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## Running a simple 6LoWPAN network consisting of one receiver node and one or more sensor nodes in a Sub-1GHz RF band

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Main components	
SPSGRF	Sub-GHz (868 or 915 MHz) low power programmable RF transceiver modules
X-NUCLEO-IDS01A4	Sub-1 GHz RF expansion board based on the SPSGRF-868 module for STM32 Nucleo
X-NUCLEO-IDS01A5	Sub-1 GHz RF expansion board based on the SPSGRF-915 module for STM32 Nucleo
X-NUCLEO-IKS01A1	Motion MEMS and environmental sensor expansion board for STM32 Nucleo
NUCLEO-L152RE	STM32 Nucleo-64 development board with STM32L152RE MCU, supports Arduino and ST morpho connectivity
STM32L152RET6	Ultra-low-power 32-bit MCU ARM®-based Cortex®-M3 with 512KB Flash, 80KB SRAM, 16KB EEPROM, LCD, USB, ADC, DAC

### Purpose and benefits

This design tip explains how one receiving and multiple transmitting STM32 Nucleo boards running the Contiki operating system's 6LoWPAN protocol stack and related applications can exchange and process sensor data. Each of these boards is equipped with one of either the X-NUCLEO-IDS01A4 or X-NUCLEO-IDS01A5 Sub-1 GHz RF X-Nucleo expansion board, but they all must be the same type. Additionally, each transmitting node is equipped with one X-NUCLEO-IKS01A1 motion MEMS and environmental sensors X-Nucleo expansion board to generate data for transmission.

### Description

#### HARDWARE PREREQUISITES

The complete list of the hardware (HW) prerequisites is the following:

Receiver node (one unit):

- 1 *NUCLEO-L152RE* STM32 Nucleo board
- 1 *X-NUCLEO-IDS01A4* Sub-1 GHz RF expansion board based on the SPSGRF-868 module or alternatively 1 *X-NUCLEO-IDS01A5* Sub-1 GHz RF expansion board based on the SPSGRF-915 module

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Sensor nodes (2 or more units):

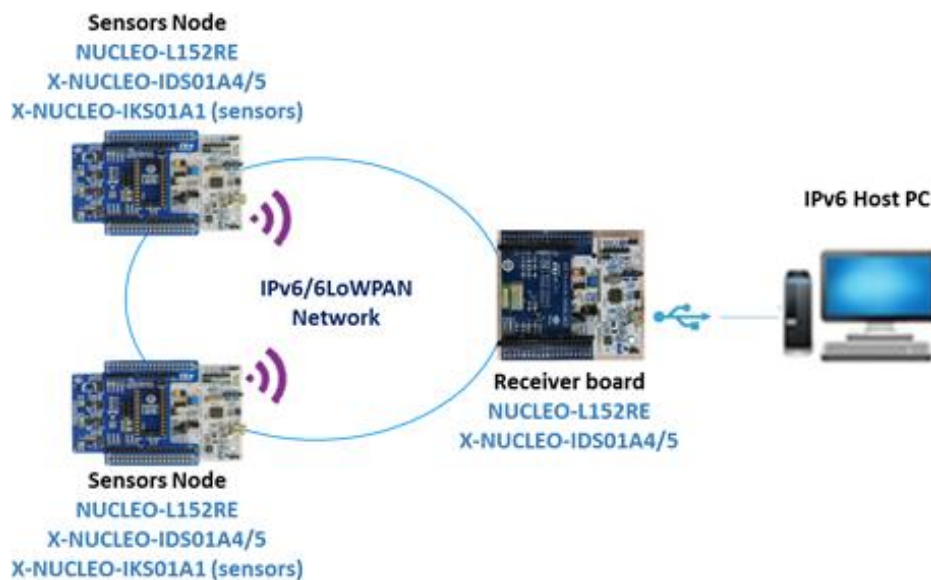
- 2 or more *NUCLEO-L152RE* STM32 Nucleo boards
- 2 or more *X-NUCLEO-IDS01A4* Sub-1 GHz RF expansion boards based on the SPSGRF-868 module or alternatively 2 or more *X-NUCLEO-IDS01A5* Sub-1 GHz RF expansion boards based on the SPSGRF-915 module, but they must agree with the Receiver board.
- 2 or more *X-NUCLEO-IKS01A1* Motion MEMS and environmental sensor expansion boards

System setup:

- 1 Laptop/PC with Windows 7/8
- 3 or more USB type A to Mini-B USB cables for connecting and supplying power to the 3 or more STM32 Nucleo boards.

