

## On-board LED blinking example

This application blinks an LED forever using the GPIO API. The board has an LED connected via a GPIO pin which is toggled. The LED must be configured using the led0 devicetree alias. This is usually done in the BOARD.dts file or a devicetree overlay. The same is

```
leds {
    compatible = "gpio-leds";
    led0: led_0 {
        gpios = <&gpio0 13 GPIO_ACTIVE_LOW>;
        label = "Green LED 0";
    };
};
```

Figure 2: led0 is BOARD.dts

also present in the final devicetree source file after an application is built for a specific board. This can be found in **build/zephyr/zephyr.dts**

Once the application (blinking in this case) is built, zephyr stores the cache files in **/home/.cache/zephyr**. If the application is built again, zephyr uses the cached files to reflect the output instead of building the whole application again. It is the speciality of zephyr that, in most cases, only specific parts of the code is compiled again where the newest changes are made, to save time (which is done using the cached contents). Here is an image showing the cached files: The

```
./ .cache/zephyr > ls
ToolchainCapabilityDatabase
./ .cache/zephyr > cd ToolchainCapabilityDatabase
./ .cache/zephyr/ToolchainCapabilityDatabase > ls
00054d5282582c8c2605505f0029f0e6 358987816c1074d93420ae6aa2f2dab0 63783b198a9a330ceb2c0844a870db28 944733ac0791512a959d0656fd0abca7 ccf912a7ce45ab8dcfb2e0a4c143373d
01c039c12b0d47f2106da4982a91cf1b 3592716b7a3e592708c9972770bda0a8 6645eba148733ee0edf848426ebd11d4 97fed22a75893f3614d4aa05e2494052 cdecff9a70d1493e3d28059ae34854c
555f5d4fb92fb7380026f1bd2b1c0ae8 376bc03c6bf1fd0f777090958ed3528 66b8feca391aabc5f5da6b45b96e2f42 9807651731d6118af03d50d4c6e548ad cf4d66c4dc5041c7b9d2b3d8643617ce
06026add7a8b9783ee5c7256fb104c0d 3a527b534e3d065c43886b0261f7c7ee 676212d6036d7421d7c79f7c9934ec5a 990747e7706979f578502aa1d46e2f25 cfe91b61e55e77c13709345afbfcd4b0
723c69ddb71ca1aa0eb33af9eaa5af 3ae75c01f3268075186725644889019e 6934a06c7ed2907c285f39ff1bfc9c1d 9ccad06c930fc5da5d1e725dd357d36e d170149006d58c70615a206f8201a6f7
07a000d6947e217e5bc6a8d5bea91781 3c0d1079de2ec6527091168a287548fe 6c27f8711b450c496697491d26496af2 9f307c99b2902af150713255064a616f d528e364d65f65f756b0813867e31a30
08a898b71f967a3b37890ea8d535187d 3cf8a81fd84452a0a7f58fe3649e79b 6d5e6c95e5c0ed9eae078b95828bd4f1 9fe7b1f02c958e669a049d812f042c39 d6d1d3f2d4e144f9477ce44060935606
999377460de63970cf7f0ff7a80d4274 3d85dcfad00e799c0ae9aa6583b5cd93 6dffdf791fb7da89ad513fe70f8f2f9e4 a0179c4884974773cca79dec391a6c10 db6a9ae027d2812057fe159900cbcd39
0a008f4115798dab619d34c5b318c16 3d93a6aec5da4e4f9275529a1b29ca49 6e4f8bbcd7eda053b04d3c6348e2cf5 a412b9a50f46ce940a2d170f08e8ed57 dbbbbc18778b0836274606c22f3af8227
b5e306e963e8329d9da0b85625980a 3da6518984d40f19ae7b23aeec750947 737f8f38a00f8f41a12161cfad6c2e37 a4efe84c64ba694d00d87d0768c431be dbf3b89ca924f40480571f664d37c613
