LinuxCon

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Secure IoT Gateway

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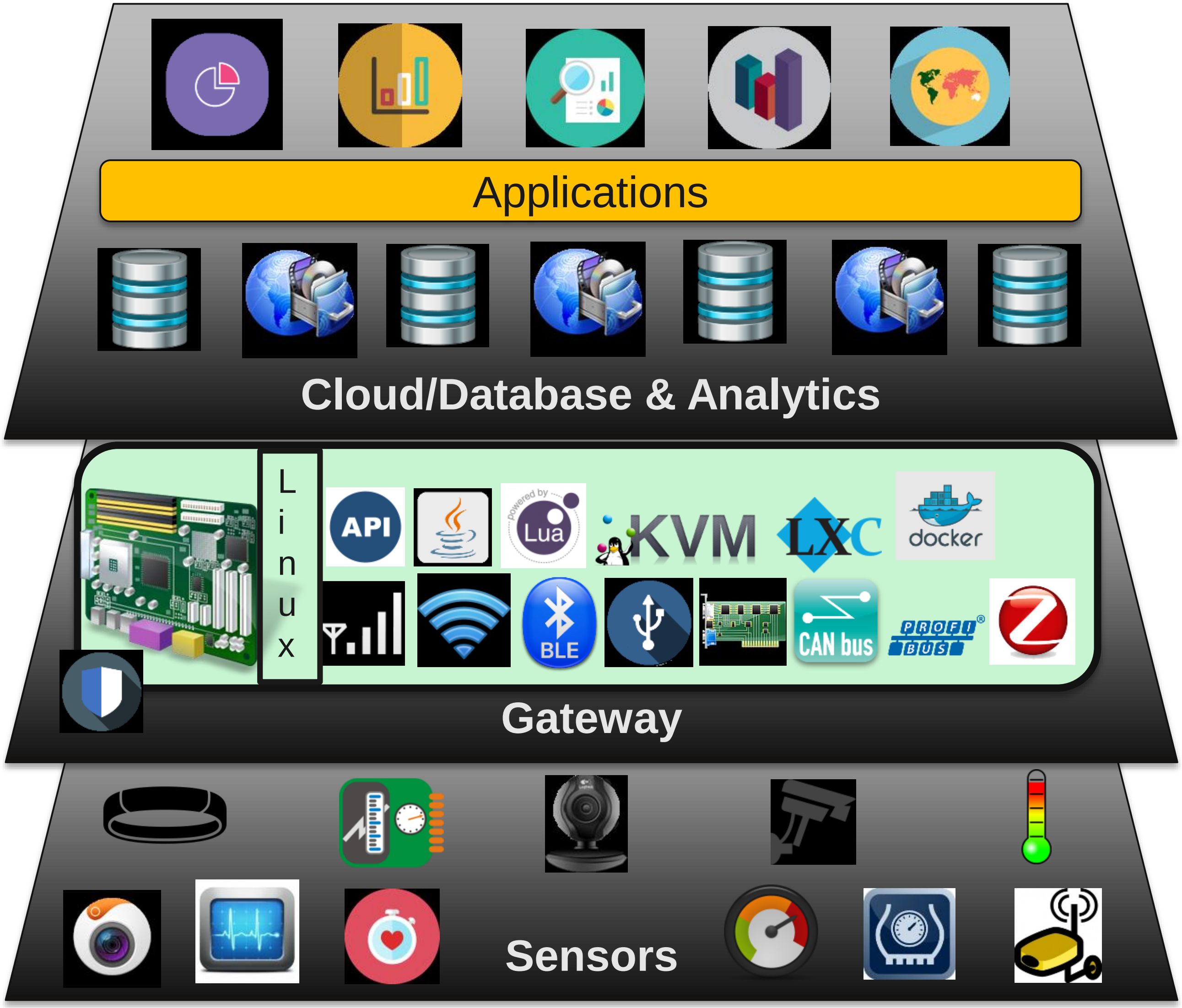
Setting the Stage

- This presentation will focus on developing Secure Gateways (Edge Computing & Connectivity) in the IoT Architecutre

- Primarily discussion will be on Architecture, Security, and Maintainence features



Agenda!

