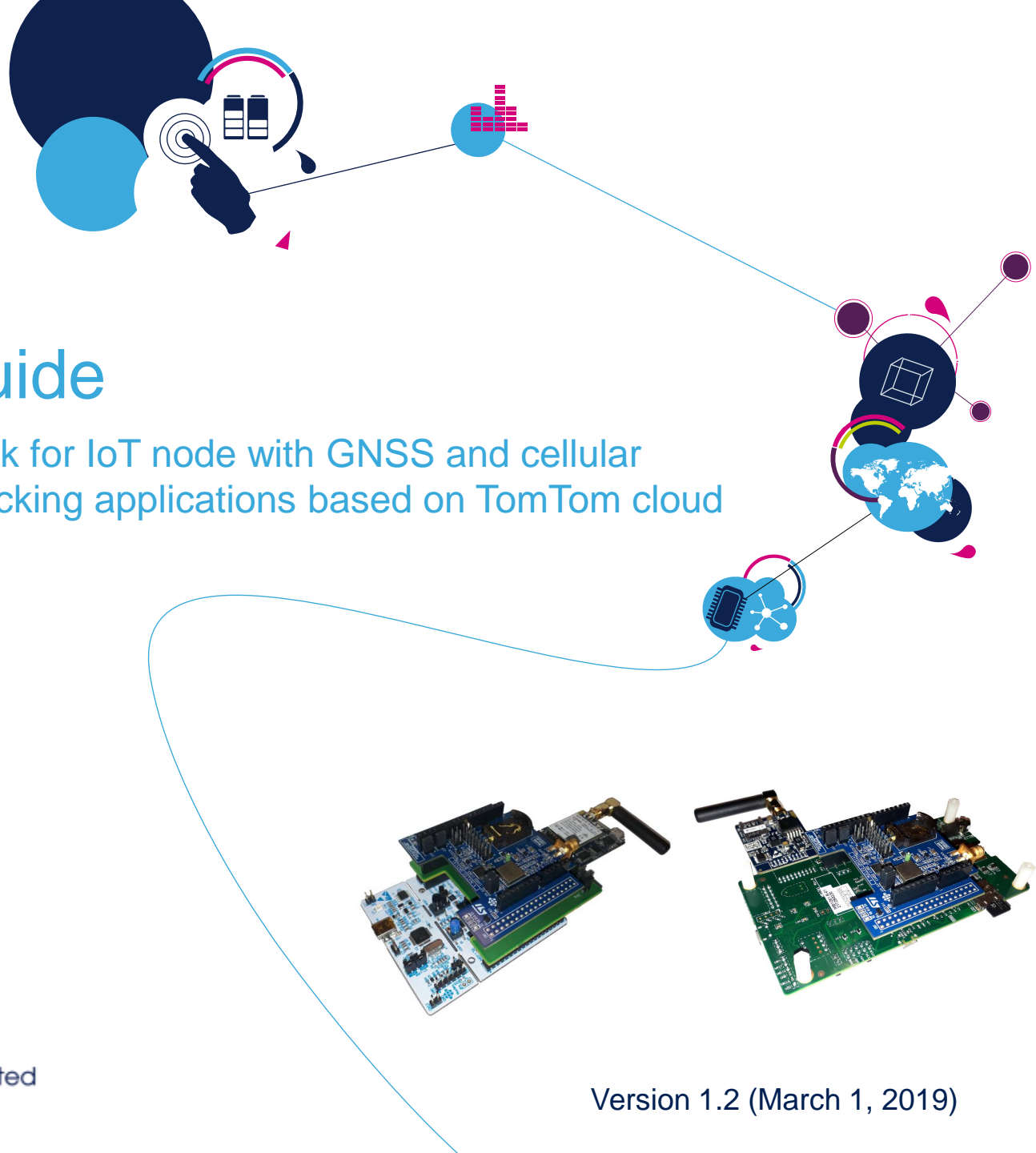
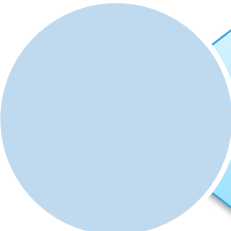


Quick Start Guide

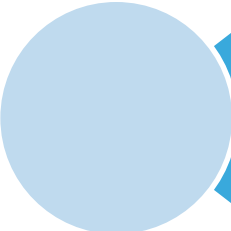
STM32Cube function pack for IoT node with GNSS and cellular connectivity for Asset Tracking applications based on TomTom cloud services

(FP-ATR-TOMTOM1)





FP-ATR-TOMTOM1: STM32Cube function pack for IoT node with GNSS and cellular connectivity for Asset Tracking applications based on TomTom cloud services
Hardware and Software overview



Setup & Demo Examples
Documents & Related Resources



STM32 Open Development Environment: Overview

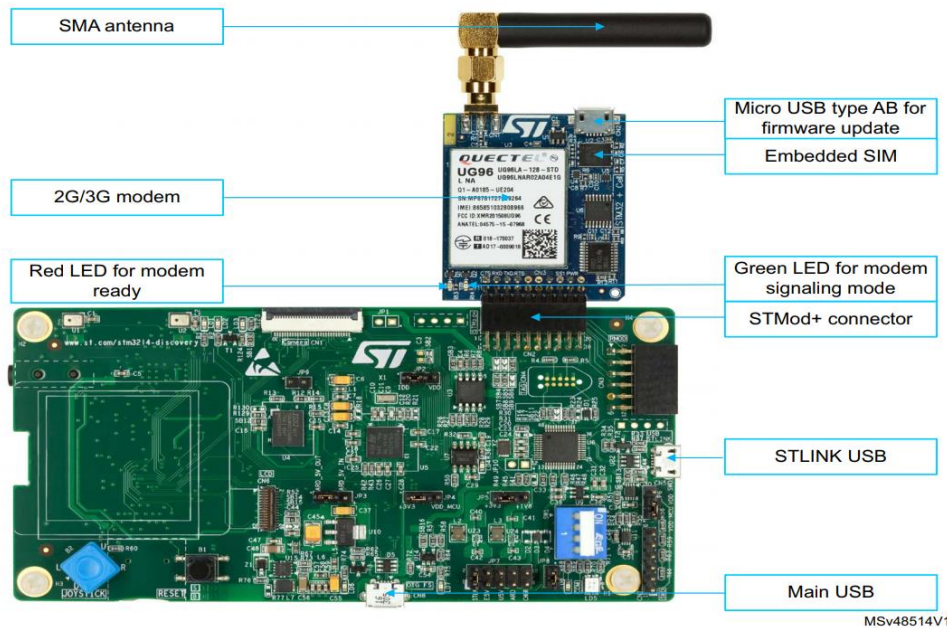
P-L496G-CELL01 discovery kit

Hardware Overview

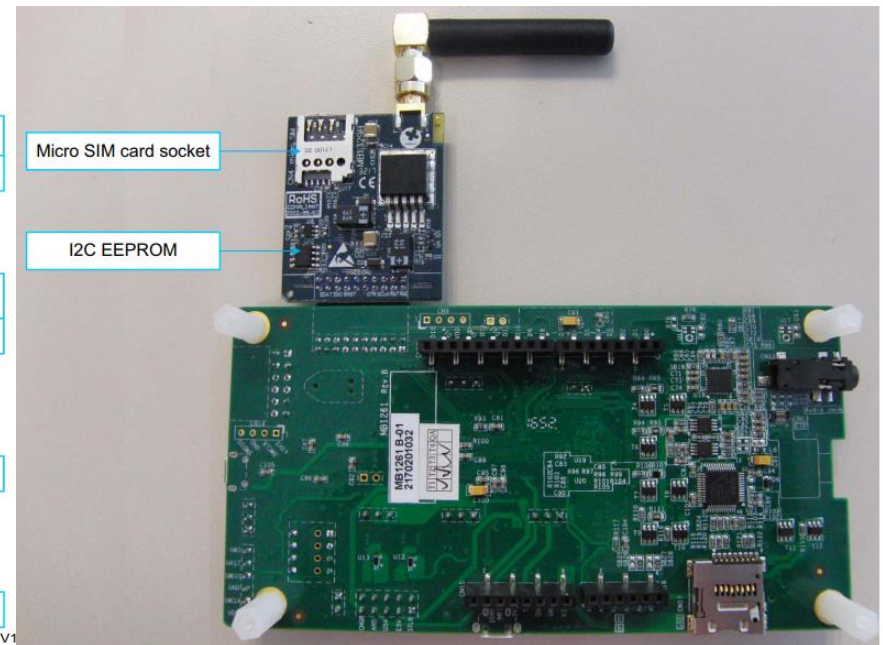
3

P-L496G-CELL01 Hardware Description

- The P-L496G-CELL01 STM32 discovery pack for 2G/3G cellular to cloud (STM32-C2C/2G-3G) is a turnkey development platform for cellular and cloud technology based solutions.
- The pack is composed of an STM32L496AGI6-based low-power discovery mother board with preloaded firmware, and an STMod+ cellular expansion board with antenna.
- It features STM32L496AGI6 Arm®-based microcontroller featuring 1 Mbyte of Flash memory and 320 Kbytes of RAM in a UFBGA169 package
- Board expansion features Quectel UG96 worldwide cellular modem penta-band 2G/3G module, 7.2 Mbps downlink, 5.76 Mbps uplink.



Top View



Bottom View

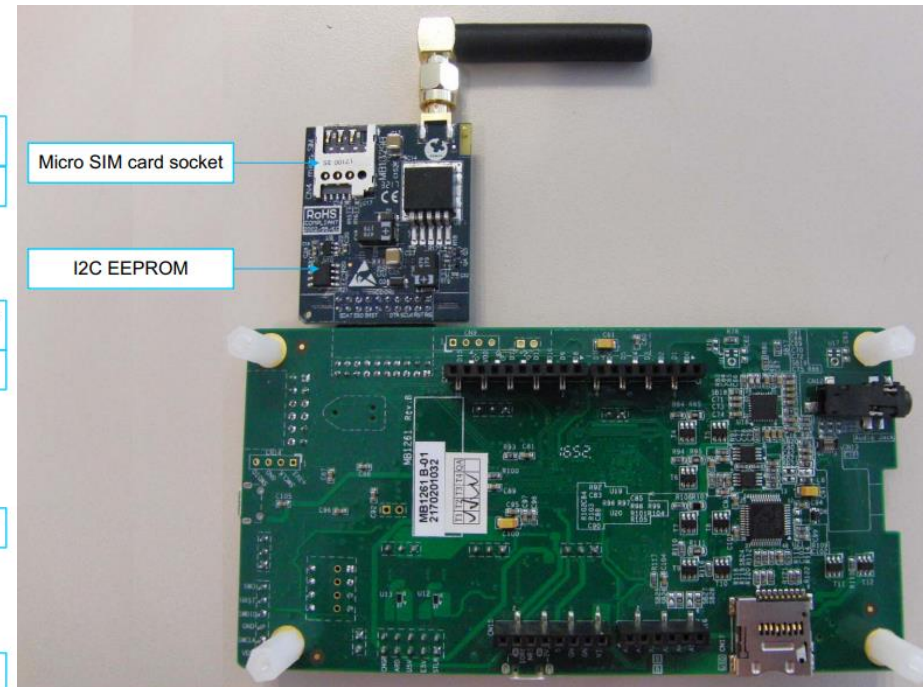
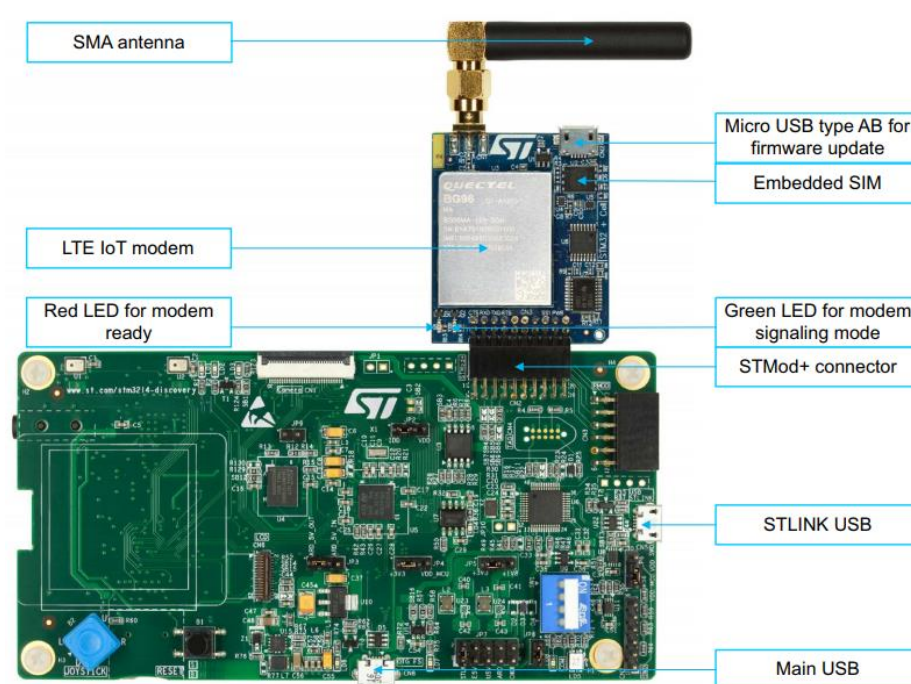
P-L496G-CELL02 discovery kit