0f83b10886ecc83cb4086bd8db356336 405524d83ba4308c6d6e17bd48a531e 75bc93113b6d19a974d3787e782ee17d dc0f1b318403e5cb3a43e7566cb2cf21
121020431964879c220a93cd267ce0c 4348245e9777ea0017b2655d6fe2d6f7 771b738142532a35d589cf56af1d190d3 dc78284d17c3a994988f9c9abba0aa474
127eal74af1344671e7d75d4d54b0feb 4461a5f3101b04f8404e744a25623fe1 776e27b02e1b0bbaafbf91a5eb1ff7d313 d000db10badf8c8924a5f58d7f638f0da
12845064cd3bde6f5b4d340dc50dd124 4721619658b7f31d0ec59976eeae94cfe 7794eb261cb79d304d2c1269739e1dc9 deaa353a74084ed91847ed5139a5c02e
289116c65a61c9b07a6d9f5d9e521bc 472445b763a0e1b51800bafae097a4f5 78894c208c7e9b299380f8a3375de7d ac89ea9ced5f3348d036c2e85f46312c deef3f3b65f08cf1c4ea05a719469b
3935703067526eb26272bce8078674 48bc35fe15f21dd4e054949d1d8a2 78da577adfb59c23893b8f278002652 deea7b5a18b2f5ddce0fbd0691f4611f deea7b5a18b2f5ddce0fbd0691f4611f
56022b25ce4dfad132a660f68e9b 49e2cd09330fa4082881a8b932b1cbe 7baa5512e7a894ca3c8750973af4c7eb fdd0b22f13b534d2737831777f1d16f9 fdd0b22f13b534d2737831777f1d16f9
08054d3c68d4911ceda65f7772c870 45c4449a2f5dbfca10d59ae8869664 7c13e980d26923b4b5c8e8ca0ad85d60 e8b46080f118d6e6239f4c60818000b
9c06690938327500a19ca82f20b10f 4d36526ac39fc4141b1bec4150c63bb8d 7c16e8d123c9de19729e81acd0bde1ce e8f7280c235b9b069e1c3028395d753fe
1af6a85b9291755b1b6214d6a17a05d0 4ff8ab9274eb29c82428e5ef6feb01e6 7ce92592f473e3c8b7ca980e1b65acc b1948f0977afac1184c2013e72b2c28
b0e559d1fc11bd054d8c83f737087d7f 5d29c2a2d4b841c5036a6197a65477fa 7ceeb76d3b36a4c50408fc50a53f3631 b2ad75b4c954ea76e9be1db71d745427
c3ae62dd86e7075e703eb54bad9d6a3 54e0fff1b6359e550e1bdd29d0878ba88 8047569cb307a3a358c3055f18371c29f b4737a28ca151e7eeca9782e67c6966
cb6450f48750958d930911ba2cd42df 59922563a24613d59a97936606ef95b1 82306a6b2e56e1e127e1b2f92841844 b500387e0365de6a80632b04159c4107
ef12a3001ecdded0953c1282e2ca9f 56a74cd959b08ed1332a19e3e653d242b 84169e6f6aa2ac24422e7257fbeb60a5 b542db6ed262e98a24c204ec1578afce
01d1a283db5257c69cab34840a1f0936 57889e55cb052146752d36733dded2be 87c00f05ed994caefb76b88d19fd39d3 b6546a8882c19bee13e27d61ea159c8c
211ef28a5511df8c80b6af26ef6cfa4e 583dbad7f34eb62f07f06b66d6020aaf 88418b85e13652cdf4eeced7e2c1606 b7e402f6dffc172a19318524e5627bc4
248572508d952d6613b82990b9a2e290 5a9dbdb9fbaafcf2e19587fe9e9267134 84482f997966bcb43833cf34c7e335 b8f46920a2faa337577a74d3d5778d0d
2682d63f971c4ddc05737f0f9a0b3687 5d26e17c2ade46d4035319e55a367599 8b9e3a0c3ca132500269a8e35f0c4da8 bf1ded77557057fabc03822041a34347
792348a84dc9d0379b0334b3f783fce 5fbd0dc7dd001f2c2523641b08f88723 8d34af7b19287d56d19b89a8f715a02f c0a3c5e6a102da5a9cdaaff0425724378
295baa91513f5f15ec2679ecb7f5a65f 606aa71841626f28a4150db905917f3b 9299d3a2bf9f2972d49530df173842d c133fa48140b42da90447e1e951d0e3f
2c6ccbbe054bbd2b7923919907e5633ae 6376d9a924f6303937269c0db28bbff5 94083fc9c33d6f195b5438350c6c02e c7fdd164cb2fb629786d072af54028bc
30d26e2119ef84b9a78f98a4408cd31 6376d9a924f6303937269c0db28bbff5 94083fc9c33d6f195b5438350c6c02e caf98740e77d9dcabc3c0da1b51cf09a
./ .cache/zephyr/ToolchainCapabilityDatabase > ll
```

