Linux Secured Integrity

Verifying Boot Concept for Embedded Systems

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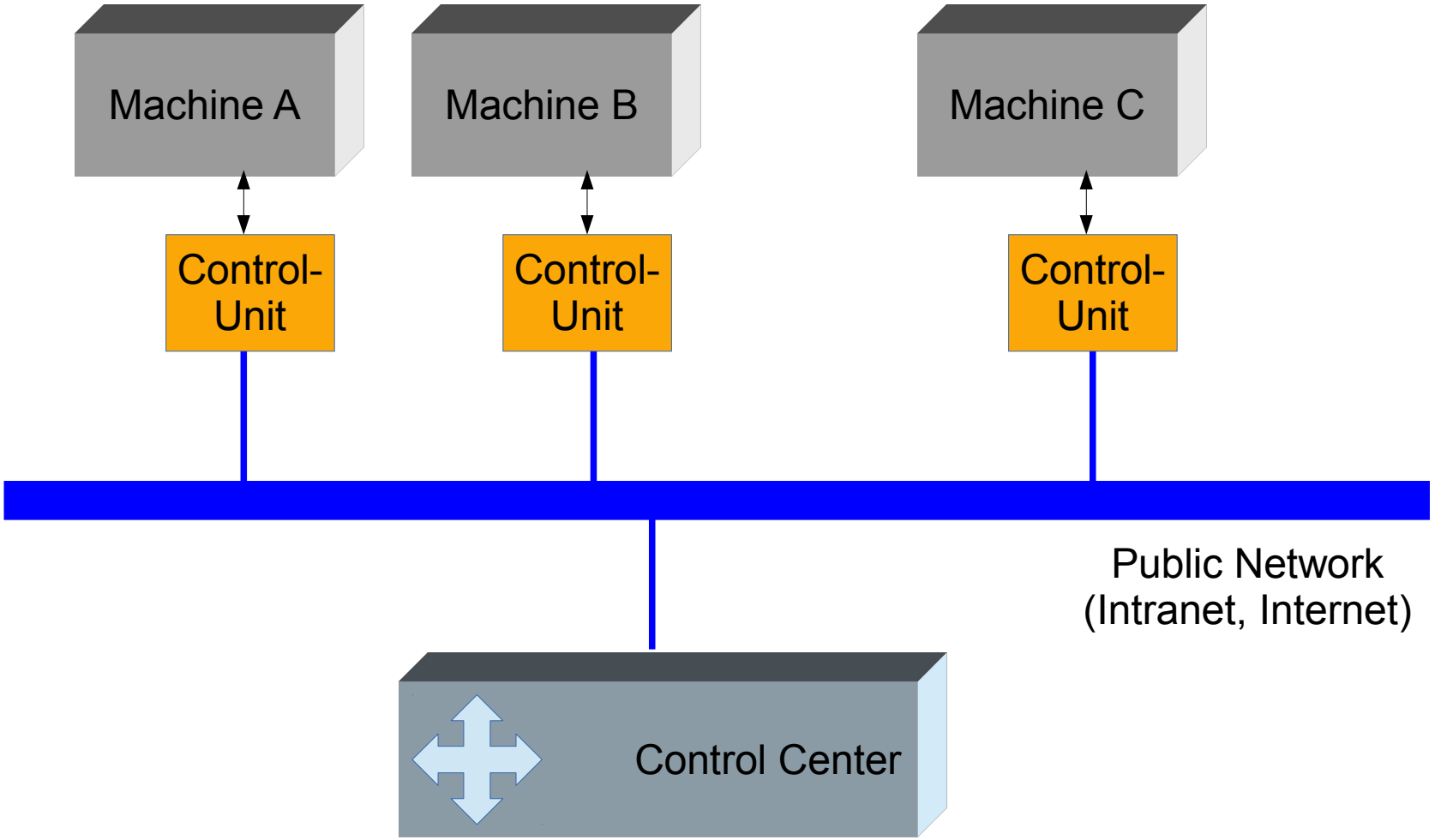
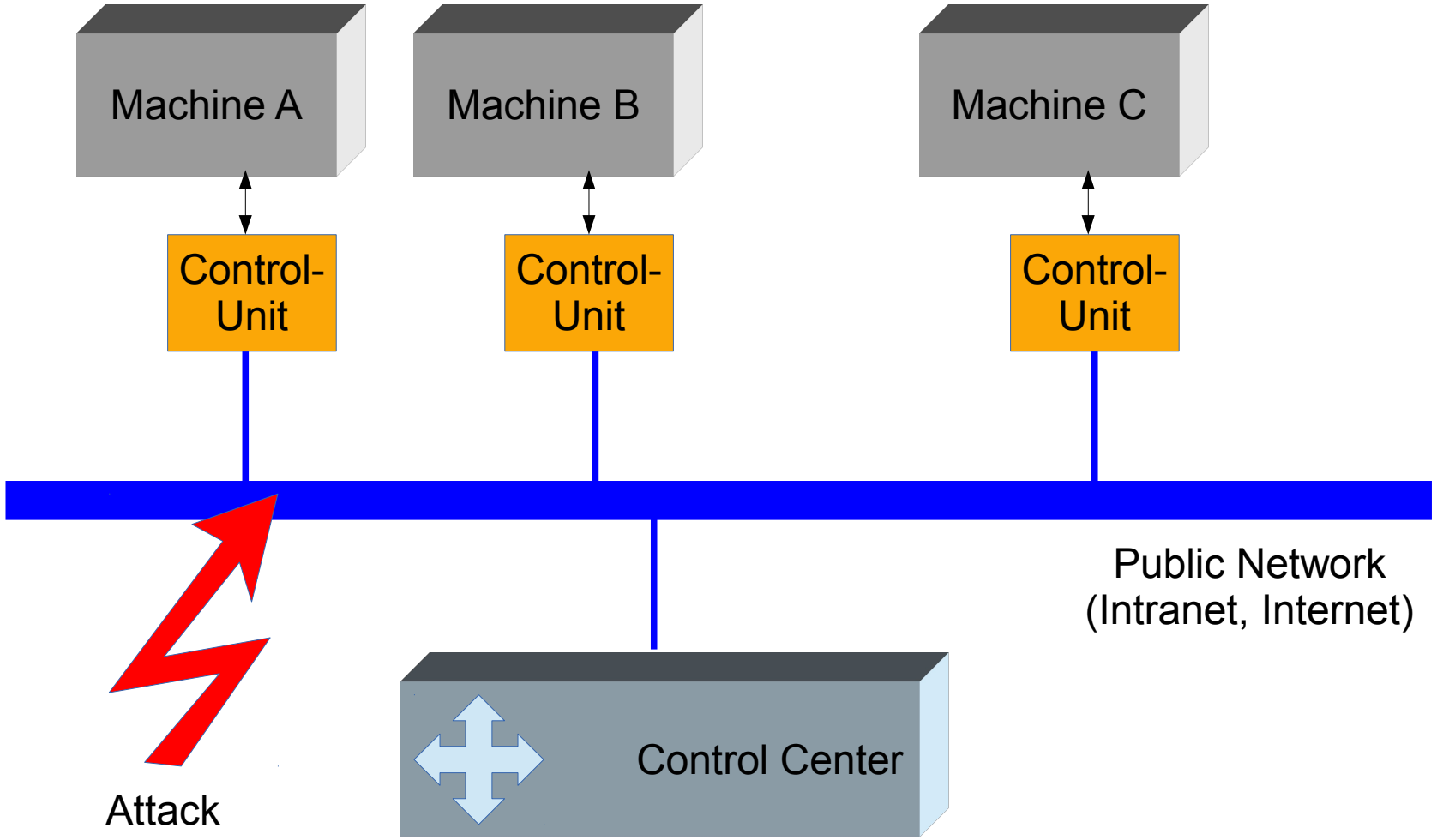
Agenda

