Skywire™ ST Micro Shield and Skywire™ Sensor Shield

User Manual

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Contents

1. Introduction

1.1 Orderable Part Numbers

Orderable Device	Description	Carrier	Network Type
NL-AB-ST-NCL	Skywire ST Nucleo Shield	Any	Any
NL-SWSK	Skywire Sensor Shield	Any	Any
NL-SW-1xRTT-A	2G 1xRTT	Aeris	CDMA
NL-SW-1xRTT-S	2G 1xRTT	Sprint	CDMA
NL-SW-1xRTT-V	2G 1xRTT	Verizon	CDMA
NL-SW-GPRS	2G GPRS	Any GSM (AT&T, T-Mobile, etc.)	GSM
NL-SW-EVDO-A	3G EVDO, GPS, GLONASS	Aeris	CDMA
NL-SW-EVDO-V	3G EVDO, GPS, GLONASS	Verizon	CDMA
NL-SW-HSPA	3G HSPA+, GPS, GLONASS, GLOBAL BANDS	Any GSM (AT&T, T-Mobile, etc.)	GSM
NL-SW-HSPAP	3G HSPA+	Any GSM (AT&T, T-Mobile, etc.)	GSM
NL-SW-HSPAPE	3G HSPA+, European Version	Any EU GSM	GSM
NL-SW-HSPAPG	3G HSPA+, GPS, GLONASS	Any GSM (AT&T, T-Mobile, etc.)	GSM
NL-SW-LTE-TSVG	LTE without Fallback, GPS, GLONASS	Verizon	CDMA
NL-SW-LTE-TNAG	LTE with HSPA+ Fallback, GPS, GLONASS	Any GSM (AT&T, T-Mobile, etc.)	GSM
NL-SW-LTE-TEUG	LTE with HSPA+ Fallback, GPS, GLONASS, EU	Any EU GSM	GSM
NL-SW-LTE-GELS3	LTE CAT1, Verizon	Verizon	CDMA
NL-SW-LTE-S7588-V	LTE CAT4, Verizon	Verizon	CDMA
NL-SW-LTE-S7588-T	LTE CAT4	Any GSM (AT&T, T-Mobile, etc.)	GSM

1.2 Overview

This document is the System Reference Manual for the Skywire™ ST Micro Shield (NL-AB-ST-NCL) and the Skywire™ Sensor Shield (NL-SWSK). Throughout the document, these parts will often be referred to as 'the shield,' although they may be referred to by its full name.

The NimbeLink Skywire™ modem is available with bundled data plans from leading cellular carriers.

The Skywire™ cellular modem and antennas are sold separately.

Make sure you check NimbeLink's Skywire™ Sensor Shield product page for the most up to date information.

1.3 Product Description

Connect the Nucleo development platform to the Internet of Things (IoT) quickly and easily with NimbeLink's Skywire™ ST Micro Shield and Skywire™ Sensor Shield. Whether you are a hobbyist or a developer preparing a product for launch, NimbeLink's shields and your choice of NimbeLink Skywire™ plug-in cellular modems will provide the cellular connectivity you need. With Cellular connectivity, several included ST sensors, and example code you can have your proof of concept up and running in minutes with a clear path to production.

Here are some of the benefits of developing with the Skywire™ ST Micro Shield and Skywire™ Sensor Shield:

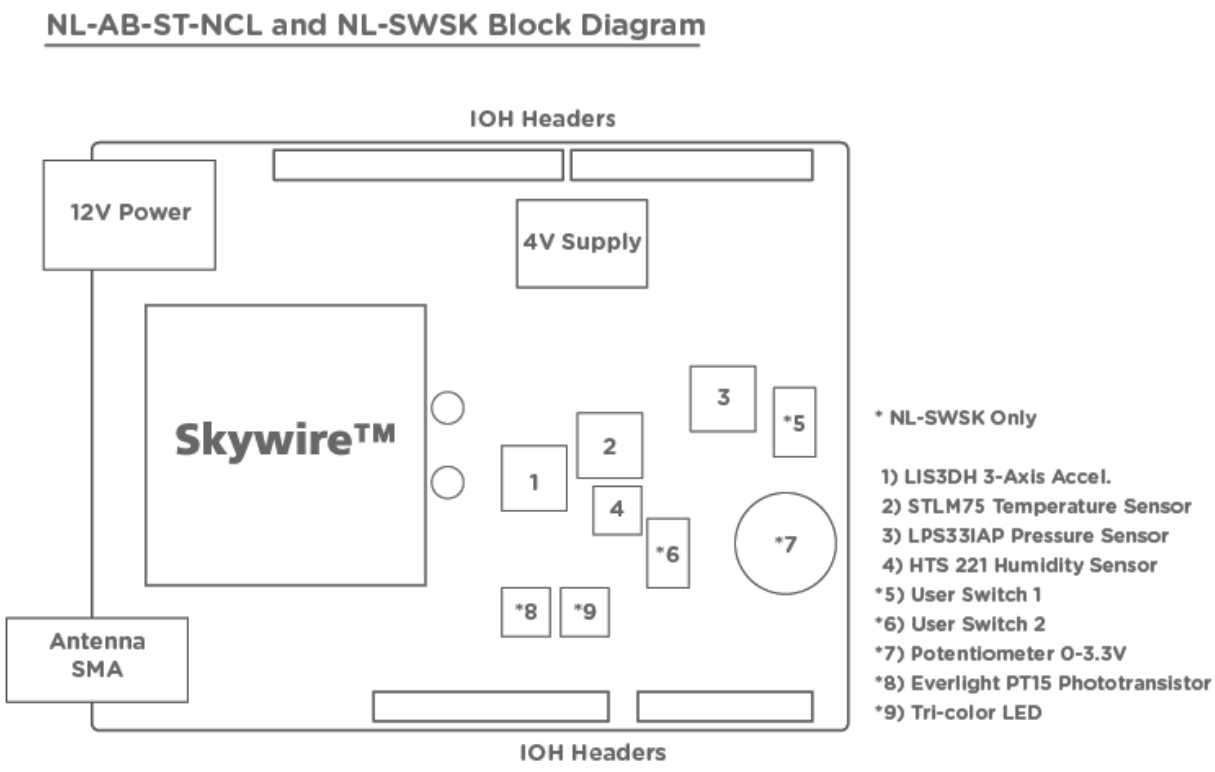
- Skywire™ socket that supports 2G, 3G, and 4G modems
- NimbeLink's certified modems and bundled data plans can have you connected to the network faster than any other cellular solution
- Four ST Microelectronics sensors to demonstrate your IoT solution (Temperature, Acceleration, Pressure, and Humidity)
- Two buttons, a potentiometer, a tri-color LED, and a Light Sensor (NL-SWSK only)
- Example code to upload sensor data to Bug Labs Freeboard dashboards

1.4 Additional Resources

- NimbeLink's Skywire™ ST Micro Shield Product Page
- NimbeLink's Skywire™ Cellular Modems
- ST Micro F401 Nucleo Platform Page

2. Technical Specifications

2.1. Block Diagram - NL-AB-ST-NCL



2.2. Pinout

Table 2.1: Skywire™ ST Shield Default Pinout		
PIN Name	**Header**	**Shield Connection**
IO0	IOL	*No Connect*
IO1	IOL	*No Connect*
IO2	IOL	Skywire™ DOUT
IO3	IOL	*No Connect*
IO4	IOL	LM75 INT
IO5	IOL	LIS3DH INT1
IO6	IOL	HTS221 DRDY
IO7	IOL	LPS331 INT1
IO8	IOH	Skywire™ DIN
IO9	IOH	Skywire™ Reset
IO10	IOH	Skywire™ DTR
IO11	IOH	Skywire™ RTS
IO12	IOH	Skywire™ ON/OFF
IO13	IOH	*No Connect*
GND	IOH	GND
AREF	IOH	*No Connect*
SDA	IOH	I2C_SDA
SCL	IOH	I2C_SCL
All Pins	AD	*No Connect*
VIN	POWER	12V Output
GND	POWER	GND
5V	POWER	*No Connect*
3V3	POWER	3.3V Input
RESET	POWER	*No Connect*
IOREF	POWER	Skywire™ Vref

3. Getting Started

3.1 Introduction

NimbeLink's Skywire™ ST Micro Shield and Skywire™ Sensor Shield are designed to be compatible with all STMicroelectronics Nucleo development boards. The shield also provides headers to plug in additional shields to further the platform's functionality. The user must ensure the pins on expansion shields do not interfere with the pins of the Skywire™ ST Shield or Skywire™ Sensor Shield.