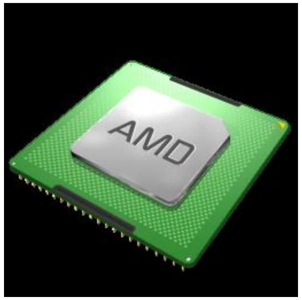
1. Architecture
2. Connectivity
3. Security
4. Maintainability
5. Summary and Q&A

Architecture:
Modern vs Wild West

Architecture choices

Embedded processor considerations:

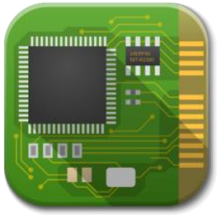
- Processor family
  - ARM
  - Intel x86
  - PowerPC and MIPS possible but not as popular
- Power consumption
  - ARM: low power, advanced PM features
  - Intel x86: limited PM options



Architecture choices (ctd)

Embedded processor considerations:

- Performance
  - ARM: Good core performance on lower Ghz
  - Intel x86: ”Add Ghz -> more perf”
- Optimizations
  - Security offload
  - Virtualization
- Deployment model
  - SOC model vs. ”generic compute”
  - Longevity?

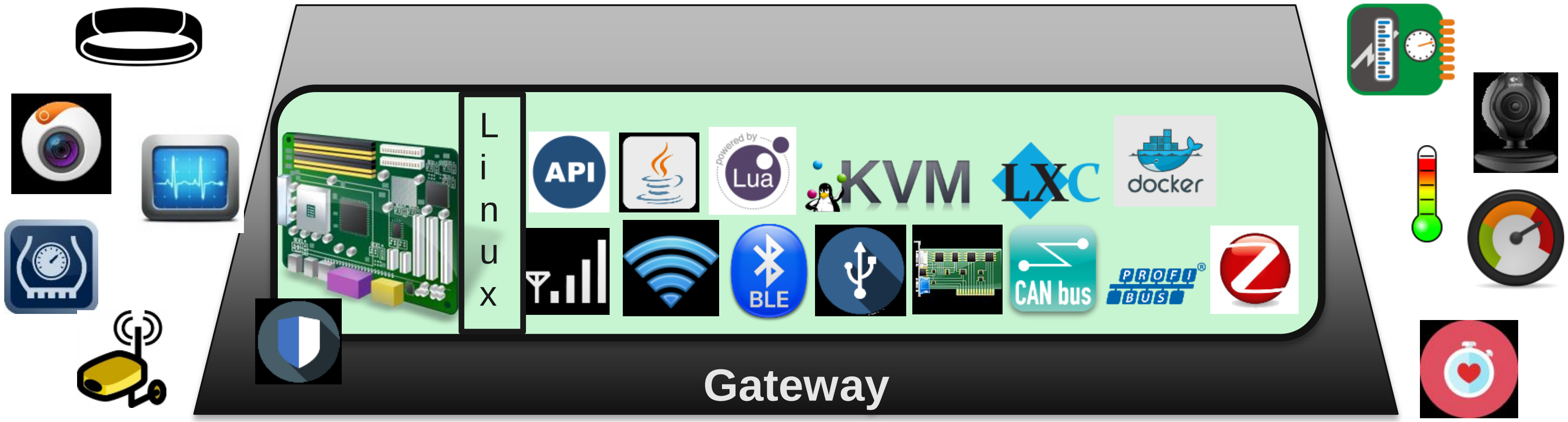


Ecosystem

- Intel vs. ARM really
  - PPC and MIPS thin and fading ecosystem
  - Ubuntu, Fedora, Debian, OpenSUSE, MontaVista, WindRiver, and Enea all have/will have x86 and ARM support for mainstream distros
  - LINARO (ARM lead)
- Yocto project (Intel lead)
  - Consolidate embedded development on OE/bitbake

Connectivity

Sensors, Sensors everywhere!



- Simple sensor data drives the IoT engine
  - Fitness trackers, heart monitors, oil and pressure temperature gauges, & packet latency in SDN

- What connects them
  - Wireless: Bluetooth, Wi-fi, Cellular Modem, (3G/4G/5G), Zigbee, & 6loPAN
  - The bus lineup: Canbus, Profibus, & Modbus
  - Serial, SPI, I2C
  - Near Field Communication (NFC)
  - Prioprietary

- Implications
  - Selected architecture must support (directly or USB/PCI) ALL
  - Drivers as well...possible port from different architecture
  - Enough performance
  - Maintain versions
  - Brace for the new

