Getting started with the STM32Cube function pack for GNSS and cellular connectivity enabling Assisted-GNSS applications

Introduction

The FP-SNS-AGNSS1 function pack for STM32Cube lets you connect your IoT node to a cellular network and enable Assisted-GNSS applications.

Assisted-GNSS provides ephemeris assistance from an external source (RxNetworks online service), thus considerably reducing the time to obtain a FIX, especially in critical environments when the ephemeris download time could be very long.

The software runs on STM32L496AG MCUs and it is easily portable across different MCU families thanks to STM32Cube.

The package contains a sample implementation for 32L496GDISCOVERY board equipped with the X-NUCLEO-GNSS1A1 expansion board (featuring a GNSS receiver based on Teseo-LIV3F module), and the LTE IoT expansion board featuring a Quectel BG96 module.

The cellular expansion board included in the P-L496G-CELL02 package is connected directly to the STMod+ connector of the 32L496GDISCOVERY board.

RELATED LINKS

Visit the STM32Cube ecosystem web page on www.st.com for further information

1 FP-SNS-AGNSS1 software expansion for STM32Cube

1.1 Overview

The FP-SNS-AGNSS1 is an STM32 ODE function pack and expands STM32Cube functionality.

The software package shows how to enable Assisted-GNSS mechanism (both Predictive and RealTime types) supported by the Teseo-LIV3F device through the partnership with RxNetworks.

The package key features are:

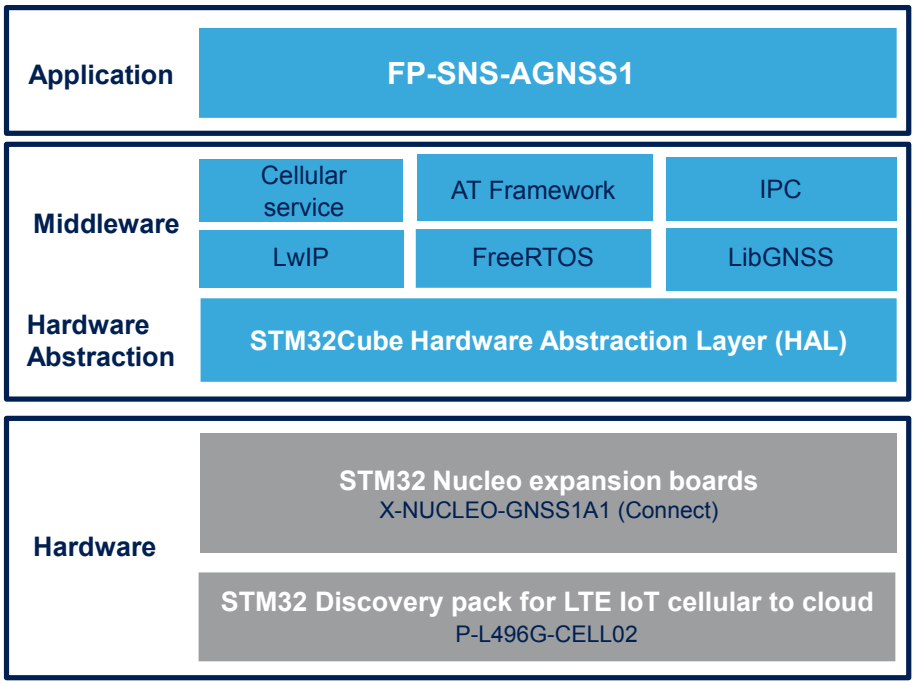
- Complete firmware to connect an IoT node with GNSS module to an LTE IoT cellular network
- Support for Assisted-GNSS through RxNetworks online services
- Middleware libraries with support for FreeRTOS, GNSS, NMEA and JSON parsing functionalities
- Sample implementation available for the X-NUCLEO-GNSS1A1, and the LTE IoT cellular expansion boards, when connected to a 32L496GDISCOVERY board
- Easy portability across different MCU families, thanks to STM32Cube
- Free, user-friendly license terms

1.2 Architecture

The application software accesses the X-NUCLEO-GNSS1A1 and cellular expansion boards through the following software layers:

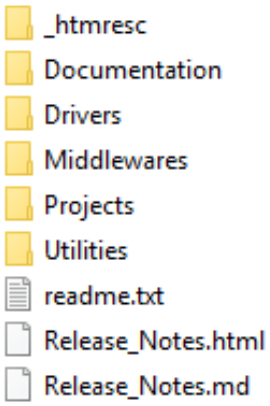
- the **STM32Cube HAL layer**, which provides a simple, generic, multi-instance set of application programming interfaces (APIs) to interact with the upper application, library and stack layers. It has generic and extension APIs and is directly built around a generic architecture and allows successive layers like the middleware layer to implement functions without requiring specific hardware configurations for a given microcontroller unit (MCU). This structure improves library code reusability and guarantees an easy portability on other devices.
- the **board support package** (BSP) layer supports all the peripherals on the STM32 Nucleo except the MCU. This limited set of APIs provides a programming interface for certain board-specific peripherals like the LED, the user button, etc. This interface also helps in identifying the specific board version.

Figure 1. FP-SNS-AGNSS1 software architecture



1.3 Folder structure

Figure 2. FP-SNS-AGNSS1 package folder structure



The following folders are included in the software package:

- **Documentation**: contains a compiled HTML file generated from the source code which details the software components and APIs.
- **Drivers**: contains the HAL drivers and the board-specific drivers for each supported board or hardware platform, including the on-board components and the CMSIS vendor-independent hardware abstraction layer for ARM Cortex-M processor series.
- **Middlewares**: contains libraries and protocols related to FreeRTOS, GNSS, NMEA, JSON parsing, and the cellular framework.
- **Projects**: contains a sample application used to perform the Assisted GNSS. This application is provided for P-L496G-CELL02 platform with three development environments: IAR Embedded Workbench for ARM, RealView Microcontroller Development Kit (MDK-ARM-STR) and STM32CubeIDE.
- **Utilities**: contains some complementary project files.

1.4 APIs

Detailed technical information with full user API function and parameter description are in a compiled HTML file in the “Documentation” folder.

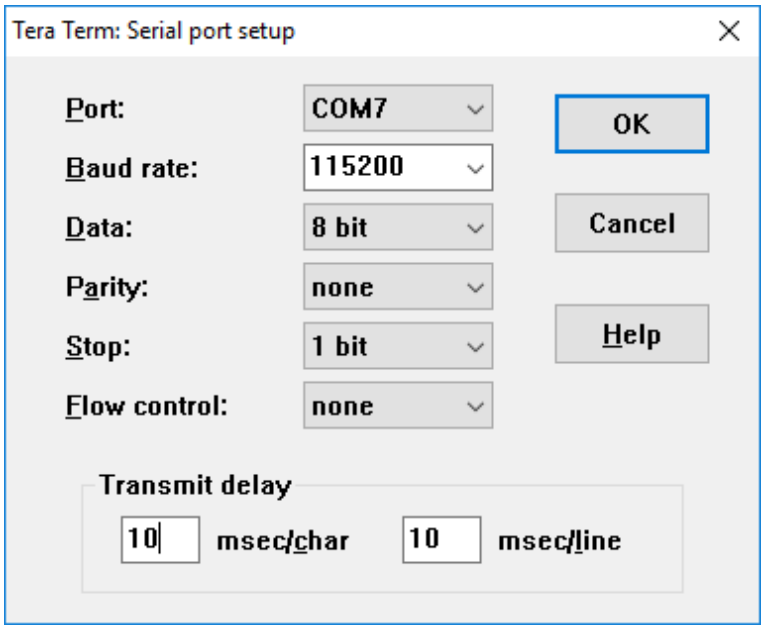
1.5 Sample application description

A sample application is provided in the Projects folder, using the X-NUCLEO-GNSS1A1 and LTE IoT cellular expansion boards with P-L496G-CELL02.

Ready-to-build projects are available for multiple IDEs.

The user interface is provided via serial port and must be configured with the settings shown below.

