Standard Embedded Boot with EBBR

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A-Profile Architecture Specifications

Arm Specs

- PSCI
- SMCCC
- Arm TF
- Arm FFH
- Arm MM

SBBR: Server Base Boot Requirements

Operating systems running on standard server hardware require standard firmware interfaces to be present in order to boot and function correctly. The Server Base Board Boot Requirements (SBBR) document describes these firmware requirements. The SBBR covers UEFI, ACPI and SMBIOS industry standards as well as standards specific to Arm, such as PSCI. Together with SBSA, the SBBR provides a standard based approach to building Arm servers and their firmware. The specification is developed in conjunctions with partners across the industry.

For more information, please visit:
https://developer.arm.com/products/architecture/system-architecture/server-system-architecture

License

Arm Confidential Proprietary Notice for drafts and Arm Non-Confidential Proprietary Notice for released final spec.

Contribution

Members of the Arm Server Advisory Committee may submit Engineering Change Requests (ECRs) and the Committee decides to approve/reject the ECRs. There is a mailing list and a monthly conference call.

Industry Standards

- UEFI
- ACPI
- SMBIOS
- TCG FW spec
- PCI FW spec

A-Profile Architecture Specifications

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EBBR: Embedded Base Boot Requirements

The Embedded Base Boot Requirements specification defines requirements for embedded systems to enable inter-operability between SoCs, hardware platforms, firmware implementations, and operating system distributions. The aim is to establish consistent boot ABIs and behavior so that supporting new hardware platforms does not require custom engineering work.

For more information, please visit:
https://github.com/ARM-software/ebbr

License

Contributions are accepted under the same with sign-off under the Developer's Certificate of Origin.

Contribution

Anyone may contribute to EBBR. Discussion is on the boot-architecture@lists.linaro.org and arm.ebbr-discuss@arm.com mailing list, and there is a weekly conference call.

Industry Standards

devicetree
.org

Brief History of Booting

Server/Desktop/Laptop:

- Many Binary OSes
- End-users OS installation
- Horizontal integration
- Combinatorial explosion of supportable options

Lots of economic incentive for interoperability

∴ UEFI, ACPI, Plugfests

Embedded/Mobile

- OS built from source
- Vertically Integrated
- OS image tied to hardware

Interoperability useful to developers, but little economic incentive to make sure it happens

∴ Custom boot flow, little interoperability testing

Problems for Distributions (Embedded)

- Many interesting SBCs, but
  - Every SBC behaves subtly differently
  - Impossible to support generically
- Board-specific images abound
  - DT shipped with OS does not scale
- Painful to upgrade kernel and/or firmware
- Domain specific behaviour
  - Android firmware optimized to fastboot model
  - Custom-specific scripts in U-Boot
  - ChromeOS firmware architecture is different still
- No pre-boot execution
- The world isn't all Linux (though we pretend it is)

"Exciting" is not a good firmware feature

Solvable Problems

- No technical barriers to boot standardization
- Boot flow is more than just a distro problem
  - Even vertical software stacks benefit from standardization
  - Easier to integrate standard features (PXE, Secure Boot, firmware drivers, etc.)
- Platform specific features aren't impeded by standards
- Stop duplicating the same work!

EBBR was conceived to create a firmware standard suitable for embedded, but aligned with server/desktop.

Case Study: Cable Set-top box

Characteristics:

- Minimal local storage
- Check network for updates on each boot
- Needs remote pre-boot agent for management
- Multiple hardware variants
- Single OS image

Benefits of standardization

- Pre-boot agent can be built against common firmware API
  - Custom applications can be separate from firmware stack
- Kernel doesn't need to carry every hardware variant when firmware provides HW description
- Update and Security model already proven in other domains

Survey of Embedded Firmware

Projects

- U-Boot
- Little Kernel (Android)
- Core Boot (ChromeOS)
- Tianocore (UEFI EDKII)