Figure 3: Cache

contents of **/home/.cache/zephyr** are not human-readable, which can be observed from the image above.



```

1 CONFIG_GPIO=y
2 # CONFIG_SPI is not set
3 # CONFIG_I2C is not set
4 # CONFIG_KSCAN is not set
5 # CONFIG_WIFI is not set
6 CONFIG_NET_CONFIG_IEEE802154_DEV_NAME=""
7 # CONFIG_MODEM is not set
8 # CONFIG_UART_INTERRUPT_DRIVEN is not set
9 CONFIG_BOARD="nrf52840dk_nrf52811"
10 CONFIG_SOC="nrf52811_QFAA"
11 CONFIG_SOC_SERIES="nrf52"
12 CONFIG_NUM_IRQS=30
13 CONFIG_SYS_CLOCK_HW_CYCLES_PER_SEC=32768
14 # CONFIG_WATCHDOG is not set
15 CONFIG_HEAP_MEM_POOL_SIZE=0
16 CONFIG_ROM_START_OFFSET=0
17 # CONFIG_UART_NSI6550 is not set
18 CONFIG_PM=y
19 # CONFIG_PM_DEVICE is not set
20 CONFIG_SOC_HAS_TIMING_FUNCTIONS=y
21 CONFIG_ARCH_HAS_CUSTOM_BUSY_WAIT=y
22 # CONFIG_CORTEX_M_SYSTICK is not set
23 CONFIG_CLOCK_CONTROL=y
24 CONFIG_NRF_RTC_TIMER=y
25 CONFIG_SYS_CLOCK_TICKS_PER_SEC=32768
26 CONFIG_BUILD_OUTPUT_HEX=y
27 CONFIG_FLASH_SIZE=192
28 CONFIG_FLASH_BASE_ADDRESS=0x0
29 # CONFIG_GPIO_MCUX is not set
30 # CONFIG_CPU_HAS_CUSTOM_FIXED_SOC_MPU_REGIONS is not set
31 # CONFIG_TINYCRYPT is not set
32 CONFIG_SERIAL=y
33 # CONFIG_UART_PL011 is not set
34 # CONFIG_SRAM_VECTOR_TABLE is not set

```

Figure 6: Caption

Unsure explanation: The *prj.conf* file has similar configuration options as that of *.config* file shown above. The *prj.conf* in the application directory may be a derivative of the *.config* file in some way.

Alternate explanation: From the zephyr codebase, *Kconfig* and *Kconfig.zephyr* is parsed. All the board related configuration files are loaded from the zephyr codebase's *zephyr/boards/arm/nrf52840dk\_nrf52811/nrf52840dk\_nrf52811\_defconfig* and then *west* merges the mentioned *defconfig* file with the application directory's *prj.conf* file. The final configuration file is saved to */build/zephyr/.config*. If this is successful, the *Kconfig* header is generated in */build/zephyr/include/generated/autoconf.h*.

