



life.augmented

STM32WL Lorawan & Sigfox

Coexistence is possible

Key learning

- Cover both Lorawan & Sigfox protocol stack in **one app**,
- Basic introduction to sw implementation
- Working Lorawan & Sigfox application example in practice,

Dual protocol

Thanks to Sequencer it is easy to combine more than one app process

IDE LoRaWAN_Sigfox_send_on_timer (in STM32CubeIDE)

- > Binaries
- > Includes
- ▼ Application
 - > Core
 - ▼ LoraWan_App
 - > app_lorawan.c
 - > lora_app.c
 - > lora_info.c
 - ▼ Sigfox_App
 - > app_sigfox.c
 - > ee.c
 - > mcu_api.c
 - > mn_api.c
 - > rf_api.c
 - > se_nvm.c
 - > sgfx_app.c
 - > sgfx_credentials.c
 - > sgfx_cstimer.c
 - > sgfx_eeprom_if.c
 - > Startup
 - > Target
 - > Debug
 - > Drivers
 - ▼ Middlewares
 - > LoRaWAN
 - > Sigfox
 - > SubGHz_Phys
 - > Utilities

```
while (1)
{
    if (active_app == ACTIVE_APP_LORAWAN)
    {
        MX_LoRaWAN_Process();
    }
    else
    {
        MX_Sigfox_Process();
    }
}
```

Dual protocol

B1 button EXTI is used to switch active LPWAN protocol

```
void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin)
{
    switch (GPIO_Pin)
    {
        case SYS_BUTTON1_PIN:
            if (active_app == ACTIVE_APP_LORAWAN)
            {
                active_app= ACTIVE_APP_SIGFOX;
            }
            else
            {
                active_app= ACTIVE_APP_LORAWAN;
            }
            NVIC_SystemReset();
            break;
        .
        .
        .
    }
}
```



Dual protocol

App Sigfox/Lorawan control variable is placed in RAM2 and not initialized (no init) to keep value after MCU reset

```
UTIL_MEM_PLACE_IN_SECTION("MB_MEM2") uint32_t active_app;
```

Linker code excerpt

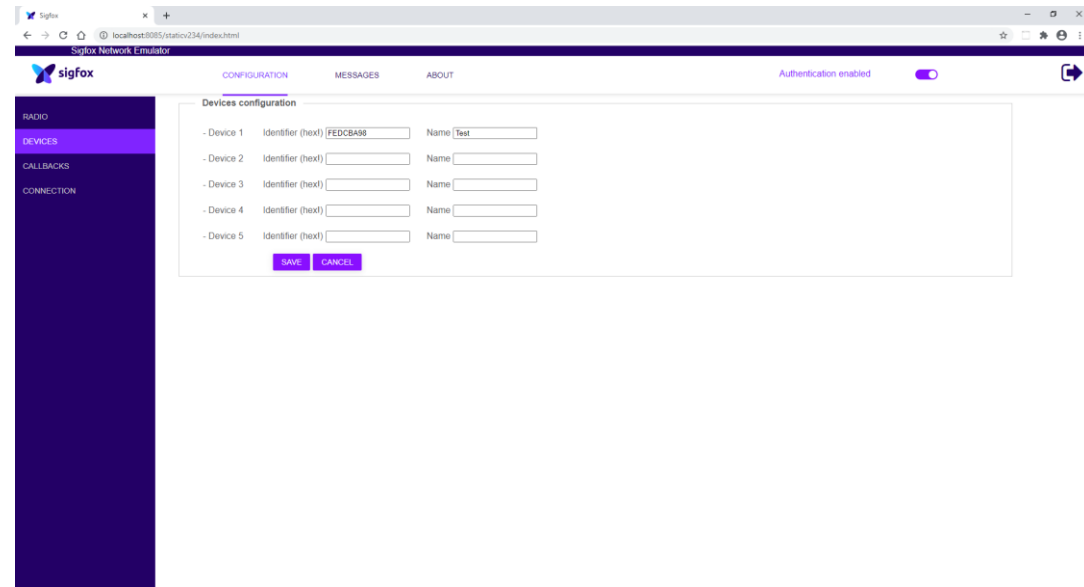
```
RAM2    (xrw)    : ORIGIN = 0x20008000, LENGTH = 32K    /* Backup SRAM2 */  
.  
.  
MB_MEM2 (NOLOAD) : { *(MB_MEM2) } >RAM2
```

Dual protocol

- Lorawan hands-on scenario is reused (uplink/downlink),
- Sigfox app (default) sends periodically to the network temperature value (2 bytes),
- Public Key is used for Sigfox app,





```
if (E2P_Read_KeyType() != CREDENTIALS_KEY_PUBLIC)
{
    E2P_Write_KeyType(CREDENTIALS_KEY_PUBLIC);
}
```

- SDR Dongle and Sigfox Network Emulator is used
www.sdrdongle.sigfox.com



Dual protocol

Memory footprint, STM32CubeIDE, Optimization level: NONE (-O0)

Memory Regions		Memory Details				
Region	Start address	End address	Size	Free	Used	Usage (%)
 ROM	0x08000000	0x08040000	256 KB	117,8 KB	138,2 KB	53,99%
 SIGFOX_DATA	0x0803e500	0x0803e800	768 B	768 B	0 B	0,00%
 RAM1	0x20000000	0x20008000	32 KB	19,55 KB	12,45 KB	38,89%
 RAM2	0x20008000	0x20010000	32 KB	32 KB	4 B	0,01%

Dual protocol

Sigfox Network Emulator, MESSAGES view

The screenshot displays the Sigfox Network Emulator interface, specifically the MESSAGES view. The browser address bar shows `localhost:8085/staticv234/index.html`. The interface includes a navigation bar with tabs for CONFIGURATION, MESSAGES (selected), and ABOUT. A toggle for 'Authentication enabled' is visible on the right.