To the Cloud

- Data from sensors is the lifeblood of IoT
  - Connects to cloud or database
  - Gateways can filter/preprocess data
  - Push must be secure (encrypted and authenticated)
  - Connectivity is bi-redirectional so IoT Gateway must be secure from the cloud
- IoTivity
  - Community framework to connect end devices
- Alljoyn Open Source Framework
  - Connect and communicate across transports/OSes

Security

ON-LIFE
Accept
PHYSICS
COMMUNICATION
INTERNET
SOCIAL MEDIA
SEO
TV
ON-LINE
ON-LIFE
PHYSICS
Accept

Recent Real-World Examples

- DHS confirms Public Sector Control system hacked
  - Attacking inadequate perimeter security, an attacker could compromise the SCADA system with capability to inject commands and read data at will
  - The controlled device was brought down for maintenance so no damage done
- Boeing and Airbus
  - Hacker used in-flight Wi-Fi connection to hack into flight control systems
  - Allegedly controlled thrust for engines, oxygen mask deployment, etc.
- Drones
  - Johns Hopkins University research demonstrated 3 different ways to send unwanted commands
  - Could force drones to land or just **crash**
- Personal vehicles
  - Jeep hacked through navigation and Corvette hacked by SMS
  - Activate wipers, apply brakes, **disable engine & brakes**