3.2 Mounting the Shield to a Nucleo

Switch the jumper JP5 on the Nucleo over to E5V. This allows the Nucleo to be powered off of the shield's 12V supply instead of the USB port.

The USER and RESET buttons on the Nucleo (B1 and B2) can interfere with the Skywire™ shields and prevent the Nucleo from functioning by holding it in a reset state. Remove the button caps from those buttons by pulling straight up on them.

The shield is designed to interface with the Arduino headers on the Nucleo development board. To mount the shield, orient the pins correctly over the Arduino headers and press down on the shield until the shield is seated fully.

NL-SWSK Note: Make sure jumpers J3 and J4 are on pins 1 and 2.

3.3

3.4

3.5 Skywire™ Placement

The Skywire™ Cellular modem is designed to be placed as shown below in figure 3-1.

Figure 3-1 Skywire™ ST Micro Shield With Skywire™ 3G EVDO Modem

To mount your Skywire™ Cellular modem follow these steps:

1. Gather the following:
   a. Skywire™ ST Micro Shield
   b. Skywire™ Cellular Modem
   c. U.FL extractor tool (Always use a U.FL extractor tool when placing or removing U.FL cables on the Skywire™ modem to avoid damaging the U.FL connectors).
2. Line up the Skywire™ cellular U.FL connector(s) with the circles inside the cape's Skywire™ sockets footprint. Depending on the type of Skywire™ Modem you have you might have one or two U.FL connections.
3. Carefully seat your Skywire™ into the cape's Skywire™ socket (J6). Take care to ensure that the pins are correctly aligned. Failure to properly align the pins may damage your Skywire™!
4. Attach the U.FL cable to the U.FL connector marked X1 on the Skywire™ modem.

3.6 UART Configuration

By default, the UART connection between the Skywire™ and the Nucleo connects to UART1. To switch to using UART2, see the following:

Shield: NL-AB-ST-NCL

To switch the connection to UART2, Resistors R2 and R8 can be populated while removing resistors R1 and R7.

Shield: NL-SWSK

To switch the connection to UART2, move jumpers J3 and J4 to pins 2 and 3.

Note: UART2 is connected to the Nucleo's debug interface so it is not recommended for typical applications.

3.7 Sensor Connections

The shield has four sensors connected to the I2C interface coming from the Nucleo. The shield also provides 4.75K pullup resistors on this interface. See the table below for details on each sensor.

Table 2.1: Skywire™ ST Shield Default Pinout

Sensor	Function	I2C address
HTS221	Humidity: 0-100% RH	*0xBF*
LIS3DH	3-Axis Accelerometer: 2g/4g/8g/16g	*0x32*
LPS331	Pressure: 260–1260 mbar	*0xBA*
STLM75	Temperature: -55C to 125C	*0x90*

3.8 Nucleo software

Go to developer.mbed.org and setup a developer account. Once you have an account go to:

http://developer.mbed.org/teams/Nimbelink/code/Skywire_Terminal/ and click "Import this program". Once the program is imported into your account's online compiler follow the directions on the mbed website to compile and program your specific Nucleo platform. Make sure the shield is powered by the supplied 12V adapter.

Skywire_Terminal is a simple application that will setup the Nucleo's USB serial port at 115200 Baud and echo all serial messages between the Skywire™ and the USB serial port.