- Problem Statement
- „Classic“ Boot Process
- Verifying Boot Concepts
- Status Quo
- Conclusion

Embedded System Environments



Embedded System Environments

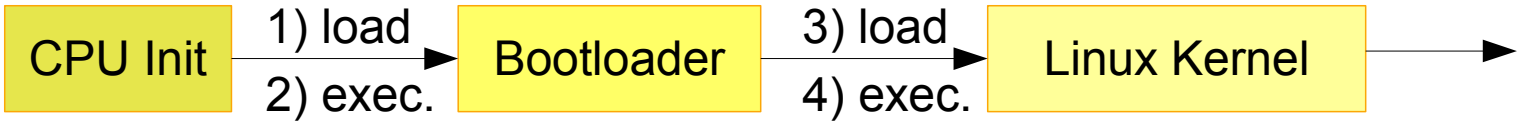


Questions

- Kernel Originator?
  - Security
  - Safety (Warranty)
- Kernel Modification?
  - Detect Violation
  - → Notification, Reaction
- Dedicated Security Hardware?

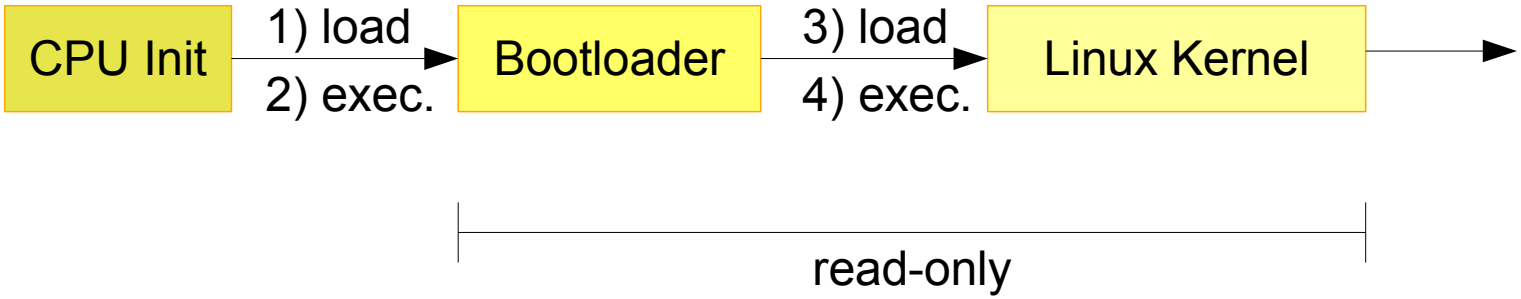
Classic Boot

- CPU Initialization
- Bootloader
- Kernel Image



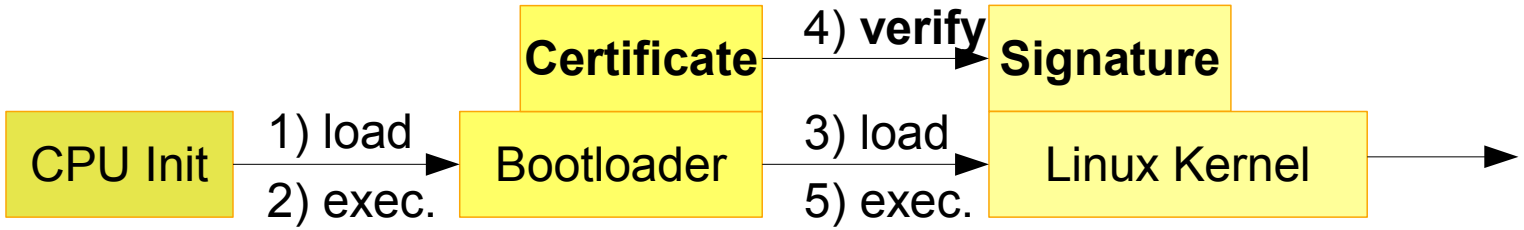
Classic Boot

- CPU Initialization
- Bootloader
- Kernel Image



Verifying Boot

- CPU Initialization
- Bootloader **with Certificate**
- Kernel Images **with Kernel Signature**
- Verify **Kernel Signature** with **Certificate**



