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SCMIv2.0

What's new

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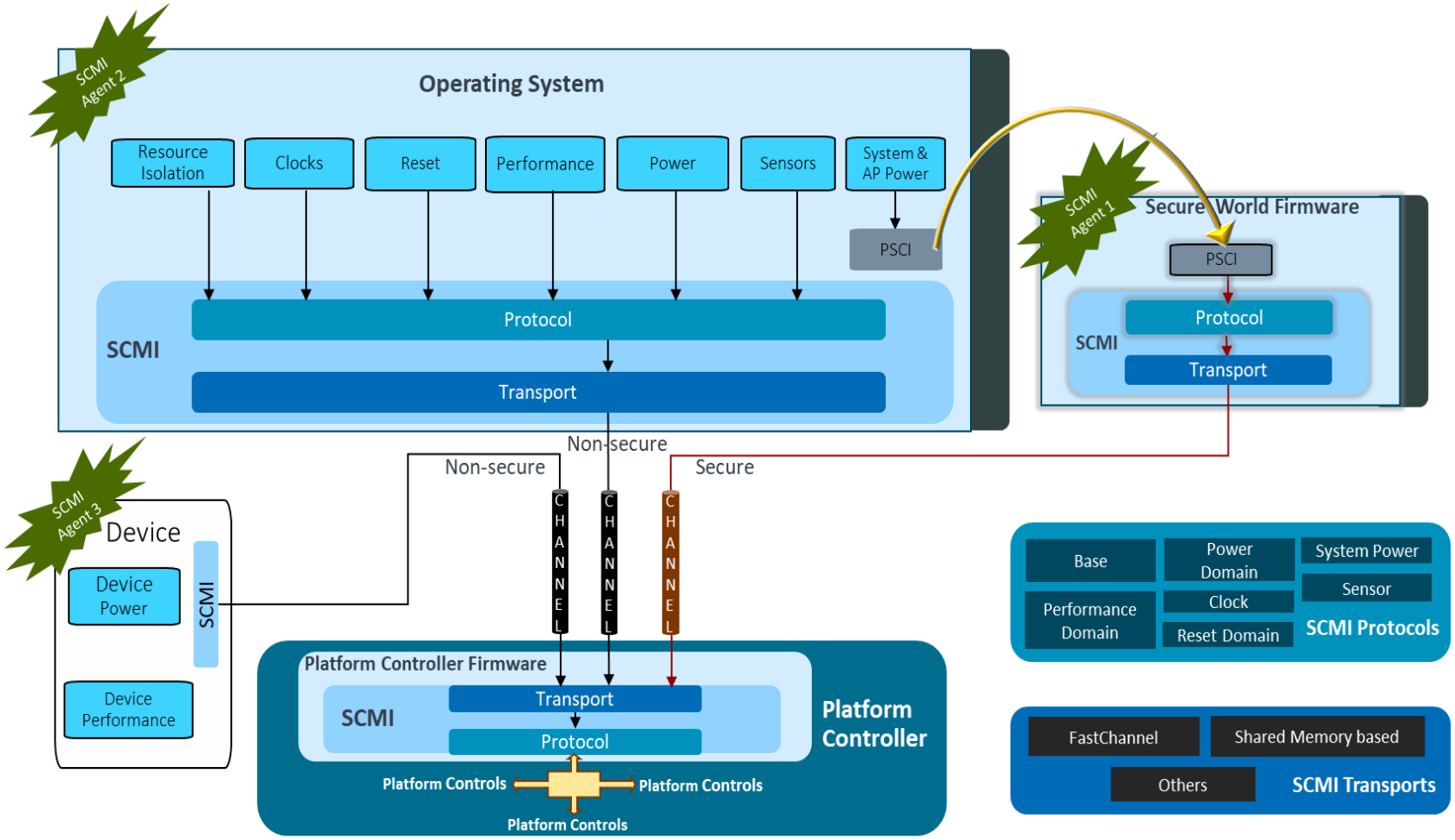
Agenda

- What is SCMI
- Power Management Models enabled by SCMI
- SCMIv2.0 – FastChannels
- SCMIv2.0 – Agent specific permission Configuration
- SCMIv2.0 – Other Features
- SCMI.next Roadmap - New Features
- Evolution & Roadmap* – High level view
- Status & Next Steps
- Useful Links

What is System Control & Management Interface (SCMI)

Publicly available ARM specification

- Standard messaging interface to a System Controller for
  - System Control
  - Power & Performance Mgmt.
- System Controller may be
  - Firmware in Secure World.
  - Firmware + microcontroller.
- New features in SCMIv2.0:
  - SMC/HVC Based standard SCMI Channels
  - Reset domain management
  - Pre-Notifications
  - FastChannel Support
    - Register or Shared memory-based Channel
  - Agent-specific Permission Configuration & Reset



