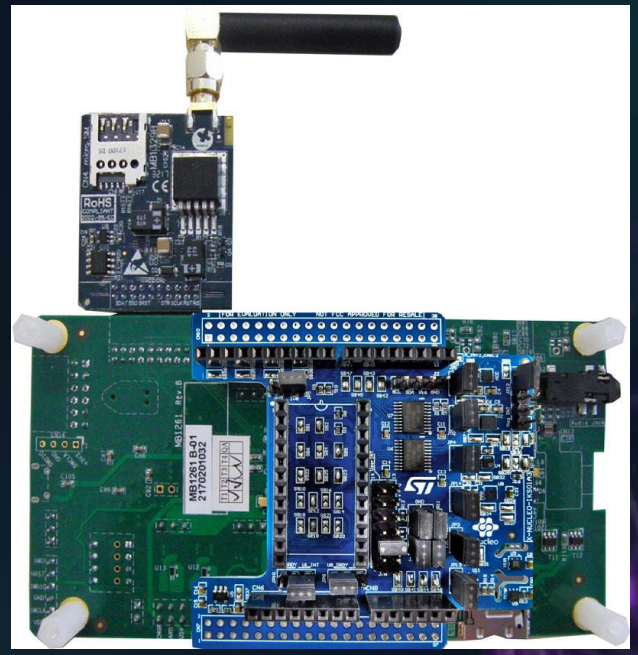

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Quick Start Guide

STM32Cube function pack for IoT sensor node with cellular connectivity enabling IOTA Distributed Ledger Technology (DLT) functions (FP-SNS-IOTA1)

Version 1.1 (November 30, 2020)

Agenda

1. Hardware and Software overview
2. Setup & Demo Examples
3. Documents & Related Resources
4. STM32 Open Development Environment: Overview

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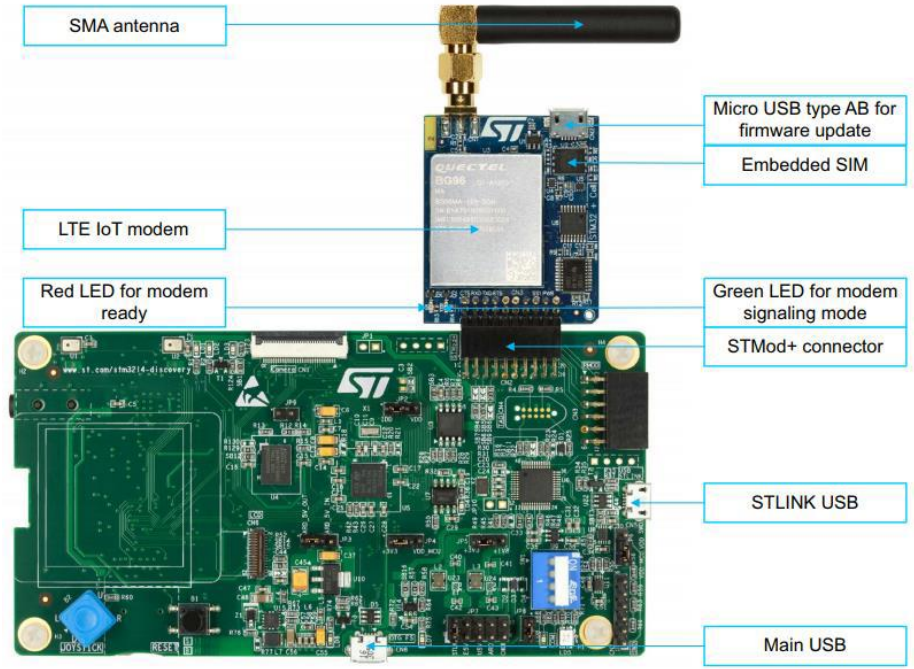
1- Hardware and Software overview

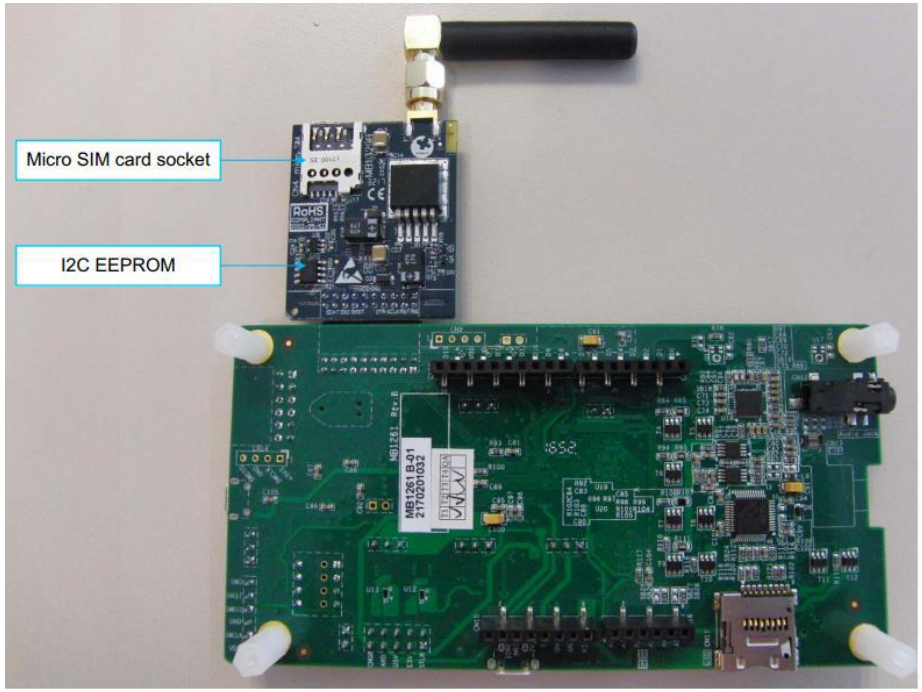
P-L496G-CELL02
Hardware Overview

P-L496G-CELL02 Hardware Description

- The P-L496-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 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 STM32L496AGI6Arm®-based microcontroller featuring 1Mbyte of Flash memory and 320Kbytes of RAM in a UFBGA169 package.
- Board expansion features QuectelBG96 worldwide cellular modem LTECatM1/CatNB1/EGPRS module, 300kbps downlink, 375kbps uplink.



