

# Devicetree BOF

ELCE 2017

Prague, Czech Republic

Frank Rowand, Sony

October 23, 2017

171023\_0006

# Agenda

- Devicetree Workshop at Kernel Summit 2017
  - questions, comments, issues, concerns from the crowd
  - Overlays
  - Plumbers 2017
  - Plumbers 2016
  - Devicetree Specification
  - documentation
  - commit statistics
  - dtc compiler
  - Status of debug tools
-

# My Goal

Do NOT show all of the slides

# Devicetree Workshop 2017

Prague, Czech Republic

October 26 -- Thursday

Time: 9:00am-5:30pm (Lunch from 12:30-2:30)

Location: Athens room - Hilton Prague

If you plan to attend, make sure you update your OSSunmitE/ELCE registration to include the DT Workshop

# Devicetree Workshop 2017

Thursday 10/26

9:30 Welcome and Schedule bashing

===Tooling & Schema=== 9:40 - 11:10

===Runtime usage=== 11:50 - 12:30

===DTS maintenance issues=== 14:30 - 16:00

=== More stuff=== 16:00 - 17:20+

# Devicetree Workshop 2017

- 9:30 (10min) Welcome and Schedule bashing
- 9:40 ( 5min) Encoding and Schema checking: Framing the problem
- 9:45 (15min) DT YAML encoding overview
- 10:00 (20min) YAML encoding discussion
- 10:20 (15min) DT Schema format - option 1
- 10:35 (15min) DT Schema format - option 2
- 10:50 (20min) DT Schema discussion - what should go in the spec?
- 11:50 (20min) Code Generation from DT
- 12:10 (20min) Runtime memory consumption
- 14:30 (15min) Overlay maintenance plan
- 14:45 (15min) Avoiding duplicate descriptions
- 15:00 (15min) Criteria for accepting board files
- 15:15 (15min) Location for maintaining bindings - how to handle foreign bindings
- 15:30 (15min) Sharing Generic bindings
- 15:45 (15min) ABI Stability
- 16:00 (30min) [break and overflow discussion]
- 16:30 (20min) DT health check
- 16:50 (15min) devicetree.org update
- 17:05 (15min) EBBR Discussion
- 17:20 Closing and feedback

# Devicetree Workshop 2017

- 9:30 Welcome and Schedule bashing
- 9:40 Encoding and Schema checking: Framing the problem
- 9:45 DT YAML encoding overview
- 10:00 YAML encoding discussion
- 10:20 DT Schema format - option 1
- 10:35 DT Schema format - option 2
- 10:50 DT Schema discussion - what should go in the spec?
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- 15:00 Criteria for accepting board files
- 15:15 Location for maintaining bindings - how to handle foreign bindings
- 15:30 Sharing Generic bindings
- 15:45 ABI Stability
- 16:00 [break and overflow discussion]
- 16:30 DT health check
- 16:50 devicetree.org update
- 17:05 EBBR Discussion
- 17:20 Closing and feedback

# What do you want to talk about?

questions

comments

issues

concerns



# Overlays - a gating factor

“a gating factor” is not meant to imply that these issues are a comprehensive list

# Overlays - a gating factor

there needs to be some restrictions around what the overlays can touch.

**We can't have it be wide open and then lock things down later and break users.**

# Overlays - a gating factor

On 10/18/17 14:46, Frank Rowand wrote:

> On Wed, 2017-10-18 at 10:44 -0500, Rob Herring wrote:

>> The issue remains that the kernel is not really setup to deal with any  
>> random property or node to be changed at any point in run-time. I  
>> think there needs to be some restrictions around what the overlays can  
>> touch. We can't have it be wide open and then lock things down later  
>> and break users.

> That paragraph is key to any discussion of accepting code to apply overlays.  
> Solving that issue has been stated to be a gating factor for such code from  
> the beginning of overlay development.

