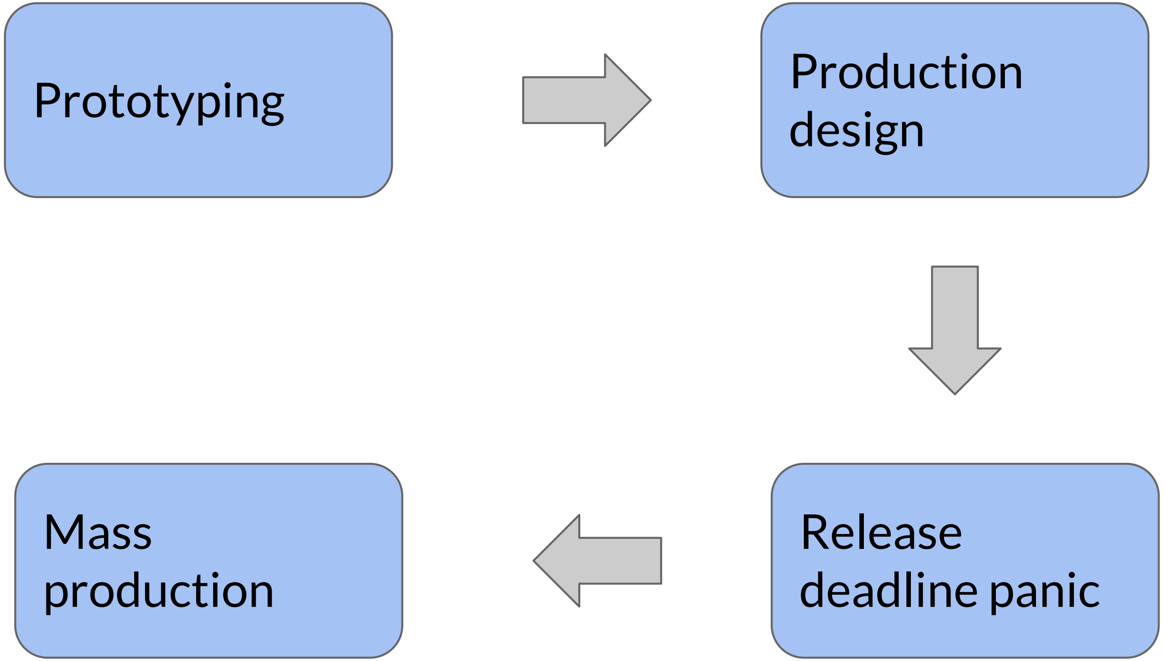
Birds of a Feather Session - ELC Portland 2018