Figure 3. Terminal settings



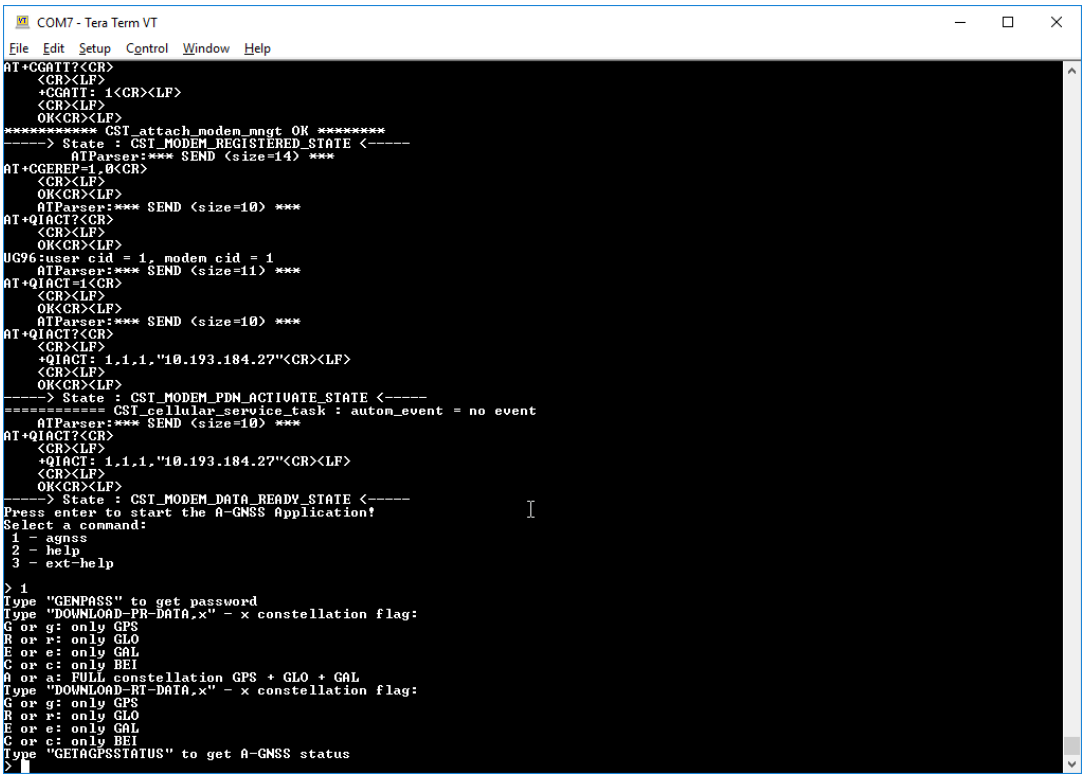
Step 1. Wait for the modem to be successfully initialized and in active state.

Note: If the modem fails initializing, push the reset button on the discovery board.

Step 2. Press enter to start the A-GNSS Application when the related message appears to notify the A-GNSS task is ready.

Step 3. Select a command from the A-GNSS main menu.