Top view



Bottom view

Latest info available at www.st.com
P-L496G-CELL02

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Motion MEMS and environmental sensors expansion board
Hardware Overview

X-NUCLEO-IKS01A3 Hardware Description

- The X-NUCLEO-IKS01A3 is a motion MEMS and environmental sensor evaluation board system.
- It is compatible with the Arduino UNO R3 connector layout, and is designed around ST's latest sensors.

Key Product on board

LSM6DSO
MEMS 3D accelerometer (±2/±4/±8/±16 g) + 3D gyroscope (±125/±250/±500/±1000/±2000 dps)

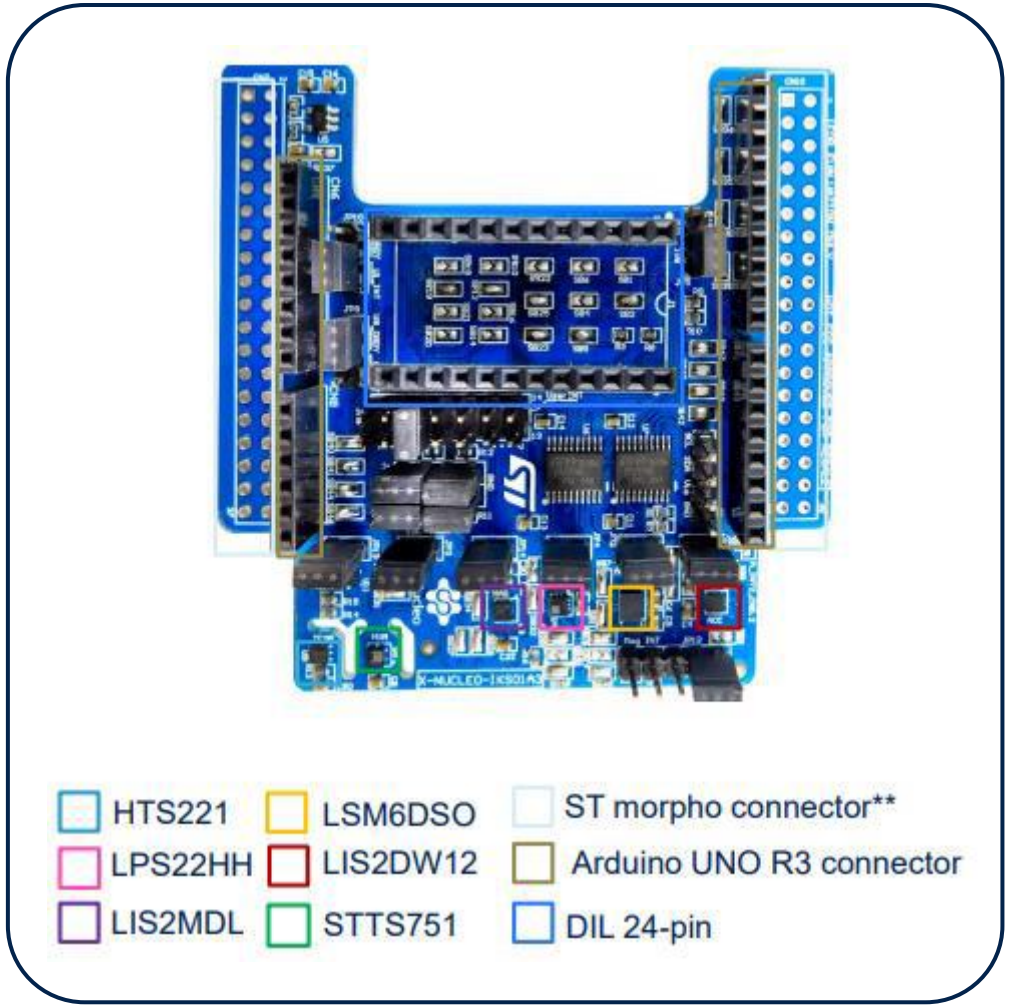
LIS2DW12
MEMS 3D accelerometer (±2/±4/±8/±16 g)

LIS2MDL MEMS 3D
MEMS 3D magnetometer (±50 gauss)

LPS22HH
MEMS pressure sensor, 260-1260 hPa absolute digital output barometer

HTS221
Capacitive digital relative humidity and temperature

STTS751
Digital Temperature sensor DIL 24-pin Socket available for additional MEMS adapters and other sensors (UV index)



** Connector for the STM32 Nucleo board

Latest info available at www.st.com
X-NUCLEO-IKS01A3

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FP-SNS-IOTA1 Software Overview