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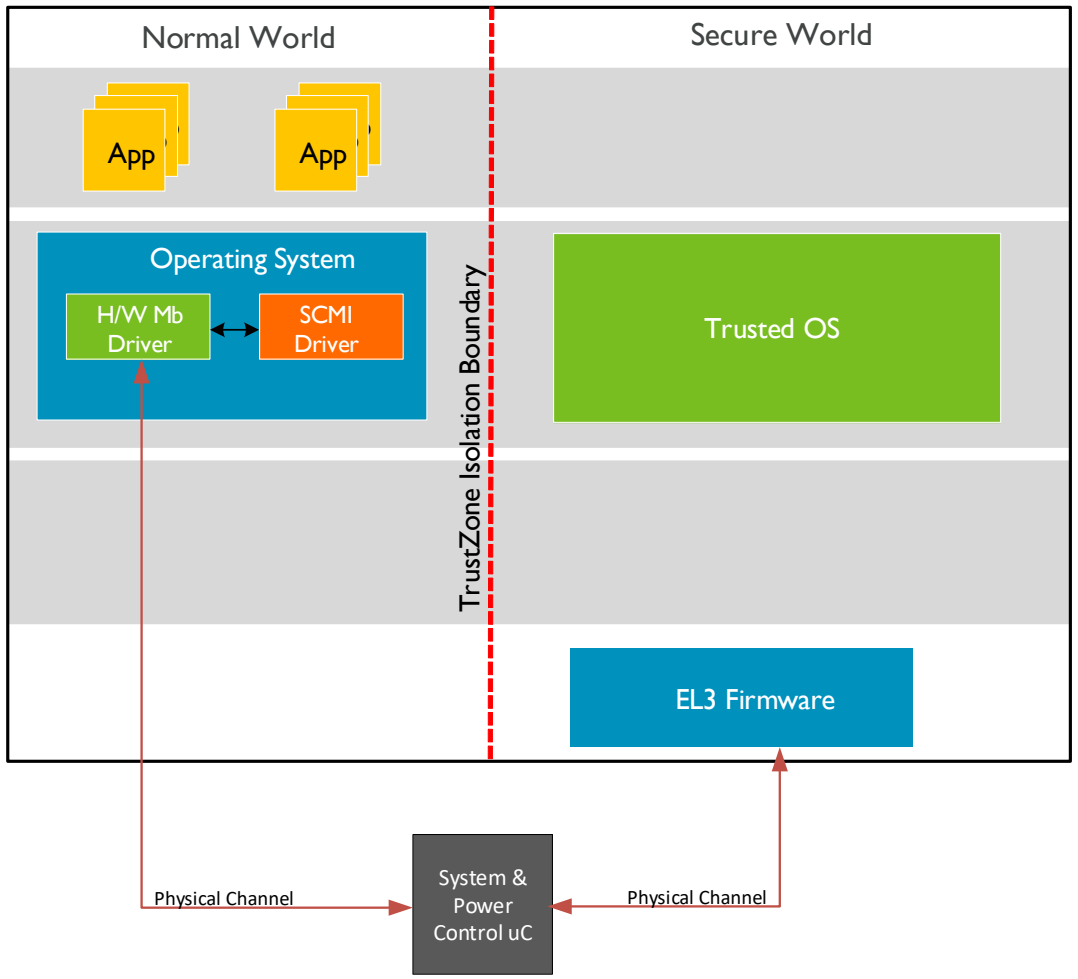
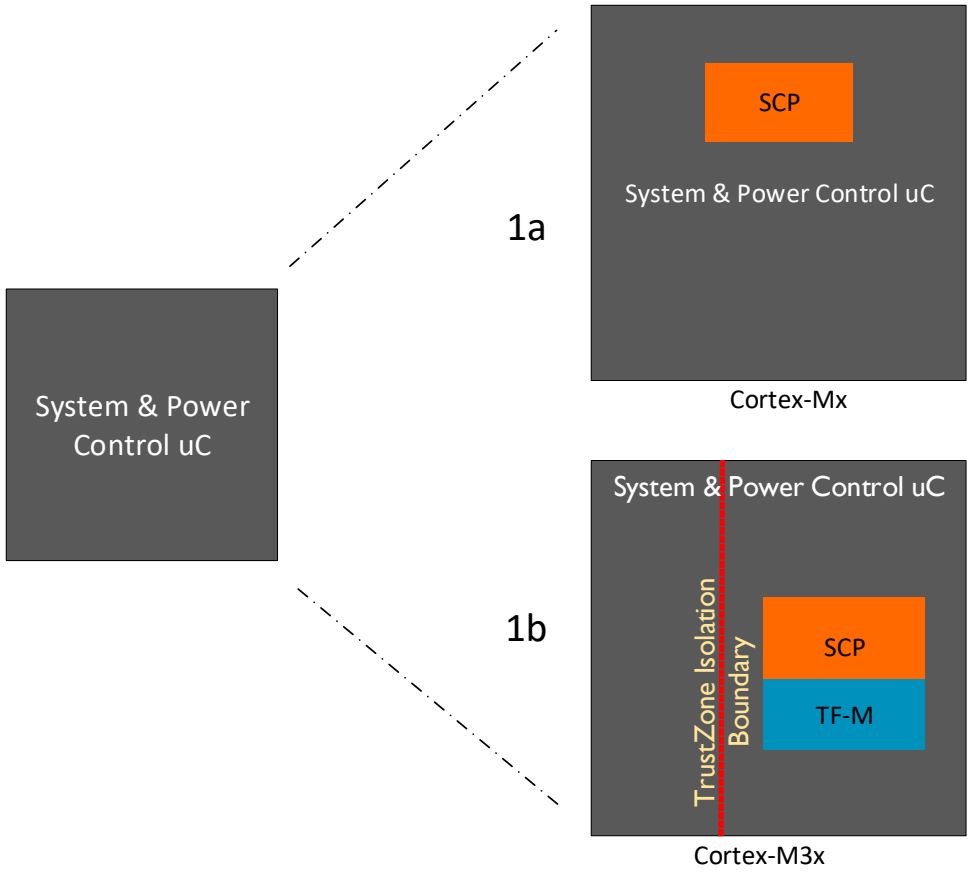
Power Management Models enabled by SCMI

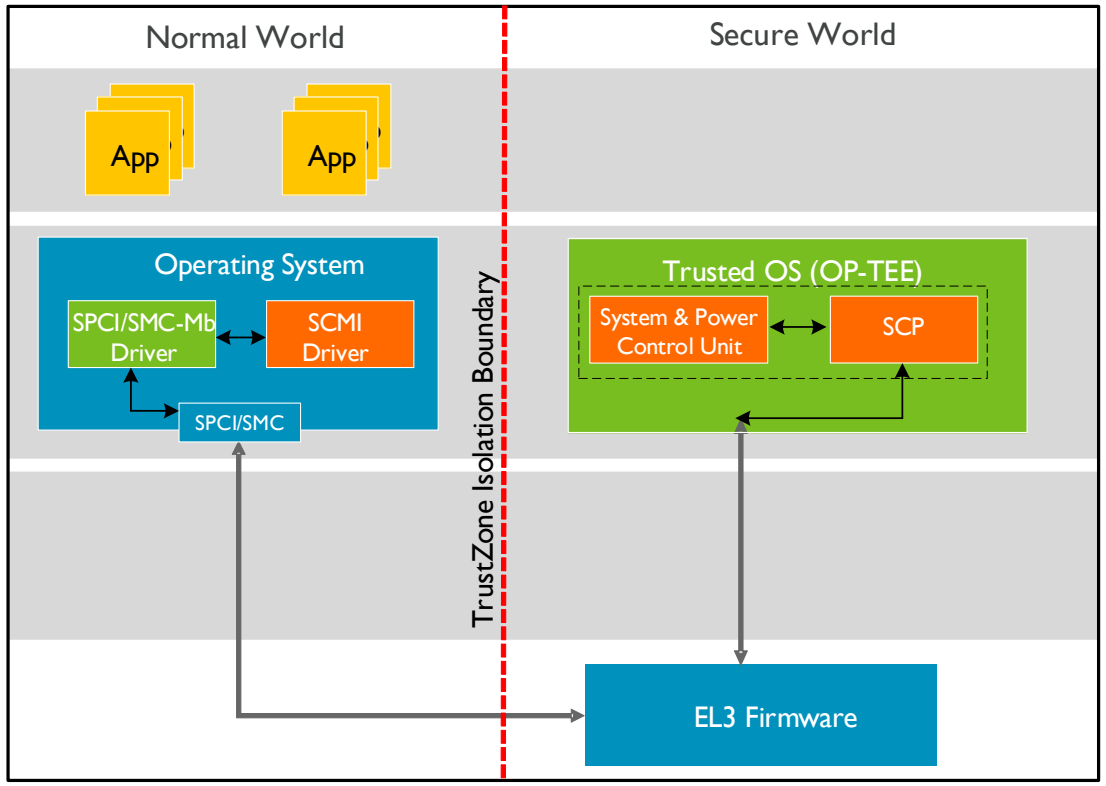
System Control firmware on a Cortex M based Microcontroller



