

ARM Device Tree status report

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Overview

- Device Tree Overview
- Integration with the Linux device model
- Current State
- Next steps

Context



Image credit: <http://xkcd.com/619/>

Terminology

- OpenFirmware (OF) Device Tree (DT)
 - Device representation exported by Open Firmware
 - This presentation is **not** about Open Firmware
- Flattened Device Tree (FDT)
 - Firmware-independent device tree encoding
- Device Tree Compiler (DTC)
 - Convert between .dts and .dtb
 - Device Tree Source (.dts)
 - Device Tree Blob (.dtb)
 - Tokenized form; used by kernel
- Bindings
 - Documentation of how the DT describes hardware

Device Tree – 3 minute overview

- Data structure for describing hardware
- Passed to kernel at boot
 - By firmware, or
 - Linked into boot wrapper
- Alternative to hard-coded platform details

Device Tree Model

- Tree Structure with nodes & properties
 - Nodes give structure
 - Properties add detail
 - Key-value pairs
 - Arbitrary data
- Secondary links - “phandles”
 - Interdependencies aside from natural tree
- Well defined usage conventions
 - 'compatible' property uniquely identifies devices
 - Each 'compatible' value associated with a 'binding'.
 - Common conventions for address ranges, irqs, gpios and others.

Device Tree – Why?

- Multiplatform
- Simplify board ports
- Standardized Firmware → Kernel data passing

Device Tree – Why not?

- Complexity (Does it buy me anything?)
- Learning curve
- More work?

Device Tree – What it is not?

- Doesn't replace board-specific code
 - Simplifies the common-case
 - Method to identify and handle special cases
- Doesn't add features to your platform
- Isn't a boot architecture
 - (but is an important component)

Model - Firmware

- Firmware obtains .dtb and passes to kernel
- How?
 - Options:
 - Load and pass verbatim
 - Load and modify
 - Generate from scratch
 - Here there be Dragons!
 - Kernel doesn't care

Model – ARM Booting

- Device Tree passed r2 instead of ATAGs
 - All firmware data passed within dt structure
- Early init
 - Determine memory
 - Determine machine
 - Boot to mm set up