Verifying Boot

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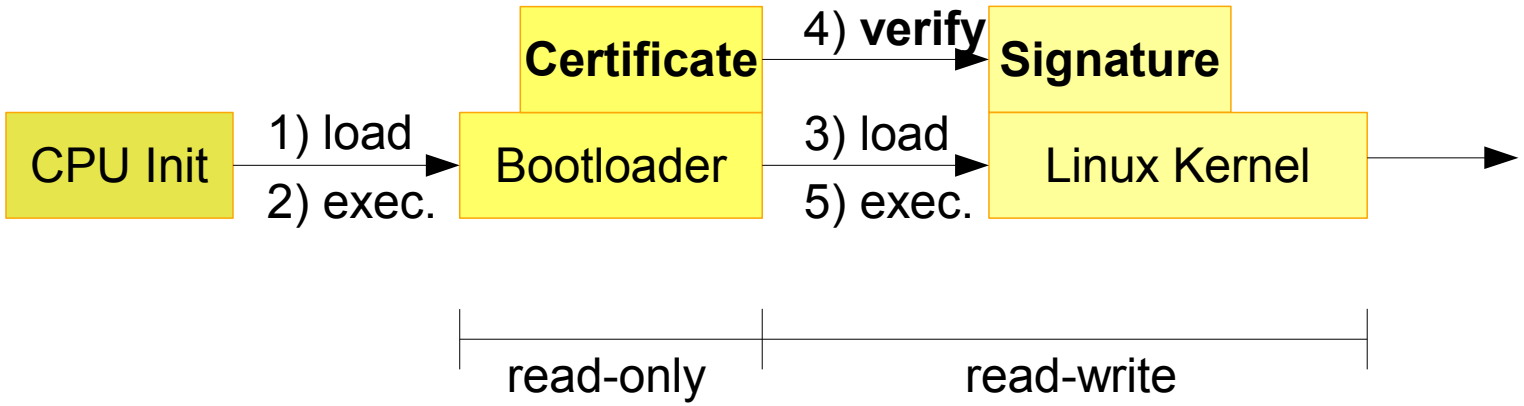
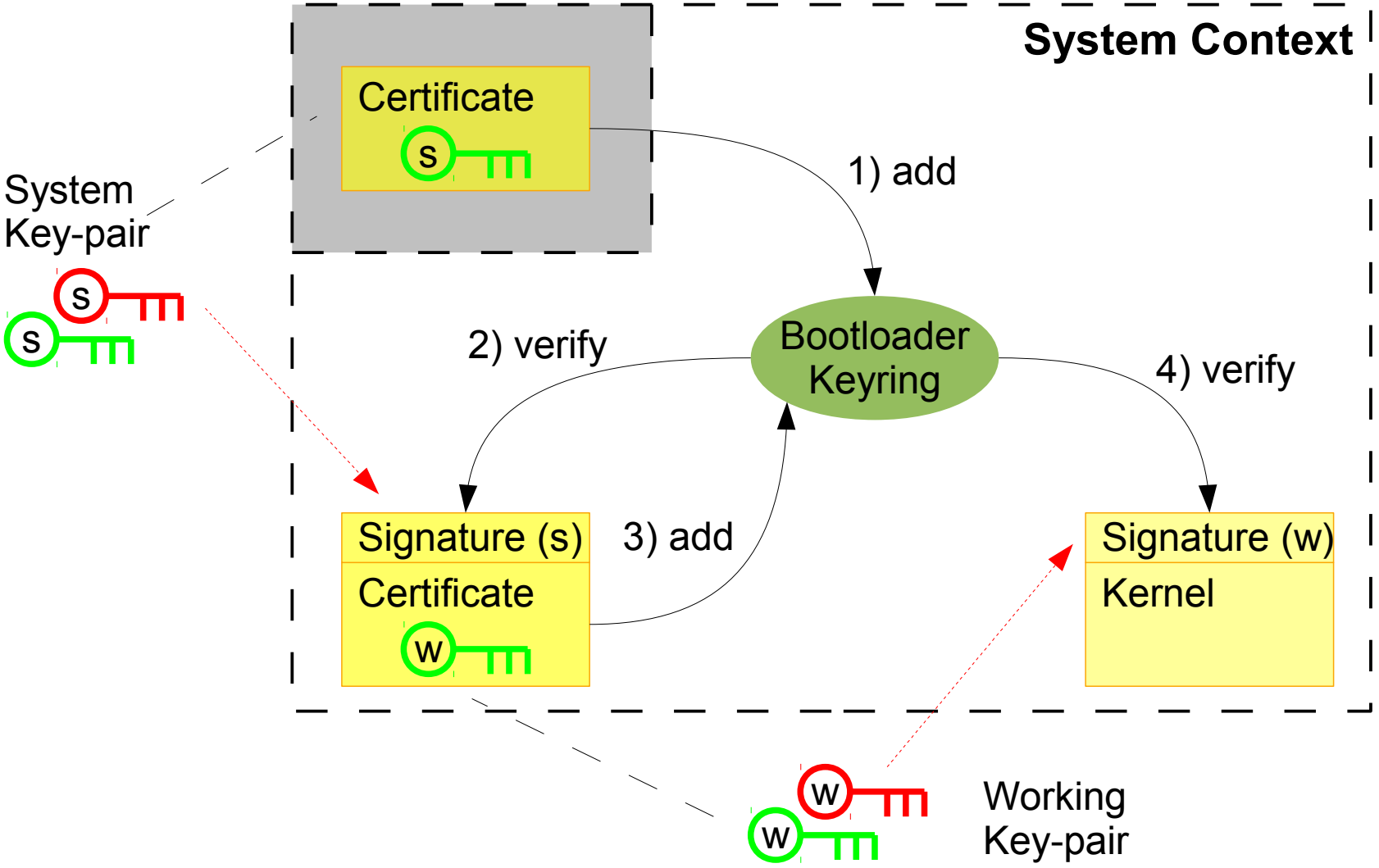


