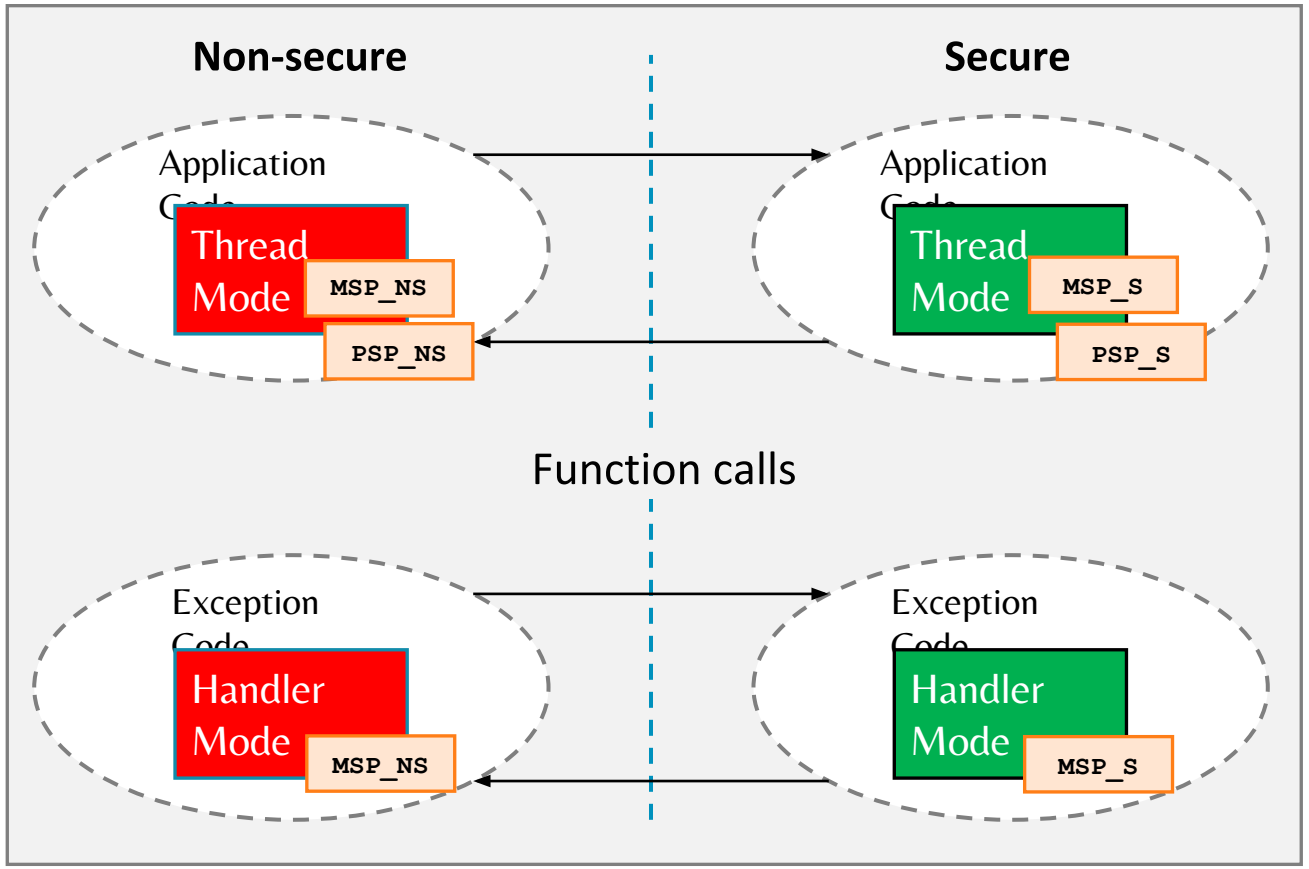
Calling between security states



Secure code can call Non-secure functions

- Non-secure functions and data should not be trusted

Non-secure code can call into Secure libraries

- Only a sub-set of the Secure code is callable
- Secure entry points are limited
- Non-secure code does not need to know it is calling a Secure function