Hardware Overview

4

P-L496G-CELL02 Hardware Description

- The STM32 Discovery pack (P-L496G-CELL02) is a turnkey development platform for cellular and cloud technology based solutions.
- The pack contains an STM32L496AGI6-based low-power Discovery mother board and an STMod+ Cellular LTE IoT worldwide expansion board with antenna.
- It features STM32L496AGI6 Arm®-based microcontroller featuring 1 Mbyte of Flash memory and 320 Kbytes of RAM in a UFBGA169 package
- Board expansion features Quectel BG96 worldwide cellular modem LTE Cat M1/Cat NB1/EGPRS module, 300 kbps downlink, 375 kbps uplink.



GNSS expansion board

Hardware Overview

5

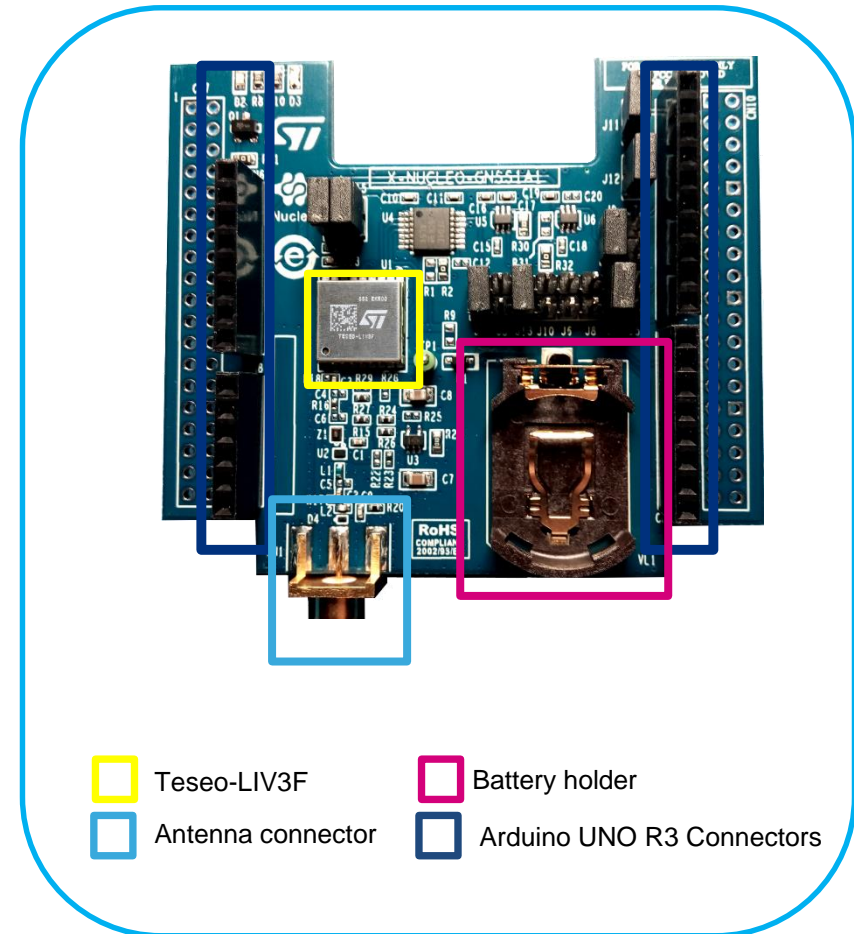
X-NUCLEO-GNSS1A1 Hardware Description

- 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 Teseo III 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 complete 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.

Key Products on board

Teseo-LIV3F: Single die standalone positioning receiver IC working on multiple constellations, 10x10mm compact size.

26MHz Temperature Compensated Crystal Oscillator (TCXO) and reduced Time To First Fix (TTFF) relying to a 32KHz Real Time Clock (RTC) oscillator for superior accuracy.



- | | |
|---|---|
|  Teseo-LIV3F |  Battery holder |
|  Antenna connector |  Arduino UNO R3 Connectors |

Latest info available at www.st.com
X-NUCLEO-GNSS1A1

X-NUCLEO-STMODA1 expansion board

Hardware Overview

6

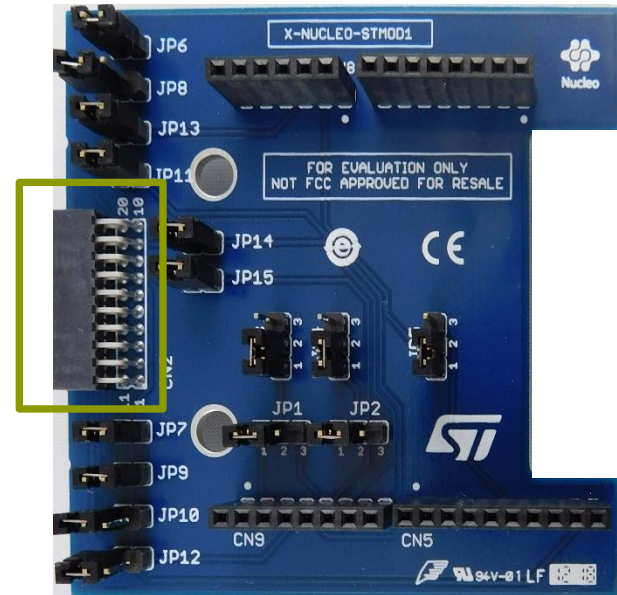
X-NUCLEO-STMODA1 Hardware Description

- The X-NUCLEO-STMODA1 is a passive adaptation board between Arduino Uno and STMod+ connectors.
- It provides an easy-to-use solution for expanding the Arduino UNO based ST ecosystem with devices using STMod+ connector.
- The X-NUCLEO-STMODA1 includes a comprehensive set of jumpers that allows to modify the way the connector mapping is operated, allowing to be compatible with a wider range of STM32 Nucleo board.
- Since fully passive, no software is associated

Key Products on board

STMod+ connector

Connector used by the Cellular modem



□ Arduino UNO R3 connector □ STMod+ connector

Latest info available at www.st.com
X-NUCLEO-STMODA1

FP-ATR-TOMTOM1 Software Description

FP-ATR-TOMTOM1 is a STM32Cube function pack which lets you connect your IoT node to a cellular network and send a GPS coordinate, provided by a Global Navigation Satellite System (GNSS) receiver, to TomTom online services. This coordinate is used to perform Reverse Geocoding, which is the translation of GPS coordinates into a street address.

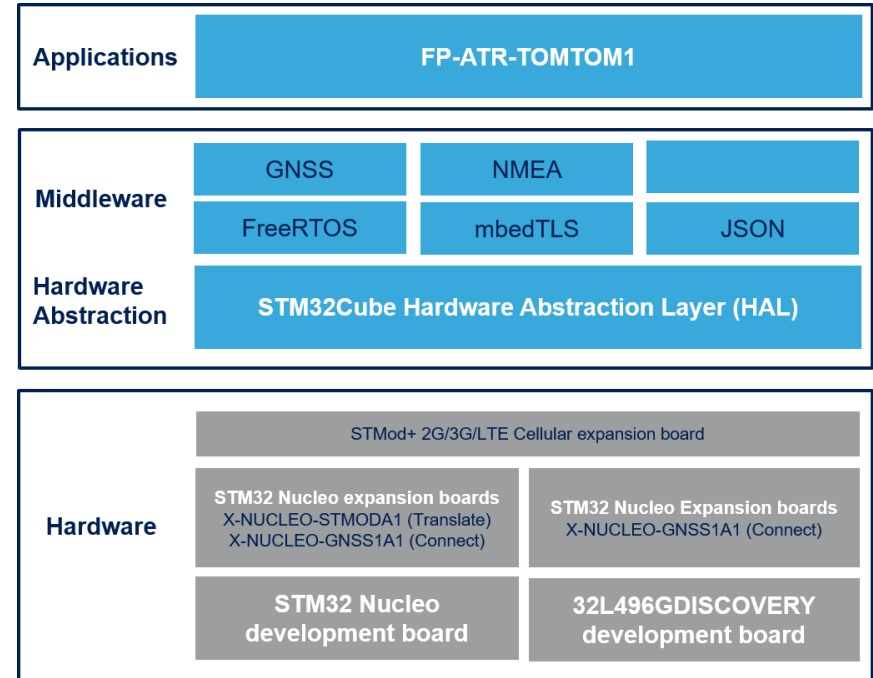
This software, together with the suggested combination of STM32 and ST devices, can be used, for example, to develop asset tracking applications.

Key features

- Complete firmware to connect an IoT node with GNSS module to a cellular network using 3G communication technology
- Support for Reverse Geocoding by the means of TomTom online services.
- Middleware libraries for FreeRTOS, mbedTLS, GNSS, JSON and NMEA
- Sample implementation available for X-NUCLEO-GNSS1A1 and 2G/3G or LTE Cellular expansion boards, when connected to a NUCLEO-F401RE or a 32L496GDISCOVERY board
- Easy portability across different MCU families, thanks to STM32Cube
- Free, user-friendly license terms

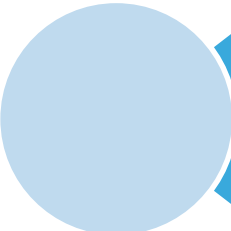
FP-ATR-TOMTOM1 Software Overview

Overall Software Architecture

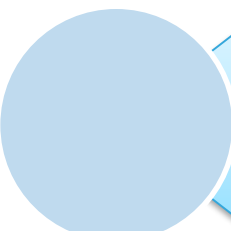


Latest info available at www.st.com

FP-ATR-TOMTOM1



FP-ATR-TOMTOM1: STM32Cube function pack for IoT node with GNSS and cellular connectivity for Asset Tracking applications based on TomTom cloud services
Hardware and Software overview



Setup & Application Examples
Documents & Related Resources



STM32 Open Development Environment: Overview

Setup & Application Examples

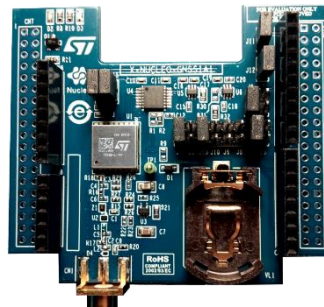
HW prerequisites with L496G-DISCOVERY (1/2)

