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Integrity Protection for Mobile Devices

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Outline

- Motivation
- Mobile Device Architectures
- Situation Today
- Our Contribution
  - Attestation of Mobile Baseband Stacks [1]
  - SobTrA: A Software-based Trust Anchor for ARM Cortex Application Processors [2]
  - Improving Mobile Device Security with Operating System-level Virtualization [3]
  - Page-based Runtime Integrity Protection of User and Kernel Code [4]
- Conclusion

Motivation

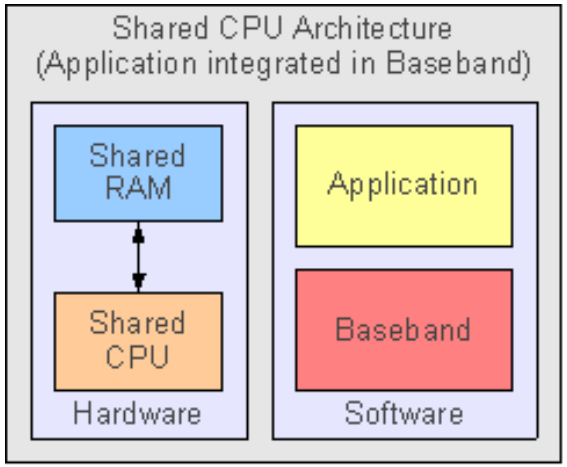
What is to be achieved?

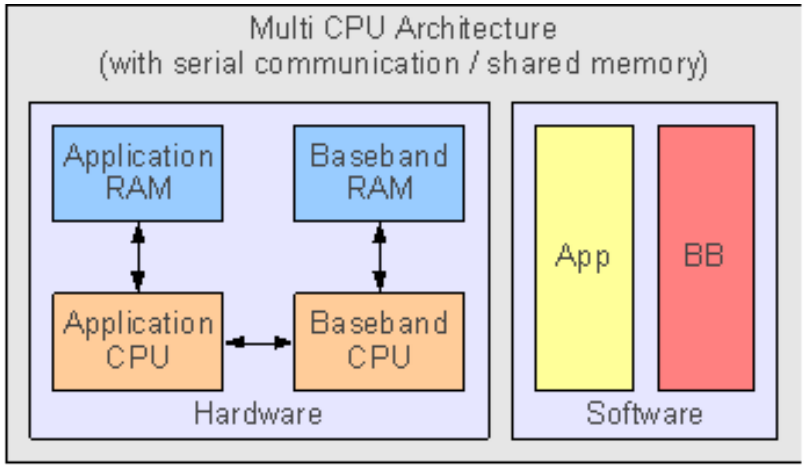
- Guarantee that a piece of software runs *untampered* on the device
  - Detect and prevent malicious modifications *on the device*
  - Detect malicious modifications at connect or during a transaction *in the backend*

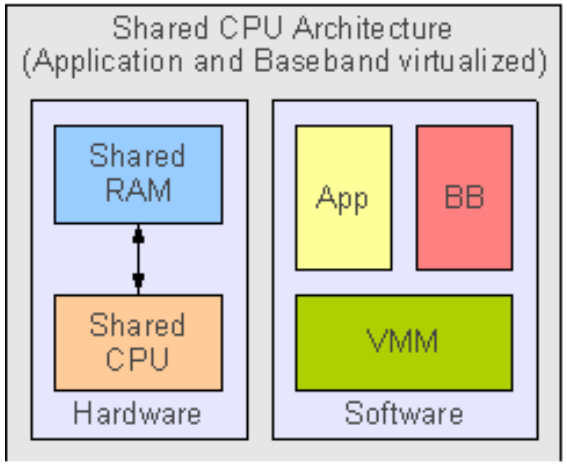
And why?