# Overlays - a gating factor

I do not want to enable overlays when there is fundamental breakage in the implementation

# Overlays - a gating factor

I do not want to enable overlays when there is fundamental breakage in the implementation

Simple real world overlay usage exists out of mainline

This does not prove lack of fundamental breakage

# Overlays - a gating factor

Devicetree source files with hand coded overlay internal information are not acceptable

Overlay internal information is not a stable API, in the sense that the format can change when the DTB format version changes

# Overlays - gating factor - STATUS

- restrict what overlays can touch
  - ==> discussed, no momentum
  - ==> connectors appear to be the way forward
  - ==> apply overlay(s) early boot or pre-boot  
may be another approach
- fundamental breakage in the implementation
  - ==> slow progress
- overlay internal information in source form
  - ==> in the pipeline, maybe 4.15-rc1

# dtc - overlays - Linux v4.15-rc1 ??

dtc creates the .dtb **OVERLAY INTERNAL DATA**

Do not hand code overlay internal data nodes  
in DTS source:

```
fragment@  
__overlay__  
__fixup__  
__local_fixup__  
__symbols__
```

Currently in Rob's dt/next branch



# dtc - overlays - example

```
$ diff -b -u old.dts new.dts
--- old.dts
+++ new.dts
@@ -1,13 +1,7 @@
 /dts-v1/;
 /plugin/;

-/ {
-     fragment@0 {
-         target-path = "/soc/base_fpga_region";
-         #address-cells = <1>;
-         #size-cells = <1>;
-         __overlay__ {
+&fpga_region {
             ranges = <0x00000000 0x00000000 0xc0000000 0x00040000>,
                    <0x00000001 0x00000000 0xff200000 0x00001000>;

@@ -28,6 +22,4 @@
             interrupt-parent = <&intc>;
             interrupts = <0 21 4>;
         };
     };
};
```

# dtc - overlays - example - old.dts

```
/dts-v1/;
/plugin/;

/ {
    fragment@0 {
        target-path = "/soc/base_fpga_region";
        #address-cells = <1>;
        #size-cells = <1>;

        __overlay__ {

            external-fpga-config;

            #address-cells = <2>;
            #size-cells = <1>;

            fpga_pr_region0 {
                compatible = "fpga-region";
                fpga-bridges = <&freeze_controller_0>;
                ranges;
            };

            freeze_controller_0: freeze_controller@100000450 {
                compatible = "altr,freeze-bridge-controller";
                reg = <0x00000001 0x00000450 0x00000010>;
                interrupt-parent = <&intc>;
                interrupts = <0 21 4>;
            };
        };
    };
};
```

# dts - overlays - example - new.dts

```
/dts-v1/;
/plugin/;

&fpga_region {
    ranges = <0x00000000 0x00000000 0xc0000000 0x00040000>,
            <0x00000001 0x00000000 0xff200000 0x00001000>;

    external-fpga-config;

    #address-cells = <2>;
    #size-cells = <1>;

    fpga_pr_region0 {
        compatible = "fpga-region";
        fpga-bridges = <&freeze_controller_0>;
        ranges;
    };

    freeze_controller_0: freeze_controller@100000450 {
        compatible = "altr,freeze-bridge-controller";
        reg = <0x00000001 0x00000450 0x00000010>;
        interrupt-parent = <&intc>;
        interrupts = <0 21 4>;
    };
};
```

# .dtsi source vs overlay .dtsi

With the new dtc --

Overlay .dts file contains directives:

```
/dts-v1/;
```

```
/plugin/;
```

.dtsi include file does not

# Use include as .dtsi or overlay

## ----- base tree -----

```
$ expand fpga_tree.dts
/dts-v1/;

/ {
    soc {
        intc: interrupt_ctrl {
        };
        fpga_region: base_fpga_region {
        };
    };
};

/include/ "fpga_plugin_or_dtsi.dts"
```

## ----- overlay -----

```
$ expand fpga_overlay.dts
/dts-v1/;
/plugin/;

/include/ "fpga_plugin_or_dtsi.dts"
```

# Use include as .dtsi or overlay

```
$ expand fpga_plugin_or_dtsi.dts
&fpga_region {
    ranges = <0x00000000 0x00000000 0xc0000000 0x00040000>,
            <0x00000001 0x00000000 0xff200000 0x00001000>;

    external-fpga-config;

    #address-cells = <2>;
    #size-cells = <1>;

    fpga_pr_region0 {
        compatible = "fpga-region";
        fpga-bridges = <&freeze_controller_0>;
        ranges;
    };

    freeze_controller_0: freeze_controller@100000450 {
        compatible = "altr,freeze-bridge-controller";
        reg = <0x00000001 0x00000450 0x00000010>;
        interrupt-parent = <&intc>;
        interrupts = <0 21 4>;
    };
};
```

# Fundamental Breakage

Locking

Memory Leaks

- drivers can NOT be expected to correctly have direct access to devicetree internal data

Apply / Remove dependencies

- frameworks
- devices
- drivers (static and modules)
- other overlays

Subsystem support

---

# Restrict what overlays can touch



# Restrict what overlays can touch

Related to uses cases

We do not need to enable every use case at the same time, but we must be aware of other use cases any time we choose how to implement a given use case

# Some Use Case Categories

- add-on card exposes small set of signals  
(eg Grove connector)
- add-on card exposes most or all of SOC's pads  
(eg Beaglebone)
- fpga

# Orthogonal to Use Case

- connector is stackable / daisy chain vs single target
- single connector of a given type on the board vs multiple connectors of the same type on the board

Multiple connectors lead to wanting to use a single relocatable overlay dtb instead of hard-coding a dtb to be tied to a specific connector on the board

# Use Cases -- tool

If the only tool you have is a hammer, then every problem you have looks like a nail.

