SubGHz KIT
Development guide

Version 1.0

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1. Revision History

Version	Author(s)	Description	Date
1.0	A. Matveev	Init version	2011-05-13
1.1	A. Voronov	Finished the document	2014-01-17

2. Content

3. Introduction

3.1. DOCUMENT'S PURPOSE

The document describes ZBOSS SubGHz development KIT, based on OLIMEX STM32-E407 or STM32F4DISCOVERY boards and Texas Instruments SimpleLink CC1200 Low Power, High Performance RF Transceiver.

3.2. INTENDED AUDIENCE

Developers
QA Engineers
Users

3.3. DEFINITIONS, ACRONYMS, AND ABBREVIATIONS

ZBOSS ZigBee Open Source stack http://zboss.dsr-wireless.com
Wireshark open source packet analyzer http://www.wireshark.org
TI Texas Instruments http://ti.com

4. What is SubGHz Development KIT

The SubGHz Development KIT is designed as a cheap and easy-to-buy solution to get started with ZBOSS Open Source Stack v1.0 for SubGHz. It allows user to upload custom applications and build his own ZigBee network using SubGHz radio.

The kit is based on TI's CC1200 fully integrated single-chip radio transceiver and two variants of popular master controller boards: OLIMEX STM32-E407 and STM32F4DISCOVERY with ARM Cortex-M4 MCU onboard. All components are available for order from manufacturer's online shops or from regional dealers.

All, that you have to do to start working with ZBOSS Open Source Stack for SubGHz is to connect components together, download ZBOSS source code and application example from http://zboss.dsr-wireless.com, compile and upload it to SubGHz Development KIT.

Features:

A basic SubGhz Development KIT includes:

- ✈ ZBOSS Open Source Stack for SubGHz;
- ✈ 2 ARM Cortex-M4 based boards (can be OLIMEX STM32-E407 or STM32F4DISCOVERY);
- ✈ 2 TI's CC1200 radio transceiver;
- ✈ Radio transceiver connection cable for STM32F4DISCOVERY board (optional);
- ✈ ST-LINK/V2 debugger/programmer for STM32-E407 board (optional);
- ✈ Antennas and USB cables;
- ✈ IAR or any other compiler for ARM Cortex-M4.

5. How to build SubGHz development KIT

5.1. Hardware requirements

ZBOSS SubGHz Stack supports two popular types of ARM Cortex-M4 MCU boards for SubGHz development KIT. User can choose one of them, then solder a connection cable for CC1200EM 868-930 MHz according to provided schema. For the Olimex board external programmer ST-LINK/V2 is required.

5.1.1. Olimex STM32-E407 board description

STM-E407 is a low-cost entry board for developing custom applications with STM32F407ZGT6 Cortex M4 microcontrollers from ST. This board has plenty of resources and all GPIO ports are available on extension connectors.

FEATURES:

✈STM32F407ZGT6 Cortex-M4 210DMIPS, 1MB Flash, 196KB RAM, 3 x 12-bit 2.4 MSPS A/D, 2 x 12-bit D/A converters, USB OTG FS and USB OTG HS, Ethernet, 14 timers, 3 x SPI, 3 x I2C, Ethernet, 2 CANs, 3 x 12 bit ADCs, 2 x 12 bit DACs, 114 GPIOs, Camera interface
✈JTAG connector with ARM 2x10 pin layout for programming/debugging
✈Ethernet 100Mbit
✈UEXT Connector
✈USB host
✈USB OTG
✈SD-card
✈Input DCDC power supply which allows operation from 6-16VDC source
✈Power and User LEDs
✈Reset and User buttons
✈4 full 20-pin Ports with the external memory bus for add-on modules
✈Arduino platform with unsoldered headers
✈4 rubber pads for the mount holes
✈PCB: FR-4, 1.5 mm (0.062"), soldermask, silkscreen component print
✈Dimensions: 101.6 x 86mm (4 x 3.4")

5.1.2. STM32F4DISCOVERY board description

The STM32F4DISCOVERY helps you to discover the STM32F407/417 line features and to develop your applications easily. It includes everything required for beginners and experienced users to get started quickly.

Based on the STM32F407VGT6, it includes an ST-LINK/V2 embedded debug tool, two ST MEMS, digital accelerometer and digital microphone, one audio DAC with integrated class D speaker driver, LEDs and push buttons and an USB OTG micro-AB connector.

A large number of free ready-to-run application firmware examples are available on www.st.com/stm32f4-discovery to support quick evaluation and development.

Features:

✈ STM32F407VGT6 microcontroller featuring 32-bit ARM Cortex-M4F core, 1 MB Flash, 192 KB RAM in an LQFP100 package

✈ On-board ST-LINK/V2 with selection mode switch to use the kit as a standalone ST-LINK/V2 (with SWD connector for programming and debugging)

✈ Board power supply: through USB bus or from an external 5 V supply voltage

✈ External application power supply: 3 V and 5 V

✈ LIS302DL or LIS3DSH ST MEMS 3-axis accelerometer

✈ MP45DT02, ST MEMS audio sensor, omni-directional digital microphone

✈ CS43L22, audio DAC with integrated class D speaker driver

✈ Eight LEDs:

✈ LD1 (red/green) for USB communication

✈ LD2 (red) for 3.3 V power on

✈ Four user LEDs, LD3 (orange), LD4 (green), LD5 (red) and LD6 (blue)

✈ 2 USB OTG LEDs LD7 (green) VBus and LD8 (red) over-current

✈ Two push buttons (user and reset)

✈ USB OTG FS with micro-AB connector

✈ Extension header for all LQFP100 I/Os for quick connection to prototyping board and easy probing

6. TI CC1200 Evaluation Module Kit for 868-930 MHz

The **CC1200** is a fully integrated single-chip radio transceiver designed for high performance at very low power and low voltage operation in cost effective wireless systems. All filters are integrated, removing the need for costly external SAW and IF filters. The device is mainly intended for the ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency bands at 164- 190 MHz, 410-475 MHz and 820-950 MHz.