MENDER.io

Deploy Software Updates for Linux Devices

Typical product development process



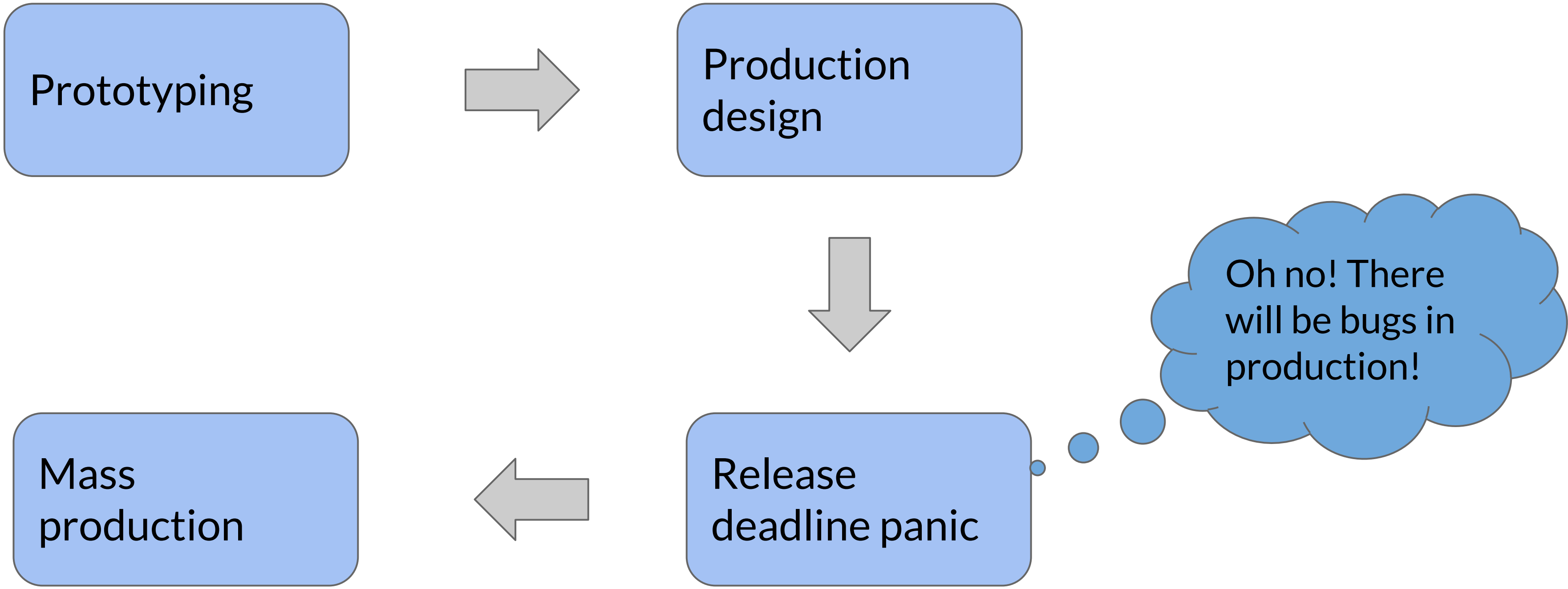
Prototyping

Production design

Release deadline panic

Mass production

Updater is too often an afterthought



Prototyping

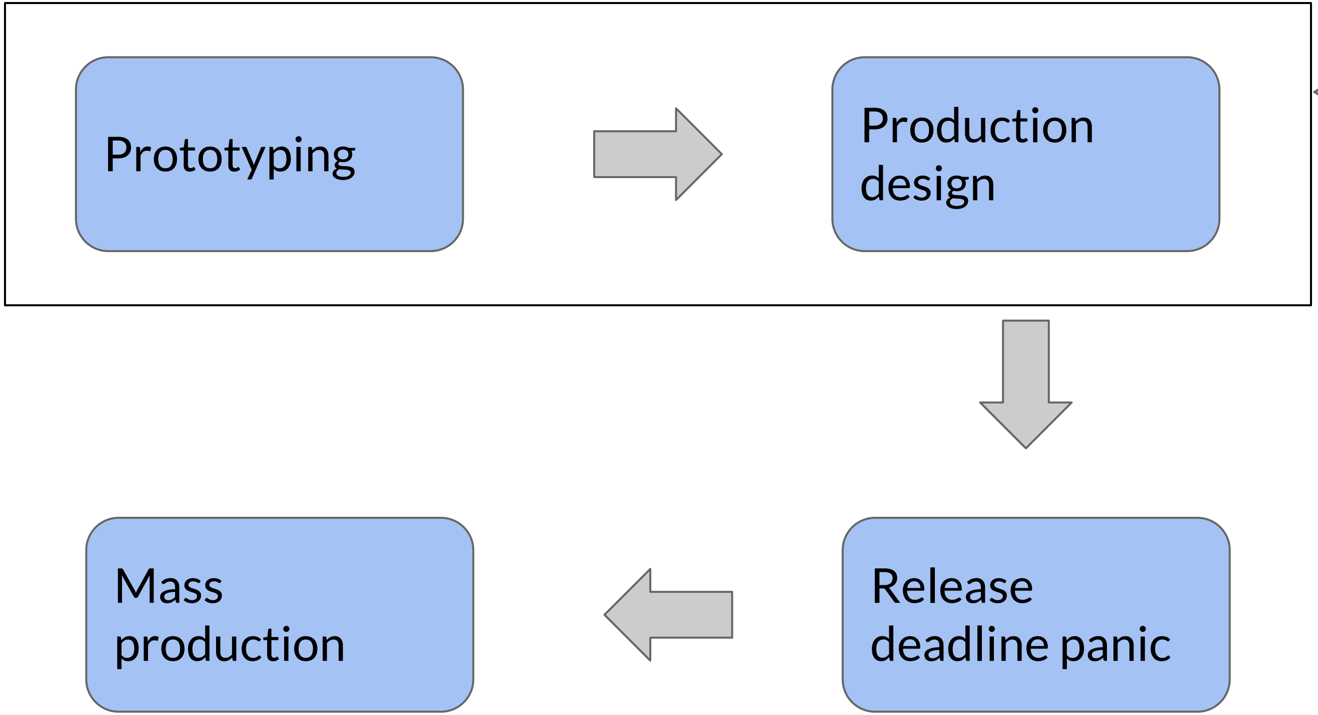
Production design

Release deadline panic

Mass production

Oh no! There will be bugs in production!

Updater is too often an afterthought



This is where you *should* design for OTA updates.

Homegrown updater #1: The **bricker**

- Developed in a hurry, not well tested