9

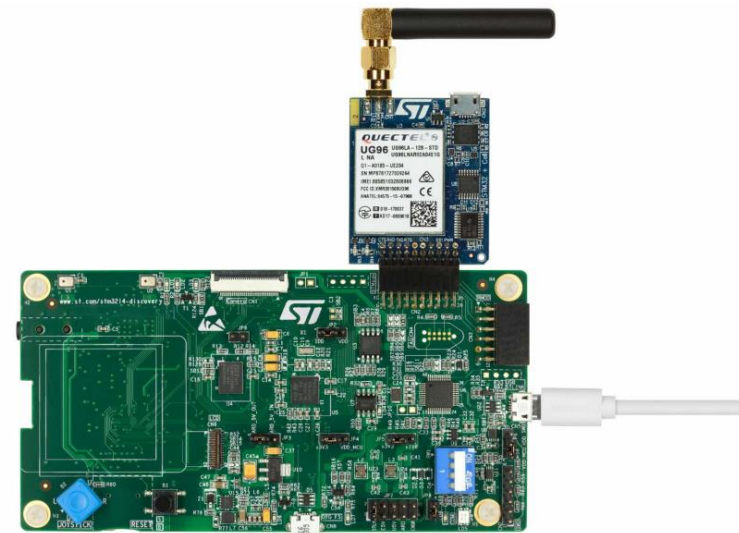
- 1x STM32 Nucleo expansion board with Teseo-LIV3F GNSS (**X-NUCLEO-GNSS1A1**) with GPS antenna
- **1x P-L496G-CELL01** or **P-L496G-CELL02** STM32 discovery pack for cellular to cloud, which contains:
 - 1x expansion board with Quectel UG96 2G/3G modem (for CELL01) or Quectel BG96 LTE modem (for CELL02), compatible with STMod+ connector
 - 1x STM32 Discovery development board **32L496GDISCOVERY**
 - 2G/3G antenna
- Laptop/PC with Windows 7, 8 or 10
- 1 x micro USB cable
- Cellular network access point



MicroUSB Cable



X-NUCLEO-GNSS1A1

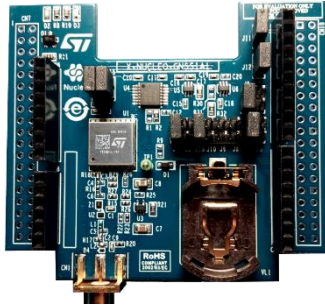


P-L496G-CELL01 discovery pack

Setup & Applications Examples

HW prerequisites with L496G-DISCOVERY (2/2)

10

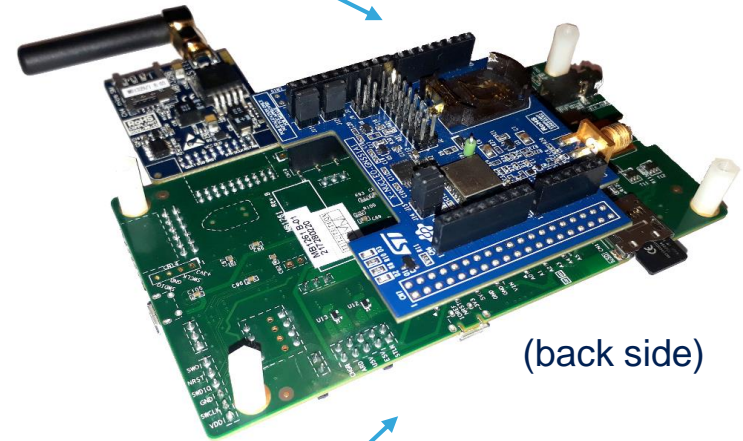


X-NUCLEO-GNSS1A1

+



P-L496G-CELL01



(back side)

Setup & Application Examples

HW prerequisites for STM32 Nucleo (1/2)

11

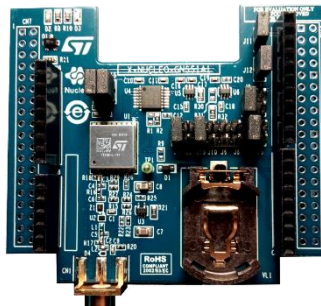
- 1x GNSS STM32 Nucleo expansion board based on Teseo-LIV3F module (**X-NUCLEO-GNSS1A1**) with GPS antenna
- 1x cellular expansion board based on Quectel UG96 2G/3G cellular modem (provided inside **P-L496G-CELL01** discovery kit) or Quectel BG96 LTE cellular modem (provided inside **P-L496G-CELL02** discovery kit) with SMA antenna
- 1x STMod+ connector expansion board for STM32 Nucleo (**X-NUCLEO-STMODA1**)
- 1x STM32 Nucleo development board (**NUCLEO-F401RE**)
- Laptop/PC with Windows 7, 8 or 10
- 1 x mini USB cable
- Cellular network access point



NUCLEO-F401RE



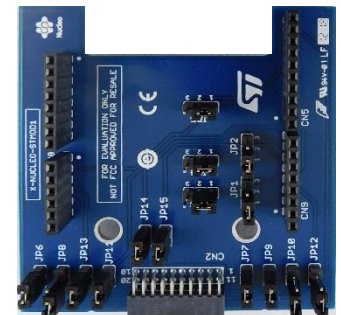
Mini USB Cable



X-NUCLEO-GNSS1A1



STM32-C2C



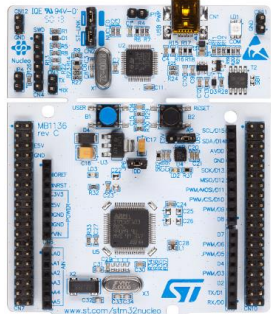
X-NUCLEO-STMODA1

Setup & Applications Examples

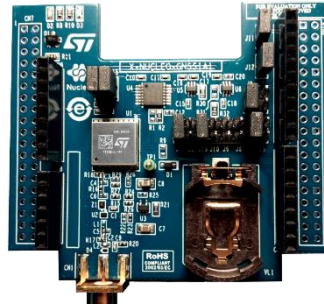
HW prerequisites for STM32 Nucleo (2/2)

12


NUCLEO-F401RE



STM32 Nucleo



X-NUCLEO-GNSS1A1

GNSS

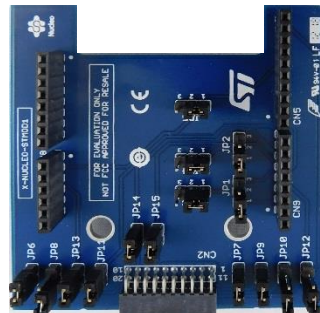
+



STM32-C2C

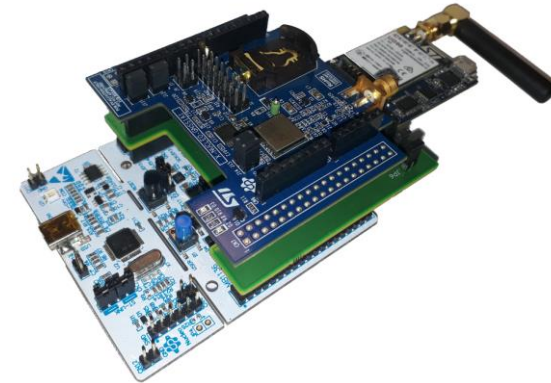
Cellular

+



X-NUCLEO-STMODA1

Adapter

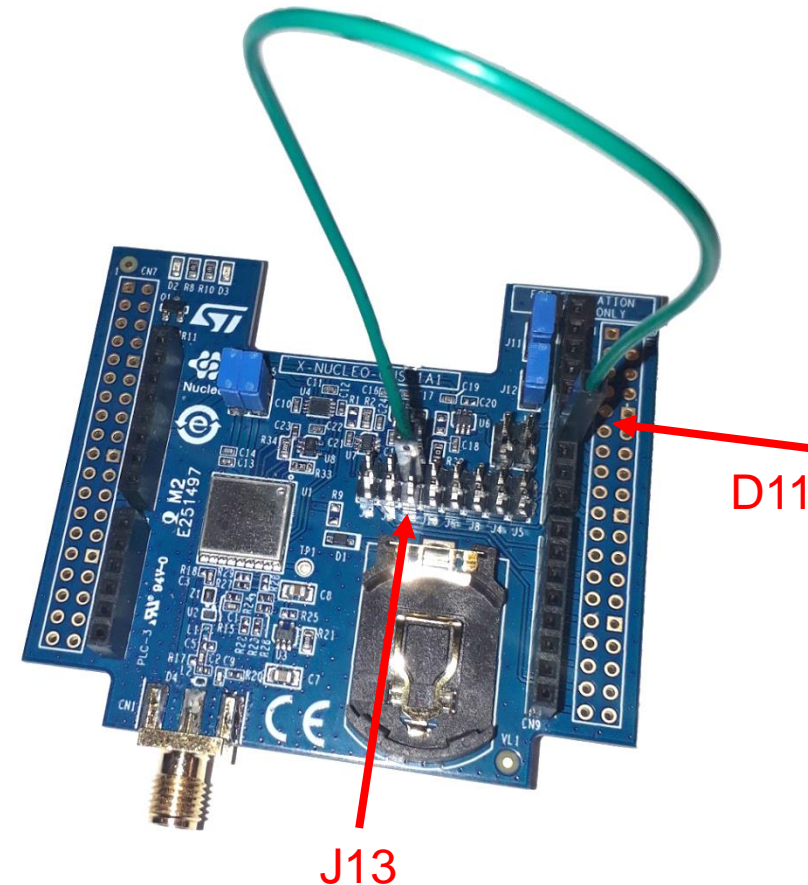


FP-ATR-TOMTOM1 hardware setup

Jumpers configuration on STM32 Nucleo Expansion boards

13

- On the X-NUCLEO-GNSS1A1
 - the following jumpers must be open: J2, J3, J4, J5, J6, J7, J8, J9 and J10
 - the following jumpers must be closed: J11, J12, J14 and J15
 - With Discovery-L496G, J13 must be closed. With Nucleo-F401RE, J13 must be open and a male-female wire must be connected to the upper pin of jumper J13 and to pin D11 of Arduino connector, as shown in figure.
- On the X-NUCLEO-STMOD1A1
 - the following jumpers must be closed: JP6, JP7, JP8, JP9, JP10, JP11, JP12, JP13
 - JP1 and JP2 must be in position 2-3
 - JP3, JP4 and JP5 must be in position 1-2



Setup & Application Examples

Software and Other prerequisites

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- **STM32 ST-Link Utility**

- Download and install [STSW-LINK004](#) from www.st.com

- **FP-ATR-TOMTOM1**

- Download [FP-ATR-TOMTOM1](#) package from www.st.com
- copy the .zip file content into a folder on your PC.
- The package contains binaries and source code with project files for several IDEs ([Keil](#), [IAR](#), [System Workbench](#)) for NUCLEO-F401RE and L496G-Discovery

- **Serial line monitor**, e.g. TeraTerm (<https://ttssh2.osdn.jp/>)

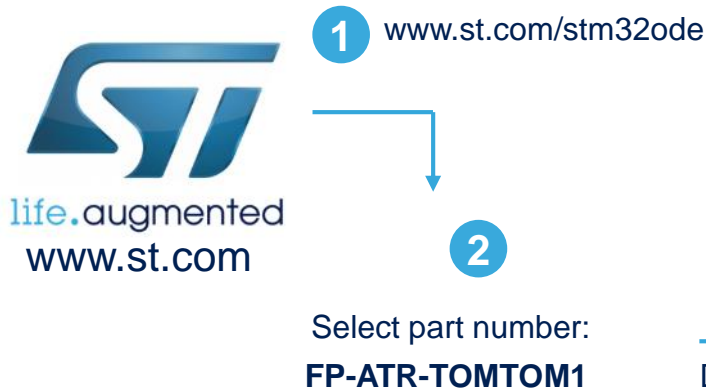
- To obtain TomTom API keys, register on <https://developer.tomtom.com>

- Before flashing the FP-ATR-TOMTOM1 firmware it is necessary to register the embedded SIM card in the P-L496G-CELL01 as described in document [UM2347](#), *Getting started with X-CUBE-CLD-GEN IoT cloud generic software expansion for STM32Cube*.