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If the only tool you have is a hammer, then every problem you have looks like a nail.

If your problem is a bolt, then you either need to extend the capabilities of your hammer tool, or create a new tool.

# Use Cases -- that are not nails

- mezzanine cpu cards
- device tree fixups
- system configuration
- more...

# Overlays

- U-Boot overlay support
- Connectors (sockets and plugs)
- Overlay Managers
  - capemgr

# Overlays

- Examples of use cases
  - beaglebone
  - raspberry pi
  - minnowboard
  - C.H.I.P.
  - Arduino
  - seeedstudios Grove 4 pin connectors
  - others?



# Overlays

- Combinatorial explosion of .dts / .dtb files

example:

Devicetree Hardware Autoconfiguration

Hans de Goede

ELC Europe 2016

# Plumbers 2017 Summary

Was not scheduled -- not enough interest / commitment

# Plumbers 2016 Summary

## Device Tree Schema Verification

Grant Likely (slides and etherpad)

## Hardware Description vs Configuration vs Policy

(slides and etherpad)

## Overlays

(etherpad)

## Slides:

[http://elinux.org/Device\\_tree\\_future#presentation\\_material\\_2](http://elinux.org/Device_tree_future#presentation_material_2)

## Etherpad Notes:

[http://elinux.org/Device\\_tree\\_plumbers\\_2016\\_etherpad](http://elinux.org/Device_tree_plumbers_2016_etherpad)

# Devicetree Specification

Devicetree Specification 0.1 supersedes ePAPR for the Linux kernel, continues to evolve

<https://www.devicetree.org/specifications/>

Mail list, Build Instructions, etc

<https://www.devicetree.org/collaborate/>

Repository

<https://github.com/devicetree-org/devicetree-specification>

# Devicetree Documentation

[elinux.org/Device\\_Tree\\_Reference](http://elinux.org/Device_Tree_Reference)

- becoming more complete
- contributions and comments welcome

# arch/\*/boot/dts/ commits

v4.2	638
v4.3	592
v4.4	666
v4.5	725
v4.6	682
v4.7	722
v4.8	674
v4.9	719
v4.10	768
v4.11	632
v4.12	658
v4.13	687

# v4.2.. arch/\*/boot/dts/ commits

405	arc
41261	arm
8820	arm64
32	cris
74	h8300
22	metag
793	mips
21	nios2
617	powerpc
15	sh
86	xtensa

# arch/\*/boot/dts/ commits

	arm	arm64
	-----	-----
v4.2	568	36
v4.3	535	46
v4.4	553	67
v4.5	571	137
v4.6	511	149
v4.7	559	117
v4.8	498	156
v4.9	489	195
v4.10	519	235
v4.11	456	151
v4.12	434	217
v4.13	381	283



# .../bindings/ commits

v4.2	488			
v4.3	411			
v4.4	418			
v4.5	467			
v4.6	428			
v4.7	445	2016	07	24
v4.8	418	2016	10	02
v4.9	453			
v4.10	491			
v4.11	421			
v4.12	468			
v4.13	460			

# scripts/dtc/ commits

v4.2	2			
v4.3	0			
v4.4	0			
v4.5	0			
v4.6	3			
v4.7	1	2016	07	24
v4.8	1	2016	10	02
v4.9	0			
v4.10	0			
v4.11	1			
v4.12	6			
v4.13	6			
v4.14-rc1	0			
	2	Rob's	dt/next	171020

# drivers/of/ commits

v4.2	29			
v4.3	16			
v4.4	38			
v4.5	22			
v4.6	29			
v4.7	40	2016	07	24
v4.8	30	2016	10	02
v4.9	24			
v4.10	28			
v4.11	19			
v4.12	32			
v4.13	36			
v4.14-rc1	32			
	26	Rob's	dt/next	171019

# v4.7.. drivers/of/ commits

(July 24, 2016 ..)

What have patch topics been?