- Typically user-space shell scripts, e.g. using ipkg/rpm or application "self update"
- Lacks update compatibility checks
- No sanity checking / rollback
- Does not meet robustness & atomicity requirements for embedded
- If the device loses power during update process it is likely bricked

Homegrown updater #2: The **honeypot**

- Developed without sufficient skills of security
- Gets updates over *plaintext protocols* or misuses crypto
- Lacks update signing / encryption
- Makes it trivial for (wireless) attacker to “pwn” the devices; install any malware on them

Homegrown updater #3: The **needy**

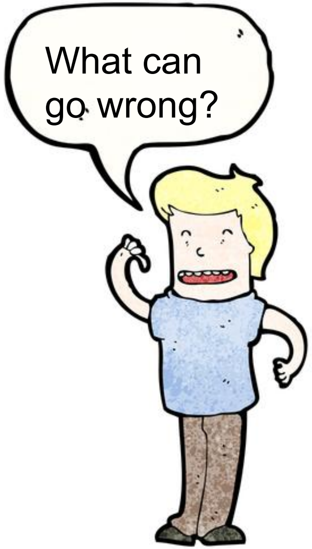
- Lacks *update server*; cannot automated updates across devices

- Manual operation to do 1-on-1 updates to devices, e.g. USB stick or remote 1-on-1 connection

- Updates become so frustrating and expensive that it is not used except during disasters

The embedded environment

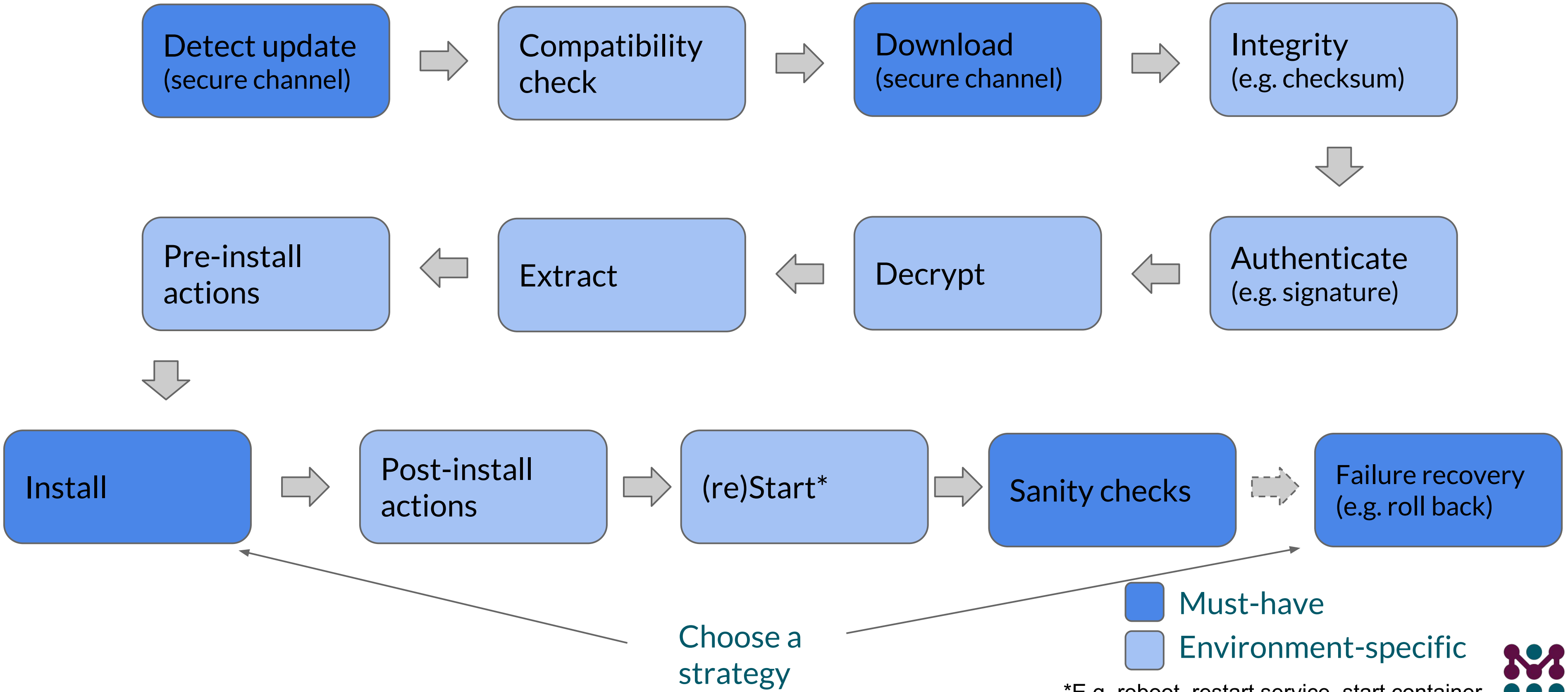
- Remote
  - Expensive to reach physically
- Long expected lifetime
  - 5 - 10 years
- Unreliable power
  - Battery
  - Suddenly unplugged
- Unreliable network
  - Intermittent connectivity
  - Low bandwidth
  - Insecure