FP-SNS-IOTA1 Software Description

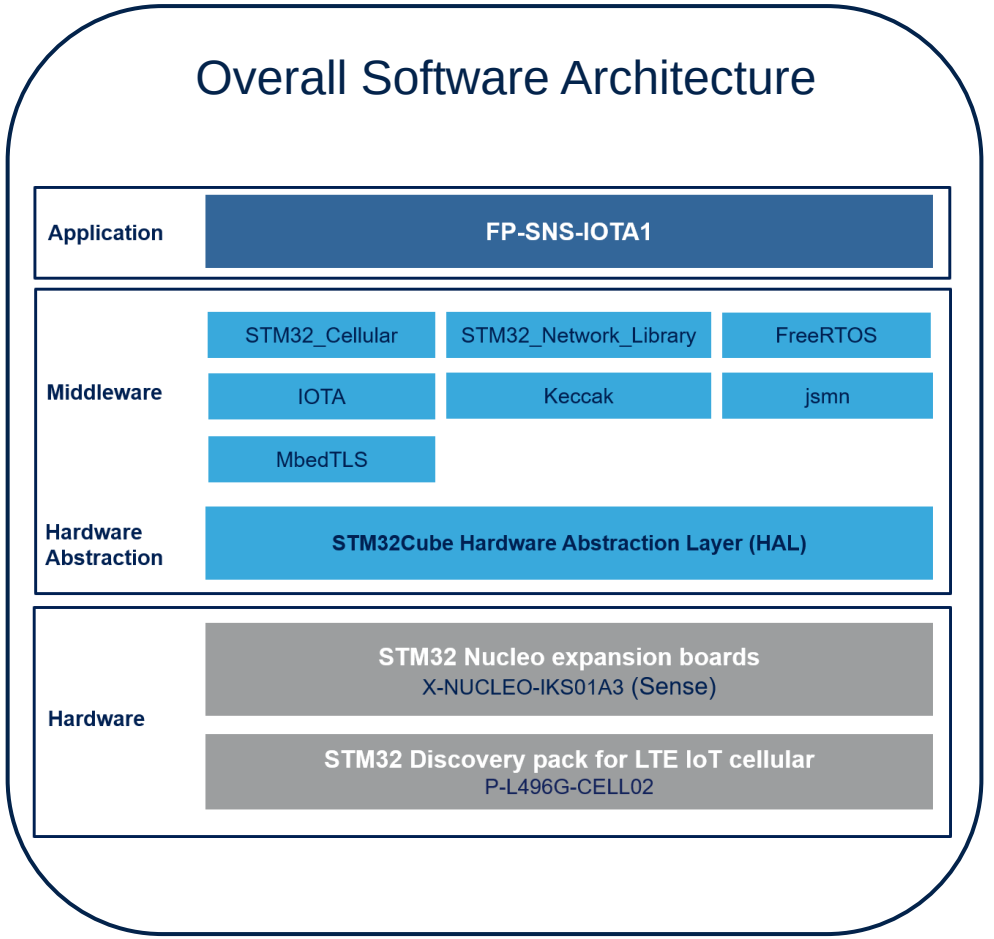
FP-SNS-IOTA1 is an STM32Cube Function Pack. Thanks to this package the user can enable IOTA DLT functions for an IoT sensor node with cellular connectivity. The application aims to implement and demonstrate IOTA DLT use cases for the STM32 MCU.

The IOTA DLT is a transaction settlement and data transfer layer for the Internet of Things (IoT). IOTA allows people and machines to transfer money and/or data without any transaction fees in a trustless, permissionless and decentralized environment.

The featured use cases acquire sensor data and send them to the IOTA Ledger (also called Tangle) via LTE cellular connectivity.

Key features

- Complete firmware to build IOTA DLT applications for STM32-based boards
- Middleware libraries featuring FreeRTOS, cellular management, transport-level security (MbedTLS), and IOTA cryptography management
- Ready-to-use binary to build IOTA transactions including sensor data and send them to the Tangle via LTE connectivity
- Sample implementation available for STM32L496GI6-based low-power Discovery board equipped with the STMod+ cellular expansion board with antenna (P-L496G-CELL02), and the sensor expansion board (X-NUCLEO-IKS01A3)
- Easy portability across different MCU families, thanks to STM32Cube
- Free, user-friendly license terms



Latest info available at www.st.com
FP-SNS-IOTA1

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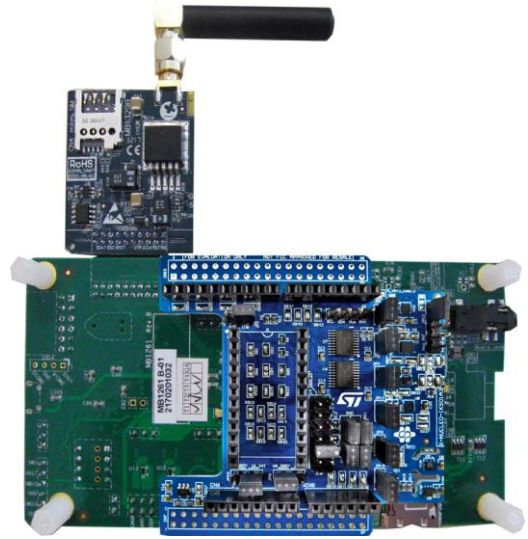
2- Setup & Demo Example