6.1.1. Connection cable for STM32F4DISCOVERY board

STM32F4DISCOVERY	TI CC1200 Evaluation Module		
	Port	Pin Num	Value
VDD	P4	8	VDD_REG
GND	P4	1	GND
PE11	P4	2	GPIO0
PE14	P4	3	GPIO2
PB10	P2	15	RESET
PE13	P2	18	GPIO3
PB13	P4	7	MISO
PD8	P4	6	MOSI
PB14	P4	5	SCLK
PB11	P4	4	CSN

6.1.2. Connection cable for STM32-E407 board

OLIMEX STM32-E407 UEXT port	TI CC1200 Evaluation Module		
	Port	Pin Num	Value
1	P4	8	VDD_REG
2	P4	1	GND
3	P4	2	GPIO0
4	P4	3	GPIO2
5	P2	15	RESET
6	P2	18	GPIO3
7	P4	7	MISO
8	P4	6	MOSI
9	P4	5	SCLK
10	P4	4	CSN

### 6.1.3. ST-LINK/V2 debugger/programmer description

The ST-LINK/V2 is an in-circuit debugger and programmer for the STM8 and STM32 microcontroller families. The single wire interface module (SWIM) and JTAG/serial wire debugging (SWD) interfaces are used to communicate with any STM8 or STM32 microcontroller located on an application board.

In addition to providing the same functionalities as the ST-LINK/V2, the ST-LINK/V2-ISOL features digital isolation between the PC and the target application board. It also withstands voltages of up to 2500 VRMS.

STM8 applications use the USB full speed interface to communicate with STMicroelectronic's ST Visual Develop (STVD) or ST Visual Program (STVP) software.

STM32 applications use the USB full speed interface to communicate with Atollic, IAR, Keil or TASKING integrated development environments.

6.2. OLIMEX STM32-E407 based SubGHz KIT
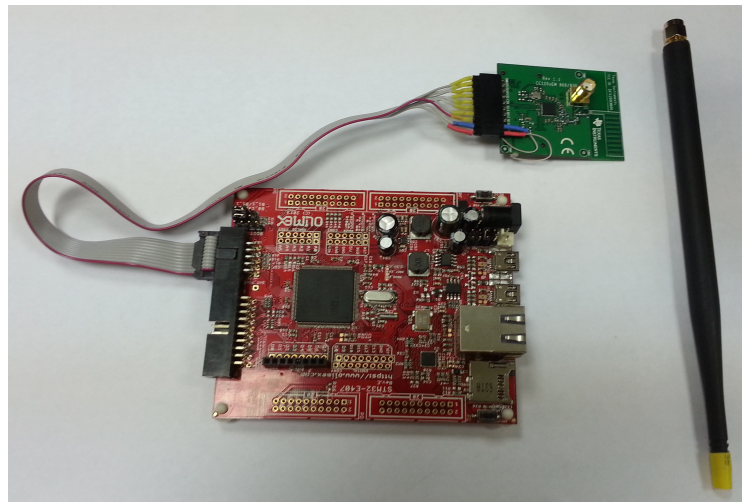
6.3. STM32F4DISCOVERY based SubGHz KIT

Photo

7. SubGHz development KIT programming

The most convenient way to work with both the platforms is to use STM32 ST-LINK Utility. This guide describes downloading the firmware with tjhis utility, but also IAR or any other downloader can be used.

7.1. Downloading firmware to OLIMEX STM32-E407

To program OLIMEX STM32-E407 connect ST-LINK Debugger is required. Process of downloading firmware includes the following steps:
1. connect ST-LINK Debugger to Olimex board via JTAG;
2. run STM32 ST-LINK Utility and click "Connect to the target";
3. in the "Target" menu select "Program";
4. choose hex image with firmware;
5. click "Start";
6. after programming has finished, click "Disconnect from the target";
7. reset device and check how it works.

7.2. Downloading firmware to STM32F4DISCOVERY

Process of programming STM32F4DISCOVERY with STM32 ST-LINK Utility doesn't differ from programming Olimex, except the fact that DISCOVERY board already has built-in ST-LINK Debugger and there is no need to use external one. That's why Olimex programming instruction written above can be used starting from the second point.

7.3. Running basic test and watching results with SubGHz sniffer

Prepared hex images are available for download on http://zboss.dsr-wireless.com. Two devices are required for the basic test (coordinator and end device). Same devices (two DISCOVERIes or two Olimexes) or mix (DISCOVERY and Olimex) can be used.

Test checks the basic behavior of Zigbee® devices after power on – forming/joining the network and infinite exchange of dummy data. To run test download firmware for coordinator and end device to the boards and reset them.

Packet exchange can be viewed online by using SubGHz sniffer. Basic test packet exchange can be caught on the channel 0 of EU2 region. ZBOSS SubGHz Sniffer is coming soon, but now TI Packet Sniffer can be the most running on TrxEB with CC1200 transceiver can be used. Generic configurations for SmartRf Studio with instruction are available in the ZBOSS SubGHz packet and can be easily exported to the SmartRf Packet Sniffer.