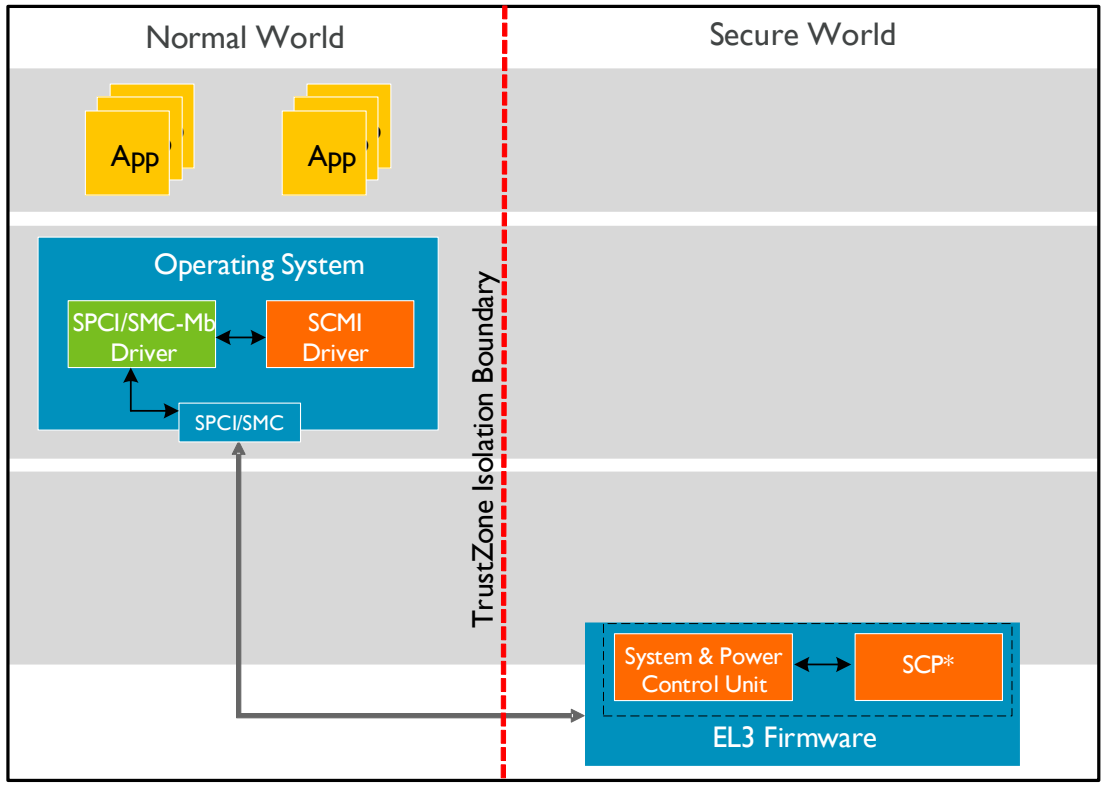


Power Management Models enabled by SCMI

System Control firmware in Cortex-A Secure World



Recommended Model



Only recommended if no Secure-EL1 Payload is present

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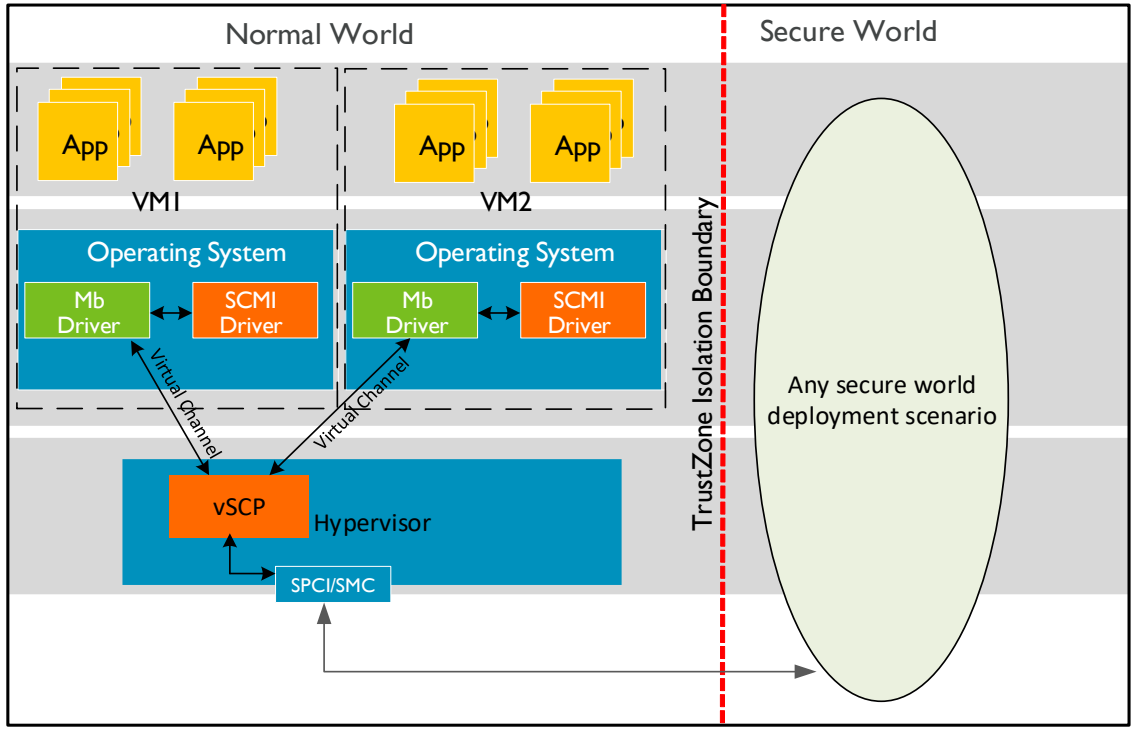
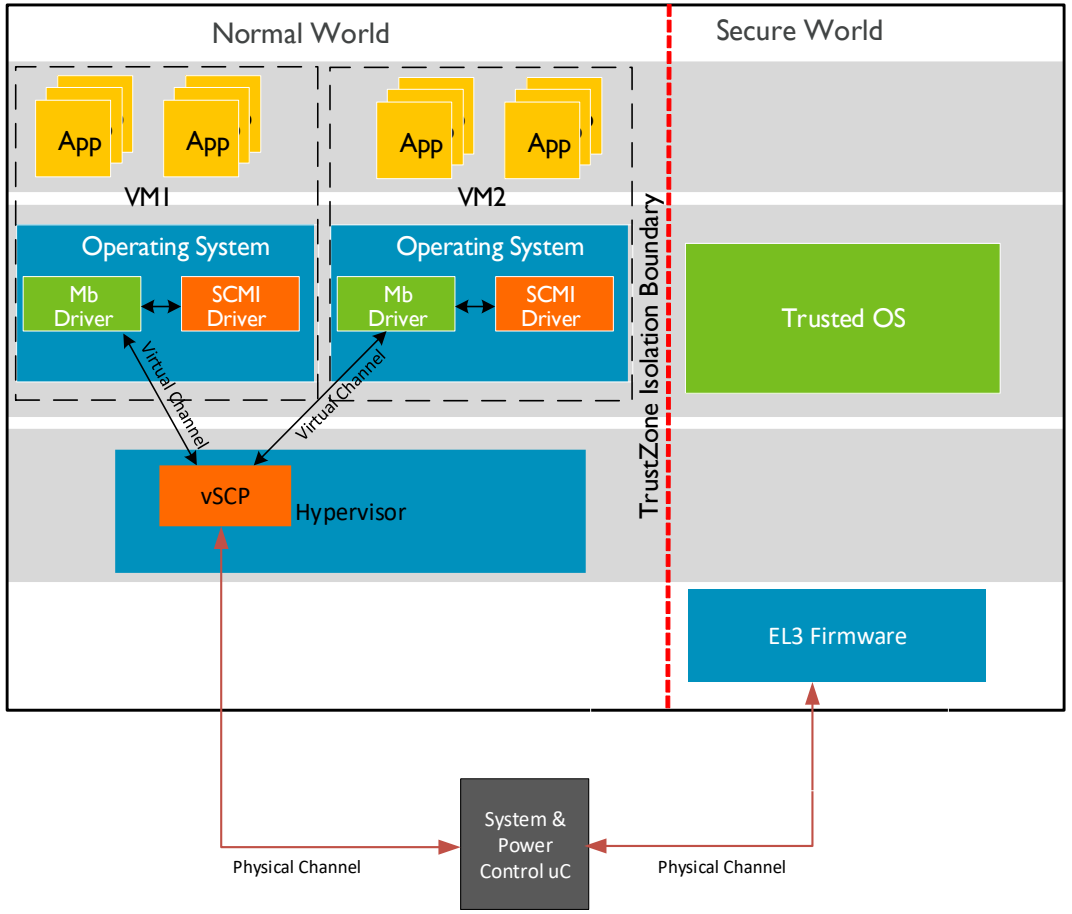
Power Management Models enabled by SCMI