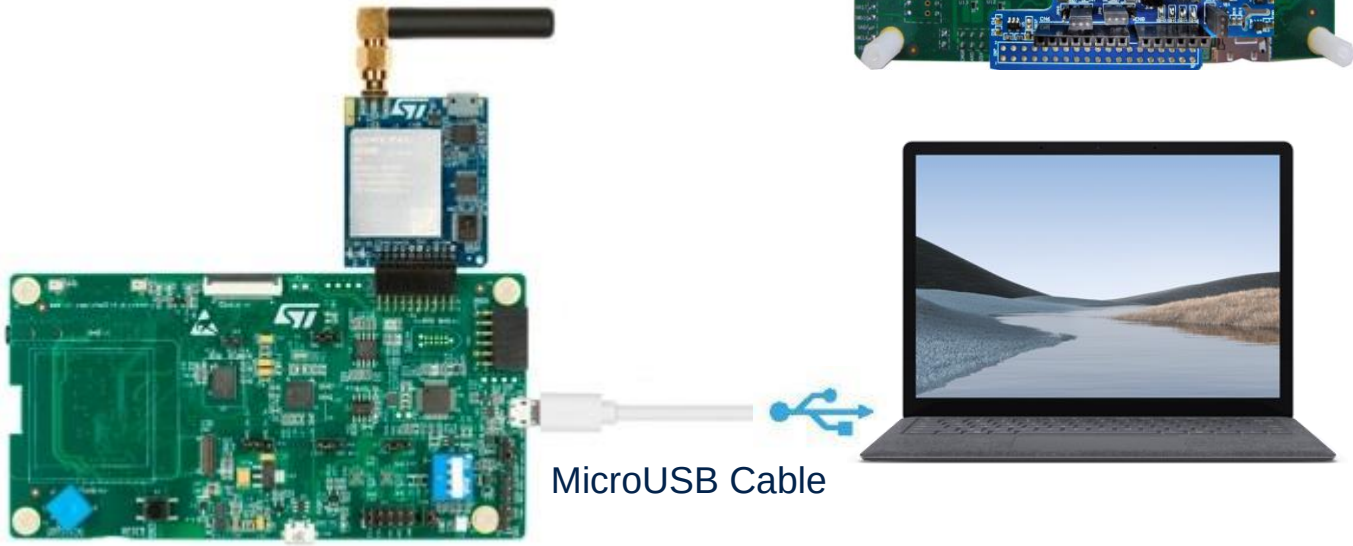
Setup & Application Examples

HW prerequisites for P-L496G-CELL02 and X-NUCLEO-IKS01A3

- 1x X-NUCLEO-IKS01A3 Motion MEMS and Environmental Sensor expansion board
- 1x P-L496G-CELL02 discovery pack, which contains:
  - 1x STM32 Discovery development board **32L496GDISCOVERY**
  - 1x expansion board with QuectelBG96 LTE IoT modem, compatible with STMod+ connector
- Laptop/PC with Windows 7, 8 or 10
- 1 x microUSB cable
- Cellular network access point



X-NUCLEO-IKS01A3



P-L496G-CELL02

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Setup & Application Examples
Software and Other prerequisites

- **STM32 ST-Link Utility**
  - Download and install STSW-LINK004 from www.st.com
- **FP-SNS-IOTA1**
  - Download the FP-SNS-IOTA1 package from www.st.com, copy the .zip file contents into a folder on your PC. The package contains binaries and source code with project files (Keil, IAR, STM32CubeIDE) based on P-L496G-CELL02.
- **Serial line monitor,** e.g. TeraTerm (https://ttssh2.osdn.jp/)
- Before flashing the FP-SNS-IOTA1 firmware it is necessary to register the embedded SIM card in the P-L496G-CELL02 as described in document UM2567, Getting started with the X-CUBE-CELLULAR cellular connectivity Expansion Package for STM32Cube.
  - External SIM – You can use your local telecom service SIM and insert it to Micro SIM card socket. The SW will detect it and connect it to your local telecom service provider.

FP-SNS-IOTA1. Sample application

Start coding in just a few minutes

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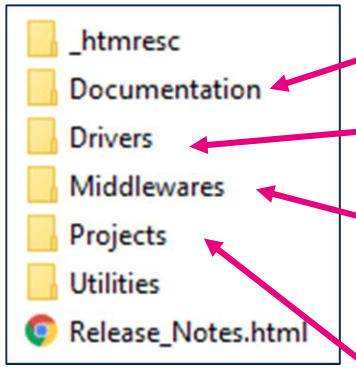
1. www.st.com/stm32ode