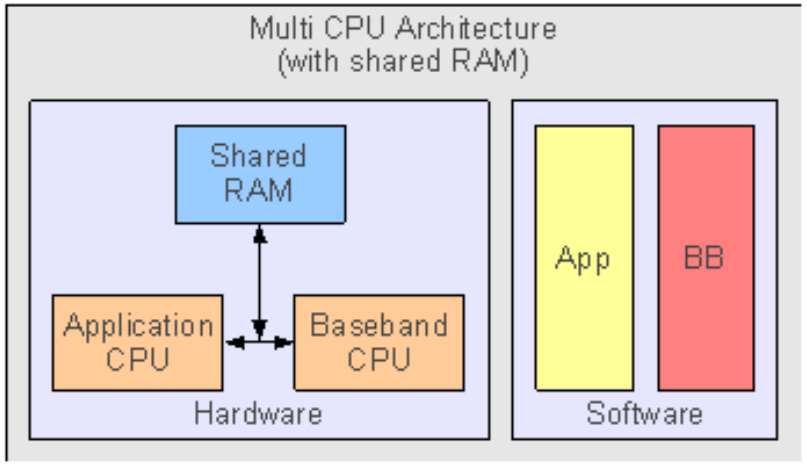
- Securing mobile banking and payment
- Trusted Network Connect
- General attack prevention