System Control firmware in Virtualized Systems





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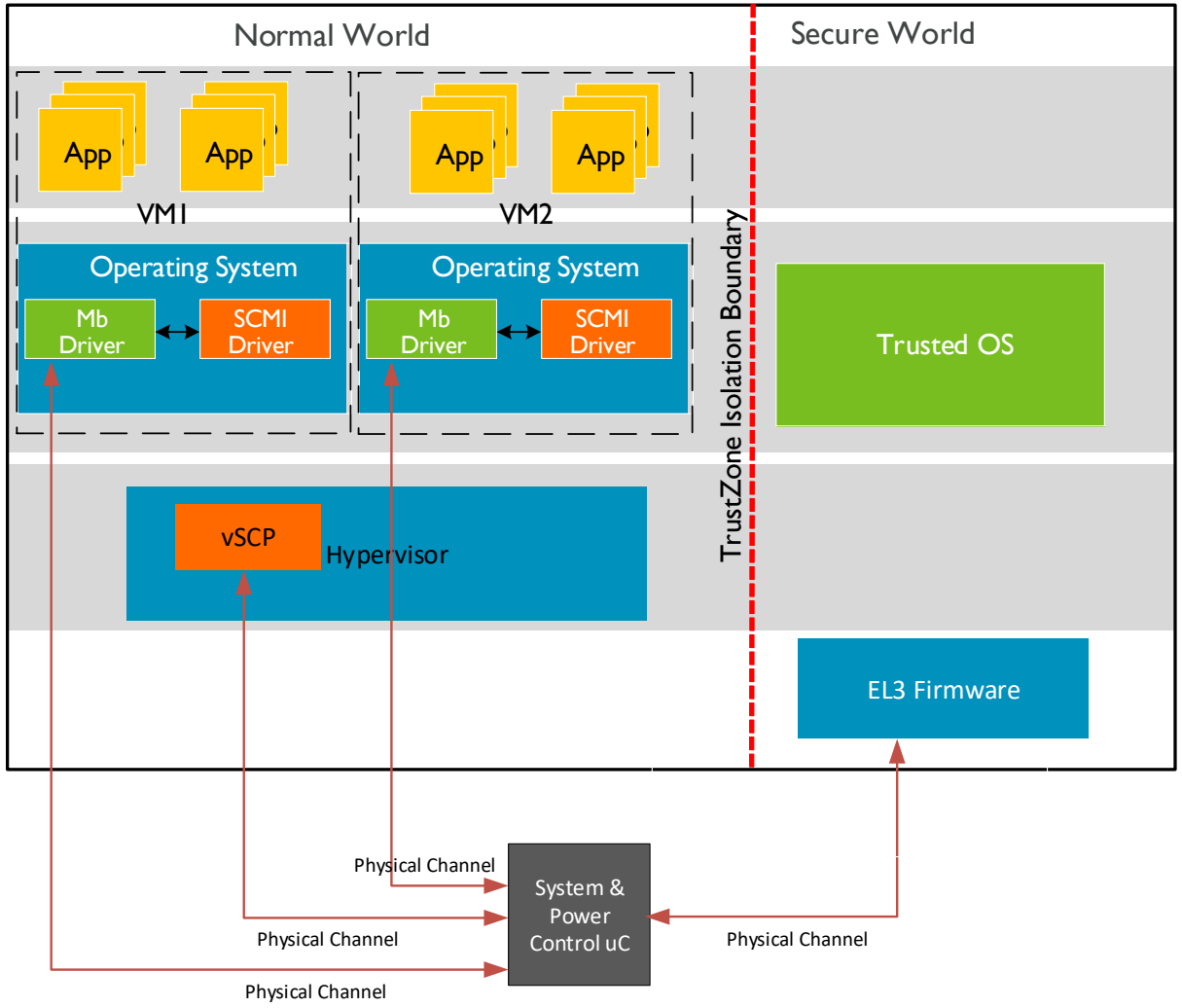
Power Management Models enabled by SCMI