Key criteria for embedded updates

1. Robust and secure
2. Integrates with existing environments
3. Easy to get started
4. Bandwidth consumption
5. Downtime during update
6. Update server enabling mass updates

Generic embedded updater workflow



Detect update (secure channel)

Compatibility check

Download (secure channel)

Integrity (e.g. checksum)

Authenticate (e.g. signature)

Decrypt

Extract

Pre-install actions

Install

Post-install actions

(re)Start*

Sanity checks

Failure recovery (e.g. roll back)

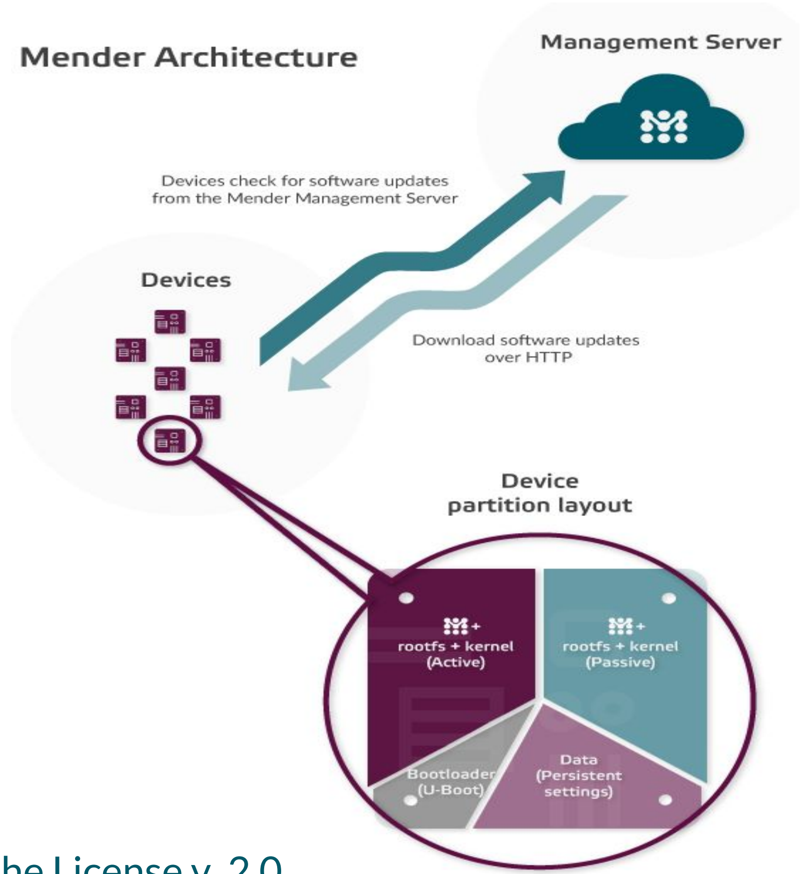
Choose a strategy

🟦 Must-have

▨ Environment-specific

*E.g. reboot, restart service, start container

Mender provides integrated client and update server


Mender Architecture
Management Server
Devices check for software updates from the Mender Management Server
Devices
Download software updates over HTTP
Device partition layout
rootfs + kernel (Active)
rootfs + kernel (Passive)
Bootloader (U-Boot)
Data (Persistent settings)

- Client-server model
  - Mender provides both
  - Easy integration: No need to “glue” several projects
  - Server can integrate with 3rd party clients through its REST API
- Dual A/B rootfs partition layout
  - Atomic deployments
  - Deploy to inactive partition
  - Robust update process
- Supports updating
  - Kernel, device tree
  - Applications

Mender demo!

2018 focus: simplify device integration (1)

- Automate U-Boot patching (for rootfs partition selection)
    - Almost done!

- Mender community integrations & free CI service

2018 focus: simplify device integration (2)

- No U-Boot/boot command patching
    - UEFI binary support
- Alternative: “POC mode” vs. production integration
- Binary post-process images to integrate Mender

2018 focus: simplify device integration (3)

- x86
- Debian, Ubuntu, Raspbian
- Buildroot

Feedback? What is missing for you?

- Is simplifying device integration worthwhile? How?
- Other product-related items?
- Areas for community & contributions?

Join OTA updates sessions

- Comparing and Contrasting Embedded Linux Build Systems and Distributions
  - Drew Moseley, Mender.io
  - Tuesday 10:50am, Pavilion East

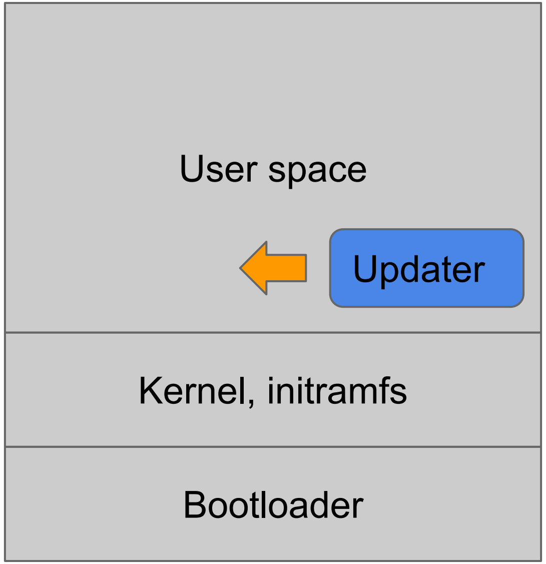
- Update My Board!
  - Mirza Krak, Endian Technologies AB
  - Tuesday 10:50am, Grand Ballroom II

- Mender booth in expo hall
  - Attendee reception Tuesday, 5:10pm - 7pm

- The IoT Botnet Wars, Linux Devices, and the Absence of Basic Security Hardening
  - Eystein Stenberg, Mender.io
  - Wednesday 3:30pm, Broadway I/II

Appendix

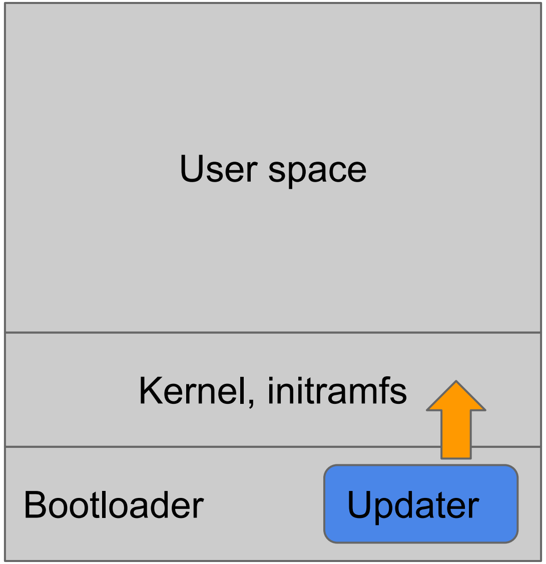
Installer strategy 1: run-time installation



