Simplifying the Use of Free and Upstream Boot Software with Origami-Paper

Embedded Freedom

Paul Kocialkowski
contact@paulk.fr

Thursday September 13th 2018

OPEN SOURCE FIRMWARE CONFERENCE
2018 SEPTEMBER 12–15

Digital Technology and End Users

Digital Technology and End Users

How Digital Technology is Made

End Users in the Proprietary Industry

Some observations from the proprietary industry:

- End users are consumers
- Consumers are passive
- Technology is black magic
- It just works

End Users in the Proprietary Industry

Some observations from the proprietary industry:

- End users are consumers
- Consumers are passive
- Technology is black magic
- It just works

Not a neutral approach:

- Developers hold:
  - knowledge
  - control
  - power
- Ownership of technology
- Hierarchy of interests

End Users in the Proprietary Industry

Some observations from the proprietary industry:

- End users are consumers
- Consumers are passive
- Technology is black magic
- It just works

Not a neutral approach:

- Developers hold:
  - knowledge
  - control
  - power
- Ownership of technology
- Hierarchy of interests

I'm sorry Dave, I'm afraid I can't do that

Tremendous Implications in Life

Digital technology is in our lives:

- Digitization of **aspects of life**:
  - communications, social
  - information access

Tremendous Implications in Life

Digital technology is in our lives:

- Digitization of **aspects of life**:
  - communications, social
  - information access
- **Devices** for daily use:
  - extended input/output
  - data collection

Tremendous Implications in Life

Digital technology is in our lives:

- Digitization of **aspects of life**:
  - communications, social
  - information access
- **Devices** for daily use:
  - extended input/output
  - data collection
- Data **infrastructure**:
  - what data, to whom, conditions
  - digital fingerprint, meta-data

Tremendous Implications in Life

Digital technology is in our lives:

- Digitization of **aspects of life**:
  - communications, social
  - information access
- **Devices** for daily use:
  - extended input/output
  - data collection
- Data **infrastructure**:
  - what data, to whom, conditions
  - digital fingerprint, meta-data

Digital Technology directly affects end users' lives
How it's done is never neutral

Bringing Guarantees with Freedom

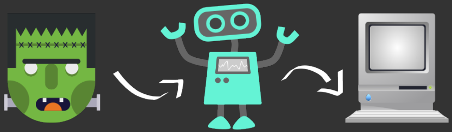
Technology affecting people in the literature:

- Frankenstein's monster **complex**
- Asimov's **Three Laws of Robotics**
- Orwell's **Telescreen** in 1984

Bringing Guarantees with Freedom

Technology affecting people in the literature:

- Frankenstein's monster **complex**
- Asimov's **Three Laws of Robotics**
- Orwell's **Telescreen** in 1984

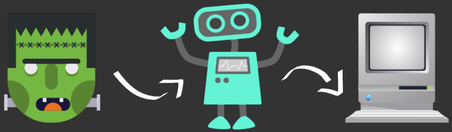


Technology should obey its users (and no one else)

Bringing Guarantees with Freedom

Technology affecting people in the literature:

- Frankenstein's monster **complex**
- Asimov's **Three Laws of Robotics**
- Orwell's **Telescreen** in 1984



Technology should obey its users (and no one else)

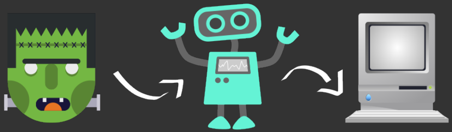
Embedding **guarantees** in technology:

- Revoking developers' **privileges**
- Allowing users to **own their technology**

Bringing Guarantees with Freedom

Technology affecting people in the literature:

- Frankenstein's monster **complex**
- Asimov's **Three Laws of Robotics**
- Orwell's **Telescreen** in 1984



Technology should obey its users (and no one else)

Embedding **guarantees** in technology:

- Revoking developers' **privileges**
- Allowing users to **own their technology**

Formalized by free software's Four Freedoms

What it Means for End Users

Implications of freedom:

- Individual and collective **control**
- Personal choice for **trust**
- Hardware and software are **distinct**

What it Means for End Users

Implications of freedom:

- Individual and collective **control**
- Personal choice for **trust**
- Hardware and software are **distinct**
- Access to **knowledge**
- No longer have to be **passive**

What it Means for End Users

Implications of freedom:

- Individual and collective **control**
- Personal choice for **trust**
- Hardware and software are **distinct**
- Access to **knowledge**
- No longer have to be **passive**

Freedom empowers users and sanitizes digital technology

Distinct Development Models

Not all software was born equal:

Distinct Development Models

Not all software was born equal:

Upstream:

- Peer-review of the code
- Common code base
- Maintenance/updates
- Long-term focus

Distinct Development Models

Not all software was born equal:

Upstream:

- Peer-review of the code
- Common code base
- Maintenance/updates
- Long-term focus

Downstream:

- Quick and dirty code
- Specific modifications
- Little to no updates
- Short-term focus (TTM)

Distinct Development Models

Not all software was born equal:

Upstream:

- Peer-review of the code
- Common code base
- Maintenance/updates
- Long-term focus

Stays relevant

Downstream:

- Quick and dirty code
- Specific modifications
- Little to no updates
- Short-term focus (TTM)

Distinct Development Models

Not all software was born equal:

Upstream:

- Peer-review of the code
- Common code base
- Maintenance/updates
- Long-term focus

Stays relevant

Downstream:

- Quick and dirty code
- Specific modifications
- Little to no updates
- Short-term focus (TTM)

Fatally outdated

Distinct Development Models

Not all software was born equal:

Upstream:

- Peer-review of the code
- Common code base
- Maintenance/updates
- Long-term focus

Stays relevant

Downstream:

- Quick and dirty code
- Specific modifications
- Little to no updates
- Short-term focus (TTM)

Fatally outdated

Deprecated software considered harmful

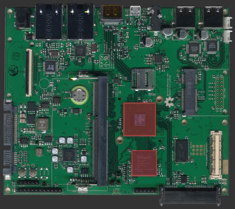
Digital Technology and End Users

Freedom From Theory to Practice

Digital Technology in Practice

Digital technology:

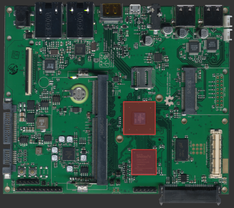
- Types of digital devices
- Aspects of digital technology
- Types of components
- Ability to reprogram

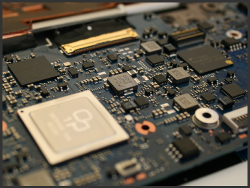


Digital Technology in Practice

Digital technology:

- Types of digital devices
- Aspects of digital technology
- Types of components
- Ability to reprogram





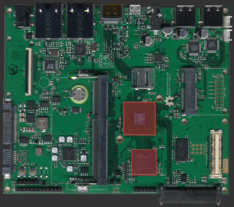
Free software on digital devices:

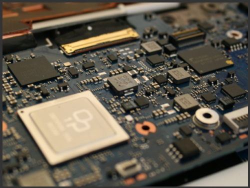
- Systems and applications
- Hardware-specific support

Digital Technology in Practice

Digital technology:

- Types of digital devices
- Aspects of digital technology
- Types of components
- Ability to reprogram





Free software on digital devices:

- Systems and applications
- Hardware-specific support

Boot software and firmwares:

- Pre-installed per-device
- Not updated with the system

Free Boot Software

Boot software is critical for freedom, privacy/security

Free Boot Software

Boot software is critical for freedom, privacy/security

- **Boot software**:
  coreboot, U-Boot, Barebox, Little Kernel

Free Boot Software

Boot software is critical for freedom, privacy/security

- **Boot software**:
  coreboot, U-Boot, Barebox, Little Kernel
- **Payloads**:
  SeaBIOS, Tianocore, GRUB, Depthcharge

Free Boot Software

Boot software is critical for freedom, privacy/security

- **Boot software**:
  coreboot, U-Boot, Barebox, Little Kernel
- **Payloads**:
  SeaBIOS, Tianocore, GRUB, Depthcharge
- **Privileged Execution Mode**:
  ARM-Trusted-Firmware, OP-TEE

Limitations and Obstacles

Replacing the boot software with free projects

Limitations and Obstacles

Replacing the boot software with free projects

Embedded limitations:

- Enforced signature verifications
- Fused public keys
- User is a threat

Limitations and Obstacles

Replacing the boot software with free projects

Embedded limitations:

- Enforced signature verifications
- Fused public keys
- User is a threat

Some devices/platforms are fatally flawed

Limitations and Obstacles

Replacing the boot software with free projects

Embedded limitations:

- Enforced signature verifications
- Fused public keys
- User is a threat

Some devices/platforms are fatally flawed

Specific level of support:

- Depends on the project
- Depends on the platform/device
- Not always documented/clear

Deploying Free Boot Software

Issues with integration:

- System distributions
- Prebuilt images
- End-user documentation

Deploying Free Boot Software

Issues with integration:

- System distributions
- Prebuilt images
- End-user documentation

Required heavy lifting:

1. Appropriate configuration
2. Building an image
3. Preparing the image
4. Installing to medium

Deploying Free Boot Software

Issues with integration:

- System distributions
- Prebuilt images
- End-user documentation

Downsides for users:

- Requires knowledge and skills
- Very specific procedure

Required heavy lifting:

1. Appropriate configuration
2. Building an image
3. Preparing the image
4. Installing to medium

Deploying Free Boot Software

Issues with integration:

- System distributions
- Prebuilt images
- End-user documentation

Downsides for users:

- Requires knowledge and skills
- Very specific procedure

Required heavy lifting:

1. Appropriate configuration
2. Building an image
3. Preparing the image
4. Installing to medium

Using free boot software should not require developer skills

Origami-Paper

General Presentation

Origami-Paper

A project that provides means to ease the development, preparation and installation of free software and logic configuration projects related to hardware support.

Mission and focus

Mission:

- Abstracting technical steps
- Providing tested revisions/configs
- Tying projects together
- Documenting steps for each device
- All in one place (distribution)

Mission and focus

Mission:

- Abstracting technical steps
- Providing tested revisions/configs
- Tying projects together
- Documenting steps for each device
- All in one place (distribution)

Focus:

- Relevant devices for freedom
- Upstream projects
- Fully free (blobs removed)

Paper Build System

Build system:

- Bash, helpers
- Project actions
- Images and tools
- Releases

Paper Build System

Build system:

- Bash, helpers
- Project actions
- Images and tools
- Releases

Setup scripts:

- Wrap specific tools
- Common/generic scripts
- Consistent interface
- Uses build or release

Paper Build System

Build system:

- Bash, helpers
- Project actions
- Images and tools
- Releases

Setup scripts:

- Wrap specific tools
- Common/generic scripts
- Consistent interface
- Uses build or release

```
$ ./paper build u-boot cubieboard2
Project u-boot build (with cubieboard2)
Project crossgcc build (with arm)
...
Project crossgcc build (with arm) completed
...
Project u-boot build (with cubieboard2) completed
```

Paper Build System

Build system:

- Bash, helpers
- Project actions
- Images and tools
- Releases

Setup scripts:

- Wrap specific tools
- Common/generic scripts
- Consistent interface
- Uses build or release

```
$ ./paper build u-boot cubieboard2
Project u-boot build (with cubieboard2)
Project crossgcc build (with arm)
...
Project crossgcc build (with arm) completed
...
Project u-boot build (with cubieboard2) completed
```

Building images and tools from the ground up

Paper-Deploy

With images/tools/scripts ready:

- Image preparation/packing
- Hardware preparation
- Image installation

Paper-Deploy

With images/tools/scripts ready:

- Image preparation/packing
- Hardware preparation
- Image installation

Automation with Paper-Deploy:

- Minimal configuration
- Build-system wrapper
- Preparation/installation steps
- Per-device documentation

Paper-Deploy

With images/tools/scripts ready:

- Image preparation/packing
- Hardware preparation
- Image installation

Automation with Paper-Deploy:

- Minimal configuration
- Build-system wrapper
- Preparation/installation steps
- Per-device documentation

```
$ ./paper-deploy u-boot
```

paper-deploy.conf:

```
BUILD_SYSTEM_PATH="$HOME/paper"
DEVICE="cubieboard2"
BOOT_MEDIUM="mmc"
KERNEL_MEDIUM="mmc"
ROOTFS_MEDIUM="mmc"
STORAGE_PATH="/dev/sdc"
```

Paper-Deploy

With images/tools/scripts ready:

- Image preparation/packing
- Hardware preparation
- Image installation

Automation with Paper-Deploy:

- Minimal configuration
- Build-system wrapper
- Preparation/installation steps
- Per-device documentation

paper-deploy.conf:

```
BUILD_SYSTEM_PATH="$HOME/paper"
DEVICE="cubieboard2"
BOOT_MEDIUM="mmc"
KERNEL_MEDIUM="mmc"
ROOTFS_MEDIUM="mmc"
STORAGE_PATH="/dev/sdc"
```

```
$ ./paper-deploy u-boot
```

Preparing and deploying images in one go

Paper-Support

Support status documentation:

- Per-device/platform/project
- Hardware features only
- Static database (CSV) in git
- Python formatting script

Paper-Support

Support status documentation:

- Per-device/platform/project
- Hardware features only
- Static database (CSV) in git
- Python formatting script

Features status:

- Status about Origami-Paper
- Criteria for Missing
- Intermediary states, comments

Device		Cubieboard2
Status Version		2018.05
DRAM		Supported
Power	PMIC	Supported
	Regulators	Supported
NAND Flash		Missing
SD Card		Supported
USB A		Supported
USB mini B		Supported
SATA		Supported
Ethernet		Supported
HDMI		Supported

Cubieboard2 U-Boot Support Status

Paper-Support

Support status documentation:

- Per-device/platform/project
- Hardware features only
- Static database (CSV) in git
- Python formatting script

Features status:

- Status about Origami-Paper
- Criteria for Missing
- Intermediary states, comments

Device		Cubieboard2
Status Version		2018.05
DRAM		Supported
Power	PMIC	Supported
	Regulators	Supported
NAND Flash		Missing
SD Card		Supported
USB A		Supported
USB mini B		Supported
SATA		Supported
Ethernet		Supported
HDMI		Supported

Cubieboard2 U-Boot Support Status

Providing a clear idea of Origami-Paper support status

Current Status

Supported devices:

- A20/H3 Allwinner Single-Board Computers
- Tegra K1/RK3288/RK3399 Chromium OS Devices

Current Status

Supported devices:

- A20/H3 Allwinner Single-Board Computers
- Tegra K1/RK3288/RK3399 Chromium OS Devices

Components:

- Paper: Usable, stable
- Paper-Deploy: Usable
- Paper-Support: In progress
- Documentation: In progress

Current Status

Supported devices:

- A20/H3 Allwinner Single-Board Computers
- Tegra K1/RK3288/RK3399 Chromium OS Devices

Components:

- Paper: Usable, stable
- Paper-Deploy: Usable
- Paper-Support: In progress
- Documentation: In progress

Infrastructure:

- Website: Ready
- Mailing list: TODO
- Source code hosting: TODO

Current Status

Supported devices:

- A20/H3 Allwinner Single-Board Computers
- Tegra K1/RK3288/RK3399 Chromium OS Devices

Components:

- Paper: Usable, stable
- Paper-Deploy: Usable
- Paper-Support: In progress
- Documentation: In progress

Infrastructure:

- Website: Ready
- Mailing list: TODO
- Source code hosting: TODO

Not launched yet but sources available at:

`https://git.code.paulk.fr`

Future Developments

Improving current support:

- Integrating more platforms:
  non-CrOS RK3288/RK3399, OMAP3/4/5, GM45 Intel
- Integrating more devices:
  more CrOS devices, Allwinner tablets, HTPC...
- Reproducible builds

Future Developments

Improving current support:

- Integrating more platforms:
  non-CrOS RK3288/RK3399, OMAP3/4/5, GM45 Intel
- Integrating more devices:
  more CrOS devices, Allwinner tablets, HTPC...
- Reproducible builds

Distributing tools/images:

- Binary+source releases
- System distributions integration (Parabola)

Future Developments

Improving current support:

- Integrating more platforms:
  non-CrOS RK3288/RK3399, OMAP3/4/5, GM45 Intel
- Integrating more devices:
  more CrOS devices, Allwinner tablets, HTPC...
- Reproducible builds

Distributing tools/images:

- Binary+source releases
- System distributions integration (Parabola)

More project components:

- Graphical UI: Paper-Center
- Automated hardware features testing

Origami-Paper Workshop

OPEN SOURCE FIRMWARE CONFERENCE
2018 SEPTEMBER 12–15

Workshop during OSFC:

- Friday, 9 AM
- Informal standing
- Showcase/demo
- Porting liberated (GM45) Intel laptops

Thank-You!

Thank-You!

Questions?