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Is the Zephyr Device Tree Too Complicated?

Tim Guite – Magpie Embedded

About the Speaker



Tim Guite is an experienced embedded systems engineer who has worked across medical devices, sub-sea robotics and particle accelerators at multiple layers of the stack. He is happy when his desk is covered in development boards, jumper wires and various sensors. He is passionate about open source and sharing knowledge in the hopes that will lead to better, more robust systems and have a positive impact on the world.

Betteridge's Law of Headlines:

Any headline that ends in a question mark can be answered by the word

NO

Maybe

(for a lot of users)
(Useful tools have arrived!)



50% Background, 50% Proposals

50% Background, 50% Proposals

50% Background, 40% Fixes, 10% Proposals

Getting Started



The screenshot shows the Zephyr Getting Started Guide webpage. The page has a dark blue header with the Zephyr logo and a search bar. The main content area is white and contains the title 'Getting Started Guide' and a list of steps to follow. The background of the entire image is a scenic view of a dirt path leading through a field with large trees under a cloudy sky.

Zephyr

Search docs (powered by Google)

Getting Started Guide

Select and Update OS
Install dependencies
Get Zephyr and install Python dependencies
Install the Zephyr SDK

Docs / Latest » Developing with Zephyr » Getting Started Guide
[Open on GitHub](#) [Report an issue with this page](#)

Getting Started Guide

Follow this guide to:

- Set up a command-line Zephyr development environment on Ubuntu, macOS, or Windows (instructions for other Linux distributions are discussed in [Install Linux Host Dependencies](#))
- Get the source code
- Build, flash, and run a sample application

Next Steps

Copyright: Jason Priem ([link](#))



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Next Steps

KConfig

DeviceTree

alias/label/node

Where is the actual
driver code?

Where does the I2C
address go?

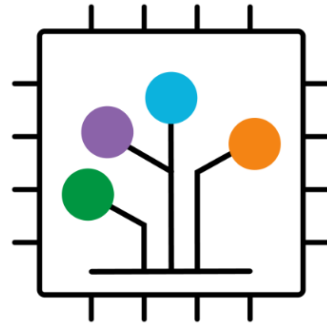
Copyright: Jason Priem ([link](#))

**This will make a lot of sense if you have
kernel development experience**



What is it for?

- “A devicetree is primarily a hierarchical data structure that describes hardware” – [Zephyr Device Tree Docs](#)
- Framework for specifying hardware for embedded systems
- Flexible and powerful for maintainers and power users
- Confusing for developers who just want to set up chains of I2C and SPI devices which are already supported in Zephyr – the majority?



Devicetree Specification

Release v0.4

`devicetree.org`

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

Sensor Samples

- Redundant information
- Device specific
- Convention driven?
- Hard to follow through to driver code
- Not well abstracted like **blinky**
- Less clear than custom HAL class in C or C++ (the competition)

```
samples > sensor > bmi270 > app.overlay
1  /*
2   * Copyright (c) 2021 Bosch Sensortec GmbH
3   *
4   * SPDX-License-Identifier: Apache-2.0
5   */
6
7  &arduino_i2c {
8      status = "okay";
9  }
10 bmi270@68 {
11     compatible = "bosch,bmi270";
12     reg = <0x68>;
13 };
14
```

Is there an easier way?

- Simple definitions for I2C and SPI devices
 - Combine with info from bindings
 - Faster feedback on DT errors
 - Easier to build portable systems
 - Compile to .dts files
-
- Reduces flexibility
 - Another tool may add complexity
 - Unforeseen interactions between DT and KConfig

Flattening the Learning Curve

- Additional info given in generated **zephyr.dts** as of 4.2
- Amazing DTS LSP work!
- DTS formatting PRs open now: #92805
- Graphical viewer from Nordic
- DTSH tool for interacting with Device Tree

DTS LSP

```
#define WITHPATH DT_PATH(soc, peripheral_50000000, )

/*
 * A build error on this line means your board is un
 * See the sample documentation for information on h
 */
static const struct gpio_dt_spec led = GPIO_DT_SPEC_
int main(void)
{
    int ret;
    bool led_state = true;

    if (!gpio_is_ready_dt(&led)) {
        return 0;
    }

    ret = gpio_pin_configure_dt(&led, GPIO_OUTPUT_ACTIVE);
    if (ret < 0) {
        return 0;
    }

    while (1) {
        ret = gpio_pin_toggle_dt(&led);
        if (ret < 0) {
            return 0;
        }
    }
}
```

adc_0000
clock_5000
clock_controller_4000
comparator_1a000
ctrlap_6000
dcnf_0
dppic_17000
egu_1b000
egu_1c000
egu_1d000
egu_1e000
egu_1f000

Path
/soc/peripheral@50000000/clock@5000

Current State
clock: clock@5000 {
 compatible = "nordic,nrf-clock";
 reg = <20480 /* 0x5000 */ 4096 /* 0x10
 interrupts = <5 /* 0x5 */ 1 /* NRF_DEF
 status = "okay";
};

Description
Nordic nRF clock control node

```
18 &spi0 {  
19     status = "okay";  
20     node@20 {  
21         reg = <0x20>;  
22         ranges = <>;  
23         compatible = "bosch,bma280";  
24     };  
25 };
```

You, 1 hour ago | 1 author (You)
Binding should be used on bus types: i2c devicetree
View Problem (⌘F8) No quick fixes available

Could It Be Easier?

- Abstract device trees for portability
- Connection between source code and device tree
- `zephyr\scripts\dts\python-devicetree\src\devicetree\edtlib.py`
- `zephyr\scripts\dts\python-devicetree\src\devicetree\dtlib.py`
- Have classes for working with device trees and bindings

Resources

- [Practical Zephyr](#) by Martin Lampacher
- [Using the Device Tree](#) by Cirbuit Dojo
- [Zephyr Tutorial](#) by Javad Rahimipetroudi at Mind
- [Device Tree Tutorial](#) by Shawn Hymel
- [DTS LSP](#) by Kyle Bonnici at Nordic Semiconductor
- [Nrf DeviceTree Editor](#) by Nordic Semiconductor
- [dtsh](#) by Chris Duf and Luca Burelli
- [Abstract Hardware Interfaces](#) by Chris Wilson at Goliath



Thank You!
magpieembedded.co.uk/zds25