System Control firmware in Hardware-assisted Virtualized Systems



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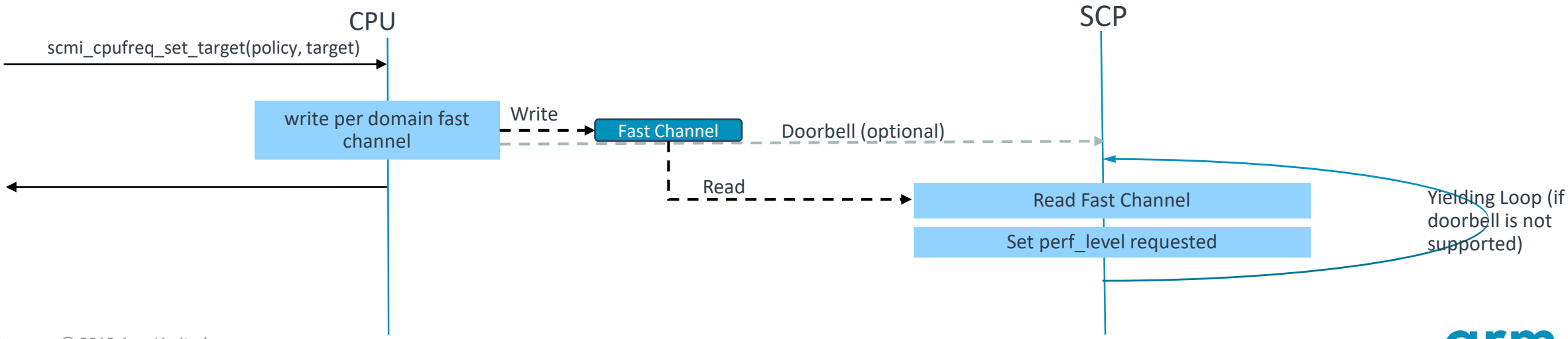
SCMIv2.0 – FastChannels

- Introduced to reduce latency during certain latency-sensitive operations like DVFS.
- FastChannel is Per-Message Per-Domain dedicated channel for Performance Protocol.
- Different command types cannot be multiplexed over the same FastChannel.
- May be any memory location shared between SCP & AP Domain (e.g. SRAM). May be non-secure.
- Optional Doorbell Support -> Location; Register size; Set/Preserve/Clear mask.
- Dynamic discovery. Cpufreq driver can check FastChannel bit per performance domain and discover them via a command.
- No Response back from Channel. Asynchronous Mode of operation (fire-and-forget).
  - Use Shared Stats region to read existing frequency.
  - If Synchronous behavior is required, use normal SCMI channels. Since hardware delays for Synchronous behavior (PLL Lock + Voltage Ramp) is of order of 10's of us, normal SCMI channel should be sufficient.



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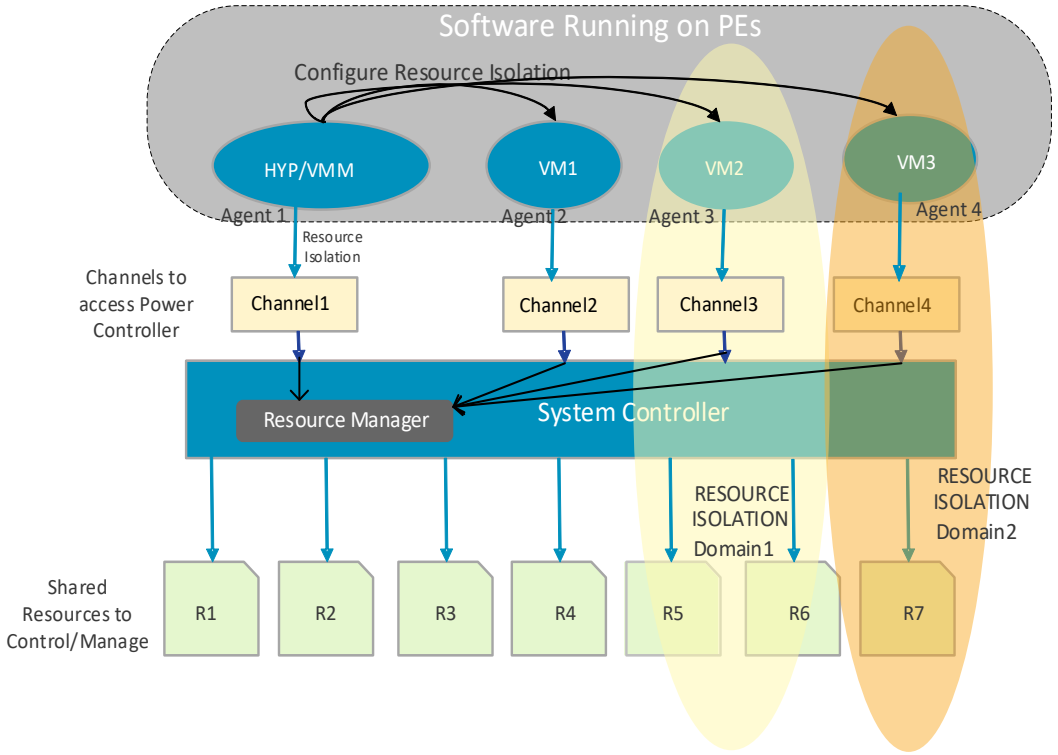
SCMIv2.0 – Agent specific permission Configuration

Direct assignment in Virtualized systems

- Hypervisor has access to all channels.
- Each channel has a unique agent-id allocated by System Controller.
  - Discoverable by BASE_DISCOVER_AGENT command
- Hypervisor chooses channels to allocate to VMs.
- Hypervisor configures access permissions of agents
  - BASE_SET_DEVICE_PERMISSIONS
  - BASE_SET_PROTOCOL_PERMISSIONS
  - BASE_RESET_AGENT_CONFIGURATION
  - Only one control channel has permissions to use above commands. Access control imposed at boot by System Controller.
  - Control channel identification is done through firmware tables and is not discoverable.
- Hypervisors maps configured channels into VM space and starts VM.
- VM can use channel mapped to its space.
  - Can send commands to access resources allowed by the hypervisor over the channel.



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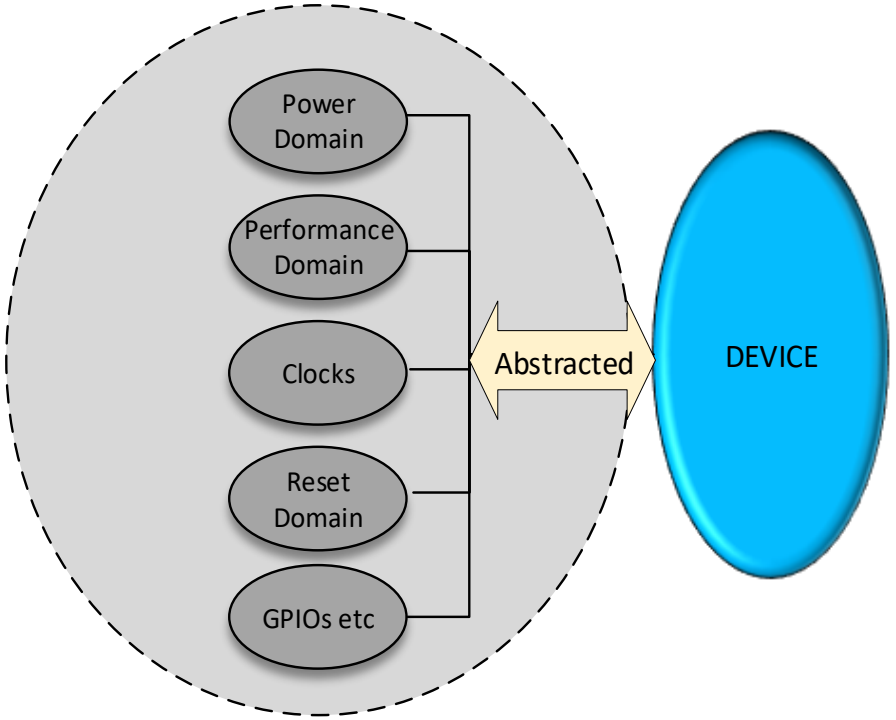
SCMIv2.0 – Agent specific permission Configuration