2. Select Function Pack: FP-SNS-IOTA1

3. Download & unpack

FP-SNS-IOTA1 package structure

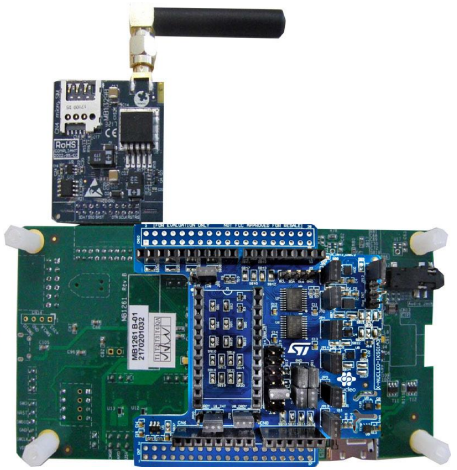


Docs

BSP, HAL drivers

IOTA, Cellular, FreeRTOS, MbedTLS libs

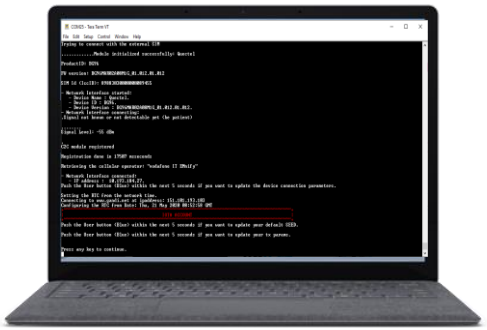
4. IOTA Sensor Node application, binary



5. KEIL Tools by ARM | IAR SYSTEMS | STM32 CubeIDE

Build/Flash and run the project

6. Evaluate using serial line terminal



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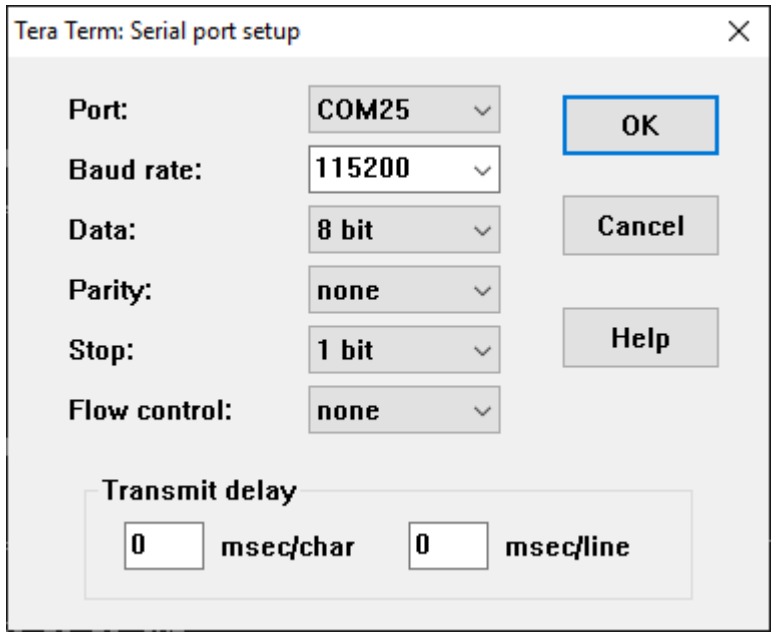
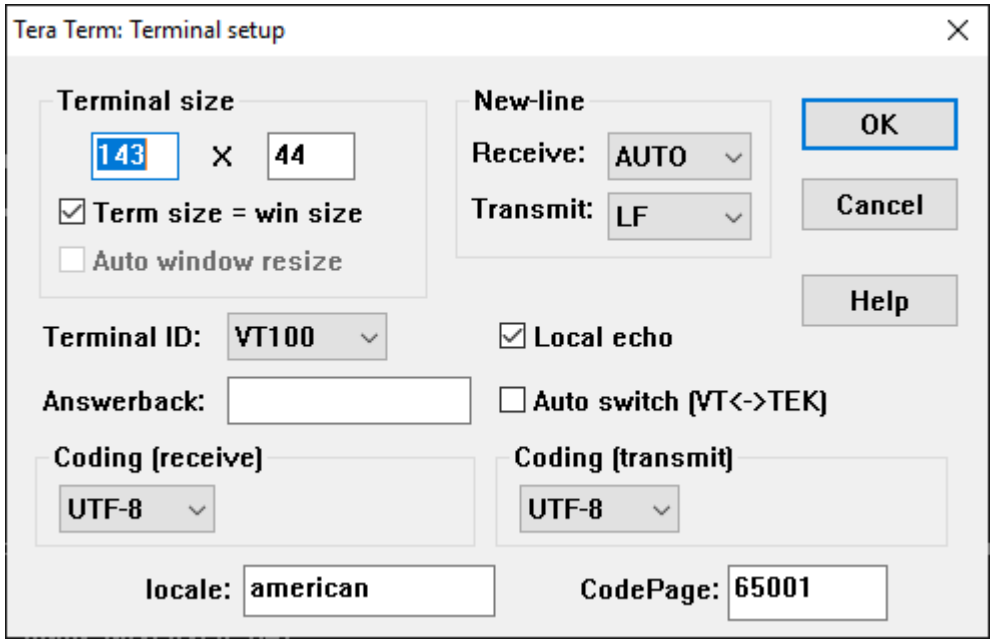
2.1- Test FP-SNS-IOTA1 with IOTA Tangle explorer

FP-SNS-IOTA1. Step by step setup

Launch sample application. Configure Serial Terminal

- The serial terminal (**Setup → Terminal** in TeraTerm) New-line receive configuration must be set to AUTO and the New-line transmit configuration must be set to LineFeed (\n or LF) in order to allow copy-paste from UNIX type text files. The Local echo option makes copy-paste visible on the console.
- The serial port (**Setup → Serial port** in TeraTerm) must be configured with:
  - COM port number
  - 115200 baud rate
  - 8-bit data
  - Parity none
  - 1 stop bit
  - No flow control