- Updater deploys to running environment
  - Package managers (ipkg, rpm, deb...)
  - OSTree
  - Many homegrown (tar.gz)

- Robustness is hard
  - Atomicity: Hard or impossible
  - Consistency (dev=test): Hard
- Integrates well
  - May already have packages
  - Some userspace tools
- Low bandwidth use (<1mb)
- Short downtime (seconds)

Installer strategy 2: boot to maintenance mode

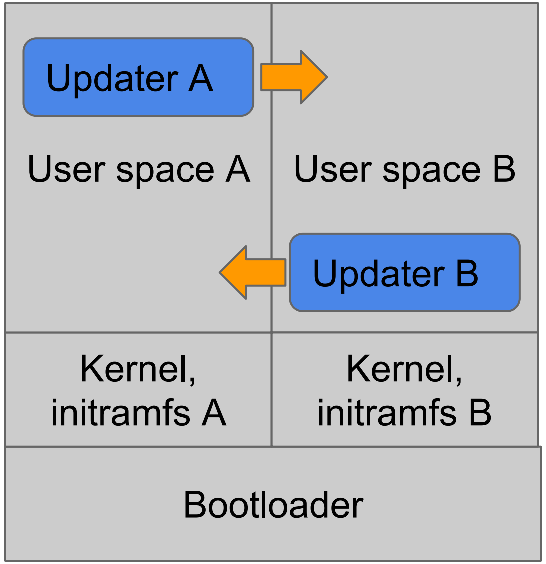


- Updater deploys “up the stack” while running in bootloader
  - Used in older Androids (before ‘N’)
  - “Rescue environment” common in embedded

- Robustness is hard
  - Not atomic (can get partial update)
  - Consistent on success (image)
- Integrates fairly well
  - Bootloader features & intelligence
- High bandwidth use*
  - Whole image
- Long downtime
  - Whole image install
  - 2 reboots

*Can mitigate: compressed/delta

Installer strategy 3: dual A/B rootfs layout

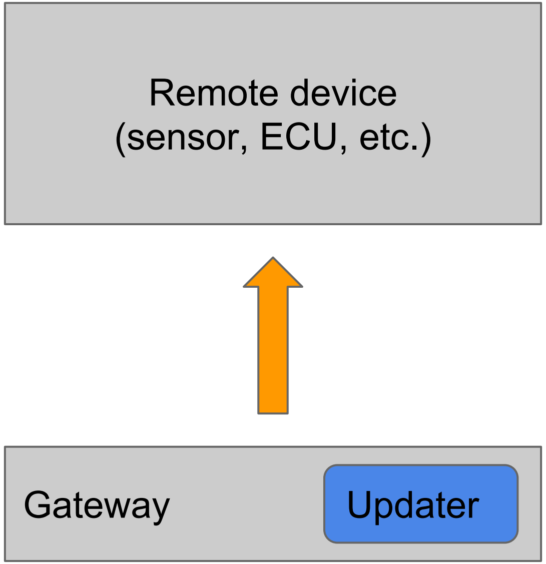


- Updater deploys to inactive partition, then reboots into it
  - Used in newer Androids ('N' and later)
  - Common in "mid/high-end" embedded

- Very robust
  - Fully atomic and consistent
- Integrates fairly well
  - OS, kernel, apps unchanged
  - Needs bootloader "flip" support
  - Partition layout, requires 2x rootfs storage
- High bandwidth use*
  - Whole image
- Fairly short downtime (minute)
  - 1 reboot

**Can mitigate: compressed/delta*

Installer strategy 4: proxy



- Updater deploys to remote system
  - Used on smaller devices (sensors, ECUs, etc.), such as in Smart Home or Automotive
  - Requires intelligent gateway to manage

- Slightly different scenario
  - Smaller devices (no client)
  - Complements the others

- Suited for closeby installations only, not internet
  - Robustness (e.g. connection/power loss)
  - Security