How Direct Assignment works

- Hypervisor configures access permissions of agents
  - BASE_SET_DEVICE_PERMISSIONS
    - System Controller Firmware groups resources into Devices.
      - Devices can be logical.
    - Devices uniquely identified by 32 bit device-identifiers.
    - Devices are mapped through firmware tables.
      - Device Dynamic discovery is planned for SCMI.next
    - If agent has access to a device, it gets access to all resources associated with the device.
  - BASE_SET_PROTOCOL_PERMISSIONS
    - Access to specific protocols for a particular device for an agent
  - BASE_RESET_AGENT_CONFIGURATION
    - Reset all permissions of an agent.
    - Reset all device specific configurations done by an agent.

- The VM can send commands to access resources allowed by the hypervisor over the channel.
  - E.g., it can directly access a Power Domain if it is associated with a device the agent has access to.



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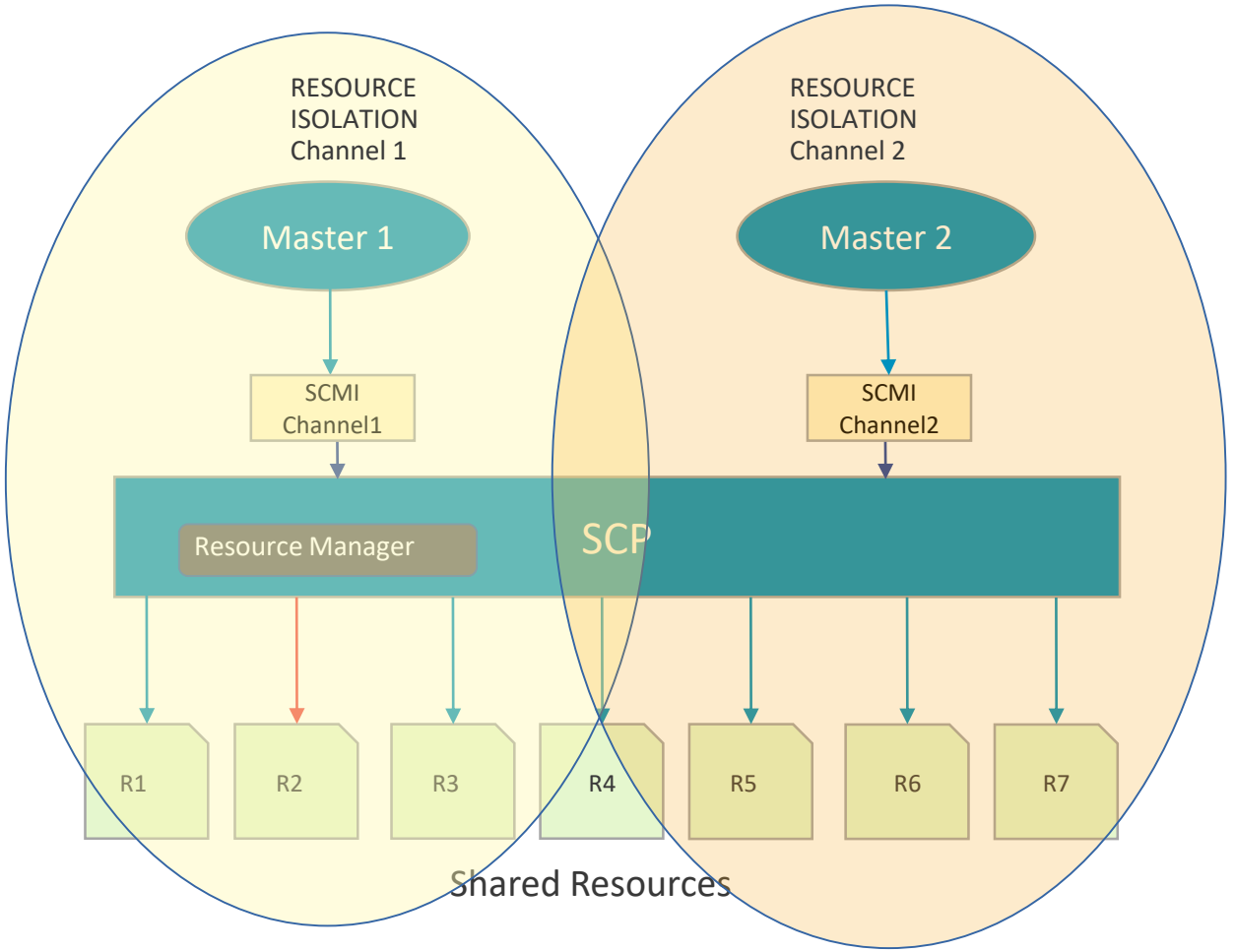
SCMIv2.0 – Agent specific permission Configuration

Multi-Master Systems



"A+M" Class SoCs

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SCMIv2.0 – Other Features

Reset Domain Management & SMC based doorbell

- Reset Domain Management Protocol
  - Reset domains are defined by the System Controller
  - Reset domains can be reset
    - Explicitly by toggling the reset signal low and high.
    - Autonomously by asking for a Reset. Firmware does the reset.
  - Compatible with Linux Reset Framework.

- SMC/HVC Based doorbells
  - SCMV2.0 introduces the possibility of doorbell being SMC/HVC based to enable secure world firmware deployment.
  - Parameters are {SMC FN_ID, 32-bit Mailbox Identifier}
  - Mailbox identifier identifies a memory region shared between normal and secure world which serves as Mailbox.
  - Secure and Normal world need to view the same map of Mailbox identifiers.
    - Mailbox ID discovery is through firmware tables.