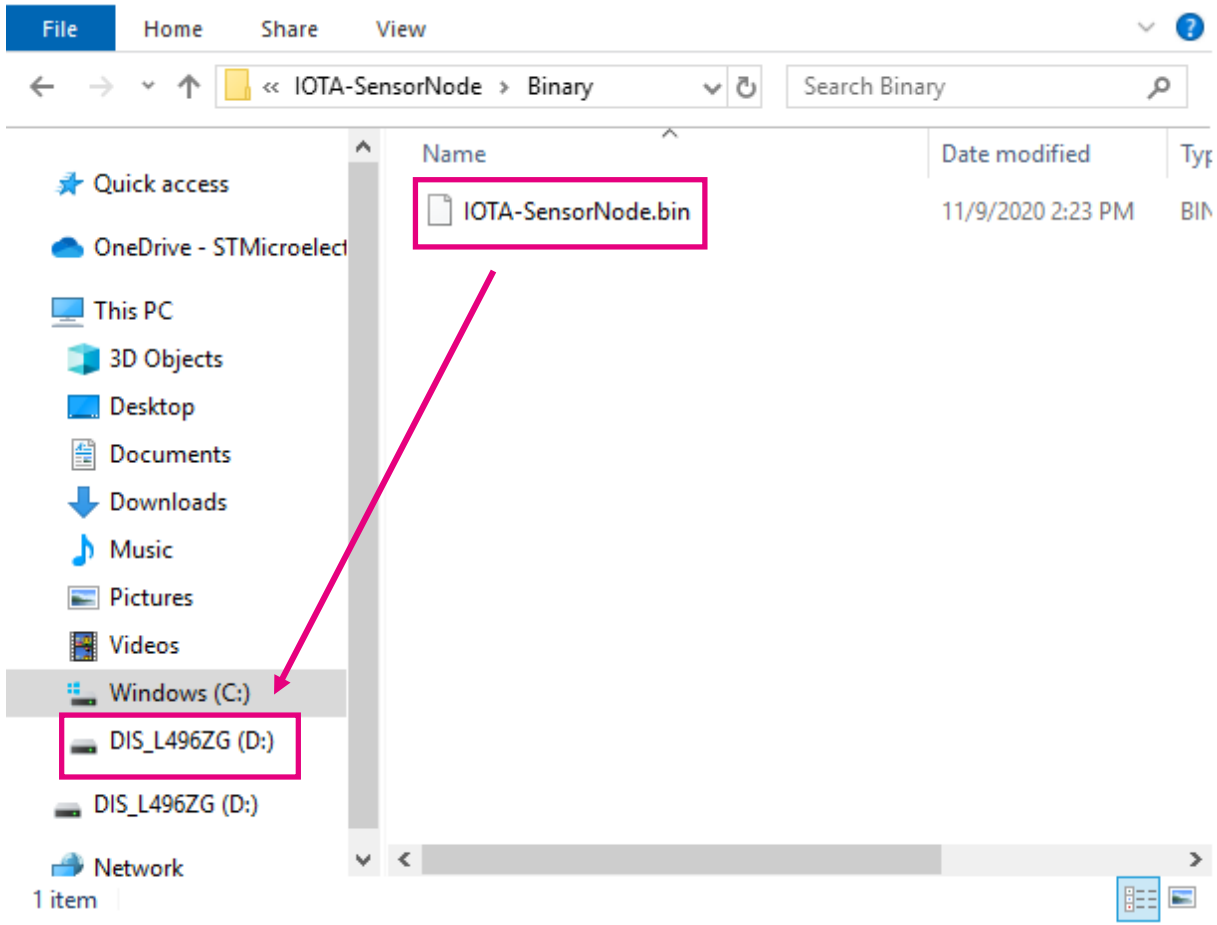


FP-SNS-IOTA1. Step by step setup

Launch sample application. Use pre-compiled binary

- The pre-compiled binary is in folder:
  - **`Projects\STM32L496G_Discovery\Applications\DLT\IOTA-SensorNode\Binary\IOTA-SensorNode.bin`**

- To start the application:
  - Connect your board to your PC
  - Using Explorer, drag the binary to the board's USB storage

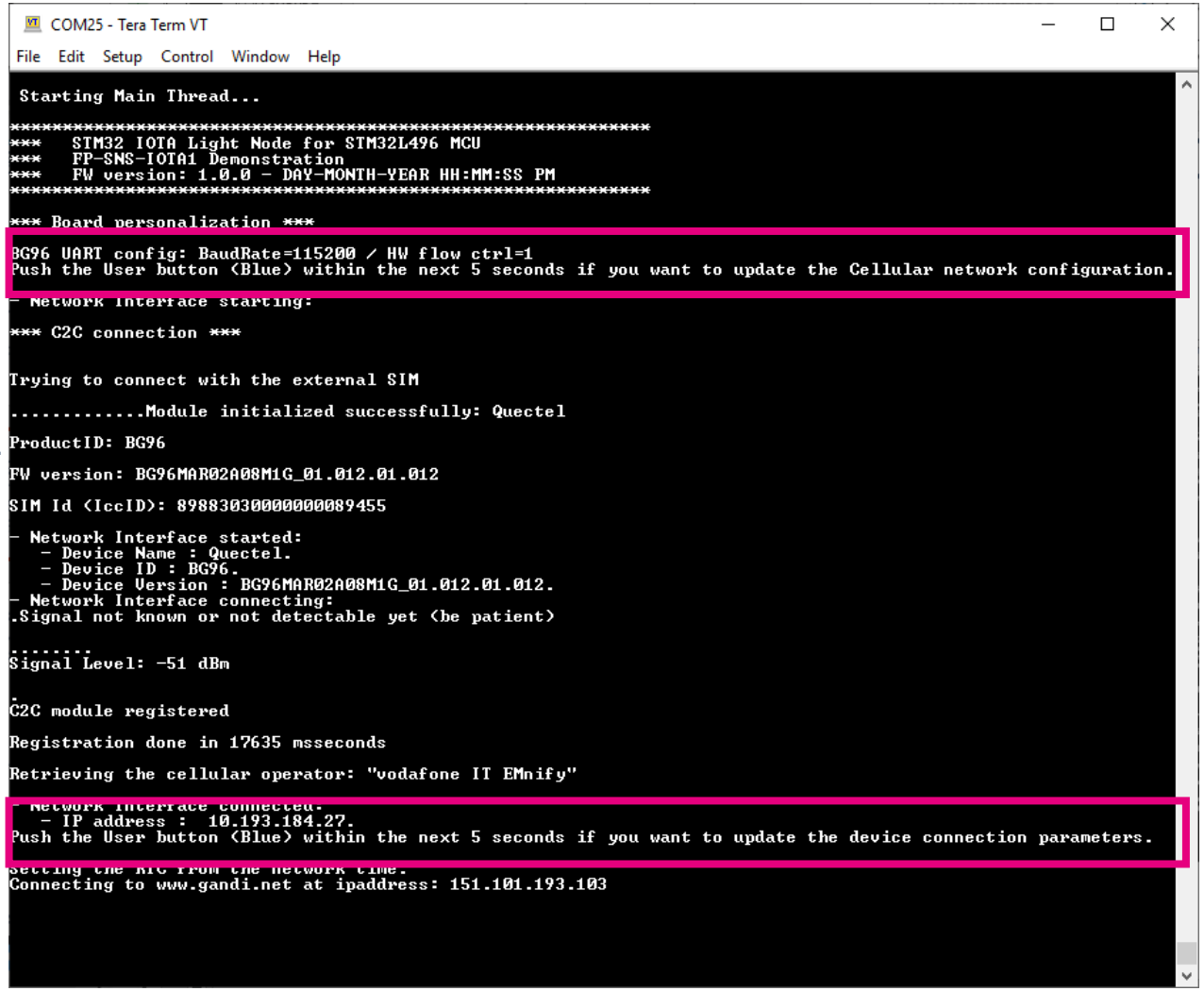


FP-SNS-IOTA1. Step by step setup

Configure Cellular network parameters

- Open a serial terminal to visualize the log of messages
- Enter your C2C network configuration (SIM operator access point code, username and password)
  - Example with Emnify SIM:

  access point: "EM", username: "", password: ""
- Set the TLS root CA certificates:
  - Copy-paste the contents of Projects\STM32L496G_Discovery\Applications\DLT\IOTA-SensorNode\usertrust_thetangle.pem
  - The device uses them to authenticate the remote hosts through TLS
- After the parameters are configured, it is possible to change them by restarting the board and pushing the User button (blue button) within 5 seconds
- This data will be saved in flash