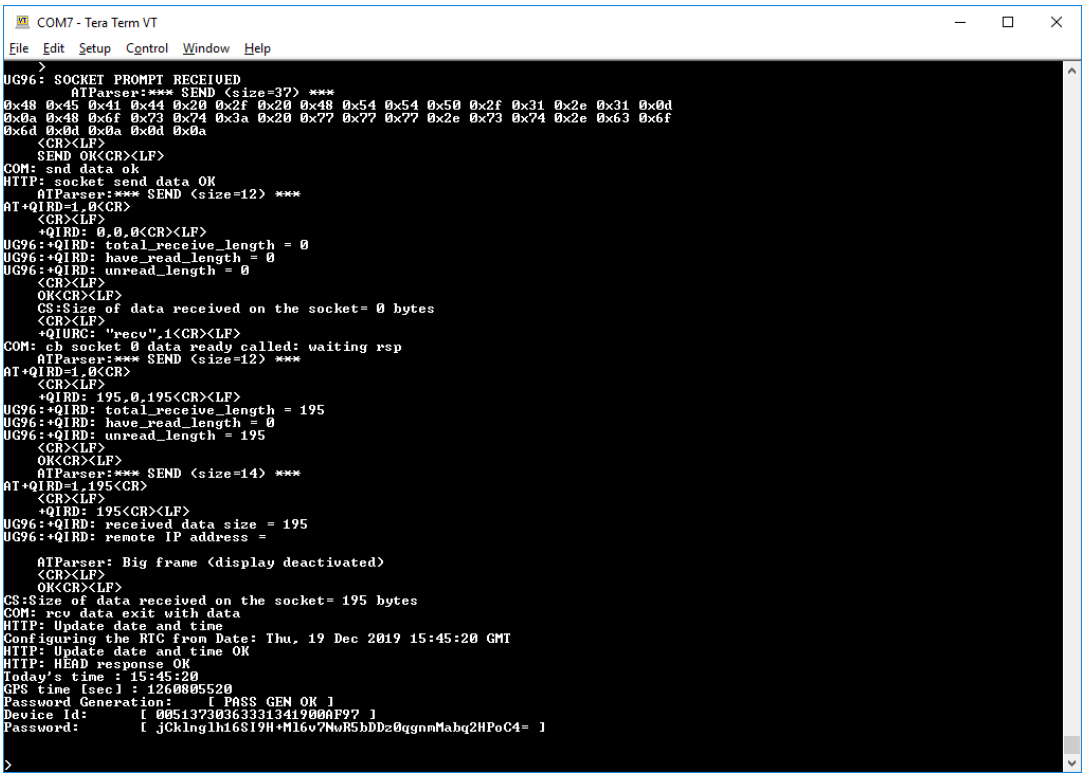
Figure 4. A-GNSS application main menu



Step 4. To access the RxNetworks servers, provide a set of parameters to generate the HTTP request.

Predictive A-GNSS and RealTime A-GNSS use the same password generator and the same NMEA commands. GENPASS is the command used to make the Teseo-LIV3F generate a password to access the RxNetworks server.

Figure 5. Password generation

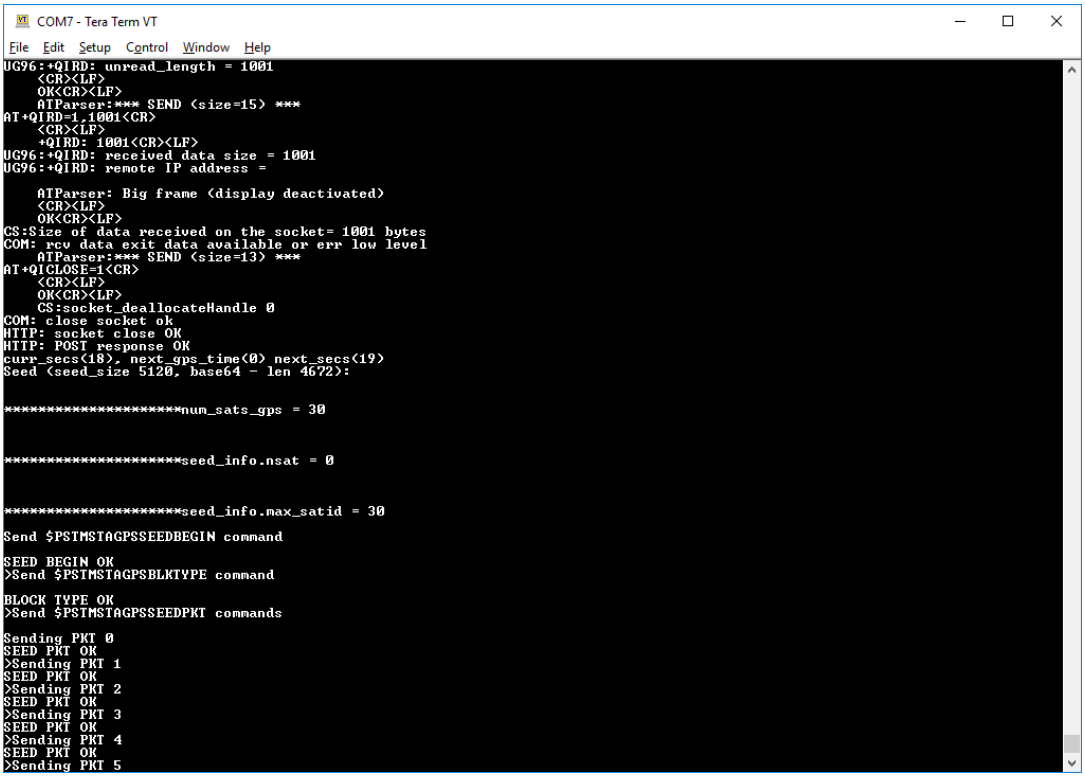


Step 5. To download the assistance data called “seed” for the Predictive A-GNSS mechanism, invoke the command `DOWNLOAD-PR-DATA,x`, where x is the flag for one of the following constellations:

- GPS
- Glonass
- Galileo
- BeiDou

When the message “SEED PROPAGATION OK” is displayed, the transmission is complete.