SCMI.next Roadmap - New Features

The Device View

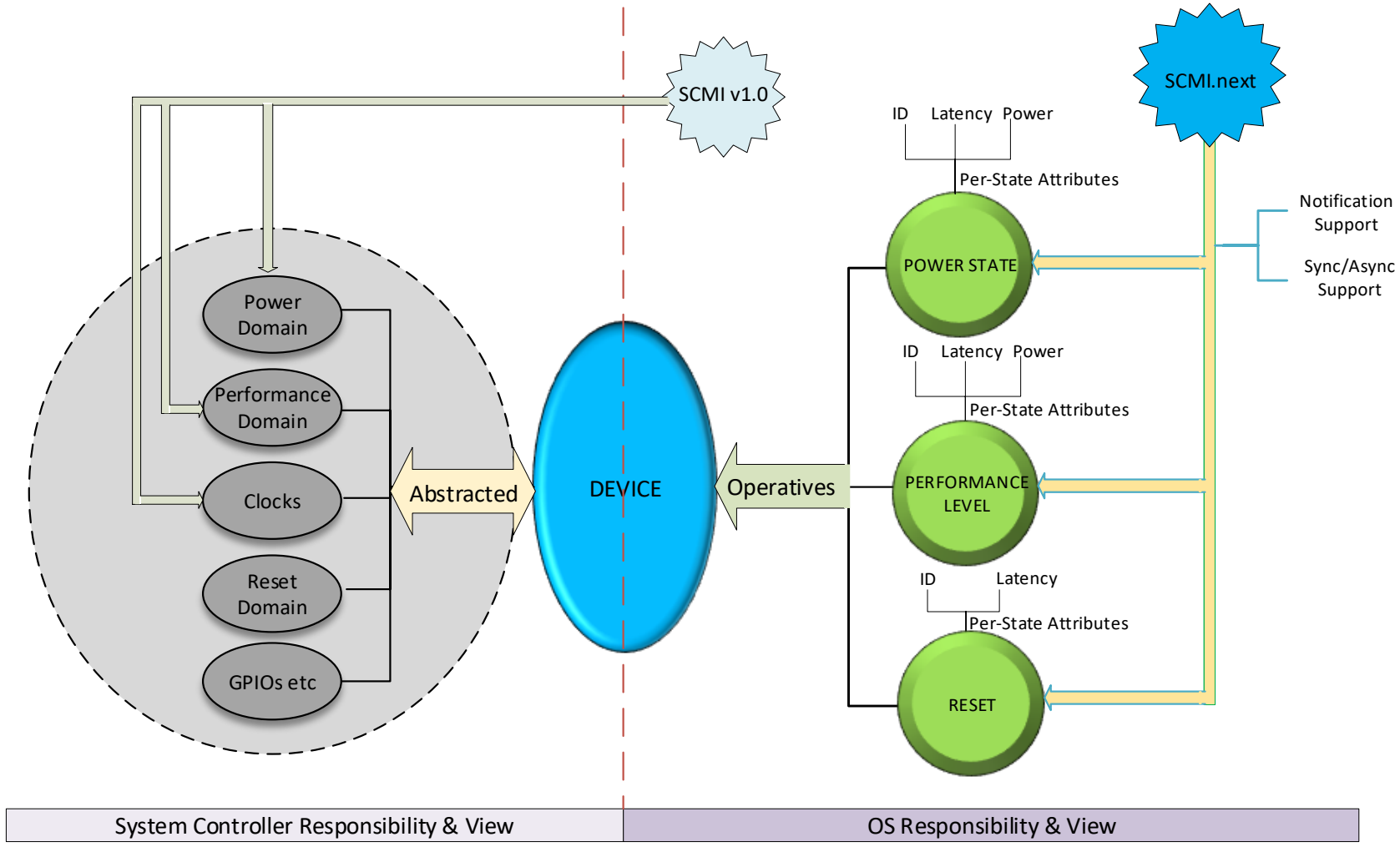
Device advertises

- Power State*
- Performance levels
- Reset States

System Controller

- Abstracts and Manages platform specific details
- Creates device attributes from constituent domains
- Manages/Resolves Domain Dependencies for SCMI Device Management calls

*CPU Power Management is still over PSCI



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SCMI.next Roadmap - New Features

PSA-FF-A (previously known as SPCI) Interface based Transport

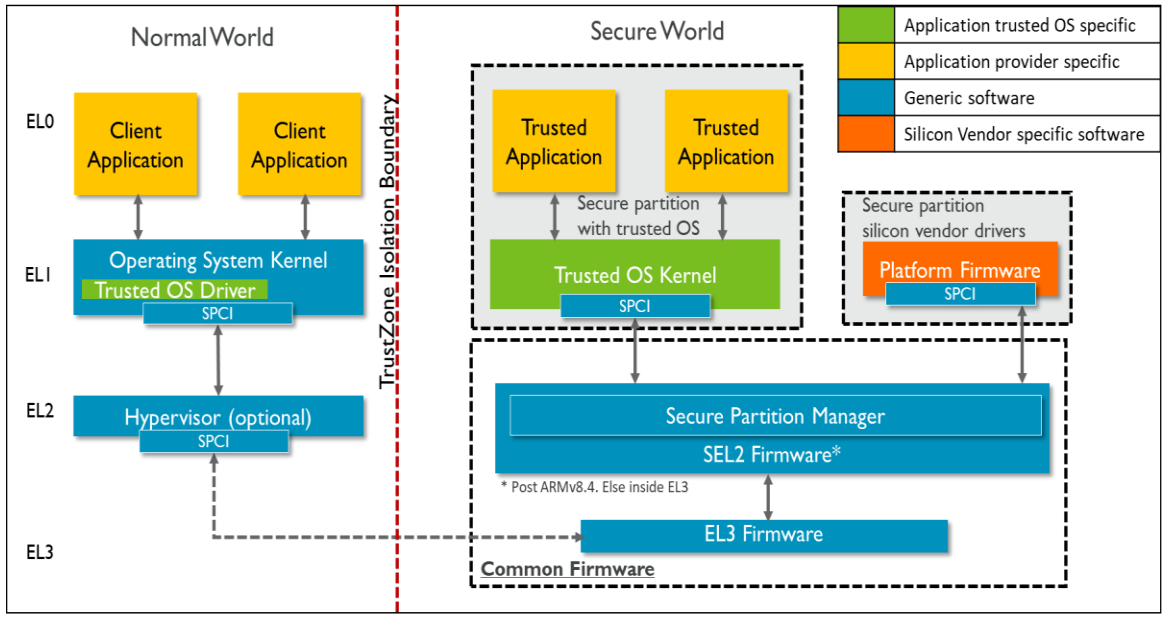
PSA-FF-A overview

A Secure Partition (SP) is a Secure world sandbox

- Can host a Trusted OS or a driver stack
- Exports services to Normal world clients and other partitions