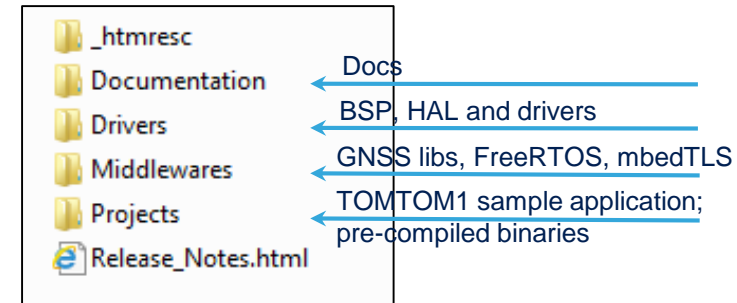
FP-ATR-TOMTOM1. Sample applications

Start coding in just a few minutes

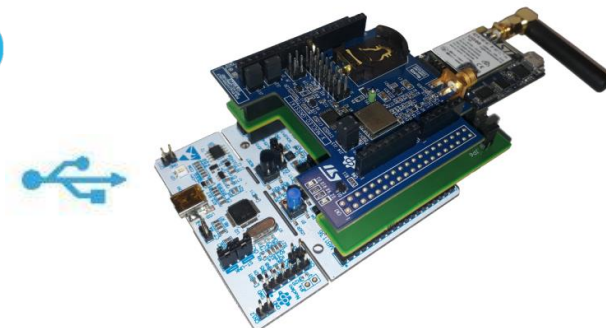
15



FP-ATR-TOMTOM1 package structure



Register on developer.tomtom.com to obtain API keys, copy them in source code and recompile the project according to the selected IDE



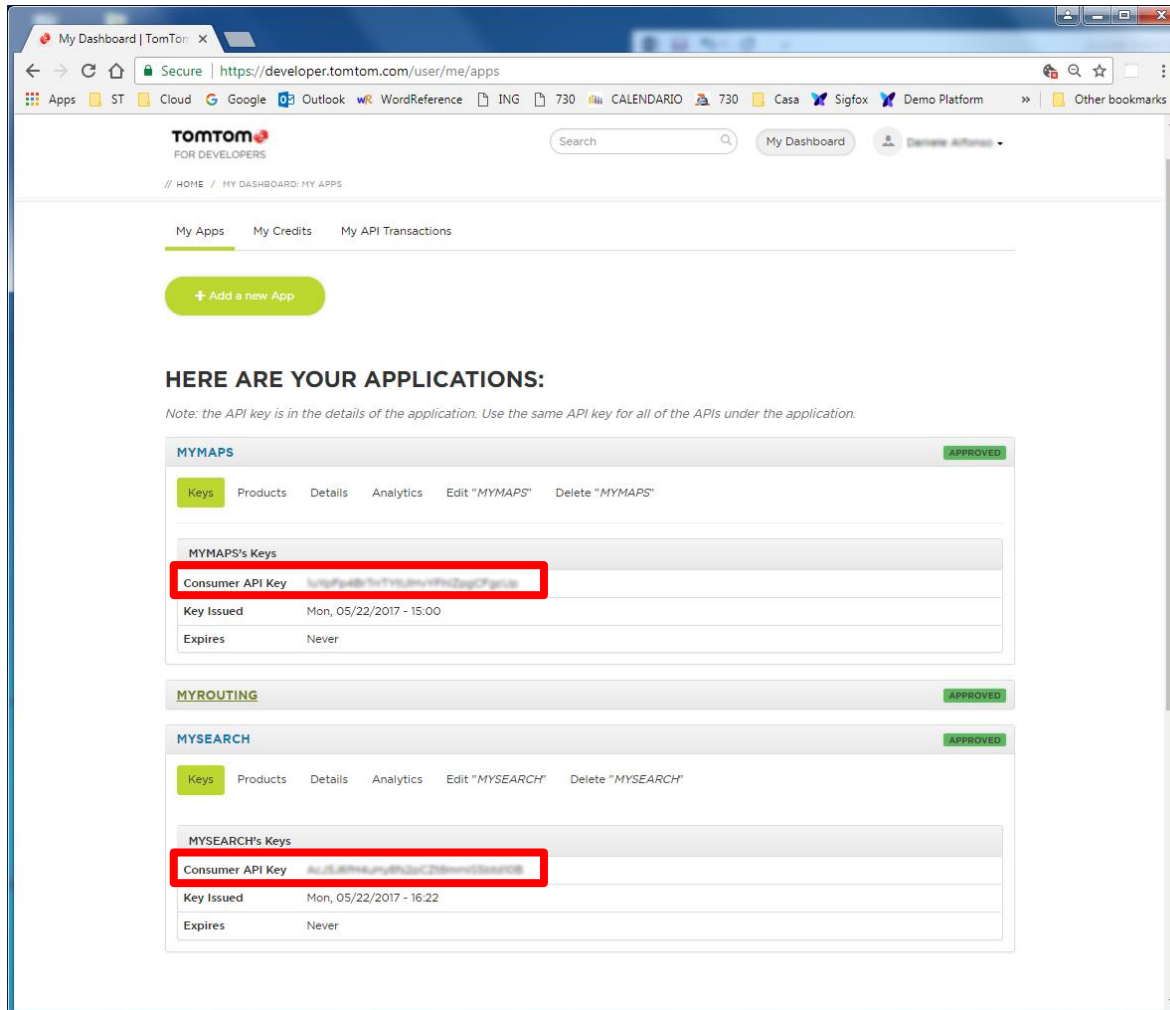
```
COM29-115200baud - Tera Term VT
File Edit Setup Control Window Help
FW version: US9CLM082408EIG
SIM Id (iccid): 8988303000000295828P
Signal Quality Level: -85 dBm (Quectel format: 14)
C2C module registered
Retrieving the cellular operator: "I WIND"
Connected to AP
Mac address: 01:02:03:04:05:06
Retrieving the IP address.
IP address: 100.84.124.1
Push the user button within the next 5 seconds if you want to update the root CA certificate(s)
Setting the RTC from the network time.
Configuring the RTC from Date: Thu, 19 Apr 2018 14:44:50 GMT
Press blue button to start demonstration
Press User Button within 5 seconds to use stored addresses
Stored addresses are:
[0] < 45.469189, 5.829660 >
[1] < 45.188530, 5.724524 >
[2] < 0.000000, 0.000000 >
Would you like to update one of them ? (y/n) n
Would you like to use one of them ? (y/n) y
Which one ? (0..2) 1
Coordinates: 45.188530 5.724524
MAP URI:
https://api.tomtom.com/map/1/tile/basic/main/11/1056/735.png?key=bfaf9b0ef9e7f1e8512
>> Opening connection
>> Socket created
>> Socket open
>> Data sent
ADDRESS: 12 Place Victor Hugo, Grenoble, 38000, France
Demonstration concluded.
Press blue button to start demonstration
```

FP-ATR-TOMTOM1: Step by step setup

Generate TomTom API keys

16

- Register on TomTom developer site (developer.tomtom.com)
- Obtain API keys for MAPS and SEARCH services



The screenshot shows the TomTom Developer Dashboard at the URL <https://developer.tomtom.com/user/me/apps>. The page displays the 'My Apps' section with a green 'Add a new App' button. Below this, it lists applications: MYMAPS, MYROUTING, and MYSEARCH, each marked as 'APPROVED'. The 'MYMAPS' section is expanded, showing its 'Keys' tab. A table titled 'MYMAPS's Keys' contains one entry: 'Consumer API Key' with a value highlighted by a red box. Below this, it shows 'Key Issued' as 'Mon, 05/22/2017 - 15:00' and 'Expires' as 'Never'. The 'MYSEARCH' section is also expanded, showing its 'Keys' tab. A table titled 'MYSEARCH's Keys' contains one entry: 'Consumer API Key' with a value highlighted by a red box. Below this, it shows 'Key Issued' as 'Mon, 05/22/2017 - 16:22' and 'Expires' as 'Never'.

TomTom FOR DEVELOPERS

Search My Dashboard Generate App

HOME / MY DASHBOARD: MY APPS

My Apps My Credits My API Transactions

+ Add a new App

HERE ARE YOUR APPLICATIONS:

Note: the API key is in the details of the application. Use the same API key for all of the APIs under the application.

MYMAPS APPROVED

Keys Products Details Analytics Edit "MYMAPS" Delete "MYMAPS"

MYMAPS's Keys

Consumer API Key	4c7f44b7c7f7b7b7b7b7b7b7b7b7b7b7
Key Issued	Mon, 05/22/2017 - 15:00
Expires	Never

MYROUTING APPROVED

MYSEARCH APPROVED

Keys Products Details Analytics Edit "MYSEARCH" Delete "MYSEARCH"

MYSEARCH's Keys

Consumer API Key	4c7f44b7c7f7b7b7b7b7b7b7b7b7b7b7
Key Issued	Mon, 05/22/2017 - 16:22
Expires	Never

FP-ATR-TOMTOM1: Step by step setup

Copy and paste keys into project

17

- Open header file *connection.h* and paste the TomTom API keys in the corresponding #define lines.
- Delete the line with #error directive
- Recompile the project and program the STM32 board

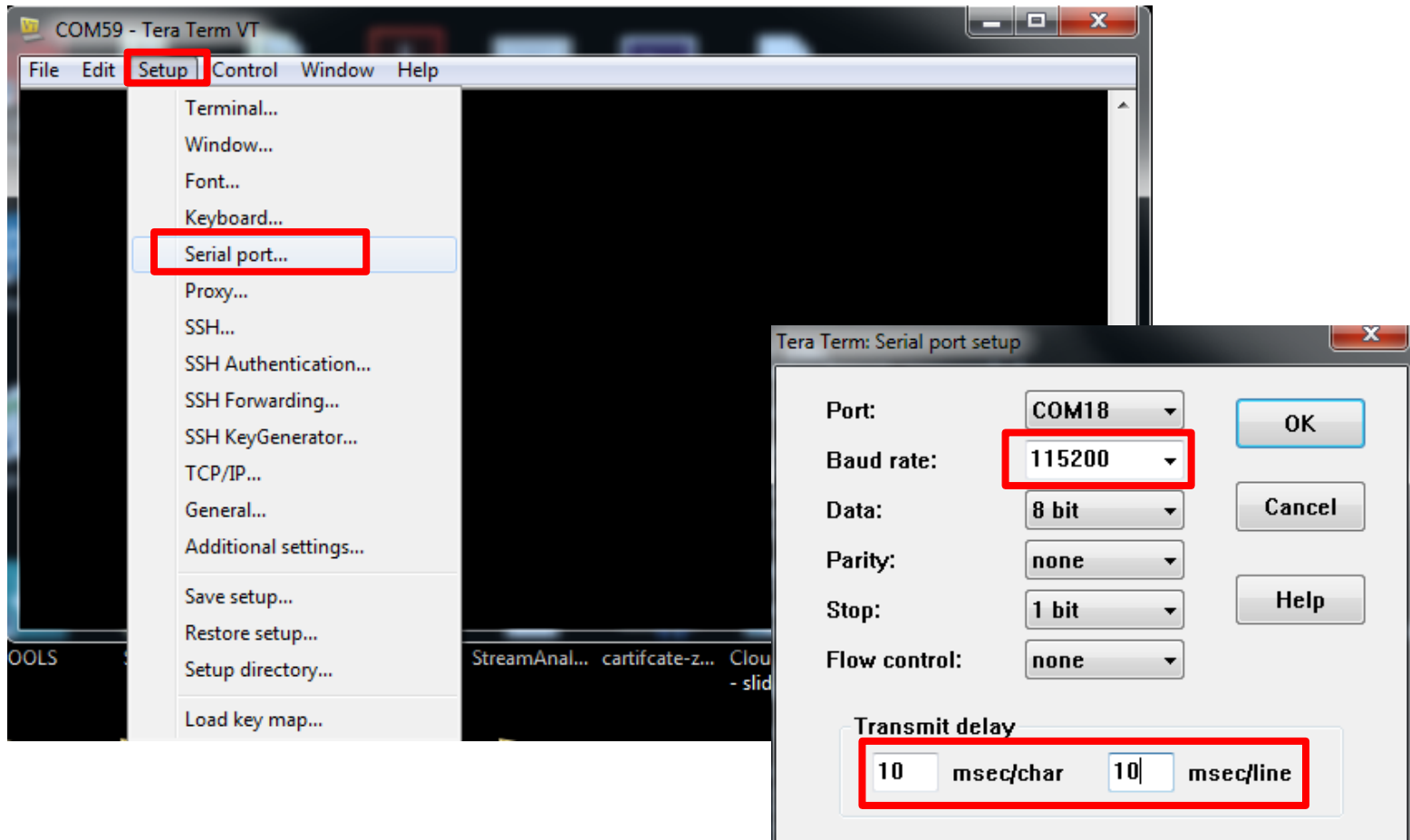
```
connection.h
1  #ifndef __CONNECTION_H
2  #define __CONNECTION_H
3
4  static const char *hostname = "api.tomtom.com";
5  static const uint32_t portnumber = 443;
6  static const char *protocol = "api.tomtom.com";
7
8  /** TOMTOM Search API key */
9  #define TOMTOM_SEARCH_KEY "add your key here"
10
11 /** TOMTOM Map API key */
12 #define TOMTOM_MAP_KEY "add your key here"
13
14 #error Add TOMTOM keys and delete this line
15
16 #endif // __CONNECTION_H
17
```