Related Projects

- Trusted Firmware A
- OP-TEE
- SoC Proprietary

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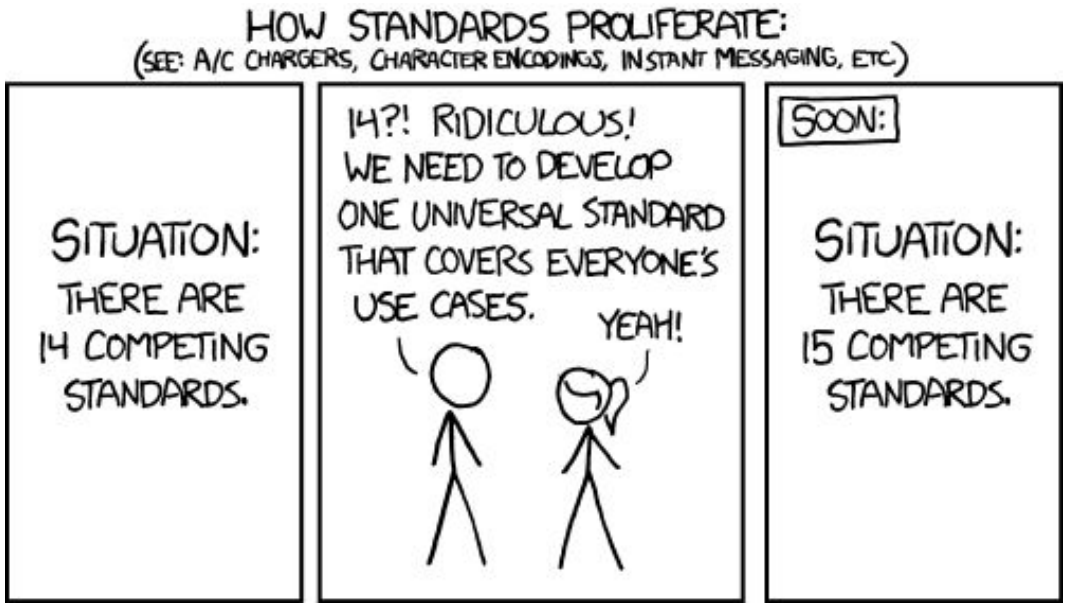
What do we start with?

- Work with existing ecosystem
- Must be implemented in upstream firmware projects
- Start with achievable goals

Most SBC supported by distros are running U-Boot, so that's a good place to start.

Overview of EBBR

- Platform requirements document
  - Points to other specifications
  - Interprets and provides design guidance
- Intended to be baseline that distros can require for support
- Open process
  - CC-BY-SA license
  - Drafts in Github
  - Conversations on mailing list
  - Contributions under DCO
  - Anyone can participate
- Architecture independent



https://www.xkcd.com/927/

Overview of EBBR

- Implementation independent
  - Implemented in both Tianocore and U-Boot
  - Other firmware implementations possible (ie. Linuxboot)
- UEFI ABI
  - Sufficient subset to boot Linux, FreeBSD as a minimum
- Additional architecture specific guidance
  - Similar to SBBR, EBBR requires PSCI
- Embedded System constraints
  - Firmware & OS on same media
    - e.x., eMMC
  - Limited hardware access at runtime
  - Limited variable access
  - Device partitioning limitations
    - E.x. firmware loaded from fixed offset into block storage

EBBR Project

- Hosted on Github
  - https://github.com/Arm-Software/ebbr
- Mailing list
  - boot-architecture@lists.linaro.org
- Weekly Conference Call
- Open Source Project
  - Creative Commons BY-SA license
  - DCO contributions
  - Anyone welcome to participate
  - Releases managed by EBBR committee

EBBR Project Status & Roadmap

- Current Release: v0.6 pre-release
- v0.7 projected to be released in next couple of weeks
- Will seek feedback at ELC-E and Linux Plumbers
- v1.0 projected for early December

Fedora, SUSE, Debian and FreeBSD server images will boot unmodified on early EBBR U-Boot Platforms

v1.0 Contents:

- AArch32 & AArch64
- Basic UEFI ABI
- Hardware Description from platform
  - Both ACPI and DT allowed, but
  - firmware must choose one or the other
- Shared storage guidance
- PSCI required on AArch64
- Runtime Services guidance
- Exceptions to UEFI spec

EBBR Next Steps

Post v1.0:

- Secure Boot
- Capsule updates
- More embedded use cases
  - A/B upgrades
  - Preboot requirements
- Better UEFI compliance
- Non-Linux representation

Thank You!

Come see EBBR Demo on Demo Friday

Questions?