Annual review ROME 2012

nSHIELD

Lessons learned from first year:

Trusted Execution Environments (TEEs)

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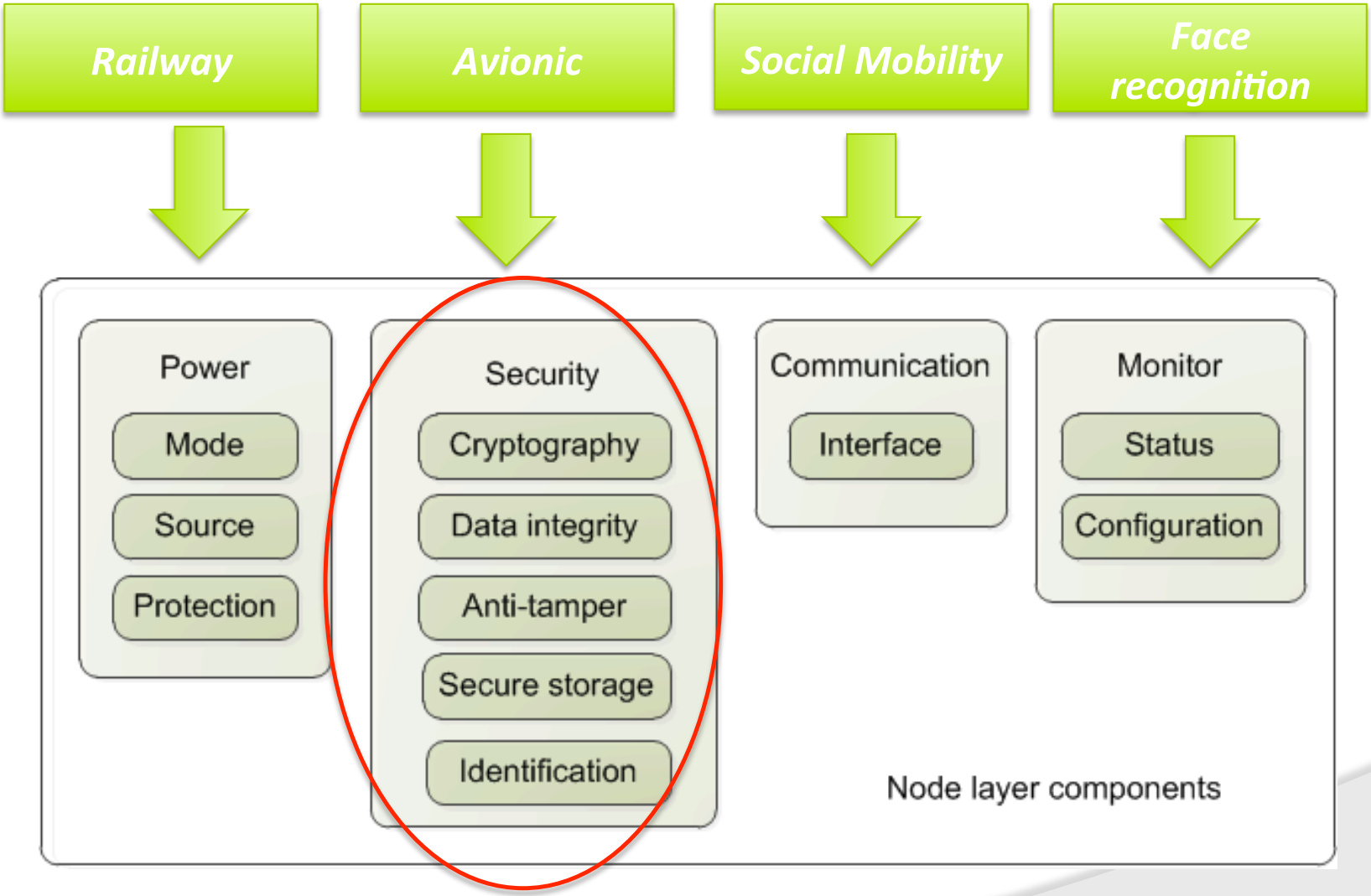
nSHIELD architecture and TEEs



Security critical functions!

