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OSS Remote Firmware Updates for IoT-like Projects

Silvano Cirujano Cuesta

Siemens Corporate Technology

About me

- Software Engineer at Siemens Corporate Technology
- Embedded Linux Corporate Competence Center
  - OSS contributors
  - Part of the OSS community (4 speakers in this event)
- Interested in enabling embedded devices to ride the „container“-wave

Agenda

- Why updating?
- Architecture
- Components
- Firmware updates
- Conclusion

State of Update Affairs in Industrial Domains

- Devices are either
  - disconnected or
  - in isolated networks
- On-site updates
- Very long life
- Difficult to reach
- Infrequent updates

… but the Internet of Things is coming

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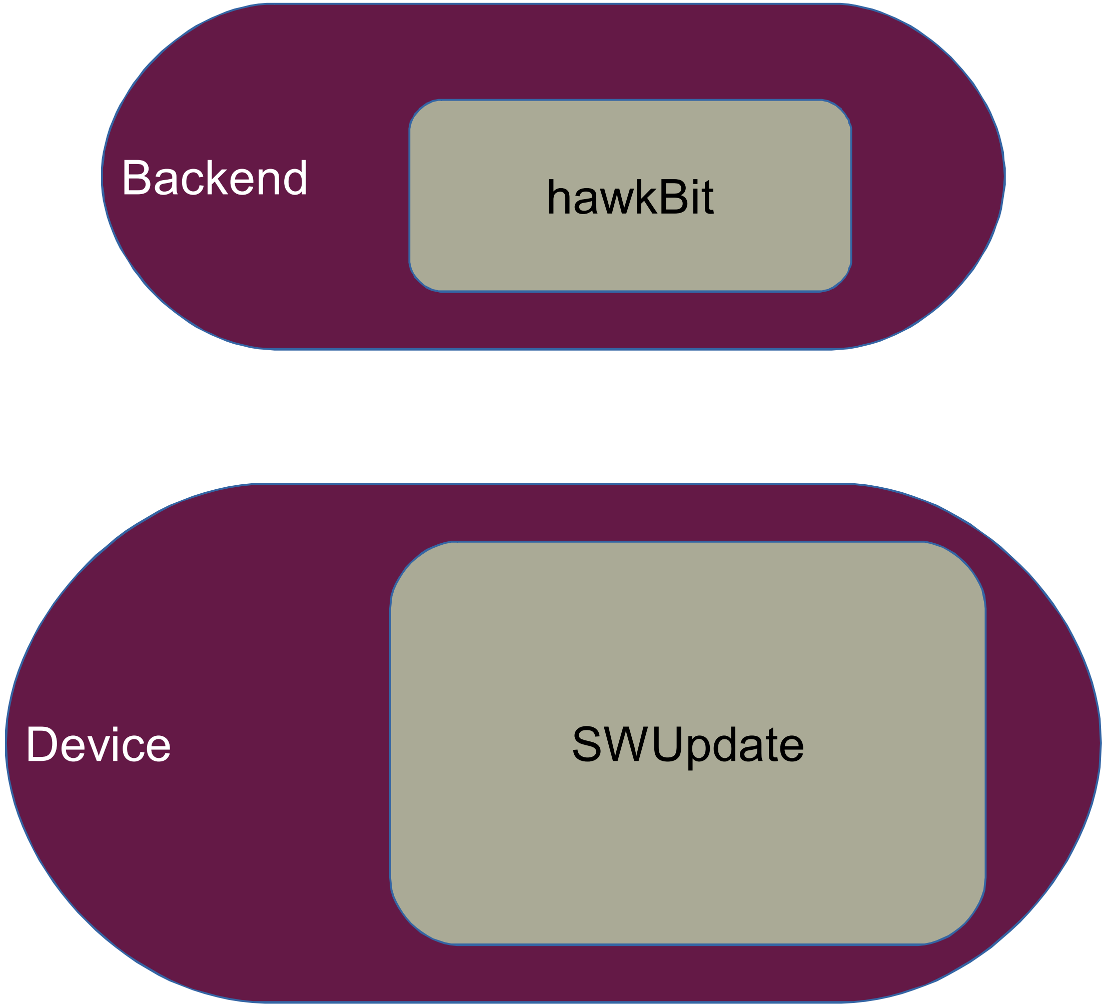
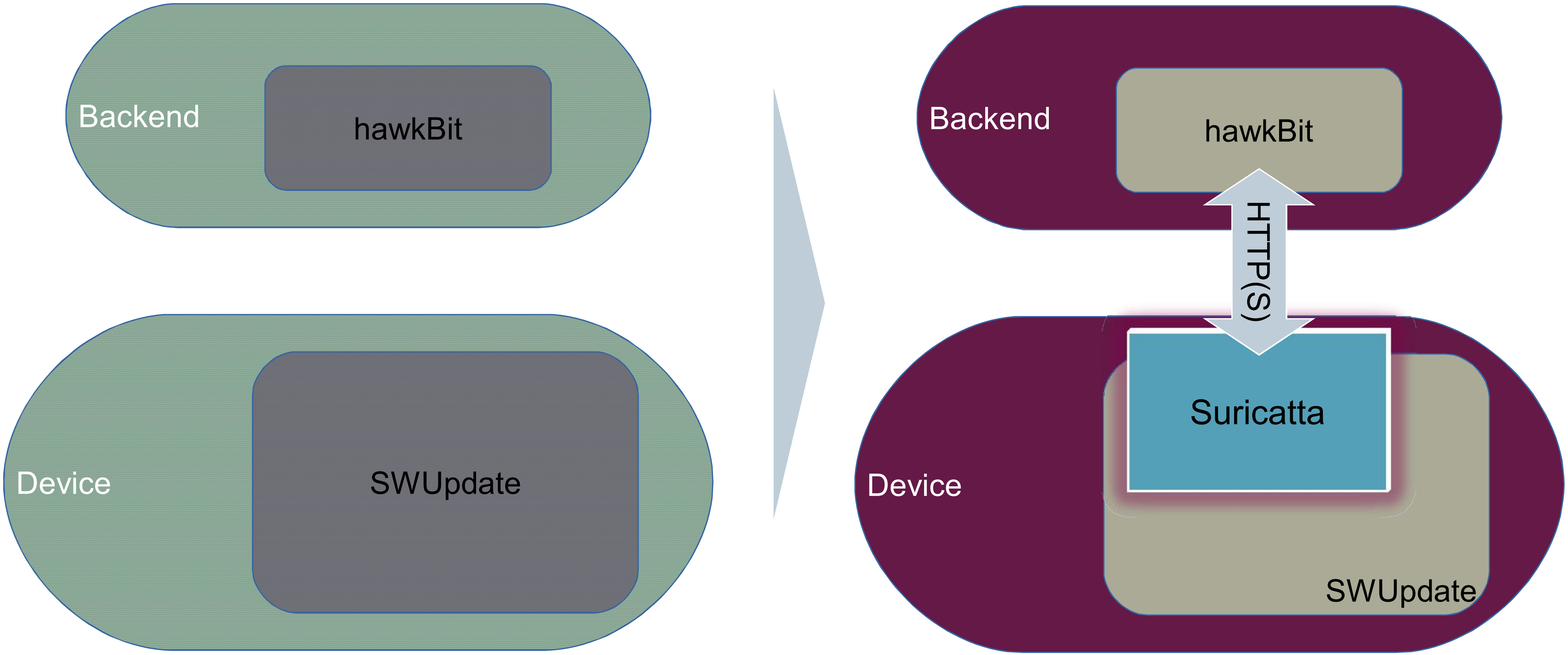
- Trend: More and more devices getting connected (including industrial products)
- Number of devices to manage explodes ⇒ remote management required
- Attack surface increases due network exposure ⇒ updates frequency will increase due to security issues
- There’s always a bug to fix
- Additional expectations due to technology exposure:
  - Easy features addition
  - Easy bugfixing