FP-ATR-TOMTOM1: Step by step setup

Launch sample application. Configure Serial Terminal

18

- Open serial terminal then configure baud rate speed to 115200 (**Setup** → **Serial port** in TeraTerm).
- Also set transmit delays to a value bigger than zero, like 10.

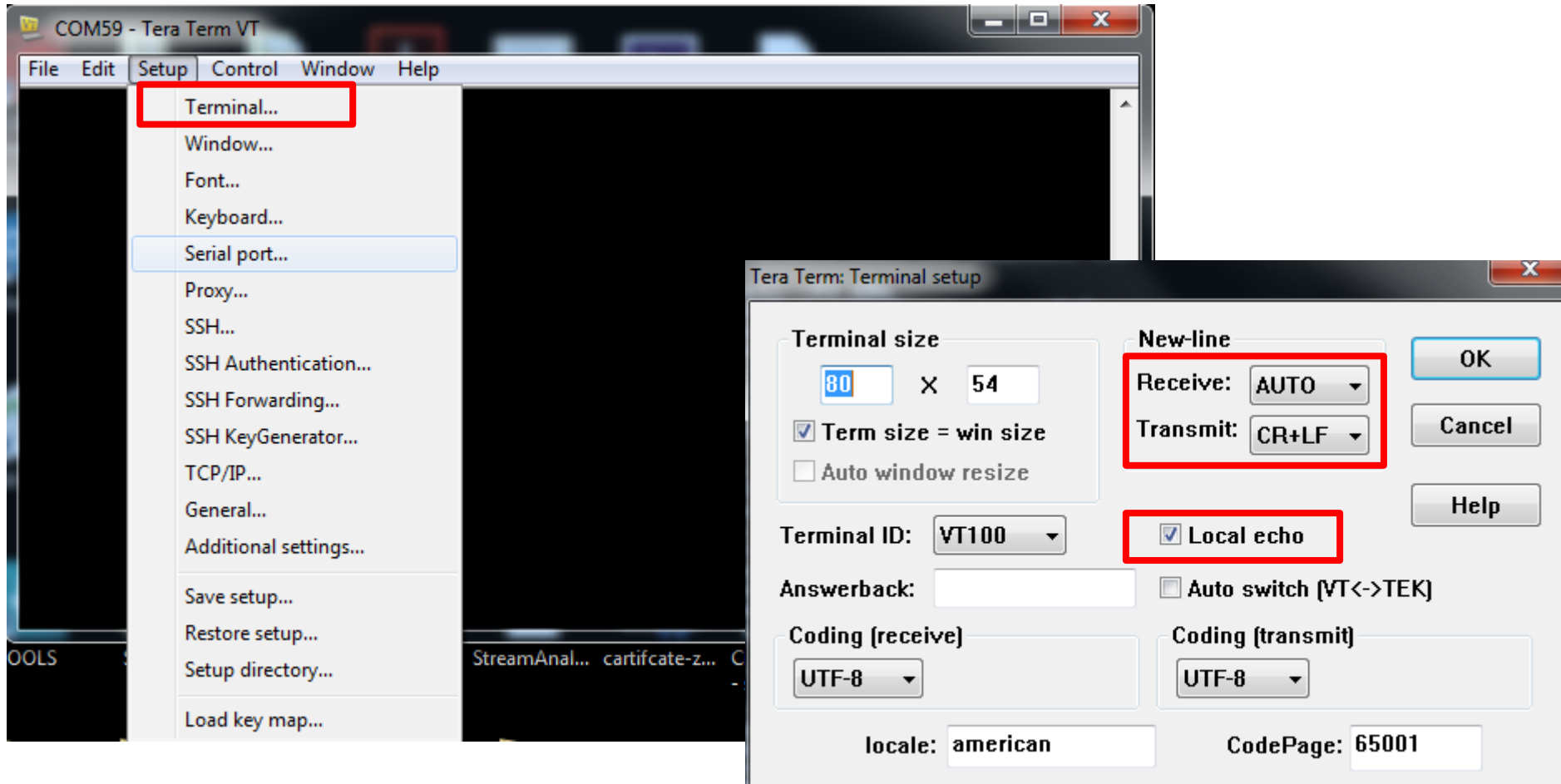


FP-ATR-TOMTOM1: Step by step setup

Launch sample application. Configure Serial Terminal

19

- In Terminal configuration (**Setup** → **Terminal** in TeraTerm) enable Local Echo and set newlines to AUTO for Receive and CR+LF for Transmit.

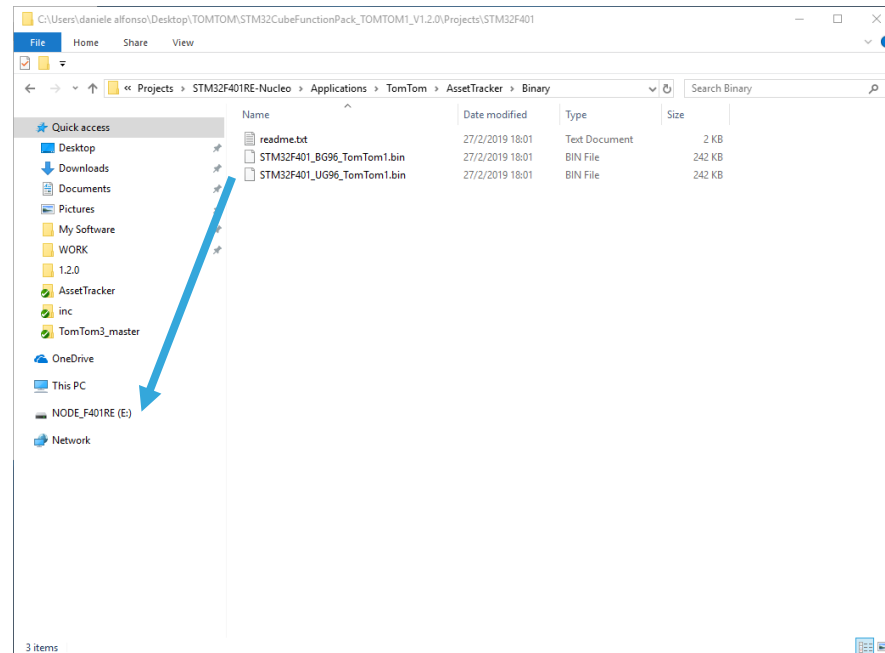


FP-ATR-TOMTOM1: Step by step setup

Launch sample application. Use pre-compiled binaries

20

- Configurable pre-compiled binaries for both platforms can be found at:
 - Projects\STM32F401RE-Nucleo\Applications\TomTom\AssetTracker\Binary\STM32F401_BG96_TomTom1.bin
 - Projects\STM32F401RE-Nucleo\Applications\TomTom\AssetTracker\Binary\STM32F401_UG96_TomTom1.bin
 - Projects\STM32L496G-Discovery\Applications\TomTom\AssetTracker\Binary\STM32L496G_BG96_TomTom1.bin
 - Projects\STM32L496G-Discovery\Applications\TomTom\AssetTracker\Binary\STM32L496G_UG96_TomTom1.bin
- To start the application, simply connect the board to your PC and drag the binary in the folder dedicated to the STM32 device (Discovery or STM32 Nucleo board)