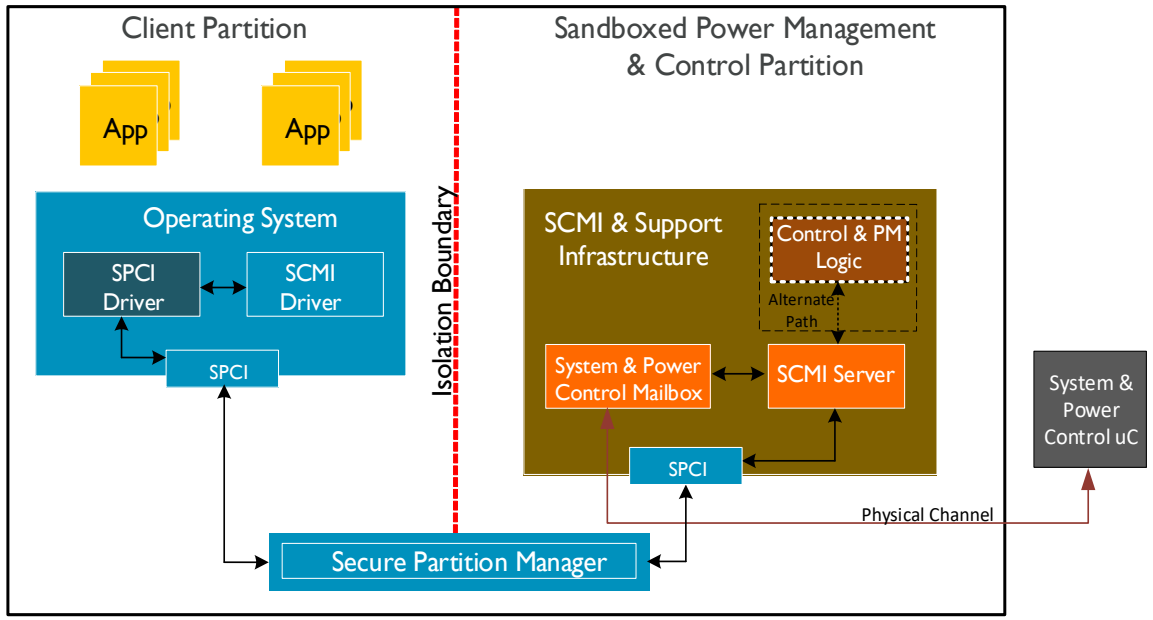
PSA-FF-A generalizes communication with SPs

- Describes ABIs to access services in a SP



SCMI transport over PSA-FF-A

- Secure World resident SCMI Server in SP
- Fixed-Function hardware or microcontroller-based design



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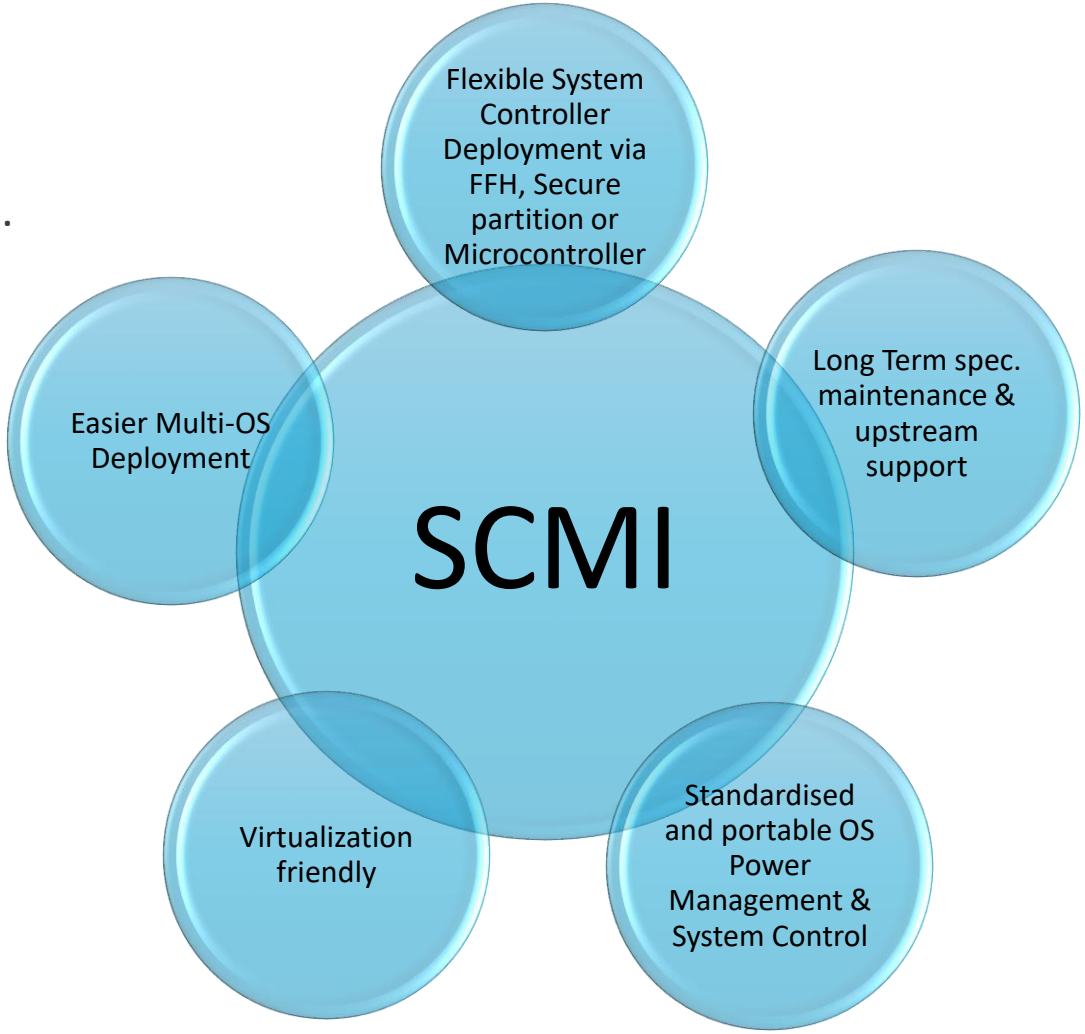
Status & Next Steps

- Device Management
  - Migration Path (Short Term) and Long-Term kernel framework under analysis.
  - Proof of Concept tentatively targeted at ARM JUNO board.

- SCMIv3.0 (Concept)
  - Device Management Protocol
  - Autonomous Power & Performance Management
  - QoS Support



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Useful Links

- SCMI: https://developer.arm.com/architectures/system-architectures/software-standards/scmi
- SCMI Specification v2.0: http://infocenter.arm.com/help/topic/com.arm.doc.den0056b/DEN0056B_System_Control_and_Management_Interface_v2_0.pdf
- Improved Power Management and System Control through SCMI (Blog) - https://community.arm.com/developer/ip-products/processors/b/processors-ip-blog/posts/improved-power-management-system-control-through-scmi?_ga=2.156623154.880774273.1565962961-2100565651.1542271883
- Power and Performance Management using Arm ACMI Specification (Whitepaper) https://developer.arm.com/-/media/Arm%20Developer%20Community/PDF/Arm_Power_and_Performance_Management_SCMI_White_Paper.pdf?revision=15e9d3dd-ecc6-40ab-a8c5-6bb4fa3fc060
- SCP Reference Firmware: https://github.com/ARM-software/SCP-firmware
- ARM Trusted Firmware: https://github.com/ARM-software/arm-trusted-firmware

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