10000 Feet Architecture

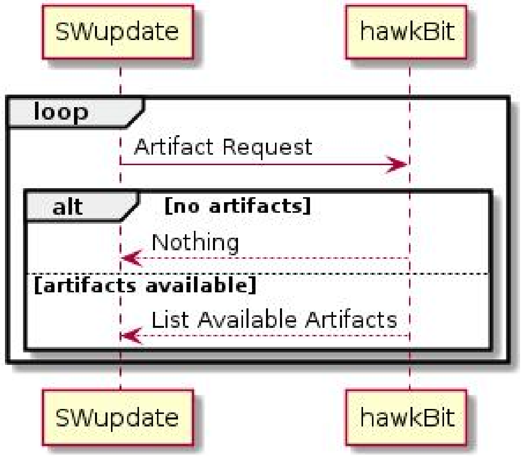


10000 Feet Architecture



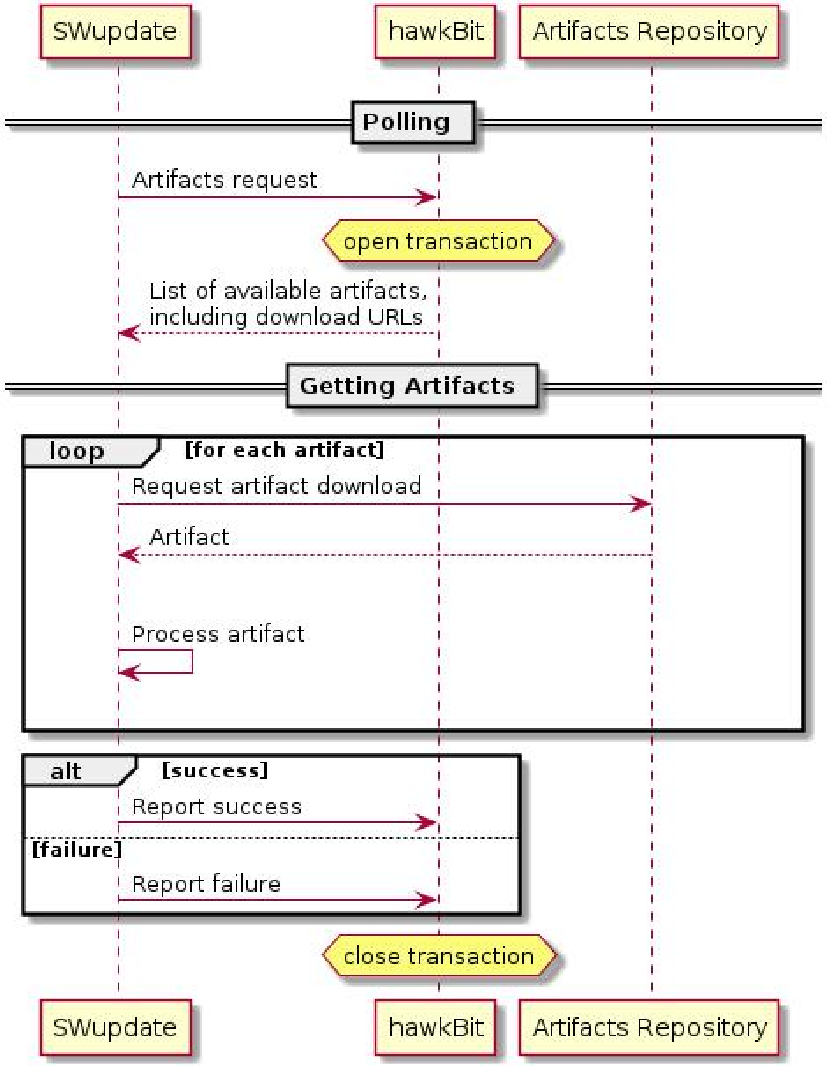
Workflow

1. Devices poll requesting artifacts (firmware updates)
2. Backend can reply
   - either no updates available
   - or list of updates with download URLs



Workflow

1. Devices poll requesting artifacts (firmware updates)
2. Backend can reply
   - either no updates available
   - or list of updates with download URLs
3. Device downloads updates
4. Device processes updates
5. Device report success/failure



SWUpdate

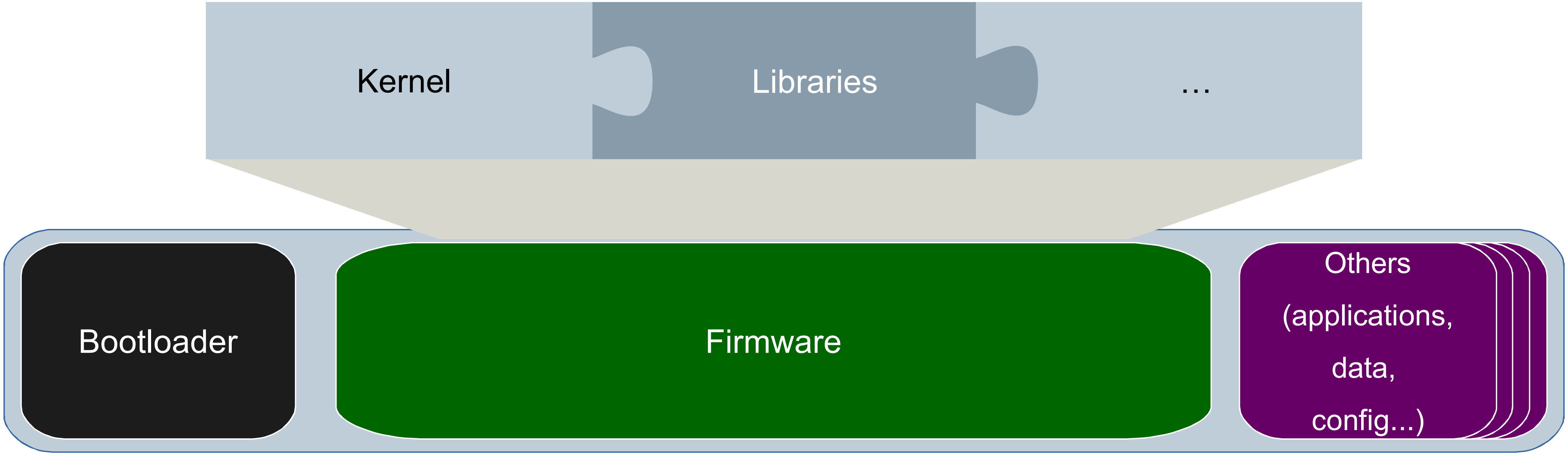
- Neither convincing OSS nor commercial alternatives back then
- Make vs. “buy” OSS decision
- Developed and open-sourced by a well-established player in the OSS arena DENX with experience in industrial domains
- Convincing feature set
  - ➢ Full power of Linux userspace for updates
  - ➢ Extensible
  - ➢ Good integration with U-Boot, support for others possible
  - ➢ …
- Battle-proof software
- … ⇒ Easy decision for “buy”

hawkBit

- Neither convincing OSS nor commercial alternatives back then
- Make vs. “buy” OSS decision
- Originally developed by Bosch and released as OSS under the umbrella of the IoT working group of the Eclipse Foundation
- Bosch as Siemens in industrial domains
- Shifting from device-managed provisioning to remote-managed provisioning
- Convincing present and future feature set:
  - Easy integration via REST-APIs
  - Direct or indirect devices connection
  - External artifacts repository
  - Reporting and monitoring
- Young project working on stabilization and new features
- … ⇒ Decision for “buy”