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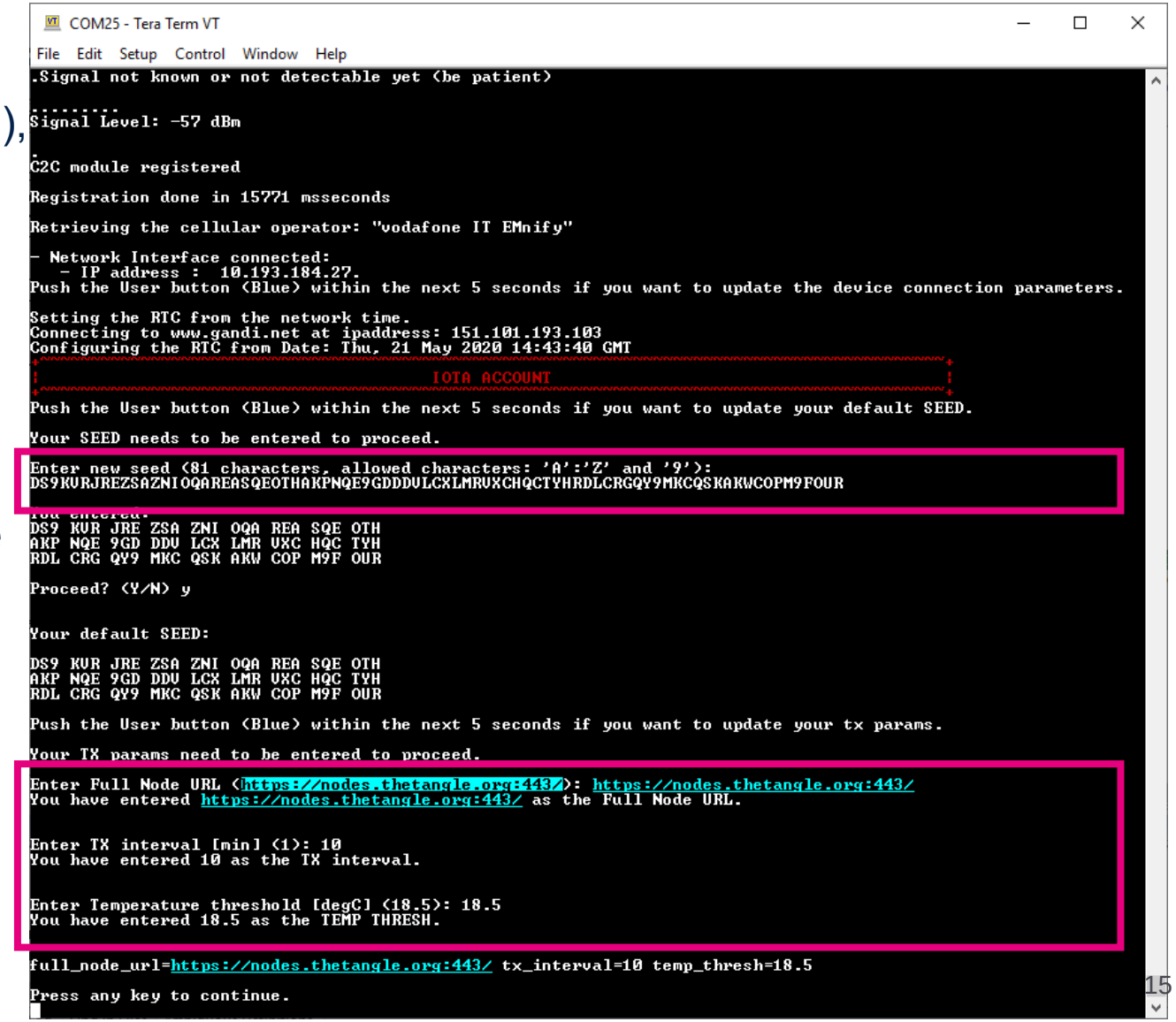
FP-SNS-IOTA1. Step by step setup

Configure IOTA application parameters

- Enter a seed (a character string, 81 characters long, composed only by capital letters from 'A' to 'Z' and ‘9’), representing the IOTA account
- Enter the IOTA transaction parameters (Full Node URL, tx-interval, and temperature threshold).
- After the parameters are configured, it is possible to change them by restarting the board and pushing the User button (blue button) within 5 seconds
- This data will be saved in flash