Extended Key Handling



Kernel up & running. And now?

- Signed Modules
  - prevent Low-Level Hacking
- Linux Integrity Subsystem
  - prevent Filesystem Violation
- Linux Security Modules
  - restrict Resource Access

Status Quo

+ Phytec (phyCore, ARM Cortex-A8)
+ U-Boot 2013.07
+ some Changes (minimal DTS support)
+ RSA Key-pair (2048bit Key length)
+ some Configurations & Scripts

= Prototype with Kernel Signature Verification

Status Quo: Features

- Linux Kernel Verification during Boot
- Simple Key-chain
  - Public Key in U-Boot image
  - Signature in Kernel Image
- RSA 2048bit Key length

Status Quo: Sample Configuration

```
/dts-v1/;
/ {
        description = "Phytec Verified Boot";
        #address-cells = <1>;
        images {
                kernel@1 {
                        data = /incbin/("../../out/arch/arm/boot/zImage");
                        type = "kernel";
                        arch = "arm";
                        os = "linux";
                        compression = "none";
                        load =  <0x80508000>;
                        entry = <0x80508000>;
                        kernel-version = <1>;
                        signature@1 {
                                algo = "sha1,rsa2048";
                                key-name-hint = "lx-phy";
                        };
                };
        };
        configurations {
                default = "conf@1";
                conf@1 {
                        kernel = "kernel@1";
                };
        };
};
```

Conclusion

- No Dedicated Security Hardware required
  (Protection against Remote Attacks only)
- Adaptable
- Extensible
- Completely Reviewable
- No Secrets on System
- It's already there. Use it!

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Questions?

Thanks for your attention!

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