Firmware definition

- Linux base system that makes system runnable

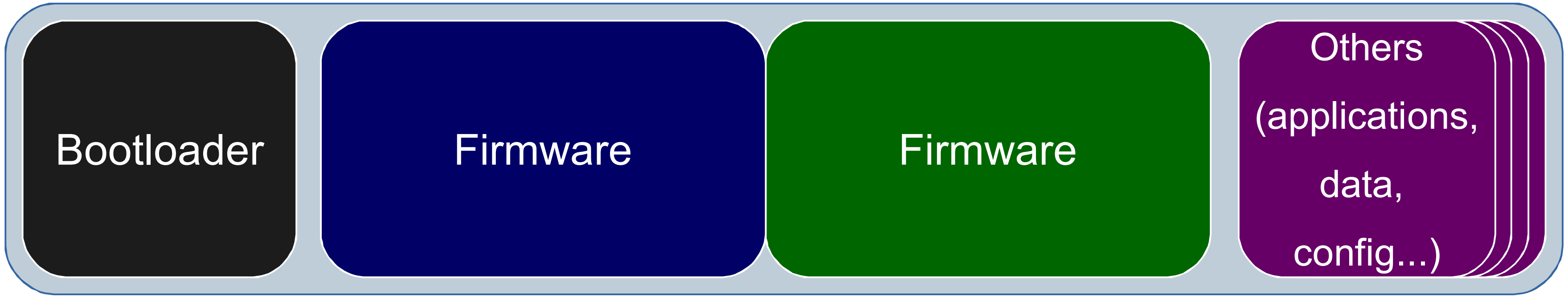


Supported update strategies

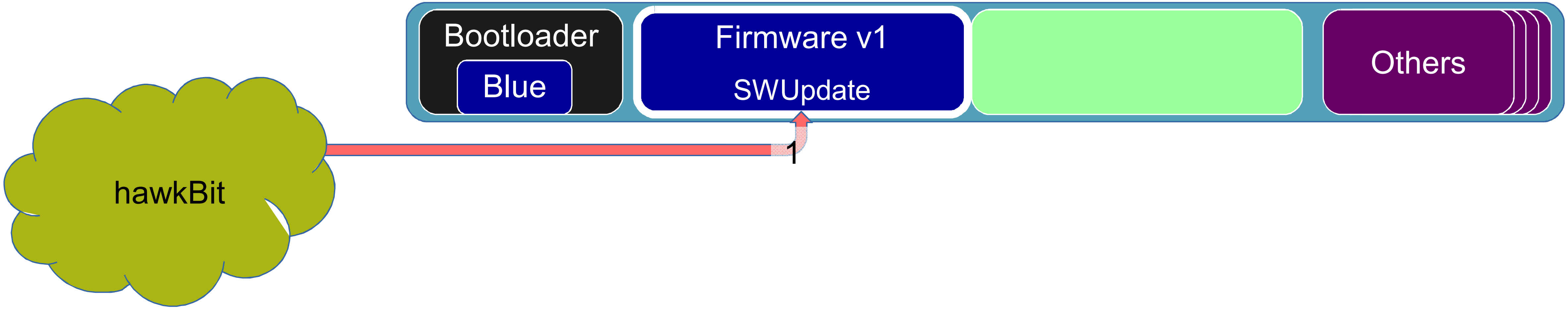
- Trade-off between time and space
- Two extremes in IoT domain:
  - With two firmware partitions (best for time, worst for space)
  - With one firmware partition (best for space, worst for time)
- Hybrid solutions possible by reducing firmware storage footprint
- Minimalistic firmware images reduce the differences between both with regard to space

Two Firmware Partitions

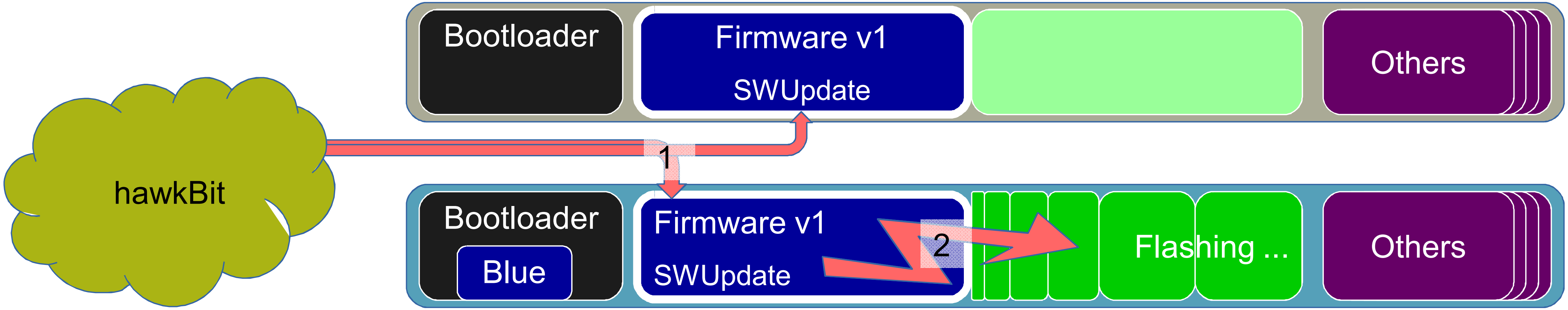
- No device bricking and rollback possibility (only 1 version back)
- Double firmware storage footprint
- Minimal downtime (usually only reboot)
- Update cancellation in case erroneous/manipulated images, keeping working version