Design Considerations

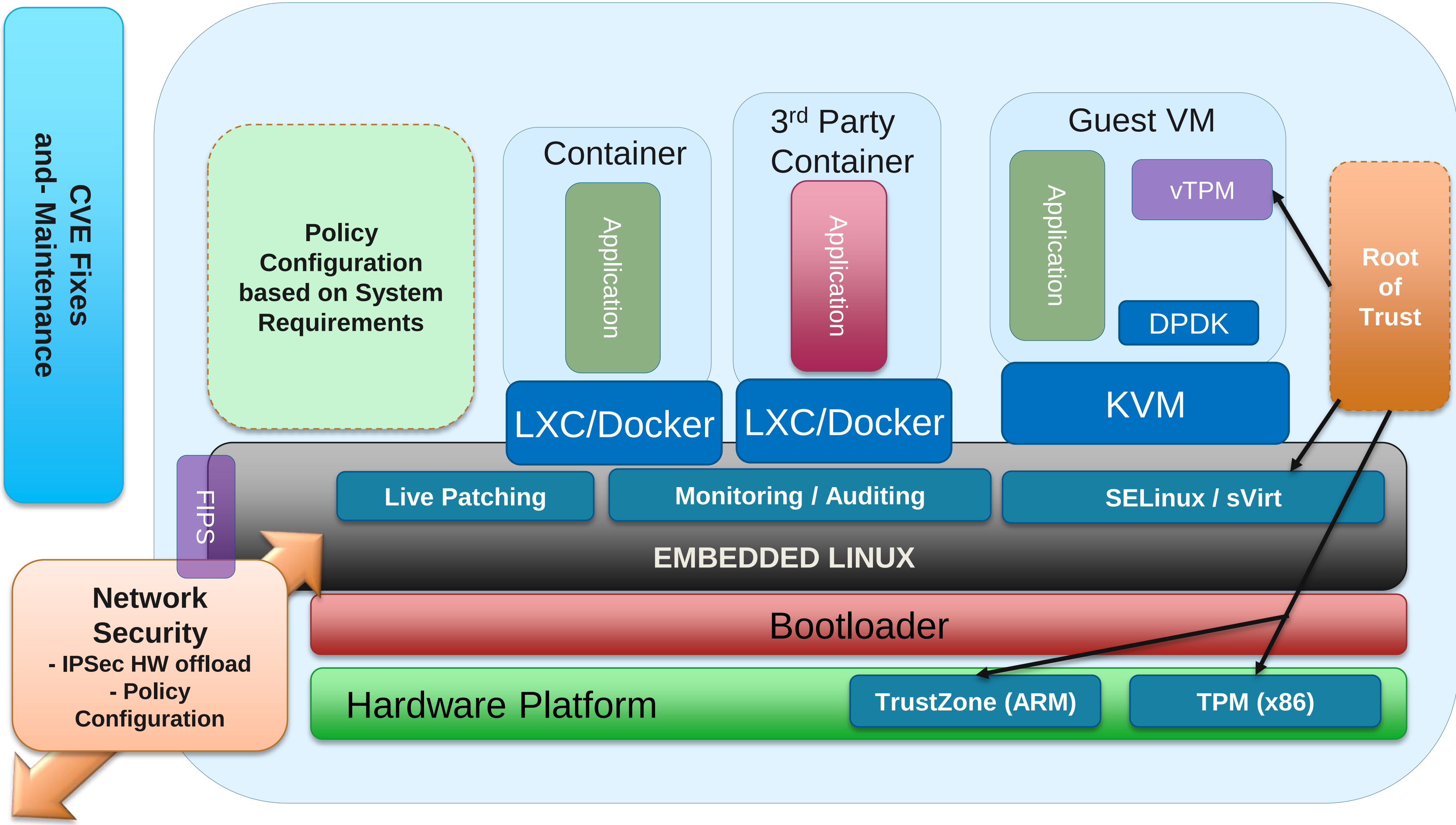
Architectural

- Lifecycle: secure firmware updates and CVEs
  - The Edge is relying on the IT-supported backend to handle the updates, requires careful consideration for the technology and process
- Provide monitoring for end-to-end data on the Gateway
  - Using DPI for heuristics-based detection of exploits
- Combining types of security: physical, networking, system integrity and isolation of domains

Functional

- Building security primarily in the Gateway?
  - Edge devices are constrained on hardened channel
  - Requires encryption for the channel and two-way authentication for setup
- Trusted edge vs. Edge Computing - two polars?
  - Moving computing to the edge can help build end-to-end efficiency, but requires edge and gateway devices to handle the security
  - Can also be seen as a way to fence out security threats for some layers of the processing so they cannot be exploited from the Cloud

IoT Platform Virtualization & Security



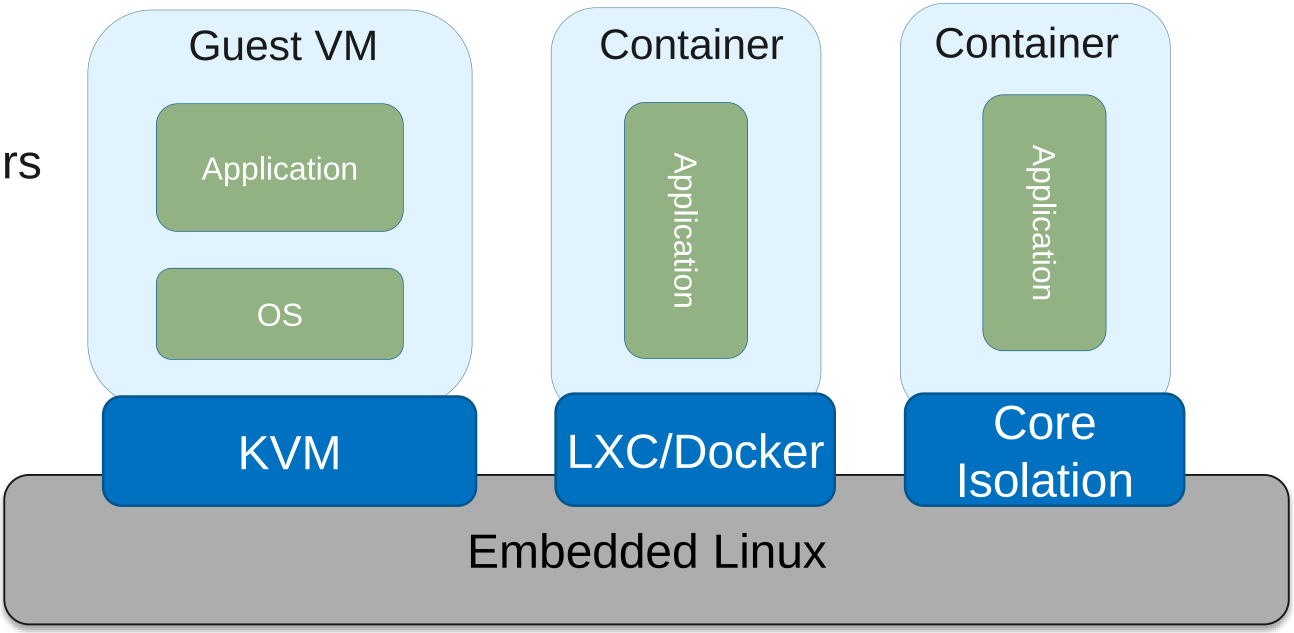
Types of Security Measures

- Reactive Measures
  - Common Vulnerabilities and Exposures (CVEs)
    - https://cve.mitre.org/
    - The standard list for holes in common systems
    - Very important to cover the affected parts in your product; MontaVista will do this for you
  - Intrusion-detection systems
    - Take action based on perceived attack
    - Several systems exist for Linux (LIDS, auditd, inotify, tripwire..)
  - Auditing and logging
    - Knowing you've been attacked prevents further damage
    - Collect evidence for litigation against the attacker
    - Example tools: Auditd, syslog, inotify, SELinux..