Open your favorite terminal emulator and set the following settings:

Set the serial port number to the USB serial of the Nucleo

Baud Rate: 115200

Data: 8bit

Parity: none

Stop: 1bit

Flow Control: none

3.9 Test Serial Communication

In the terminal program, type the letters:

AT

followed by the Enter key, and the terminal should respond with:

OK

3.10 Test Network Communication

Make sure the Antenna and U.FL coax are connected to U.FL connector X1.
For the following modems:

- NL-SW-1xRTT-A
- NL-SW-1xRTT-S
- NL-SW-1xRTT-V
- NL-SW-EVDO-A
- NL-SW-EVDO-V

Type the following command into the terminal program:

AT+CREG?

followed by the Enter key, and the terminal should respond with:

+CREG: 0,1 or **+CREG: 0,5**

For the following modems:

- NL-SW-GPRS
- NL-SW-HSPA
- NL-SW-HSPAP
- NL-SW-HSPAPE
- NL-SW-HSPAPG
- NL-SW-LTE-TSVG
- NL-SW-LTE-TNAG
- NL-SW-LTE-TEUG

Type the following command into the terminal program:

AT+CGREG?

followed by the Enter key, and the terminal should respond with:

+CGREG: 0,1 or **+CGREG: 0,5**

For the following modem:

- NL-SW-LTE-GELS3

In the terminal program, type the following command:

ATI

followed by the enter key. If the terminal responds with:

Cinterion
ELS31-V
REVISION 4.3.1.0c

you are using Version 4.3.1.0c firmware.

If the terminal program responds with:

Cinterion
ELS31-V
REVISION 4.3.2.0

you are using Version 4.3.2.0 firmware.
In the terminal program, type the command:

AT+CEREG?

followed by the Enter key. For Firmware 4.3.1.0c, the terminal should respond with:

+CEREG: 2, 1, xxxx, yyyyyyyy, z

For Firmware 4.3.2.0, the terminal should respond with:

+CEREG: 0,1 or **+CEREG: 0,5**

For all other responses, review network status responses online.

3.11 Activate Modem (one-time step)

Your cellular module does not currently have an active cellular plan. NimbeLink provides reduced rate Verizon M2M data plans for Skywire™ products. To activate a data plan, visit go.nimbelink.com.

3.12 Send Modem Activation String

This step only applies to these products:

Verizon 2G 1XRTT modem	P/N: NL-SW-1XRTT-V
Verizon 3G EVDO modem	P/N: NL-SW-EVDO-V

In the terminal program, type the letters:

ATD*22899;

followed by the Enter key, and the module will begin the activation process which can take **several minutes**. The terminal should respond with:

OK

#OTASP: 0

#OTASP: 1

#OTASP: 2

NO CARRIER

For all other responses, review network status responses online.

Reset power, and repeat steps 3.7 and 3.8 before moving on.

3.13 Send SMS Message

In the terminal program, type the letters:

AT+CMGF=1

followed by the Enter key, and the terminal should respond with:

OK

Substitute the destination phone number for the example 5554443333.

Then type:

AT+CMGS=”15554443333”

followed by the Enter key, and the terminal should respond with:

>

At this point you can type a custom message (keep to less than 160 characters).

To send the message, press the **CTRL** and **Z** keys at the same time.

If successful, the terminal should respond with:

+CMGS: xx

3.14 Receive SMS Messages

In the terminal program, type the letters:

AT+CMGF=1

followed by the Enter key, and the terminal should respond with:

OK

Then type:

AT+CMGL="REC UNREAD”

followed by the Enter key,

If the terminal responds with

OK

then there are no messages.

Otherwise, the terminal responds with the first message in the form:

+CMGL=index, message_status, address, [address_text], [time_stamp] [,address_type, body_length] <CR> <LF> sms_message_body[<CR> <LF> +CMGL: ...]

This is an example:

+CMGL: 0,"REC UNREAD","555444333","",20130925202238

SMS message

3.15 Delete Received SMS Message

In the terminal program, type the letters:

AT+CMGD=1,4

followed by the Enter key, and the terminal should respond with:

OK

3.16 Establishing a TCP/IP connection

Please refer to the following Skywire™ TCP Socket examples:

NL-SW-LTE-S7588 - CAT4 Socket Dials

NL-SW-LTE-GELS3 - Verizon CAT1 Socket Dials

All other Skywires™ - Skywire Socket Dials

3.17 Additional Skywire Examples

Please visit your respective Skywire's™ website for additional examples.

3.18 Bug Labs Freeboard Sensor Demo Setup

Please go to the website below and follow the guide to setup this demo.

http://developer.mbed.org/teams/Nimbelink/code/Skywire_Demo/