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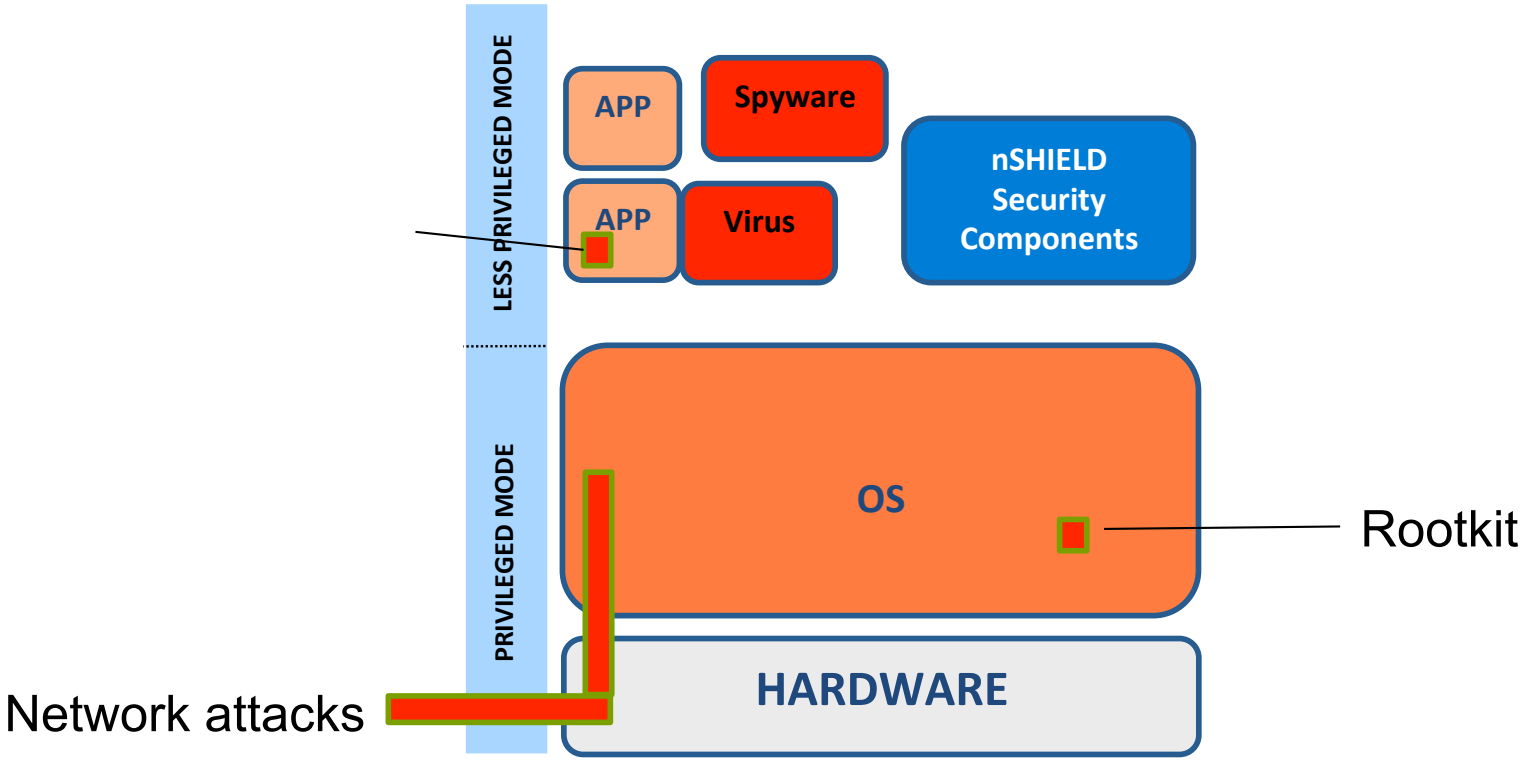
Threats!