Mobile Device Architectures









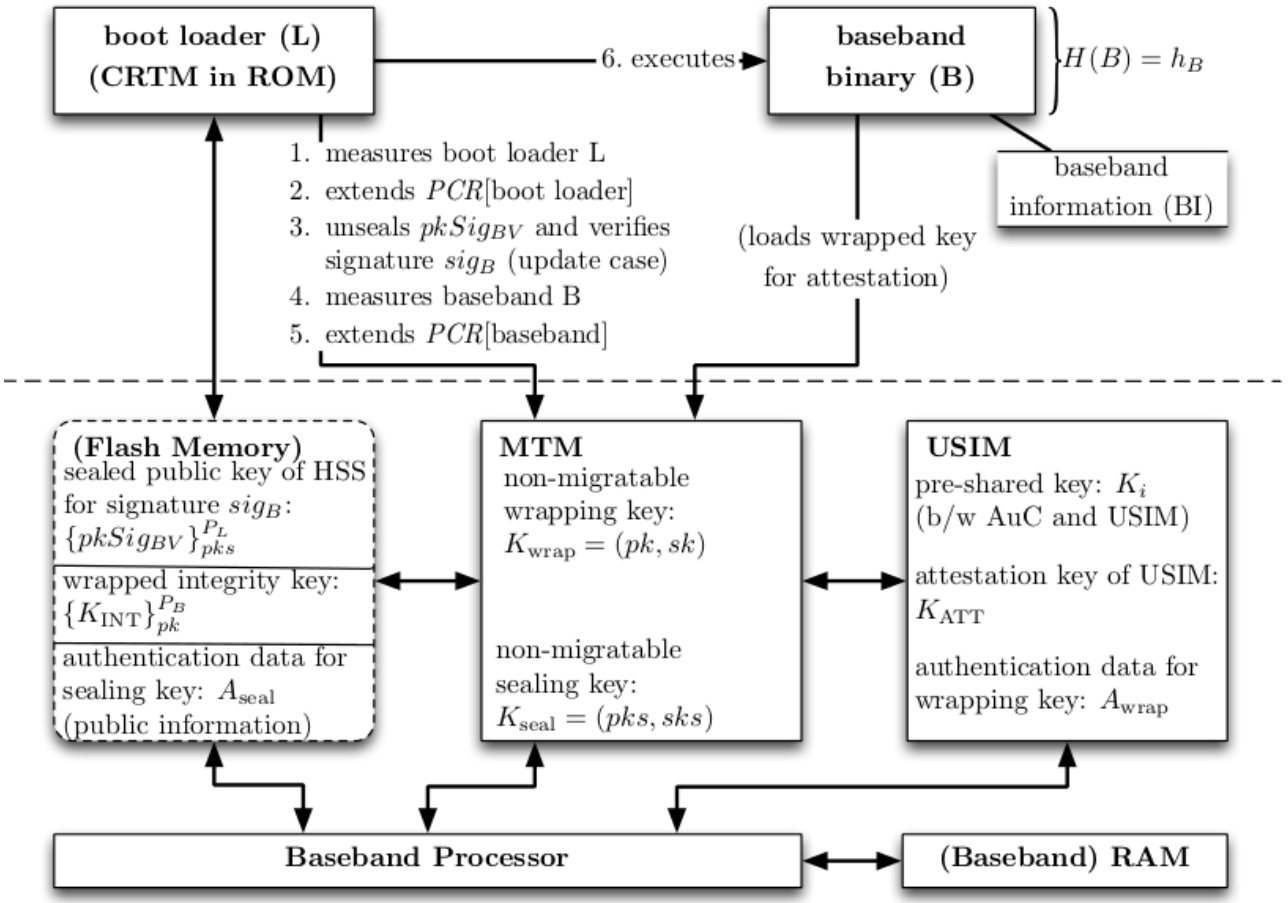
Situation Today

- Baseband
  - No integrity protection
  - Bad code quality → highly vulnerable

- Application
  - On some devices *secure boot* based on Core Root of Trust for Measurement (CRTM) using manufacturer controlled ROM
  - Application integrity protection at *install time*
  - Typically no *runtime* protection
  - Sometimes isolated parts using a Trusted Execution Environment (TEE), e.g., running in ARM's TrustZone

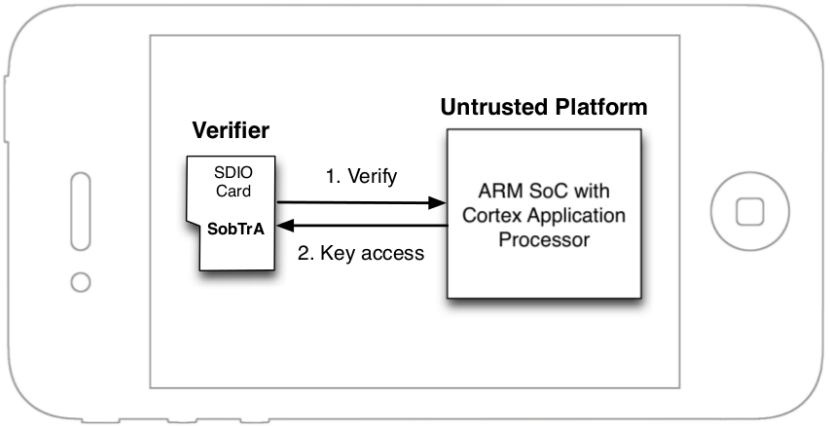
Attestation of Mobile Baseband Stacks [1]

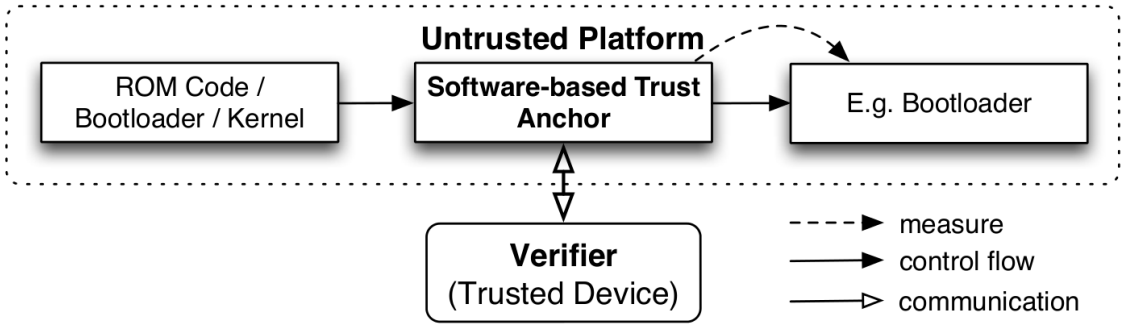
- *MTM*-based attestation
- Attestation of *baseband* at *network connect*
- No network access if attestation fails
- Requires *modifications* of *infrastructure elements* (MME)