Very imprecise topic count (useless, but interesting)

- commit short description

- ignore leading “of: “

- strip trailing “:.\*”

- sort unique and count

# v4.7.. drivers/of/ commits

(July 24, 2016 ..)

```
17 overlay
11 of_mdio
 8 device property
 7 of/platform
 6 of/fdt
 5 of/irq
 5 irq
 4 of/numa
 4 base
 3 of_graph
 3 of/device
 3 device
 2 unittest
 2 reserved_mem
 2 overlay.c
 2 of/unittest
 2 of/resolver
 2 of_pci
 2 of/pci
 2 of_numa
 2 mdio_bus
 2 fdt
 2 drivers/of
12 fix ...
with Rob's dt/next 171019
```

dtc compiler

# dtc - Devicetree Build Warnings

Rob has been enhancing dtc error checks

Enabled for “W=1” builds

```
$ make V=0 W=1 qcom-apq8074-dragonboard.dtb
```

```
make[1]: Entering directory `/local/frowand_nobackup/src/git_linus/build/dragon_linus_4.10'
```

```
  DTC   arch/arm/boot/dts/qcom-apq8074-dragonboard.dtb
```

```
Warning (unit_address_vs_reg): Node /memory has a reg or ranges property, but no unit name
```

```
Warning (unit_address_vs_reg): Node /soc/spmi@fc4cf000/pm8941@0/vadc@3100/die_temp
```

```
Warning (unit_address_vs_reg): Node /soc/spmi@fc4cf000/pm8941@0/vadc@3100/ref_625m
```

```
Warning (unit_address_vs_reg): Node /soc/spmi@fc4cf000/pm8941@0/vadc@3100/ref_1250v
```

```
Warning (unit_address_vs_reg): Node /soc/spmi@fc4cf000/pm8941@0/vadc@3100/ref_gnd h
```

```
Warning (unit_address_vs_reg): Node /soc/spmi@fc4cf000/pm8941@0/vadc@3100/ref_vdd h
```

```
make[1]: Leaving directory `/local/frowand_nobackup/src/git_linus/build/dragon_linus_4.10'
```

# Kernel Configuration Info -- OLD

```
dt_to_config \
  arch/arm/boot/dts/qcom-apq8074-dragonboard.dts \
  --short-name \
  --config ${KBUILD_OUTPUT}/.config \
  --config-format \
  > dragon_config_info
```

```
$ grep -i coincell dragon_config_info
```

```
# -d-c-----n--F : coincell@2800 : qcom,pm8941-coincell : drivers/misc/qcom-coincell.c : CONFIG_QCOM_COINCELL : n
# CONFIG_QCOM_COINCELL is not set
# CONFIG_QCOM_COINCELL=y
```

```
# -d-c-----n--F : coincell@2800 : qcom,pm8941-coincell : .....
# CONFIG_QCOM_COINCELL is not set
# CONFIG_QCOM_COINCELL=y
```



# Debug Tools -- semi-OLD

scripts/dtc/dt\_prop

- Compare properties accessed on target system vs a device tree (dtX)
- available on [elinux.org](http://elinux.org)
- Plan to submit to mail list “any day now”  
==> Stalled, awaiting some of Frank's bandwidth

# dt\_prop example snippets

```
$ dt_prop --td dmesg_4.5-rc5_160307_2100 qcom-apq8074-dragonboard.dts
```

```
# --- dmesg_4.5-rc5_160307_2100  
# +++ qcom-apq8074-dragonboard.dts  
/dts-v1/;
```

```
                // ***** i2c@f9964000 disabled *****  
i2c@f9964000 {  
+               #address-cells;  
+               #size-cells;  
+               clock-names;  
+               clocks;  
+               compatible;  
+               interrupts;  
+               reg;  
+               status;  
};
```

# Debug Tools - OLD

dt\_node\_info, dt\_stat

- Provide info about device tree nodes from /proc/device-tree files
- proof of concept on elinux.org
- Stalled, awaiting some of Frank's bandwidth

# dt\_node\_info example 1

```
$ dt_node_info coincell
```

```
==== devices
```

```
==== nodes
```

```
/soc/spmi@fc4cf000/pm8941@0/qcom,coincell@2800 qcom,
```

```
==== nodes bound to a driver
```

```
==== nodes with a device
```

```
==== nodes not bound to a driver
```

```
/soc/spmi@fc4cf000/pm8941@0/qcom,coincell@2800 qcom,
```

```
==== nodes without a device
```

```
/soc/spmi@fc4cf000/pm8941@0/qcom,coincell@2800 qcom,
```