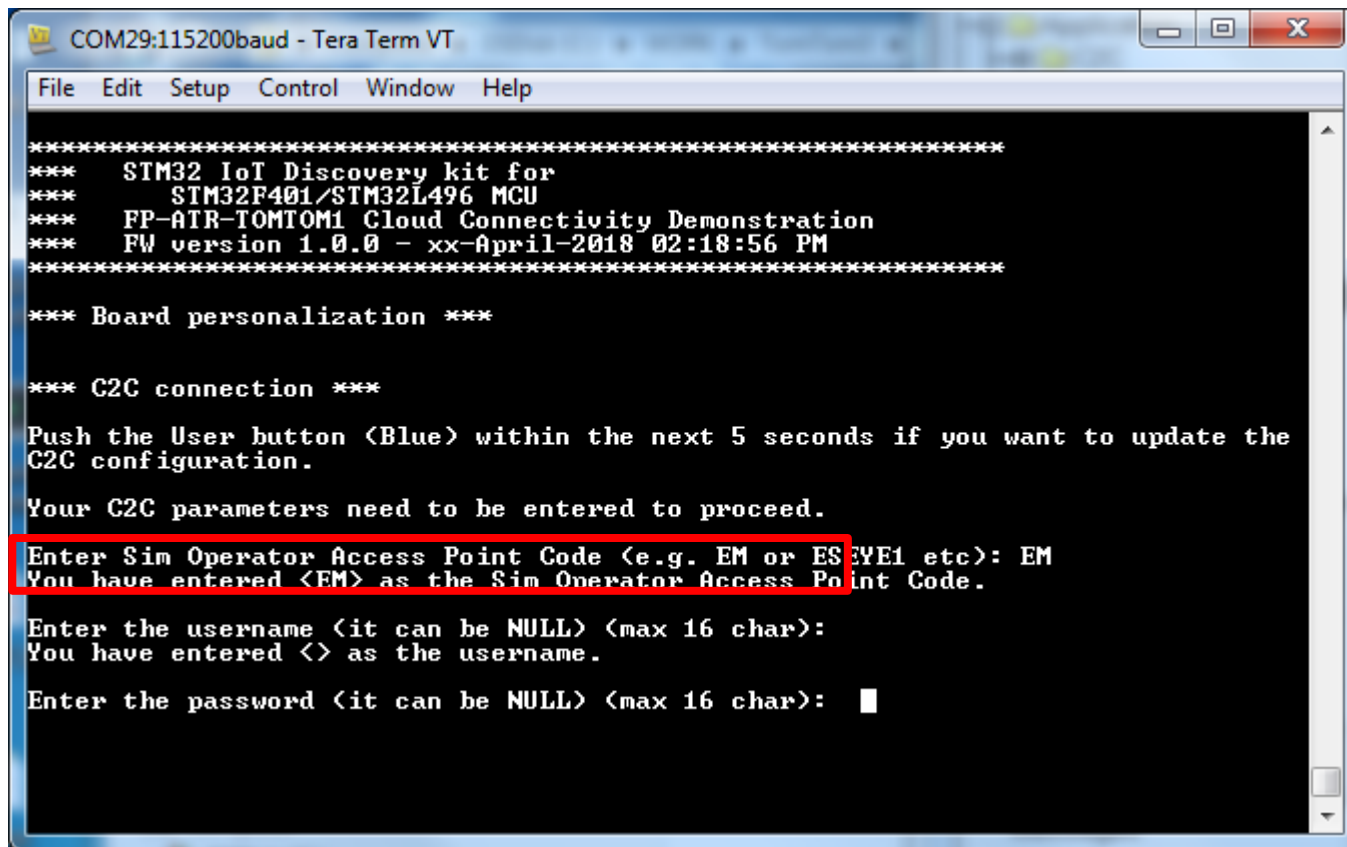


FP-ATR-TOMTOM1: Step by step setup

Configure cellular parameters

21

- Open serial terminal to display the application messages.
- As a first step the user needs to enter the cellular parameters. Those and subsequent parameters are then stored in FLASH for further use.
- If you want to use the embedded SIM within the STM32-C2C board, enter “EM” as Sim Operator Access Point Code, and leave username and password blank (just hit return).



```
COM29:115200baud - Tera Term VT
File Edit Setup Control Window Help

*****
***  STM32 IoT Discovery kit for
***  STM32F401/STM32L496 MCU
***  FP-ATR-TOMTOM1 Cloud Connectivity Demonstration
***  FW version 1.0.0 - xx-April-2018 02:18:56 PM
*****

*** Board personalization ***

*** C2C connection ***

Push the User button <Blue> within the next 5 seconds if you want to update the
C2C configuration.

Your C2C parameters need to be entered to proceed.
Enter Sim Operator Access Point Code <e.g. EM or ES EYE1 etc>: EM
You have entered <EM> as the Sim Operator Access Point Code.

Enter the username <it can be NULL> <max 16 char>:
You have entered <> as the username.

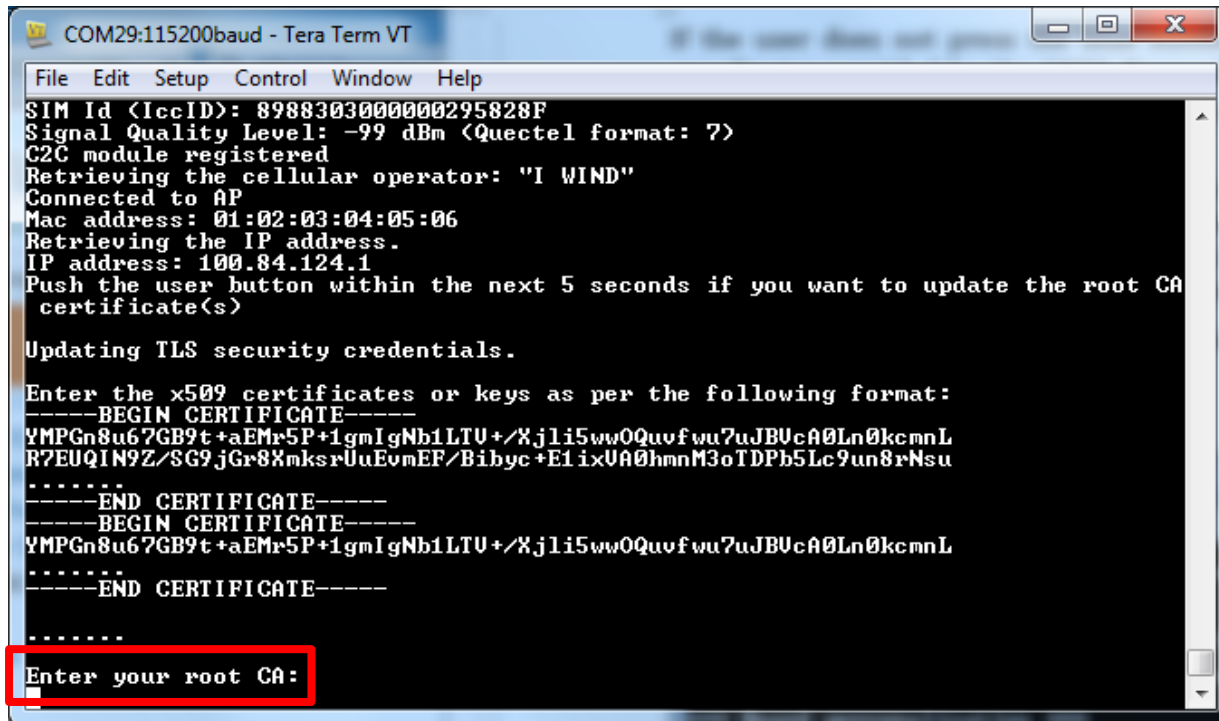
Enter the password <it can be NULL> <max 16 char>: 
```

FP-ATR-TOMTOM1: Step by step setup

Configure TLS credentials

22

- As a second step, the application asks for TLS security credentials.
- The user needs to enter the two certificates which are provided as text files at:
 - Projects\BOARD_NAME\Applications\TomTom\AssetTracker\Comodo.crt.txt
 - Projects\BOARD_NAME\Applications\TomTom\AssetTracker\TomTom.crt.txt
- It is suggested to paste both files in a single text file and then to copy and paste both certificates together in the serial terminal after the prompt “Enter your root CA:”



```
COM29:115200baud - Tera Term VT
File Edit Setup Control Window Help
SIM Id (IccID): 8988303000000295828F
Signal Quality Level: -99 dBm (Quectel format: ?)
C2C module registered
Retrieving the cellular operator: "I WIND"
Connected to AP
Mac address: 01:02:03:04:05:06
Retrieving the IP address.
IP address: 100.84.124.1
Push the user button within the next 5 seconds if you want to update the root CA
certificate(s)

Updating TLS security credentials.

Enter the x509 certificates or keys as per the following format:
-----BEGIN CERTIFICATE-----
YMPGn8u67GB9t+aEMr5P+1gmIgNb1LTU+/Xjli5ww0Quvfwu7uJBUCa0Ln0kcmnL
R7EUQIN9Z/SG9jGr8XmksrUuEvmEF/Bihyc+E1ixUA0hmnM3oTDPb5Lc9un8rNsu
-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
YMPGn8u67GB9t+aEMr5P+1gmIgNb1LTU+/Xjli5ww0Quvfwu7uJBUCa0Ln0kcmnL
-----END CERTIFICATE-----
-----
Enter your root CA:
```

23

- 

- The application then stops for user interaction



FP-ATR-TOMTOM1: Step by step setup

Use of pre-stored coordinates

24

- After pressing blue button to start the demonstration, the user is asked to push the button within 5 seconds if she/he wants to use stored addresses
- This is a set of pre-stored GPS coordinates saved in the FLASH, which can be used to test the application in place of the coordinates provided by the GNSS.



This feature can be useful to test the application even in environments where the GNSS is not available, such as indoor environments

- New coordinates can be simply entered by keyboard and then stored in FLASH for further use

```
COM18:115200baud - Tera Term VT
File Edit Setup Control Window Help

Press blue button to start demonstration

Press User Button within 5 seconds to use stored addresses
Stored addresses are:
[0] < 45.469189, 9.029660 >
[1] < 45.188530, 5.724524 >
[2] < 0.000000, 0.000000 >
Would you like to update one of them ? <y/n> n
Would you like to use one of them ? <y/n> y
Which one ? <0..2> 1
Coordinates: 45.188530 5.724524
HTTP URL:
https://api.tomtom.com/map/1/tile/basic/main/11/1056/735.png?key=
&tileSize=512

>> Opening HTTP connection
>> HTTP connection open
>> HTTP read ok

        ADDRESS: 12 Place Victor Hugo, Grenoble, 38000, France

>> HTTP connection close

Demonstration concluded.

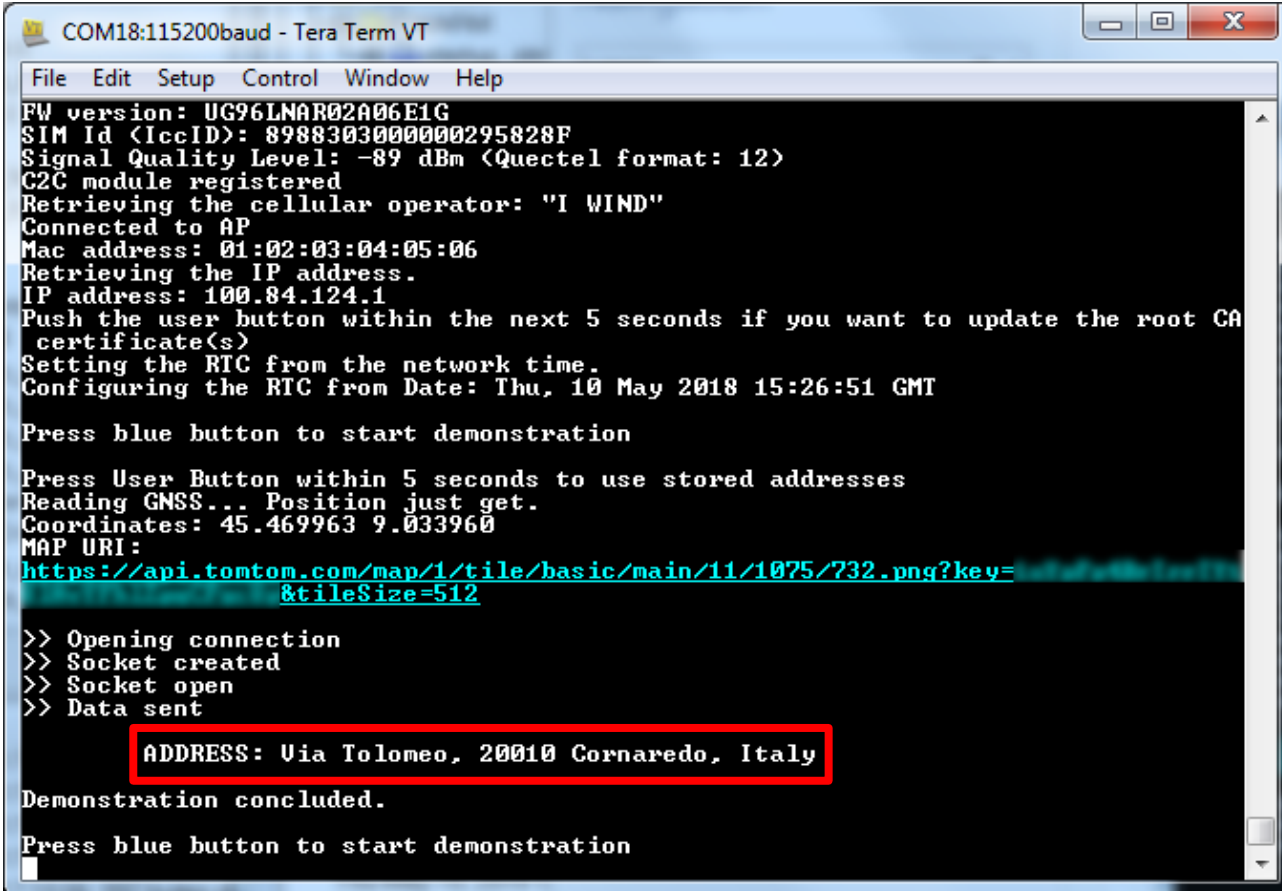
Press blue button to start demonstration
```