The main table lists messages from device `FEDCBA98`. The columns are Device ID, Time, Sequence number, Data / Decoding, LQI, and Callbacks. The 'Data / Decoding' column for the first message (Sequence number 970) shows `0018`, which is highlighted with a red box. A blue box with the text `0x18 = 16 + 8 = 24°C` has an arrow pointing to this value. The LQI column shows a signal strength indicator (four bars) for each message.

On the right side, a black box displays the 'SIGFOX APPLICATION READY' log for device `FEDCBA98`. The log shows a sequence of events, including sending data, RF API initialization, and transmission details. A red box highlights the entry `0s018:temp= 24`, which corresponds to the `0018` data value in the table.

Device ID	Time	Sequence number	Data / Decoding	LQI	Callbacks
FEDCBA98	Nov 12, 2020 10:31:17 AM	970	0018		i
FEDCBA98	Nov 12, 2020 10:31:01 AM	969	0018		i
FEDCBA98	Nov 12, 2020 10:30:47 AM	968	0019		i
FEDCBA98	Nov 12, 2020 10:30:32 AM	967	0018		i
FEDCBA98	Nov 12, 2020 10:30:17 AM	966	0018		i
FEDCBA98	Nov 12, 2020 10:30:01 AM	965	0018		i
FEDCBA98	Nov 12, 2020 10:29:47 AM	964	0018		i
FEDCBA98	Nov 12, 2020 10:29:32 AM	963	0017		i
FEDCBA98	Nov 12, 2020 10:29:17 AM	962	0018		i
FEDCBA98	Nov 12, 2020 10:29:01 AM	961	0018		i
FEDCBA98	Nov 12, 2020 10:28:47 AM	960	0018		i
FEDCBA98	Nov 12, 2020 10:28:32 AM	959	0017		i
FEDCBA98	Nov 12, 2020 10:28:17 AM	958	0017		i
FEDCBA98	Nov 12, 2020 10:28:01 AM	957	0018		i
FEDCBA98	Nov 12, 2020 10:27:47 AM	956	0018		i
FEDCBA98	Nov 12, 2020 10:27:31 AM	955	0018		i

```
SIGFOX APPLICATION READY
Device ID: FEDCBA98
0s018:temp= 24
0s018:Sending data...
0s020:RF_API_init in TX
0s021:RF at Freq 868074200
0s034:TX START:nB=18
0s044:Wait For End of Tx
1s595:OnTxDone
1s595:End Of Tx
1s595:TX END
1s595:RF_API_stop
1s597:Delay= 880 ms
2s477:Delay Up
2s477:RF_API_init in TX
2s477:RF at Freq 868114500
2s478:TX START:nB=18
2s489:Wait For End of Tx
4s040:OnTxDone
4s040:End Of Tx
4s040:TX END
4s040:RF_API_stop
4s041:Delay= 880 ms
4s921:Delay Up
4s921:RF_API_init in TX
4s921:RF at Freq 868195100
4s922:TX START:nB=18
4s933:Wait For End of Tx
6s484:OnTxDone
6s484:End Of Tx
6s484:TX END
6s484:RF_API_stop
6s486:Delay= 880 ms
7s366:Delay Up
7s366:Done
```


Dual protocol

Sigfox app

B1 button press

Lorawan app

```
4s933:Wait For End of Tx
6s484:OnTxDone
6s484:End Of Tx
6s484:TX END
6s484:RF_API_stop
6s486:Delay= 880 ms
7s366:Delay Up
7s366:Done

APP_VERSION:      U1.0.0
MW_LORAWAN_VERSION: U2.2.1
MW_RADIO_VERSION:  U0.6.1
##### OTAA #####
##### AppKey:  2B 7E 15 16 28 AE D2 A6 AB F7 15 88 09 CF 4F 3C
##### NwkKey:  2B 7E 15 16 28 AE D2 A6 AB F7 15 88 09 CF 4F 3C
##### ABP #####
##### AppSKey: 2B 7E 15 16 28 AE D2 A6 AB F7 15 88 09 CF 4F 3C
##### NwkSKey: 2B 7E 15 16 28 AE D2 A6 AB F7 15 88 09 CF 4F 3C
##### DevEui:  00-80-E1-15-00-01-94-0B
##### AppEui:  01-01-01-01-01-01-01-01

LORAWN APPLICATION READY

0s045:TX on freq 868500000 Hz at DR 0
1s550:MAC txDone
6s572:RX_1 on freq 868500000 Hz at DR 0
6s708:PRE OK
7s244:HDR OK
8s391:MAC rxDone

##### = JOINED = OTAA =====
15s068:temp= 25
15s069:TX on freq 868300000 Hz at DR 0
16s236:MAC txDone
17s257:RX_1 on freq 868300000 Hz at DR 0
17s394:PRE OK
17s930:HDR OK
18s421:MAC rxDone

##### ===== MCPS-Confirm =====
18s424:AppMsg -> INCREASE temperature.
```

Sigfox uplink done

Lorawan uplink

Lorawan downlink

Thank you