SobTrA: A Software-based Trust Anchor for ARM Cortex Application Processors [2]

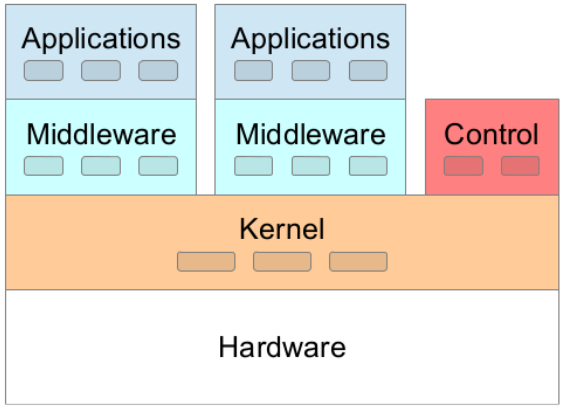
- Secure boot without hardware-based trust anchor in ROM
- Locally connected *verifier device*, .e.g., microSD card using SPI or SDIO
- Implementation based on *self-checksumming code*

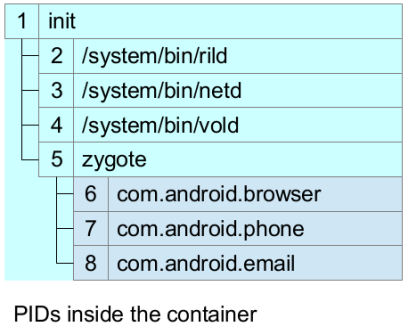




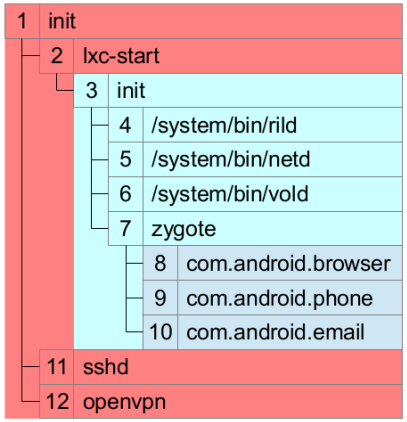
Improving Mobile Device Security with Operating System-level Virtualization [3]

- Multiple Android userland instances on one device
- Isolation based on Linux *namespaces* and *cgroups*
- Integrity protection based on *Linux Security Modules (LSM)*