The complete system is shown in Figure 1.

Figure 1: System Setup



## SOFTWARE PREREQUISITES

- osxContiki6LP software available for download from <http://www.st.com> or from Contiki GitHub repository: <https://github.com/contiki-os/contiki>
- STM32 Nucleo ST-LINK/V2-1 USB driver
- A serial terminal emulator, e.g. Tera Term

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## SOLUTION DESCRIPTION

For your convenience, use the binary files for the firmware of each example:

\\Projects\Multi\Applications\Contiki\

Or

<https://github.com/STclab/stm32nucleo-spirit1-examples/tree/master/binaries>

In the second case, you can use the following folders for 868MHz and 915 bandwidth respectively

- 868-MHz
- 915-MHz

### Programming the sensor node

- Connect the Wireless Sensor Board to a PC USB slot and program the device.
- Copy one of the binary files provided in the folder \\Projects\Multi\Applications\Contiki\Udp-sender\Binary\STM32L152RE-Nucleo between “STM32L1xx-Nucleo-Udp\_sender\_IDS01A4.bin” (for 868MHz) or “STM32L1xx-Nucleo-Udp\_sender\_IDS01A5.bin” (for 915MHz). You can use the “drag & drop” feature to the USB mass storage drive corresponding to the STM32 Nucleo board.

### Programming the Receiver node

- Connect the board to the USB and program the device.
- Copy one of the binary files provided in the folder \\Projects\Multi\Applications\Contiki\Udp-receiver\Binary\STM32L152RE-Nucleo between “STM32L1xx-Nucleo-Udp\_receiver\_IDS01A4.bin” for 868MHz or “STM32L1xx-Nucleo-Udp\_receiver\_IDS01A5.bin” for 915MHz (e.g. drag & drop) to the USB mass storage corresponding to the STM32 Nucleo board.

The user can connect the Receiver node to the PC and using a terminal emulator (e.g. TeraTerm), display the content of all packets received from the one or more Sensor nodes. The data includes temperature, humidity, and pressure from the environmental sensors and the 3-dimensional data from the accelerometer, gyroscope, and magnetometer. Additionally, some radio parameters are displayed as follows:

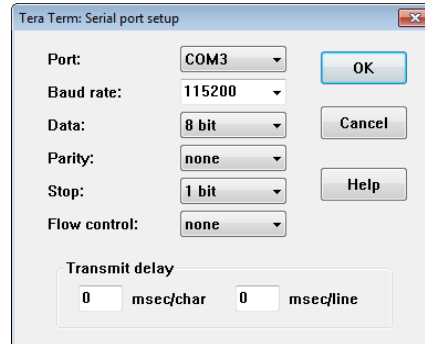
**RSSI:** Received Signal Strength Indicator. This is a measure of the received signal power at the antenna in the channel selected. The measured power is reported in steps of half a dB from 0 to 255 and is offset in such a way that -120 dBm corresponds to 20.

**LQI:** Link Quality Indicator. This represents the signal quality versus the noise received, measured after demodulation. Higher values mean better quality and less noise.

The terminal emulator should be configured as follows (in the pictures below, the setup for TeraTerm is shown):

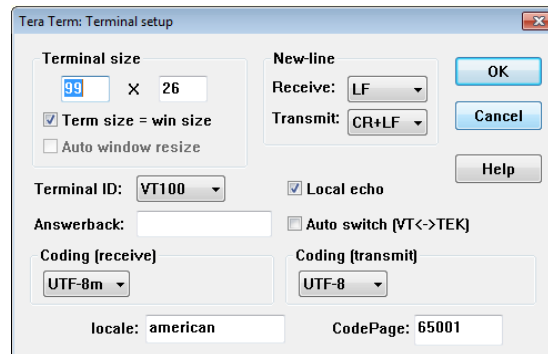
- Click on “Setup” and “Serial port...” to configure the parameters as shown in Figure 2. Note that the COM port must match the one assigned by Microsoft Windows to the Receiver node.