The image below is a comparison between the *.config* file and the *autoconf.h*

```

25 # CONFIG_SPI is not set
26 # CONFIG_I2C is not set
27 # CONFIG_KSCAN is not set
28 # CONFIG_WIFI is not set
29 CONFIG_NET_CONFIG_IEEE802154_DEV_NAME=""
30 # CONFIG_MODEM is not set
31 # CONFIG_UART_INTERRUPT_DRIVEN is not set
32 CONFIG_BOARD="nrf52840dk_nrf52811"
33 CONFIG_SOC="nrf52811_QFAA"
34 CONFIG_SOC_SERIES="nrf52"
35 CONFIG_NUM_IRQS=30
36 CONFIG_SYS_CLOCK_HW_CYCLES_PER_SEC=32768
37 # CONFIG_WATCHDOG is not set
38 CONFIG_HEAP_MEM_POOL_SIZE=0
39 CONFIG_ROM_START_OFFSET=0
40 # CONFIG_UART_NSI6550 is not set
41 CONFIG_PM=y
42 # CONFIG_PM_DEVICE is not set
43 CONFIG_SOC_HAS_TIMING_FUNCTIONS=y
44 CONFIG_ARCH_HAS_CUSTOM_BUSY_WAIT=y
45 # CONFIG_CORTEX_M_SYSTICK is not set
46 CONFIG_CLOCK_CONTROL=y
47 CONFIG_NRF_RTC_TIMER=y
48 CONFIG_SYS_CLOCK_TICKS_PER_SEC=32768
49 CONFIG_BUILD_OUTPUT_HEX=y
50 CONFIG_FLASH_SIZE=192
51 CONFIG_FLASH_BASE_ADDRESS=0x0
52 # CONFIG_GPIO_MCUX is not set
53 # CONFIG_CPU_HAS_CUSTOM_FIXED_SOC_MPU_REGIONS is not set
54 # CONFIG_TINYCRYPT is not set
55 CONFIG_SERIAL=y
56 # CONFIG_UART_PL011 is not set
57 # CONFIG_SRAM_VECTOR_TABLE is not set
58 #
59 #
60 # modules
61 build/zephyr/.config
62 com: 2% ln:27/980%1
63
64 #define CONFIG_GPIO 1
65 #define CONFIG_NET_CONFIG_IEEE802154_DEV_NAME ""
66 #define CONFIG_BOARD "nrf52840dk_nrf52811"
67 #define CONFIG_SOC "nrf52811_QFAA"
68 #define CONFIG_SOC_SERIES "nrf52"
69 #define CONFIG_NUM_IRQS 30
70 #define CONFIG_SYS_CLOCK_HW_CYCLES_PER_SEC 32768
71 #define CONFIG_HEAP_MEM_POOL_SIZE 0
72 #define CONFIG_ROM_START_OFFSET 0x0
73 #define CONFIG_PM 1
74 #define CONFIG_SOC_HAS_TIMING_FUNCTIONS 1
75 #define CONFIG_ARCH_HAS_CUSTOM_BUSY_WAIT 1
76 #define CONFIG_CLOCK_CONTROL 1
77 #define CONFIG_NRF_RTC_TIMER 1
78 #define CONFIG_SYS_CLOCK_TICKS_PER_SEC 32768
79 #define CONFIG_BUILD_OUTPUT_HEX 1
80 #define CONFIG_FLASH_SIZE 192
81 #define CONFIG_FLASH_BASE_ADDRESS 0x0
82 #define CONFIG_SERIAL 1
83 #define CONFIG_ZEPHYR_CANOPENNODE_MODULE 1
84 #define CONFIG_ZEPHYR_HAL_NORDIC_MODULE 1
85 #define CONFIG_ZEPHYR_HAS_NORDIC_DRIVERS 1
86 #define CONFIG_NRF_802154_SOURCE_HAL_NORDIC 1
87 #define CONFIG_ZEPHYR_HAS_NRF52 1
88 #define CONFIG_NRF52_CLOCK 1
89 #define CONFIG_NRF52_CLOCK_LFXO_TWO_STAGE_ENABLED 1
90 #define CONFIG_NRF52_GPIO 1
91 #define CONFIG_NRF52_PPI 1
92 #define CONFIG_ZEPHYR_L432MAC_NODE_MODULE 1
93 #define CONFIG_ZEPHYR_L432_MODULE 1
94 #define CONFIG_ZEPHYR_MBEDTLS_MODULE 1
95 #define CONFIG_ZEPHYR_NANOS60_MODULE 1
96 #define CONFIG_ZEPHYR_SOF_MODULE 1
97 #define CONFIG_ZEPHYR_TENSORTFLOW_MODULE 1
98 #define CONFIG_ZEPHYR_TRACKERORDER_MODULE 1
99 #define CONFIG_ZEPHYR_TRUSTED_FIRMWARE_M_MODULE 1
100 #define CONFIG_ZEPHYR_HAS_CM4S1S_CORE 1
101 build/zephyr/include/generated/autoconf.h
102 cpp 0% ln:1/257%1

```

Figure 7: Caption