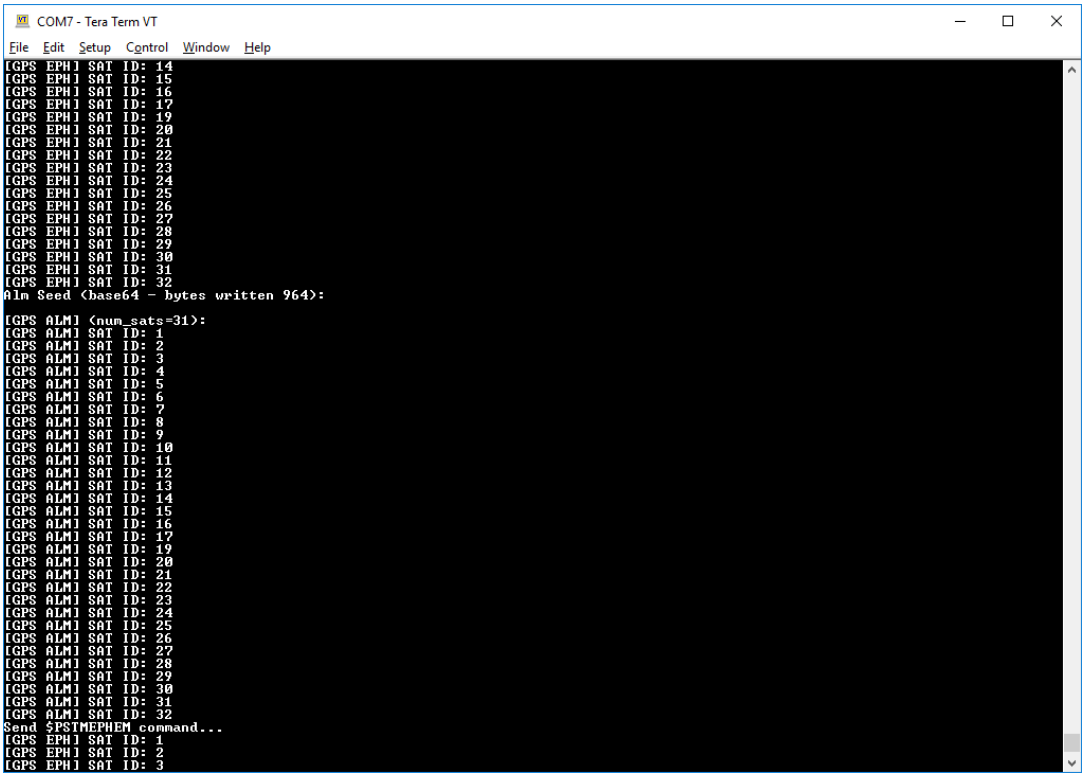
Figure 6. Predictive A-GNSS seed transmission



Step 6. To download the assistance data called “seed” for the RealTime AGNSS mechanism, invoke the command `DOWNLOAD-RT-DATA,x`, where x is the flag for one of the following constellations:

- GPS
- Glonass
- Galileo
- BeiDou

Figure 7. RealTime A-GNSS seed transmission



RELATED LINKS

For more details about Assisted-GNSS, see AN5160: "RxNetworks Assisted-GNSS Server Interface Specification" and UM2399: "ST Teseo III binary image"