LESS PRIVILEGED MODE
PRIVILEGED MODE
APP
APP
Spyware
Virus
nSHIELD
Security
Components
OS
HARDWARE
Rootkit
Network attacks

TEE implementation options

- Special purpose hardware modules
  - High security
  - No system monitoring possibilities
  - High cost
- On-chip TEE through virtualization
  - Flexible
  - Low cost!
  - System monitoring

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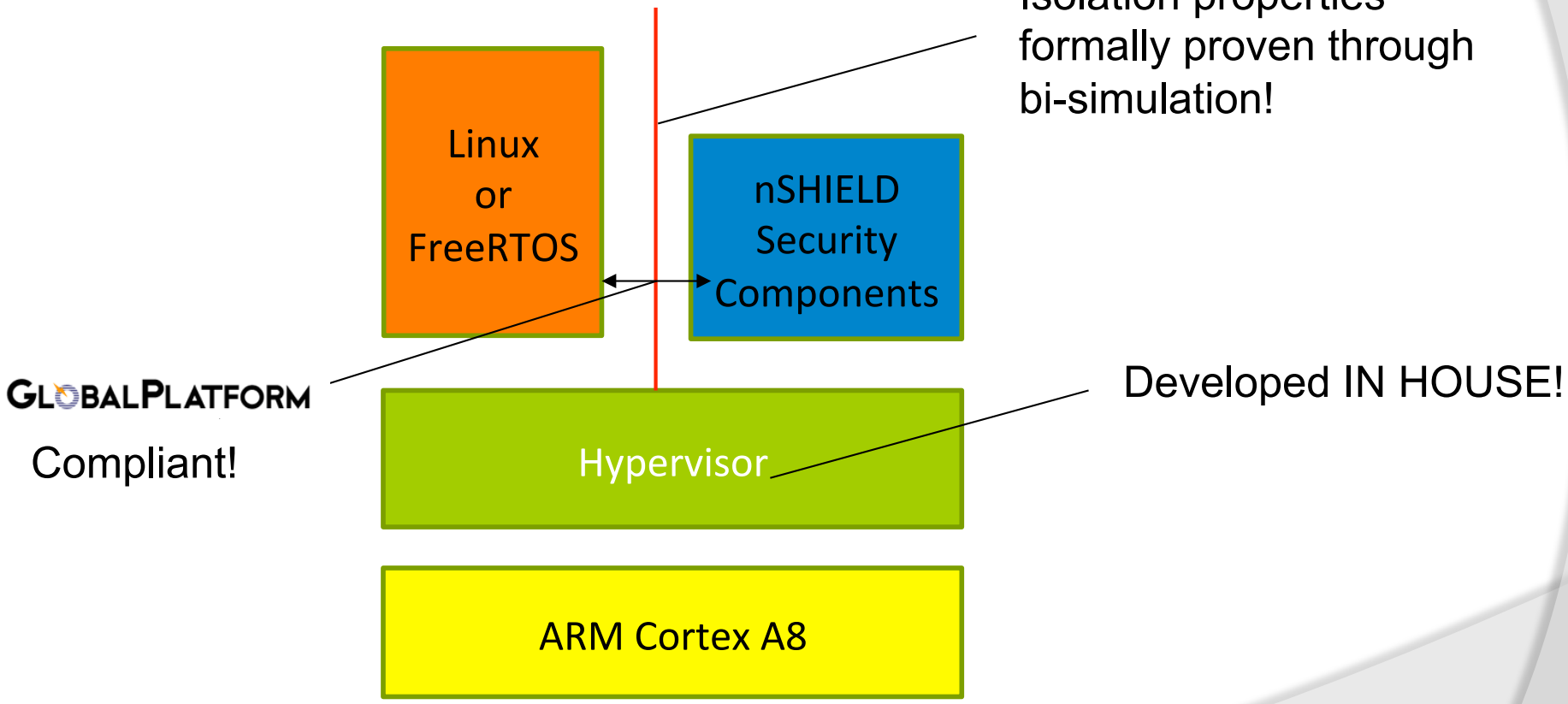
nSHIELD hypervisor based TEE

Target system!