# dt\_node\_info example 2

```
$ dt_node_info coincell
```

```
==== devices
```

```
/sys/devices/platform/soc/fc4cf000.spmi/spmi-0/0-00/
```

```
==== nodes
```

```
/soc/spmi@fc4cf000/pm8941@0/qcom,coincell@2800 qcom,
```

```
==== nodes bound to a driver
```

```
==== nodes with a device
```

```
/soc/spmi@fc4cf000/pm8941@0/qcom,coincell@2800 qcom,
```

```
==== nodes not bound to a driver
```

```
/soc/spmi@fc4cf000/pm8941@0/qcom,coincell@2800 qcom,
```

```
==== nodes without a device
```

# Debug Tools - OLD

dtc: dts source location annotation

- Provide source locations from .dts & .dtsi
- Several proof of concept versions on devicetree-compiler list
- Stalled, awaiting some of Frank's bandwidth

# source location annotation

----- short format -----

```
sdhci@f9824900 { /* qcom-apq8074-dragonboard.dts:14 */
    compatible = "qcom,sdhci-msm-v4"; /* qcom-msm8974.dtsi:240 */
    reg = <0xf9824900 0x11c 0xf9824000 0x800>; /* qcom-msm8974.dtsi:241 */
    reg-names = "hc_mem", "core_mem"; /* qcom-msm8974.dtsi:242 */
    interrupts = <0x0 0x7b 0x0 0x0 0x8a 0x0>; /* qcom-msm8974.dtsi:243 */
    interrupt-names = "hc_irq", "pwr_irq"; /* qcom-msm8974.dtsi:244 */
    clocks = <0xd 0xd8 0xd 0xd7>; /* qcom-msm8974.dtsi:245 */
    clock-names = "core", "iface"; /* qcom-msm8974.dtsi:246 */
    status = "ok"; /* qcom-apq8074-dragonboard.dts:17 */
    bus-width = <0x8>; /* qcom-apq8074-dragonboard.dts:15 */
    non-removable; /* qcom-apq8074-dragonboard.dts:16 */
}; /* qcom-apq8074-dragonboard.dts:18 */
```

THE END

Thank you for your participation...

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Questions?

Comments?

# Resources

[http://elinux.org/Device\\_Tree\\_presentations\\_papers\\_articles](http://elinux.org/Device_Tree_presentations_papers_articles)

[http://elinux.org/Device\\_Tree\\_presentations\\_papers\\_articles#debug](http://elinux.org/Device_Tree_presentations_papers_articles#debug)

[http://elinux.org/Device\\_Tree\\_Reference](http://elinux.org/Device_Tree_Reference)

# Resources

**dtx\_diff**

**dtc --annotate**

**dt\_node\_info**

Solving Device Tree Issues:

Frank Rowand, elce 2015

[http://elinux.org/images/0/04/Dt\\_debugging\\_elce\\_2015\\_151006\\_0421.pdf](http://elinux.org/images/0/04/Dt_debugging_elce_2015_151006_0421.pdf)

(In this presentation, dtx\_diff was named dtdiff.)

Supporting material for: Solving Device Tree Issues:

[http://elinux.org/Device\\_Tree\\_frowand](http://elinux.org/Device_Tree_frowand)

section: Embedded Linux Conference Europe (ELCE) - October 6, 2015

**dt\_to\_config**

Solving Device Tree Issues - Part 2:

Frank Rowand, LinuxCon Japan 2016

[http://elinux.org/images/5/50/Dt\\_debugging\\_part\\_2.pdf](http://elinux.org/images/5/50/Dt_debugging_part_2.pdf)

# Resources

## dt\_prop

Solving Device Tree Issues - Part 3:

Frank Rowand, elce 2016

[http://elinux.org/images/e/e5/Dt\\_debugging\\_part\\_3.pdf](http://elinux.org/images/e/e5/Dt_debugging_part_3.pdf)

Supporting material for: Solving Device Tree Issues - Part 3:

kernel patches

scripts/dtc/dts\_diff

scripts/dtc/dt\_prop

[http://elinux.org/Device\\_Tree\\_frowand](http://elinux.org/Device_Tree_frowand)

section: Resources for "Solving Device Tree Issues - Part 3" talk

# How to get a copy of the slides

1) [frank.rowand@sony.com](mailto:frank.rowand@sony.com)

2) [http://elinux.org/Device\\_Tree](http://elinux.org/Device_Tree)

3) <http://events.linuxfoundation.org>

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