2 System setup guide

2.1 Hardware description

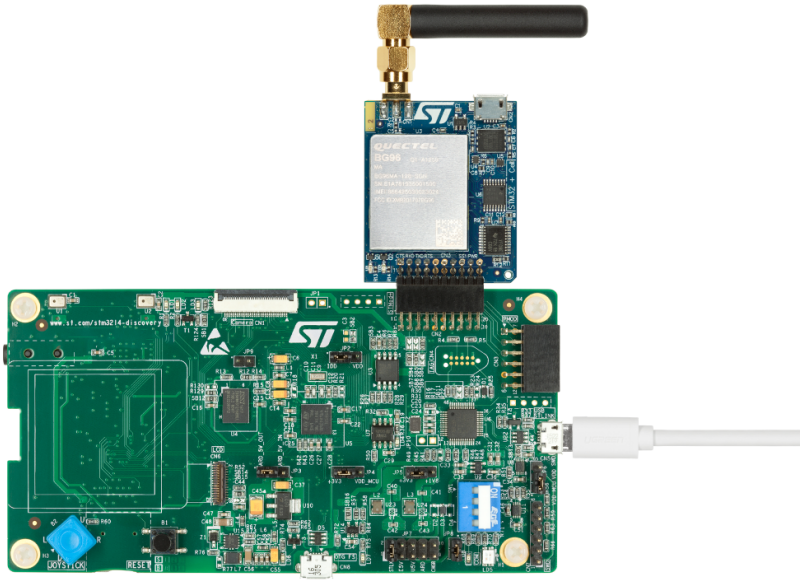
2.1.1 P-L496G-CELL02 discovery pack

The P-L496G-CELL02 STM32 discovery pack for LTE IoT cellular to cloud (STM32-C2C/LTE IoT) is a turnkey development platform for cellular and cloud technology-based solutions.

The discovery pack consists of the following boards:

1. An STM32L496AGI6-based low-power discovery motherboard with preloaded firmware (32L496GDISCOVERY). The microcontroller has 1 Mbyte of Flash memory and 320 Kbytes of RAM in a UFBGA169 package.
2. An STMod+ cellular expansion board with antenna. The expansion board features a Quectel BG96 worldwide cellular modem LTE Cat M1/Cat NB1/EGPRS module 300 kbps downlink, 375 kbps uplink.

Figure 8. P-L496G-CELL02 LTE cellular to cloud pack



2.1.2 X-NUCLEO-GNSS1A1 expansion board

The X-NUCLEO-GNSS1A1 expansion board is based on the Teseo-LIV3F tiny GNSS module.

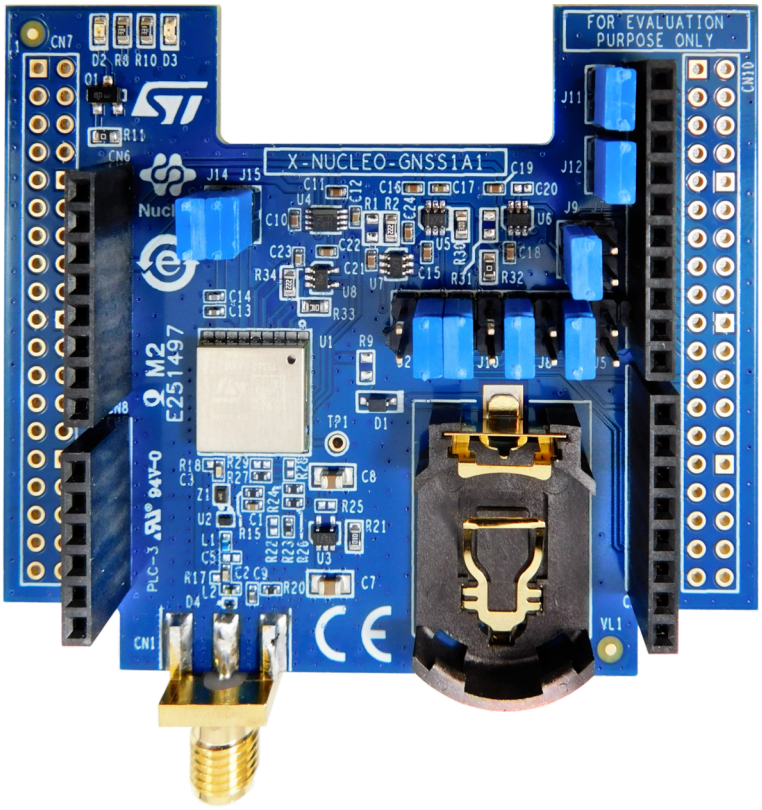
It represents an affordable, easy-to-use, global navigation satellite system (GNSS) module, embedding a TeseoIII single die standalone positioning receiver IC, usable in different configurations in your STM32 Nucleo project.

The Teseo-LIV3F is a compact (9.7x10.1 mm) module that provides superior accuracy thanks to the on-board 26 MHz temperature compensated crystal oscillator (TCXO) and a reduced time-to-first fix (TTFF) with its dedicated 32 KHz real-time clock (RTC) oscillator.

The Teseo-LIV3F module runs the GNSS firmware (X-CUBE-GNSS1) to perform all GNSS operations including acquisition, tracking, navigation and data output without external memory support.

The X-NUCLEO-GNSS1A1 expansion board is compatible with the Arduino™ UNO R3 connector and the ST morpho connector, so it can be plugged to the STM32 Nucleo development board and stacked with additional STM32 Nucleo expansion boards.