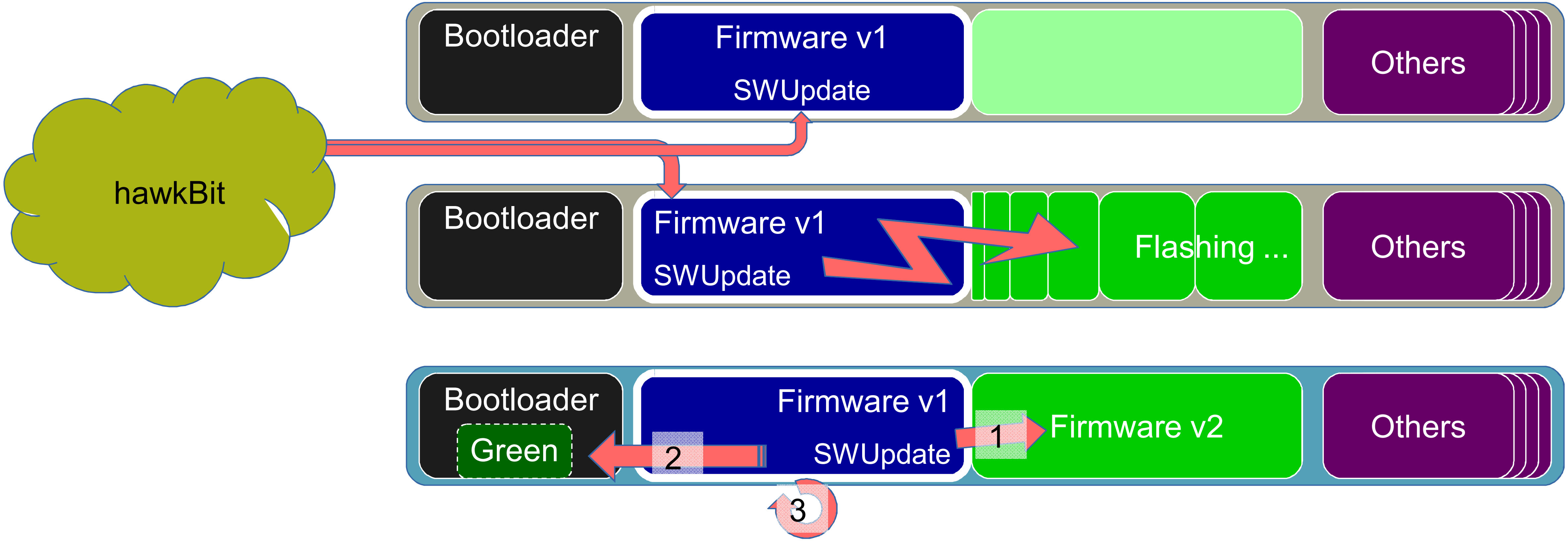
Two Firmware Partitions: Start



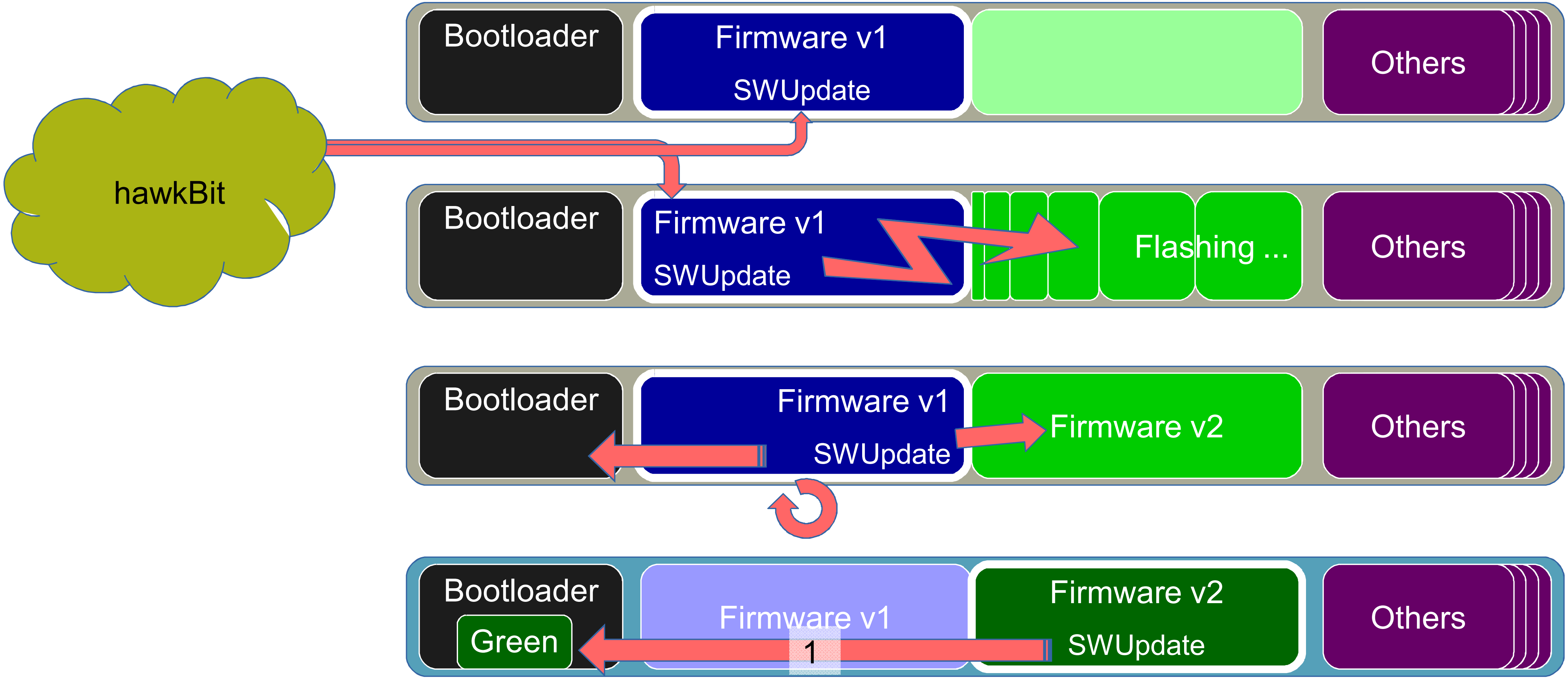
Two Firmware Partitions: Download and Flashing