Figure 2: Serial port setup



- Click on “Setup” and “Terminal...” to configure the parameters as in Figure 3.

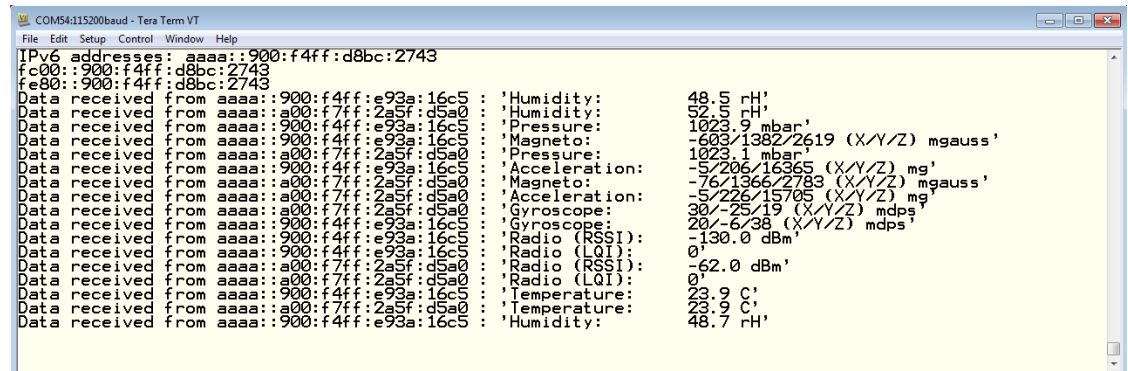
Figure 3: Terminal setup



As soon as the Sensor nodes join the network created by the Receiver node, the Sensor nodes begin transmitting the sensor data to the Receiver node and the Receiver node displays the data on the terminal as illustrated in Figure 4.

The data displayed includes the IPv6 address of the Sensor node which sent the packet.

Figure 4: Terminal emulator output on the receiver board



## Support material

Related design support material
X-NUCLEO-IKS01A1: Motion MEMS and environmental sensor expansion board for STM32 Nucleo
X-NUCLEO-IDS01A4: Sub-1 GHz RF expansion board based on the SPSGRF-868 module for STM32 Nucleo
X-NUCLEO-IDS01A5: Sub-1 GHz RF expansion board based on the SPSGRF-915 module for STM32 Nucleo
NUCLEO-L152RE: STM32 Nucleo-64 development board with STM32L152RE MCU, supports Arduino and ST morpho connectivity
Documentation
DS10619: X-NUCLEO-IKS01A1, Motion MEMS and environmental sensor expansion board for STM32 Nucleo
DB2884: Contiki OS/6LoWPAN middleware add-on for X-CUBE-SUBG1 expansion for STM32Cube
DB2552: X-NUCLEO-IDS01A4, Sub-1 GHz RF expansion board based on the SPSGRF-868 module for STM32 Nucleo
DB2553: X-NUCLEO-IDS01A5, Sub-1 GHz RF expansion board based on the SPSGRF-915 module for STM32 Nucleo
UM2040: Getting started with osxContiki6LP, Contiki OS and 6LoWPAN sub-1GHz RF communications software expansion for STM32Cube
UM1872: Getting started with the Sub-1 GHz expansion board based on SPSGRF-868 and SPSGRF-915 modules for STM32 Nucleo
UM1820: Getting started with motion MEMS and environmental sensor expansion board for STM32 Nucleo
UM1724: STM32 Nucleo-64 boards
DS10955: Sub-GHz (868 or 915 MHz) low power programmable RF transceiver modules
DS10002: STM32L152RE, Ultra-low-power 32-bit MCU ARM®-based Cortex®-M3

## Revision history

Date	Version	Changes
22-Aug-2016	1	Initial release

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