Figure 9. **X-NUCLEO-GNSS1A1 expansion board**



2.2 Hardware setup

The following hardware components are needed:

1. One STM32 discovery pack for cellular to cloud (STM32-C2C) development platform (order code: P-L496G-CELL02 for LTE IoT) with an STM32-C2C LTE IoT cellular expansion boards (provided in the P-L496G-CELL02 pack)
2. One Teseo-LIV3F expansion board (order code: X-NUCLEO-GNSS1A1)
3. One USB type A to Mini USB Type B cable to connect the STM32 discovery board to the PC

2.3 Software setup

The following software components are required for the setup of a suitable development environment to create applications for the 32L496GDISCOVERY board equipped with the X-NUCLEO-GNSS1A1 , and the LTE IoT cellular expansion boards:

- FP-SNS-AGNSS1 firmware and related documentation available on www.st.com
- Development tool-chain and Compiler. The STM32Cube expansion software supports the three following environments to select from:
  - IAR Embedded Workbench for ARM® (EWARM) toolchain + ST-LINK
  - RealView Microcontroller Development Kit (MDK-ARM-STR) toolchain + ST-LINK
  - STM32CubeIDE + ST-LINK

2.4 System setup

The 32L496GDISCOVERY board integrates the ST-LINK/V2-1 debugger/programmer. The developer can download the relevant version of the ST-LINK/V2-1 USB driver by searching STSW-LINK008 or STSW-LINK009 on www.st.com (depending on your Windows version).

The X-NUCLEO-GNSS1A1 expansion board can be easily connected to the 32L496GDISCOVERY board through the Arduino UNO R3 extension connector.

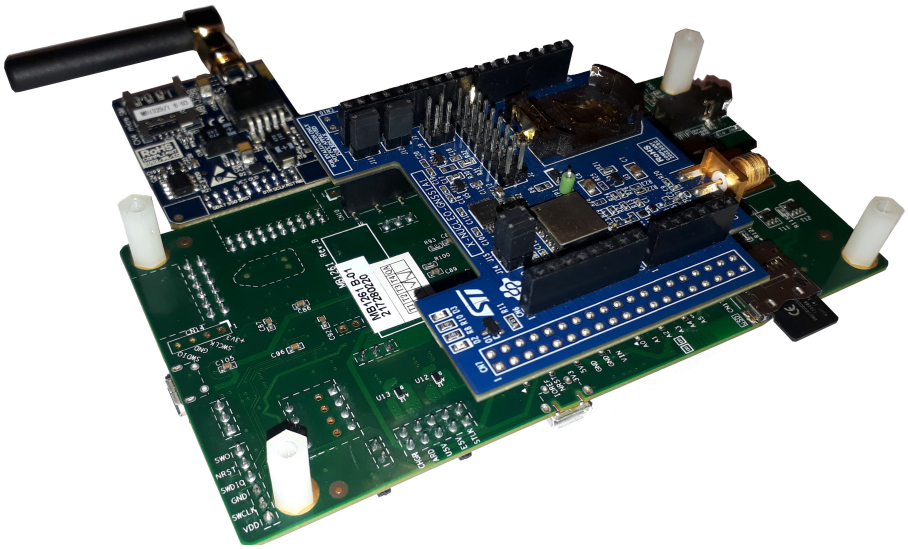
Before connecting the boards, on the X-NUCLEO-GNSS1A1 expansion board:

- open J3, J4, J6, J7, J8, J10 jumpers
- close J2, J5, J9, J11, J12, J13, J14, J15 jumpers

The board interfaces with the external STM32 microcontroller on the 32L496GDISCOVERY board using inter-integrated circuit (I²C) transport layer.

The Quectel BG96 modem expansion board can be directly connected to the 32L496GDISCOVERY board through the STMod+ port.

Figure 10. P-L496G-CELL02 plus X-NUCLEO-GNSS1A1



Revision history

Table 1. Document revision history

Date	Version	Changes
14-Jan-2020	1	Initial release.
11-Feb-2020	2	Updated Introduction, Section 1.1 Overview, Figure 1. FP-SNS-AGNSS1 software architecture, Section 1.5 Sample application description, Section 2.2 Hardware setup. Added Section 2.1.1 P-L496G-CELL02 discovery pack. Added P-L496G-CELL02 compatibility information.

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