Two Firmware Partitions: Checks and Activation

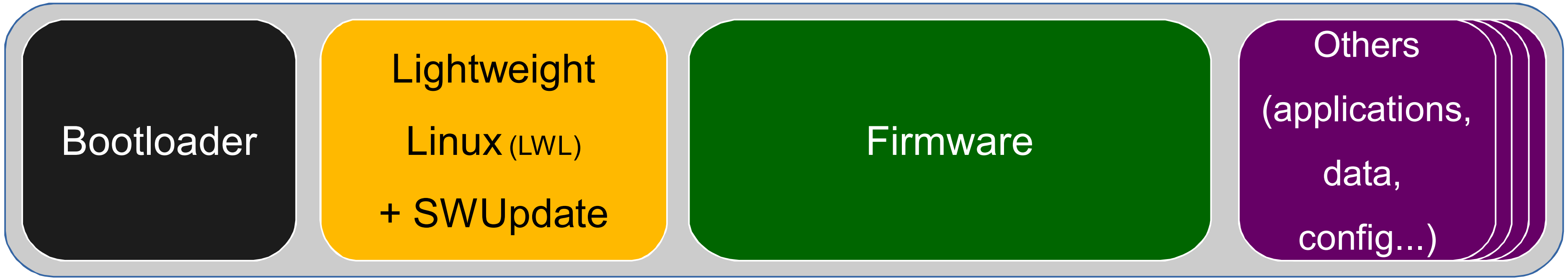


Two Firmware Partitions: End

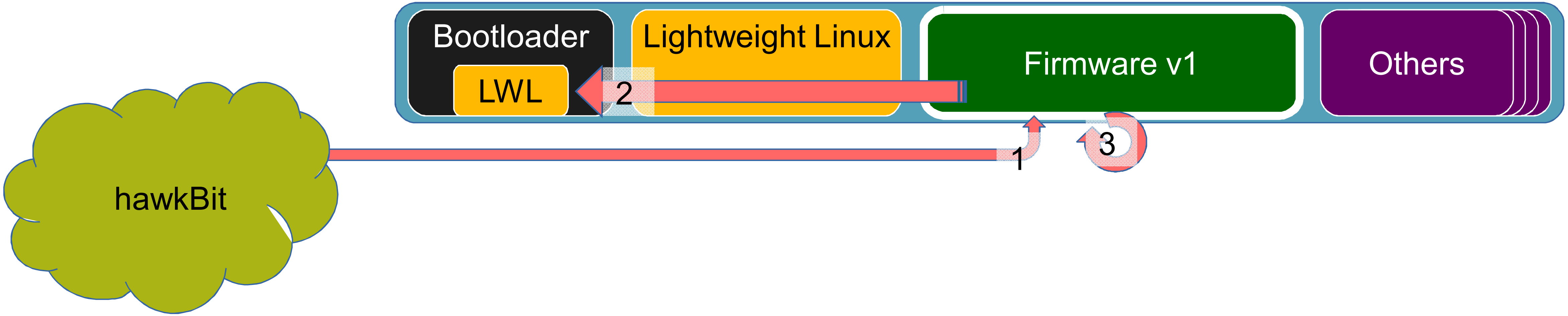


One Firmware Partition

- No device bricking
- Single firmware storage footprint
- Relatively long downtime
- Only rescue from erroneous/manipulated images is recovery mode


Bootloader
Lightweight Linux (LWL) + SWUpdate
Firmware
Others (applications, data, config...)

One Firmware Partition: Start



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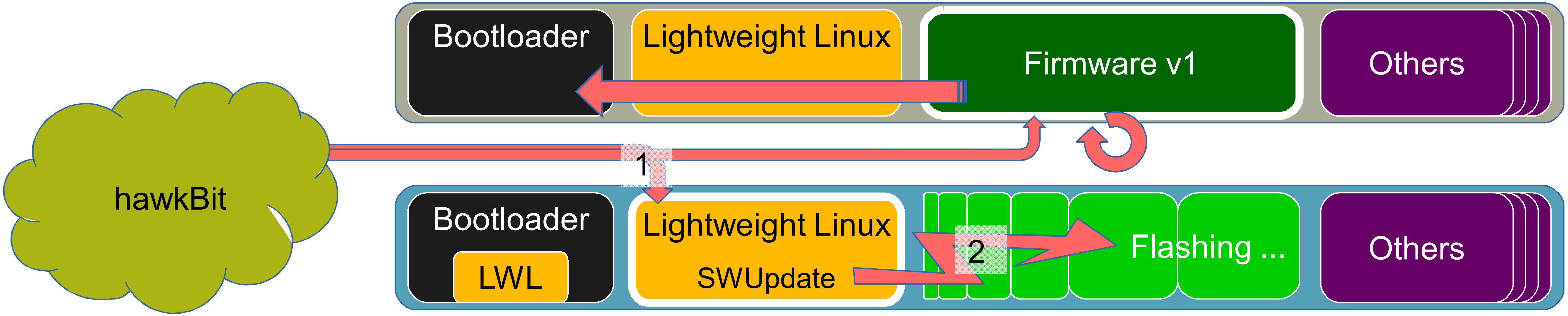