This is different from Armv8-A TrustZone

- Where changing security state can only occur on an exception boundary

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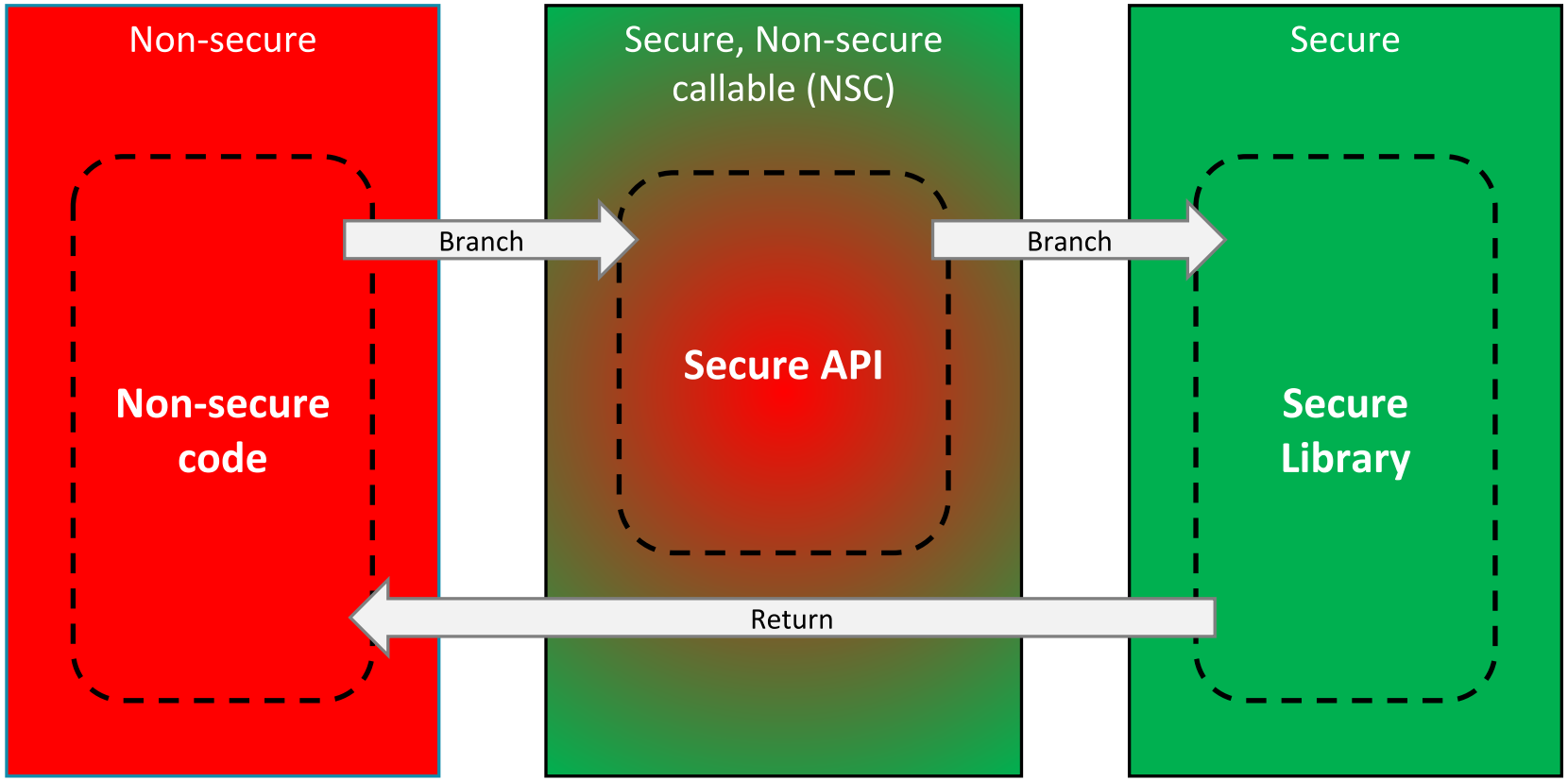
Memory security

Physical memory is split into Secure and Non-secure regions (No MMU in M-class)

- A Secure region can also be Non-Secure Callable (NSC)



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