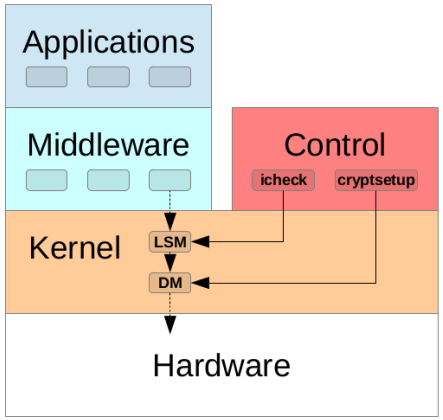




PIDs inside the container



PIDs outside the container

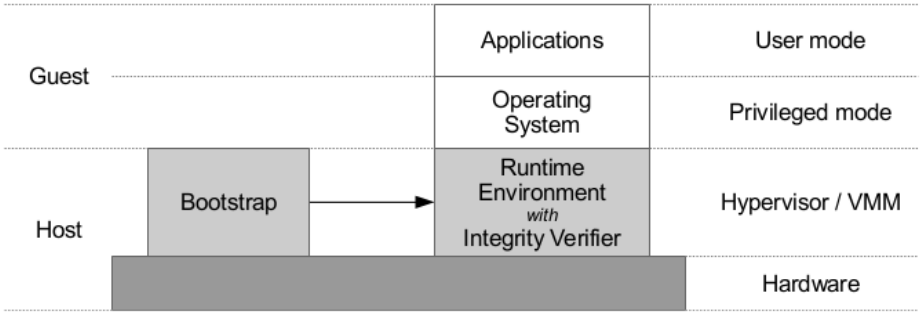


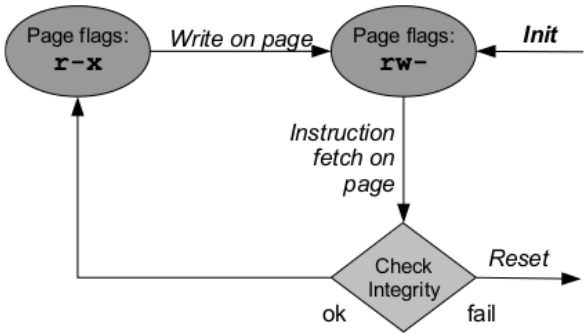
LSM Linux Security Module for system call hooks

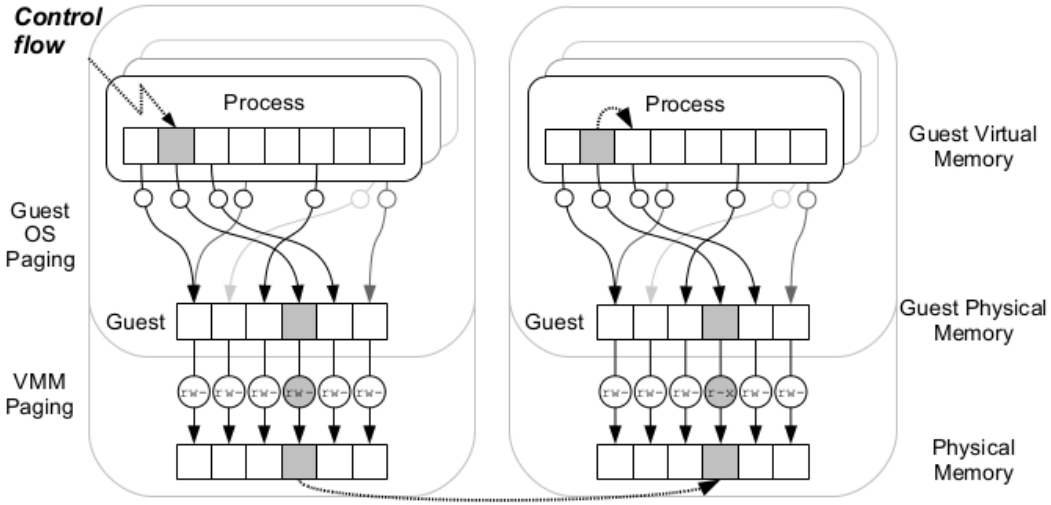
DM Device Mapper for device encryption

Page-based Runtime Integrity Protection of User and Kernel Code [4]

- Implemented in *Virtual Machine Monitor (VMM)*
- Protection based on *memory mappings* for guest operating system (executable xor writable)







Conclusion

- Integrity protection for mobile devices has several aspects
  - Our focus was on *secure boot* and *runtime protection*
  - Most of the presented mechanisms work *independently* without network connection on a device (using local whitelists)
  - These mechanisms are the base for *remote* verification or attestation, e.g., Trusted Network Connect (TNC)
  - Potential sensor for information sharing
- We implemented several *prototypes*

Thank you for your Attention

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References

- [1] Steffen Wagner, Sascha Wessel and Frederic Stumpf, Attestation of Mobile Baseband Stacks, 6th International Conference on Network and System Security, 2012.
- [2] Julian Horsch, Sascha Wessel, Frederic Stumpf and Claudia Eckert, SobTrA: A Software-based Trust Anchor for ARM Cortex Application Processors, currently under review.
- [3] Sascha Wessel, Frederic Stumpf, Ilja Herdt and Claudia Eckert, Improving Mobile Device Security with Operating System-level Virtualization, 28th IFIP TC-11 SEC 2013 International Information Security and Privacy Conference, 2013.
- [4] Sascha Wessel and Frederic Stumpf, Page-based Runtime Integrity Protection of User and Kernel Code, 5th European Workshop on System Security, 2012.