FP-ATR-TOMTOM1: Step by step setup

Display street address

25

- Using either pre-stored GPS coordinates or the output of the GNSS, the application then connects to TomTom services to perform Reverse Geocoding, and a street address is finally displayed



```
COM18:115200baud - Tera Term VT
File Edit Setup Control Window Help
FW version: UG96LNAR02A06E1G
SIM Id (IccID): 8988303000000295828F
Signal Quality Level: -89 dBm (Quectel format: 12)
C2C module registered
Retrieving the cellular operator: "I WIND"
Connected to AP
Mac address: 01:02:03:04:05:06
Retrieving the IP address.
IP address: 100.84.124.1
Push the user button within the next 5 seconds if you want to update the root CA
certificate(s)
Setting the RTC from the network time.
Configuring the RTC from Date: Thu, 10 May 2018 15:26:51 GMT

Press blue button to start demonstration

Press User Button within 5 seconds to use stored addresses
Reading GNSS... Position just get.
Coordinates: 45.469963 9.033960
MAP URI:
https://api.tomtom.com/map/1/tile/basic/main/11/1075/732.png?key=
&tileSize=512

>> Opening connection
>> Socket created
>> Socket open
>> Data sent

ADDRESS: Via Tolomeo, 20010 Cornaredo, Italy

Demonstration concluded.

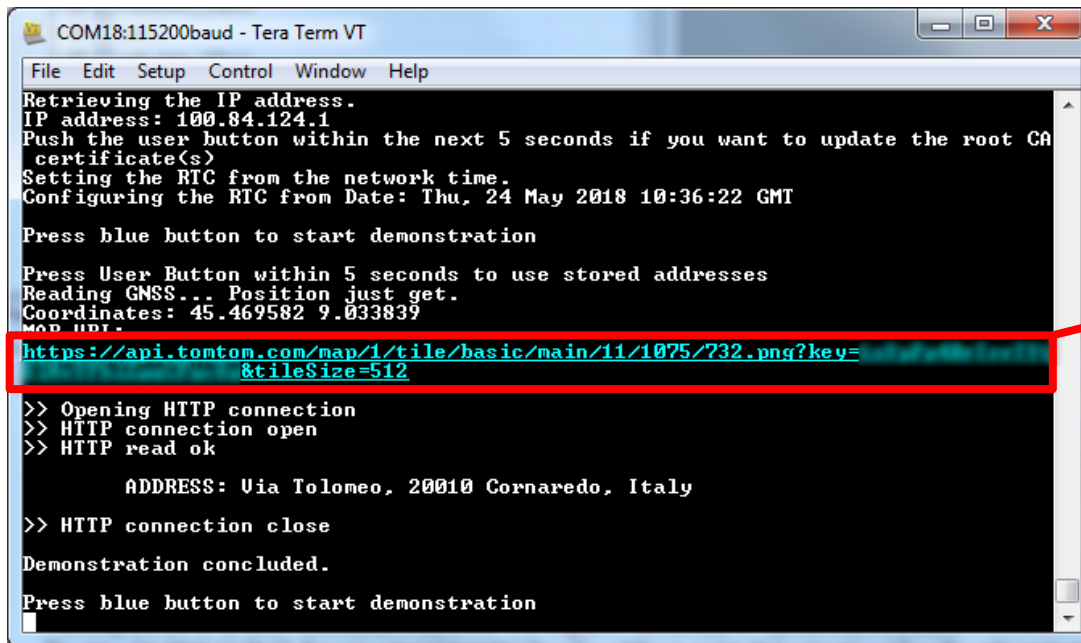
Press blue button to start demonstration
```

FP-ATR-TOMTOM1: Step by step setup

Display map

26

- The application also prints a link to the TomTom map tile which comprises the given GPS coordinates
- It is sufficient to click on the link to open the map in the web browser



```
COM18:115200baud - Tera Term VT
File Edit Setup Control Window Help
Retrieving the IP address.
IP address: 100.84.124.1
Push the user button within the next 5 seconds if you want to update the root CA
certificate(s)
Setting the RTC from the network time.
Configuring the RTC from Date: Thu, 24 May 2018 10:36:22 GMT

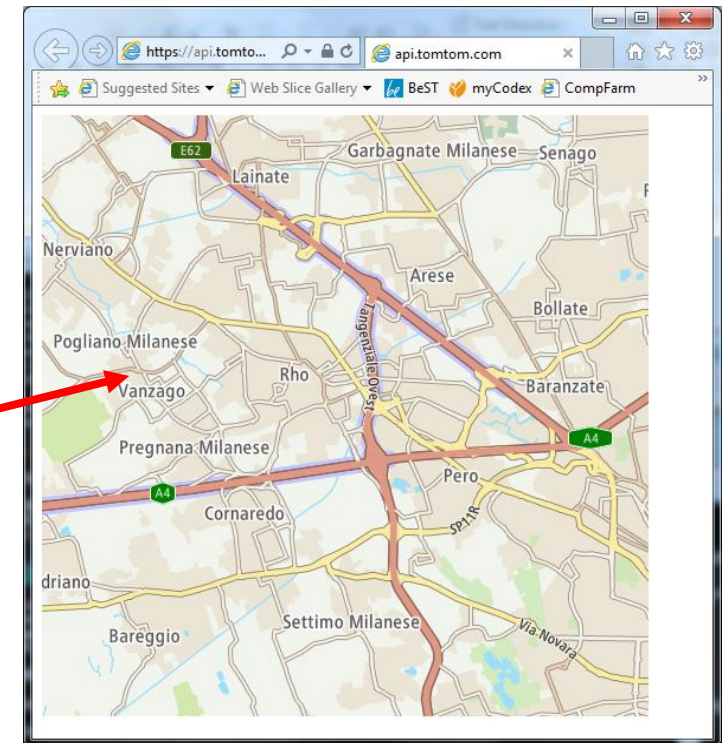
Press blue button to start demonstration

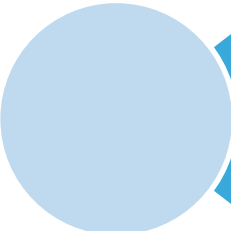
Press User Button within 5 seconds to use stored addresses
Reading GNSS... Position just get.
Coordinates: 45.469582 9.033839
MOR 001:
https://api.tomtom.com/map/1/tile/basic/main/11/1075/732.png?key=
&tileSize=512

>> Opening HTTP connection
>> HTTP connection open
>> HTTP read ok

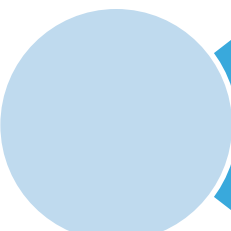
ADDRESS: Via Tolomeo, 20010 Cornaredo, Italy

>> HTTP connection close
Demonstration concluded.
Press blue button to start demonstration
```

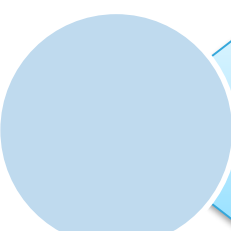




FP-ATR-TOMTOM1: STM32Cube function pack for IoT node with GNSS and cellular connectivity for Asset Tracking applications based on TomTom cloud services
Hardware and Software overview



Setup & Demo Examples
Documents & Related Resources



STM32 Open Development Environment: Overview

All documents are available in the DESIGN tab of the related products webpage

FP-ATR-TOMTOM1:

- **DB3684:** STM32Cube function pack for IoT node with GNSS and cellular connectivity for Asset Tracking applications based on TomTom online services – **databrief**
- **UM2471:** Getting started with STM32Cube function pack for IoT node with GNSS and cellular connectivity for Asset Tracking applications based on TomTom online services – **user manual**
- **UM2347:** Getting started with X-CUBE-CLD-GEN IoT cloud generic software expansion for STM32Cube – **user manual**
- Software setup file

P-L496G-CELL01:

- Gerber files, BOM, Schematic
- **DB3400:** STM32 discovery pack for 2G/3G cellular to cloud– **databrief**
- **UM2322:** STM32 Discovery pack for 2G/3G cellular to cloud – **user manual**

X-NUCLEO-GNSS1A1:

- Gerber files, BOM, Schematic
- **DB3458:** GNSS expansion board based on Teseo-LIV3F module for STM32 Nucleo – **databrief**
- **UM2327:** Getting started with the X-NUCLEO-GNSS1A1 expansion board based on Teseo-LIV3F tiny GNSS module for STM32 Nucleo – **user manual**

X-NUCLEO-STMODA1:

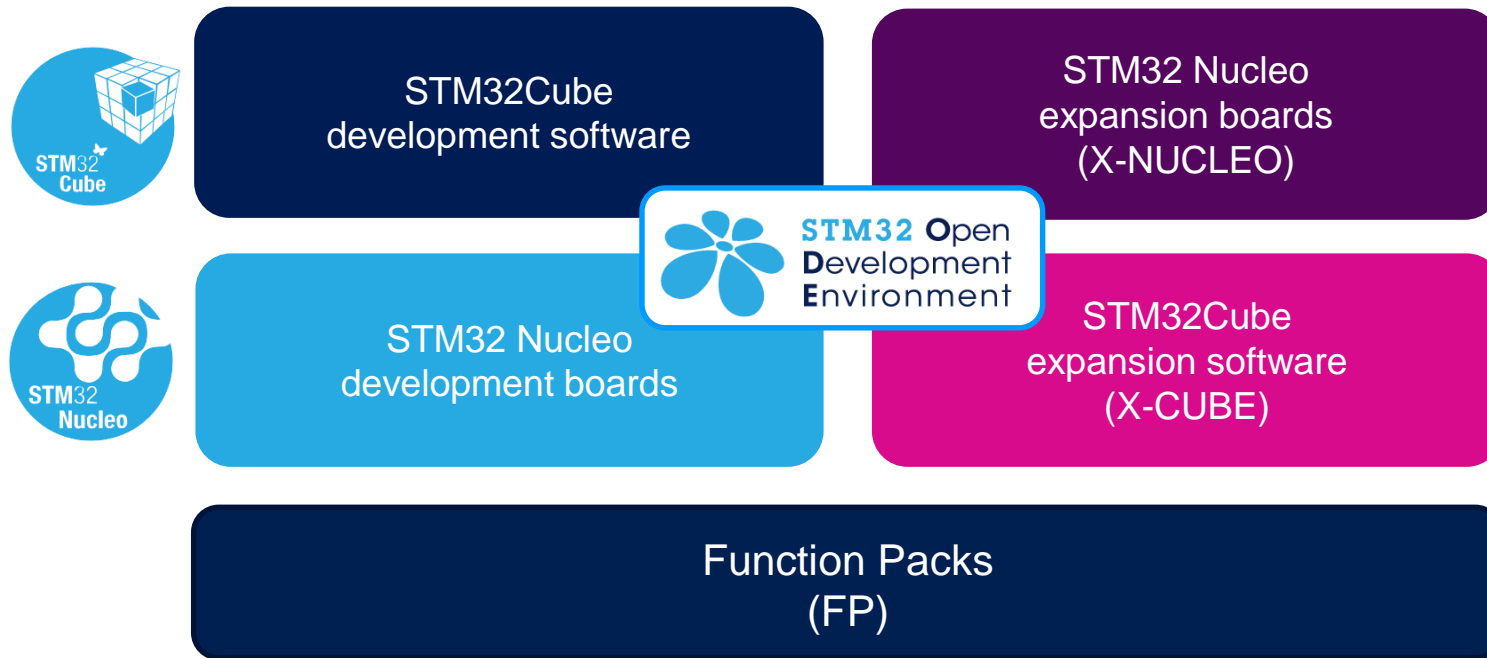
- Gerber files, BOM, Schematic
- **DB3589:** STMod+ connector expansion board for STM32 Nucleo– **databrief**
- **UM2400:** Getting started with the X-NUCLEO-STMODA1 expansion board for STM32 Nucleo – **user manual**

STM32 Open Development Environment

Fast, affordable Prototyping and Development

29

- The STM32 Open Development Environment (ODE) consists of a set of stackable boards and a modular open SW environment designed around the STM32 microcontroller family.