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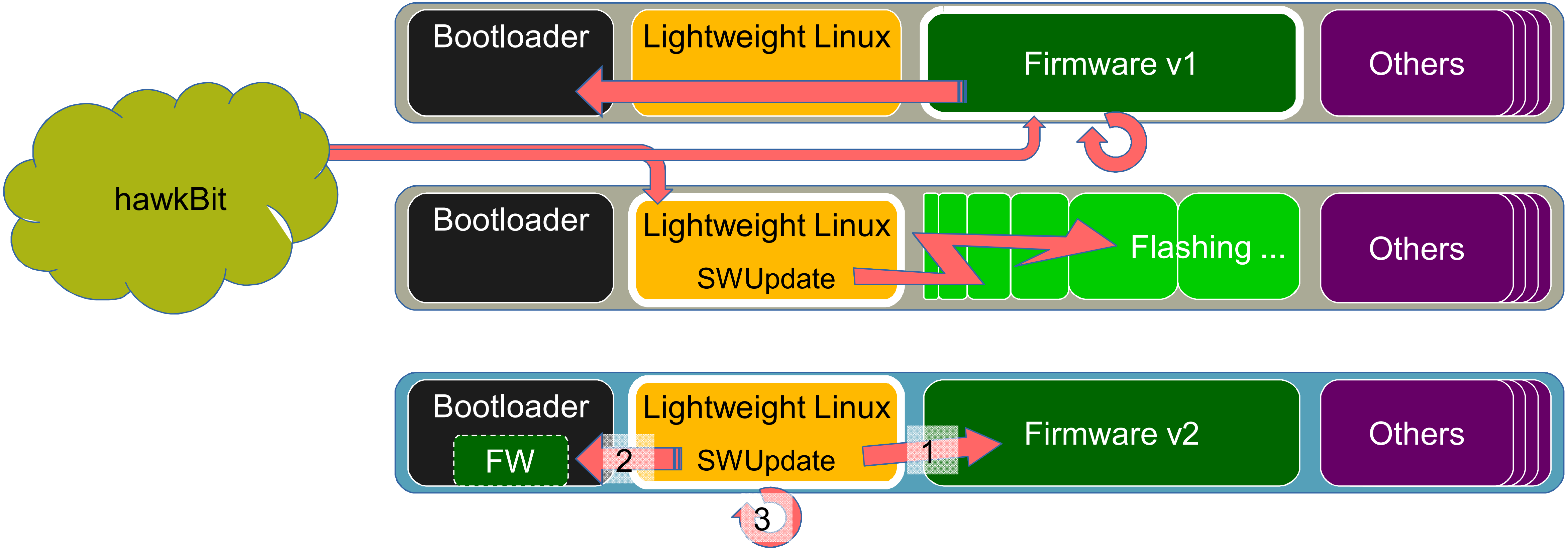
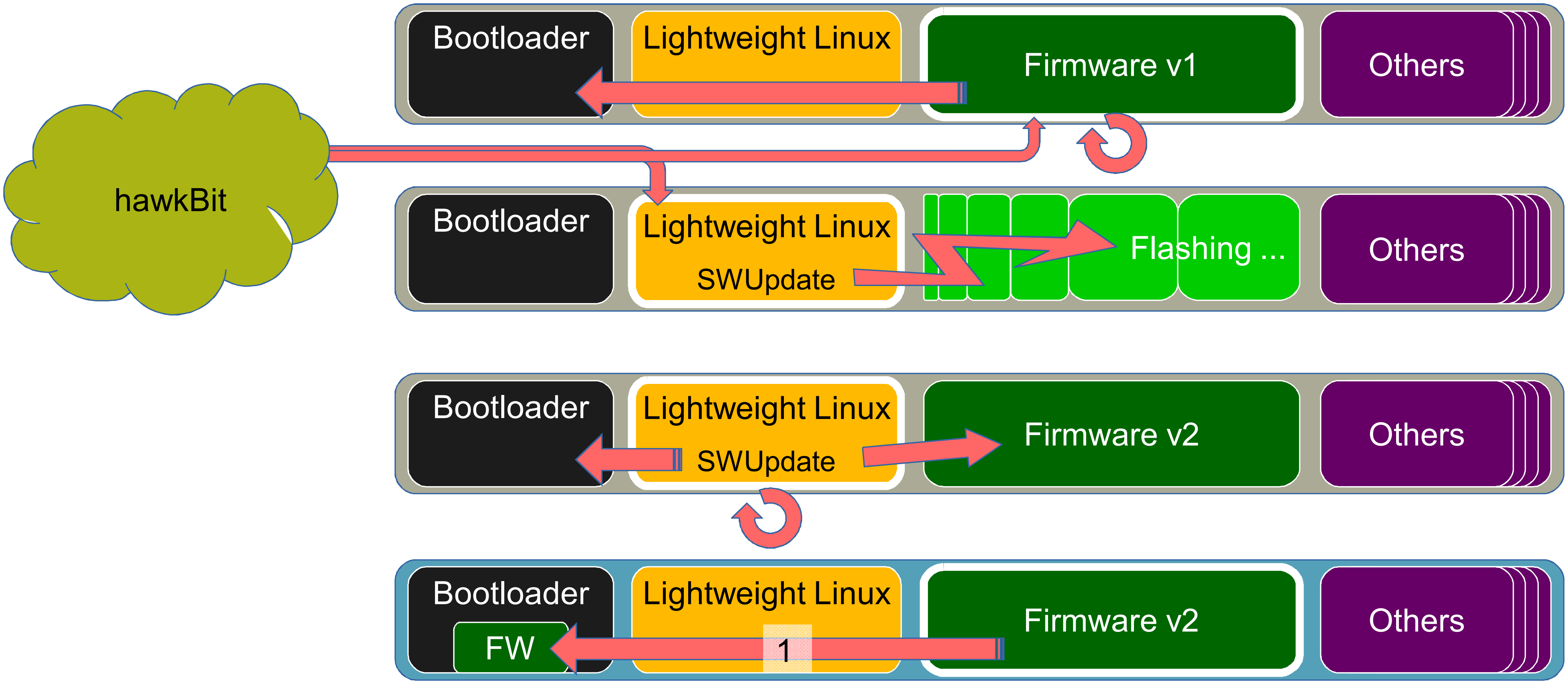