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Hypervisor based TEE status (I)

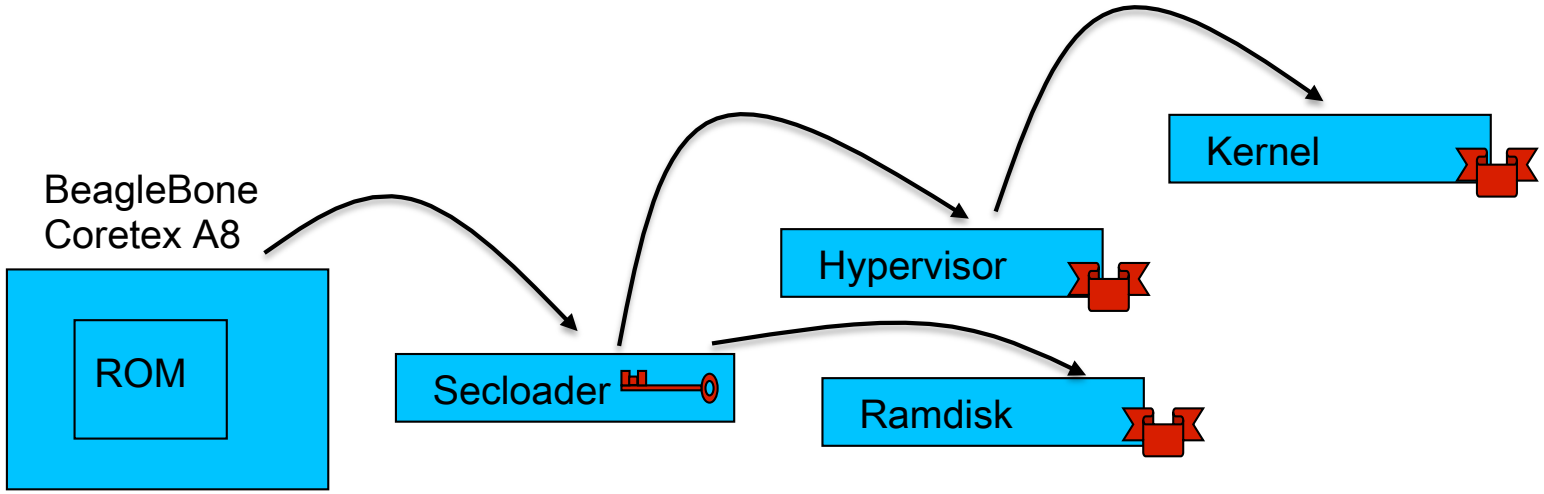
- Supports multiple OS (FreeRTOS) on ARMv5 and ARMv7
- Para-virtualization of OS system calls
- DMA protection through traps (OVP)
- Provides multiple isolated execution environments through arbitrary number of virtual guest modes
  - Kernel mode
  - Task mode
  - Trusted mode
  - Interrupt mode
- Each virtual guest mode has its own memory access configuration
- Efficient and simple hypervisor
  - RTOS performance overhead of 1-10 % (FreeRTOS)
  - ~12KB code
  - < 2KLOC (incl. debug, not HAL)

Hypervisor based TEE status (II)

- Port (ARM Cortex A8 ARMv7 OVP)
  - Ported hypervisor and FreeRTOS to ARMv7 architecture on OVP
  - Preparing hypervisor to run in real hardware
- Porting hypervisor to real hardware
  - Beagleboard and Beaglebone
    - TI OMAP 36XX & AM35X Platform
    - ARM Cortex A8 CPU
- Refactoring the hypervisor code
- Added a Hardware Abstraction Layer (HAL)
- Support for scheduling of multiple guest
- Linux port pre-study
- Started to implement global platform support

TEE and secure boot

- Without a verified boot chain the TEE will have a high risk of being compromised!



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Secure boot chain status

- Verified boot chain implemented on Beaglebone
  - RSA based signatures verified in a special purpose security loader
  - Core root of trust currently not implemented!
- Core root of trust should be in ROM!
  - We expect to have a customized ROM mask for next version of the prototype system!

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Next steps

- Linux port to hypervisor
- Global Platform API support
- Full verified boot chain including core root of trust in ROM
- Port of selected nSHIELD security services to the hypervisor based TEE
- Boot code and hypervisor code security assessment by Search LAB

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The END

That’s all folks!

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