- Proactive Measures
  - Mandatory Access Control (MAC)
    - Minimizes the damage that unknown exploits can do to your system
    - Increases the chances to block 0-day exploits (unknown vulnerabilities)
  - System Certification
    - Provide Common Criteria or similar certification for your product or platform
    - MontaVista's Linux is certifiable and we can help with the process
  - Root of Trust

Virtualization Technology for Isolation

- Full featured and lightweight virtualization solutions
  - **KVM**
    Full virtualization
  - **Docker**
    Application containers
  - **LXC**
    Full-system Containers
  - **Core Isolation**
    Dataplane and RT applications



- Make Security a Priority
- Implement Mixture
  - Reactive
  - Proactive
- Stay Current

Maintenance

IoT Maintainability Requirements

- Product life cycle support
- Ability to upgrade application, kernel, drivers, userland, or whole system
- Upgrades done with little to no “human” interaction and downtime
  - Wireless delivery
- Secure updates
  - Authentication
  - Encryption

Always On

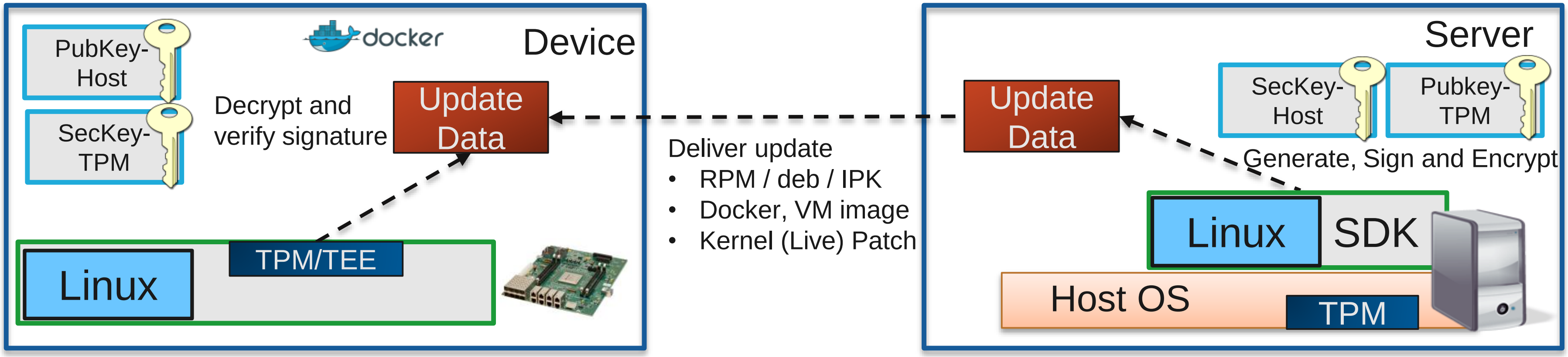
Always Connected

Addressing IoT Maintenance with Linux

- Long Term Support (LTS) Kernel
  - Can be extended beyond 10+ years in commercial Linux distributions
- SMART package manager
  - Allows for source or binary distribution
  - Flexible to update userland, application, etc.
- Live kernel patching
- Crypto API support
- Trusted Platform Module (TPM) and TrustZone for secure OTA updates

IoT: Signed OTA Updates

- IoT devices and Gateways have embedded requirements for small footprint but still a very high demand for security
- The process relies on the Kernel Live Patches, RPMs, or Container images being hashed and signed by a certificate that can be validated by the TPM or TEE on the target system if necessary
  - Can also support two-way signatures by using standard RPM signing using GPG keys, potentially enforced by the server-side TPM.
- Such processes are adopted by OSVs like Symantec, Redbend and practically all product manufacturers that are concerned about running trusted/secure SW on the devices.
- Without secure updates, the integrity of the platform cannot be maintained.



Summary

- Embedded Linux offers solid software platform to IoT Gateway developers
  - Architecture
  - Connectivity
- Security is IMPORTANT to implement
- High uptime maintainability

Thank You

Questions/Discussion

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