One Firmware Partition: End



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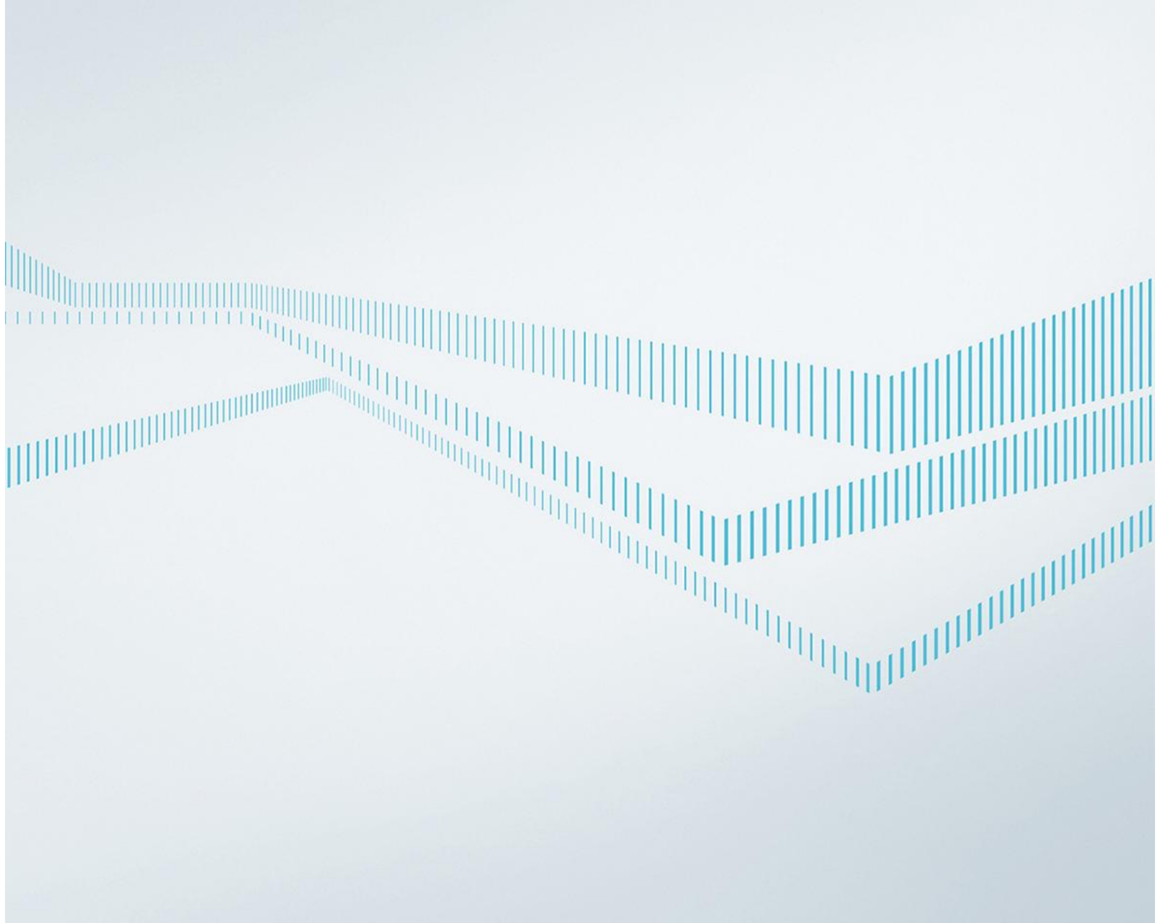
Conclusion

- 100% Open Source Software
- Open communities
  - We were welcomed in both
- Current focus on firmware updates, but software provisioning in general possible
- Modular architecture:
  - hawkBit can be contacted by other clients, via other protocols, …
  - SWUpdate can be extended to support other servers, via other protocols, …
- Future features:
  - Split preparation/realization to fit into maintenance windows
  - Synchronization of Device and Backend
  - Asymmetric key signatures

Contact Information



Silvano Cirujano Cuesta

Software Engineer

Corporate Technology
Embedded Linux Corporate Competence Center

E-mail:
silvano.cirujano-cuesta@siemens.com

Internet
siemens.com/corporate-technology

Intranet
intranet.ct.siemens.com