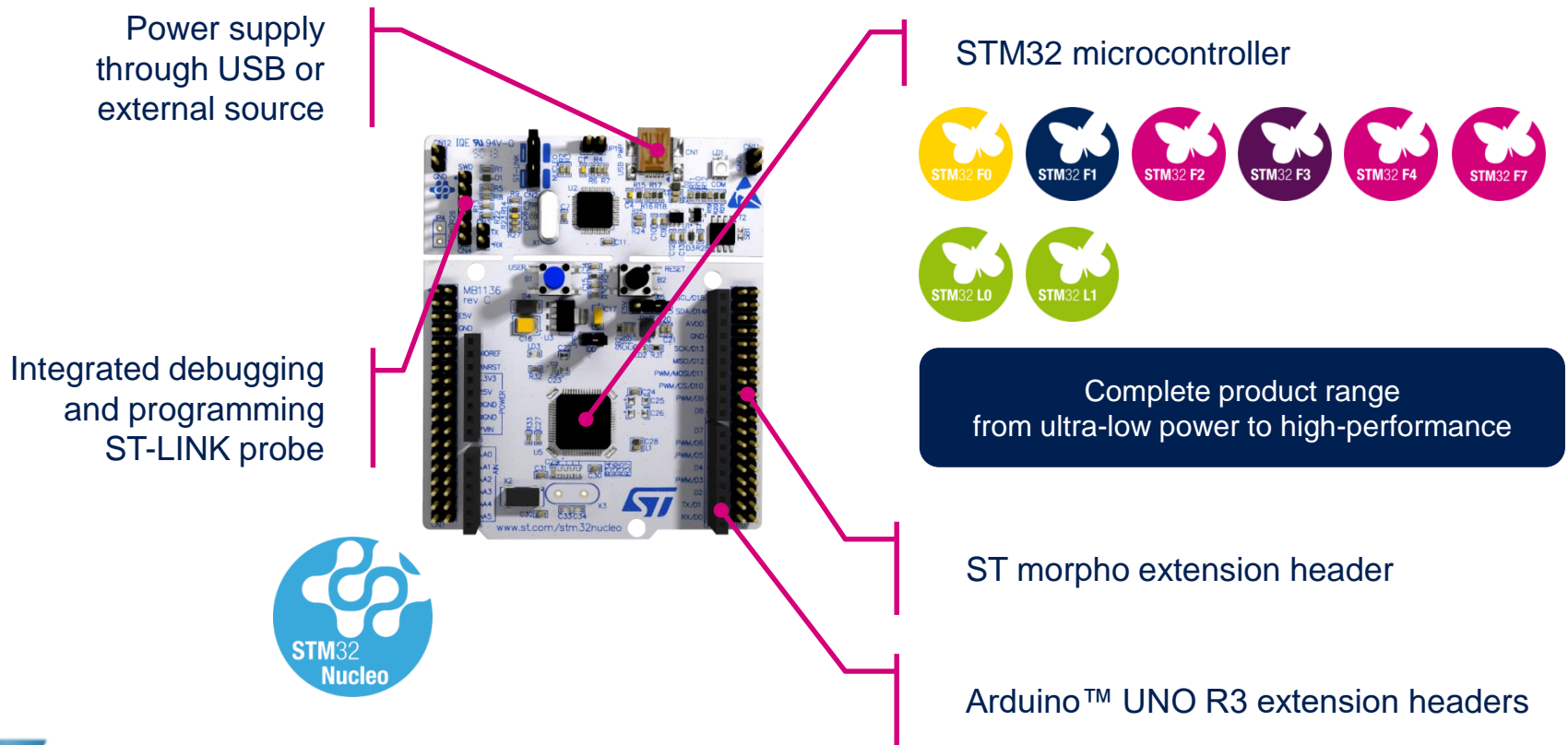


www.st.com/stm32ode

STM32 Nucleo Development Boards (NUCLEO)

30

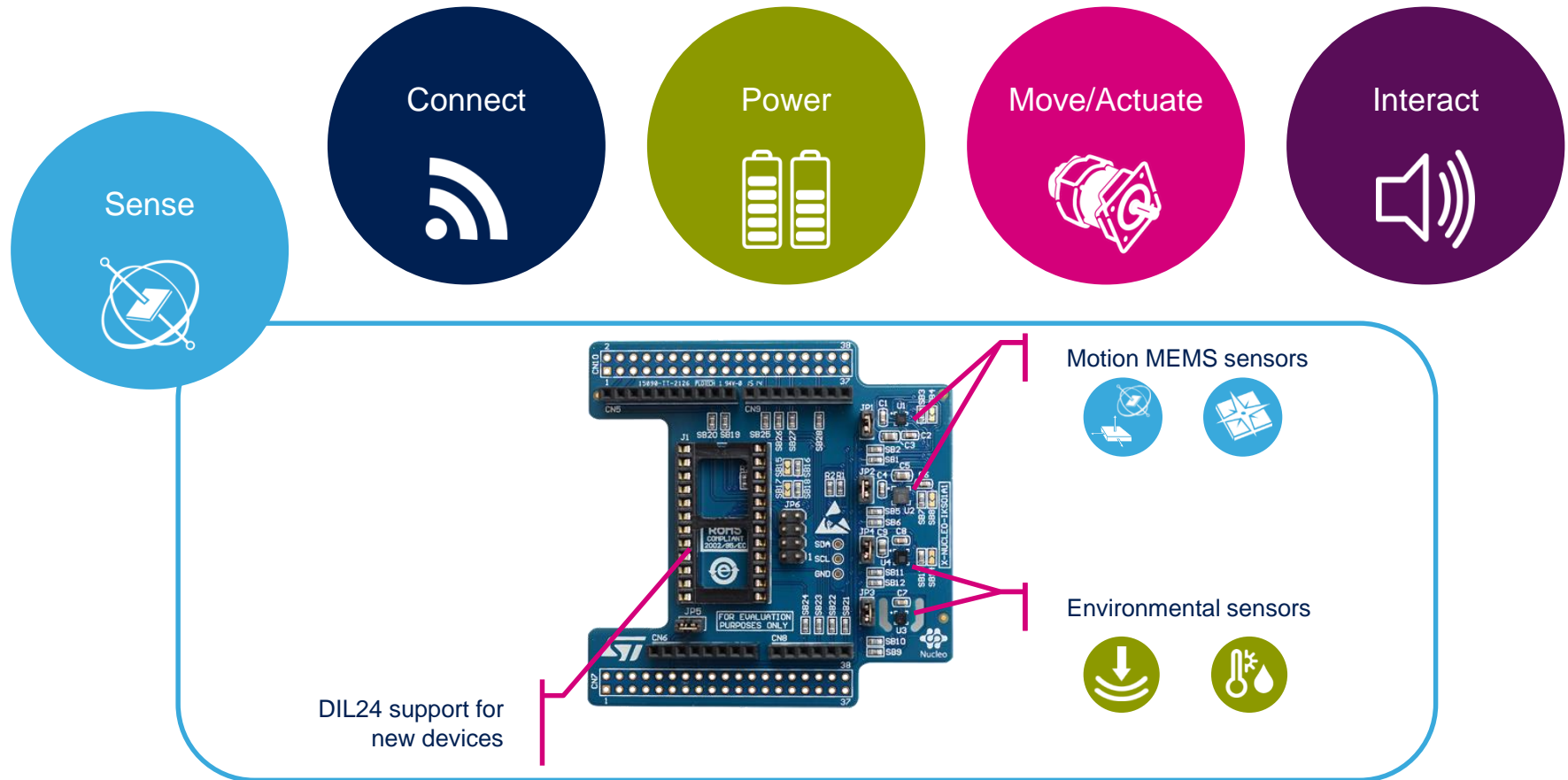
- A comprehensive range of affordable development boards for all the STM32 microcontroller series, with unlimited unified expansion capabilities and integrated debugger/programmer functionality.



STM32 Nucleo Expansion Boards (X-NUCLEO)

31

- Boards with additional functionality that can be plugged directly on top of the STM32 Nucleo development board directly or stacked on another expansion board.



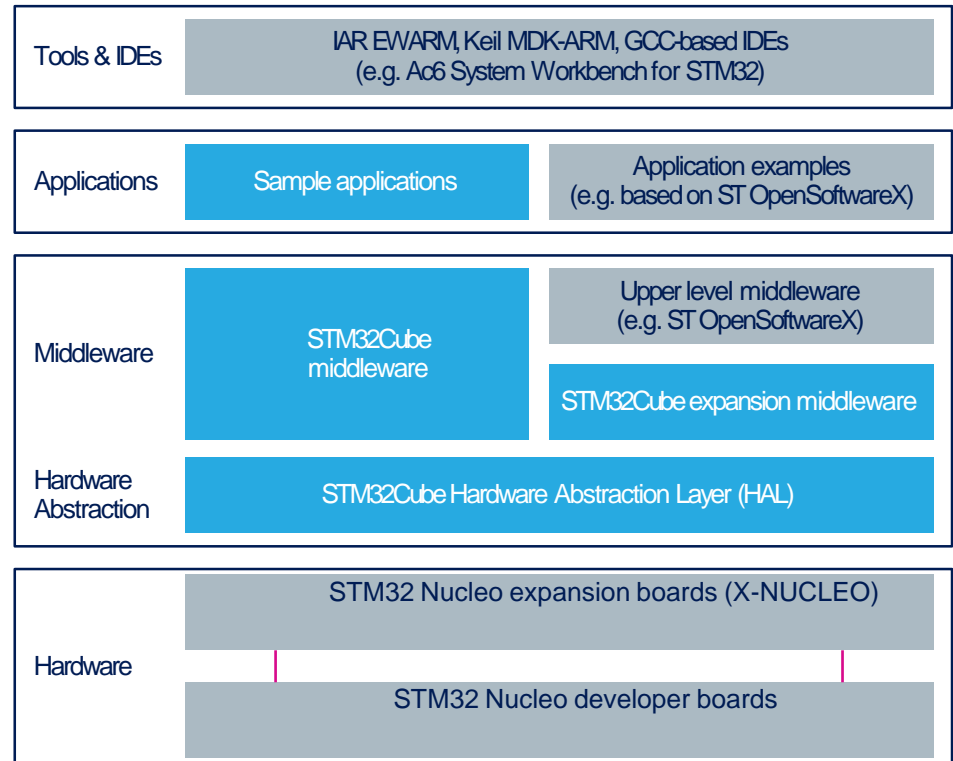
Example of STM32 expansion board (X-NUCLEO-1KS01A1)

STM32 Open Development Environment

Software components

32

- **STM32Cube software (CUBE)** - A set of free tools and embedded software bricks to enable fast and easy development on the STM32, including a Hardware Abstraction Layer and middleware bricks.
- **STM32Cube expansion software (X-CUBE)** - Expansion software provided free for use with the STM32 Nucleo expansion board and fully compatible with the STM32Cube software framework. It provides abstracted access to expansion board functionality through high-level APIs and sample applications.



- **Compatibility with multiple Development Environments** - The STM32 Open Development Environment is compatible with a number of IDEs including IAR EWARM, Keil MDK, and GCC-based environments. Users can choose from three IDEs from leading vendors, which are free of charge and deployed in close cooperation with ST. These include Eclipse-based IDEs such as Ac6 System Workbench for STM32 and the MDK-ARM environment.

STM32 Open Development Environment

Building block approach

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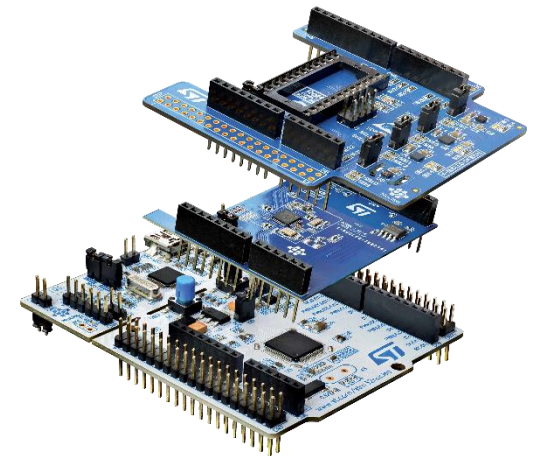
The building blocks

Your need

Our answer



 **STM32 Open Development Environment**



www.st.com/stm32code