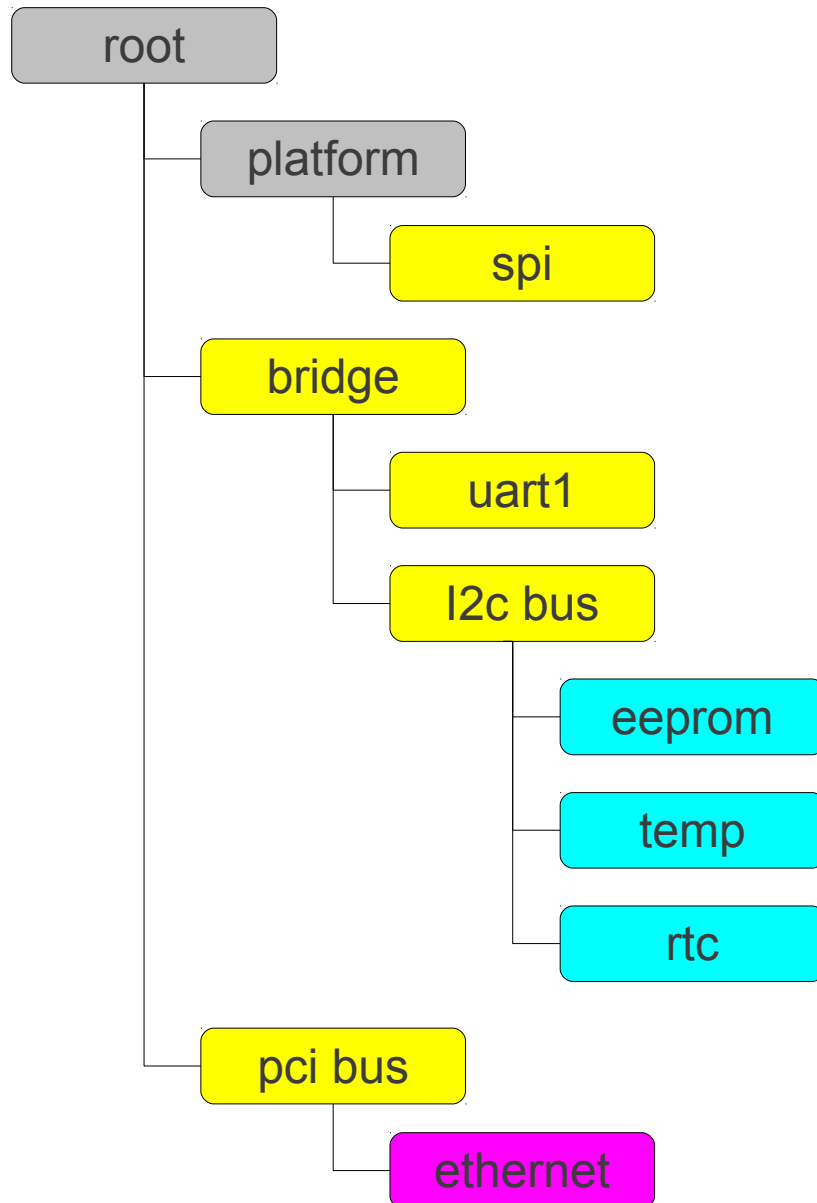
Model – ARM Booting

- Unflatten .dtb
 - Allocate space for unpacked form
 - Can now directly dereference tree
- Boot to machine_init
- Register devices

Digression: Linux device model

- Busses
- Devices
- Drivers
- Hierarchy of Devices

Digression: Linux device model



Drivers registered against bus types

platform_bus_type

i2c_bus_type

pci_bus_type

DT & Linux Device Model historical

- SPARC
 - Walk entire tree, register of_device for each node
 - drivers may bind against any node
 - Other bus registrations mirror of_device hierarchy (ie. PCI)
 - Duplicate 'struct device'

DT & Linux Device Model historical

- PowerPC/Microblaze
 - Subset of tree registered as of_devices
 - Typically only mmio devices
 - Drivers may create child busses of different types
 - No device-tree integration with non-of_devices
 - OF wrappers for other busses

DT & Linux Device Model new approach

- Conceptual flaws of of_platform_bus
 - Duplicate of platform bus
 - DT data applicable to more than just platform devices
 - platform_driver won't bind against an of_device

DT & Linux Device Model new approach

- DT is *support data*
 - Make available to all devices
- Move probe data
 - `*of_node` → struct device
 - `*of_match_table` → struct device driver
- Generalize OF-style binding functions
 - Available to any bus type
- Eliminate `of_platform_bus_type`
 - Merge with `platform_bus_type`

Current State

- Mainline Intrastructure works
 - Register mapping
 - IRQ mapping (mostly)
 - Integrated with platform, i2c, spi and mdio bus_types
- Board support (minimal)
 - Versatile on QEMU
 - Versatile Express
 - OMAP3
 - i.MX51
 - All out of mainline
- Registering platform devices
- Binding against drivers

Current State

- Added MIPS support in 2.6.37 merge window
- *Almost* added x86 support in 2.6.37
 - OLPC and Xilinx FPGA
 - Last minute changes defer to 2.6.38
- Any arch can add CONFIG_OF
- ARM remains out of mainline
 - Being cautious, nothing else

Next Steps

- Finish board support
- Complement to ARM Multi-Platform
- Documentation
 - How to use it
 - Bindings
 - <http://devicetree.org>
- Merge it!

Resources

- Secret Lab git tree
 - `git://git.secretlab.ca/git/linux-2.6`
 - Branch: test-devicetree
 - Unified code, bindings
- Web sites
 - <http://devicetree.org>
 - <https://wiki.ubuntu.com/KernelTeam/ARMDeviceTrees>

Acknowledgements

- CE Linux Forum (now Linux Foundation)
- IBM/Freescale/Canonical
- Too many people to mention