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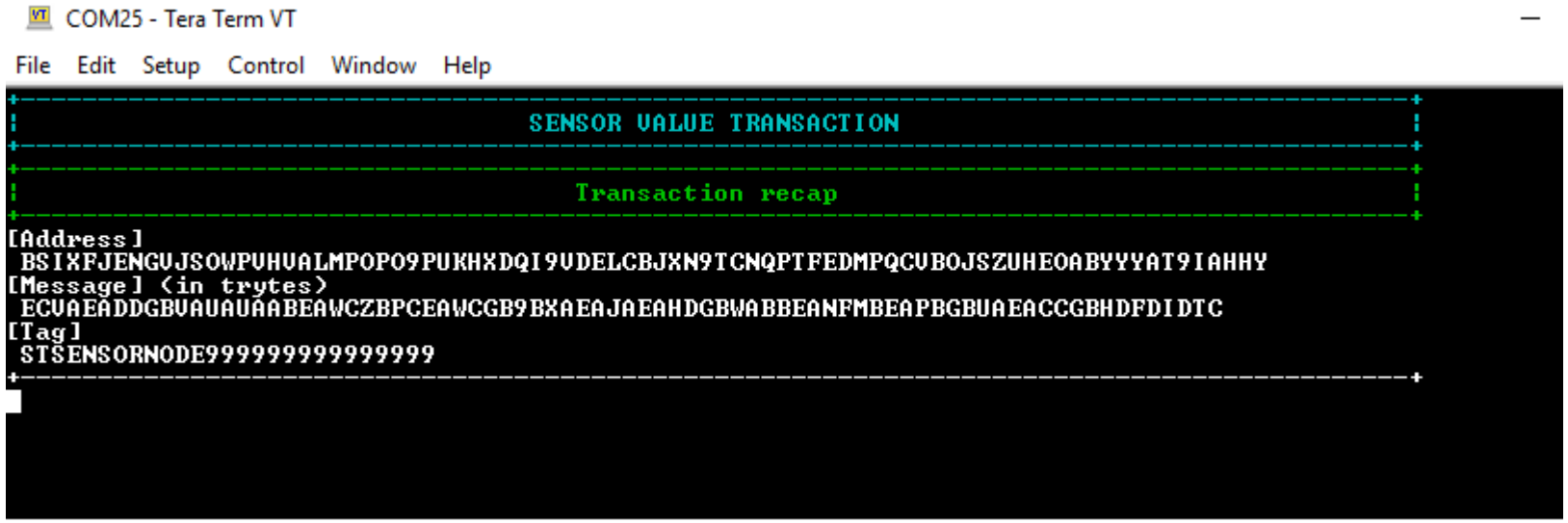
FP-SNS-IOTA1. Step by step setup

IOTA Transaction

- A new 0-value transaction will be automatically generated and sent to the Tangle every *tx_interval* minutes

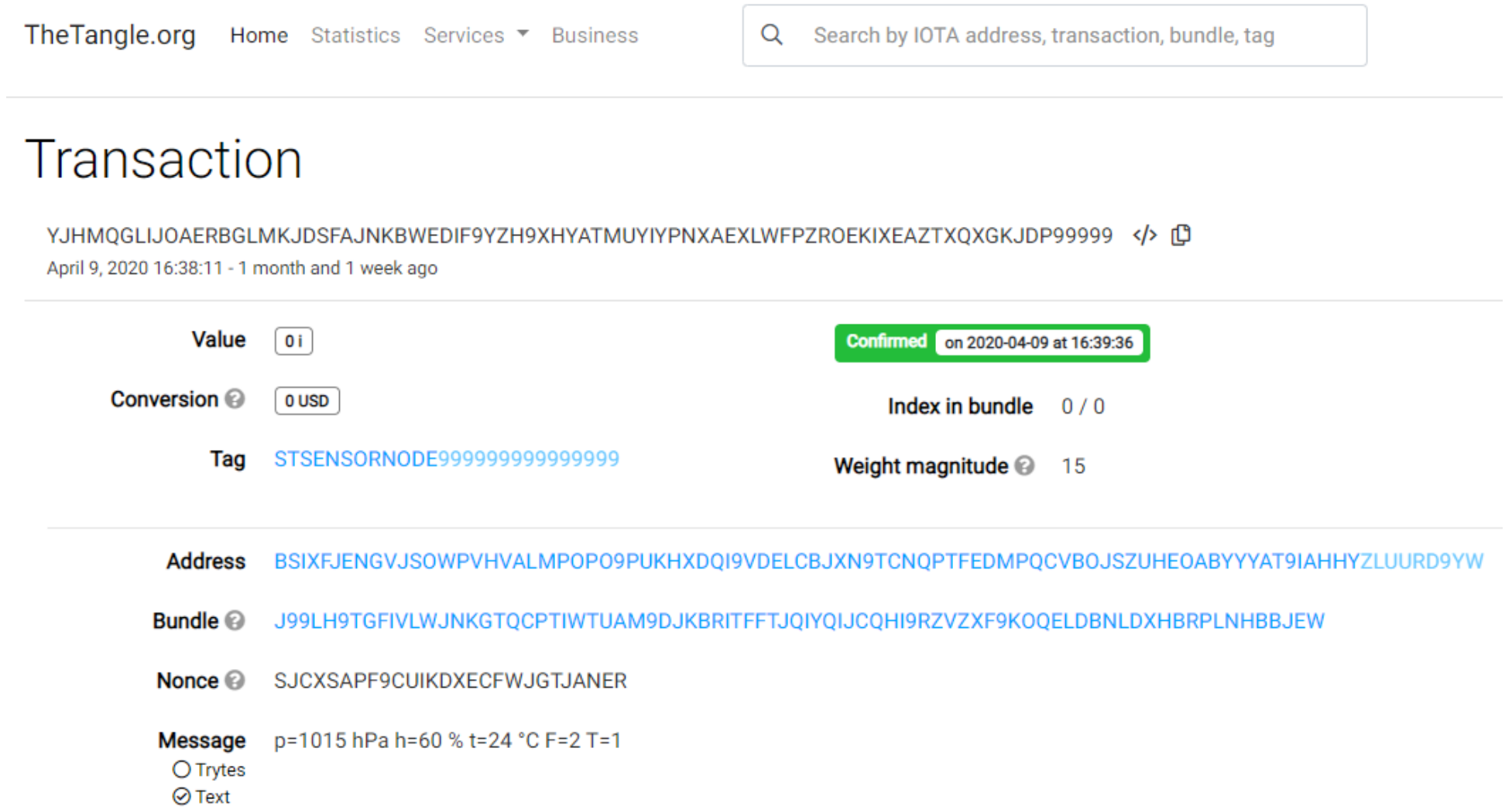
- The transaction data includes the following:
  - Pressure
  - Humidity
  - Temperature
  - FreeFall counter: number of FreeFall events occurred during a *tx_interval*
  - Temperature event: *true* if the measured temperature has overcome the configurable threshold during a *tx_interval*; *false* otherwise



FP-SNS-IOTA1. Step by step setup

Tangle explorer

- Check the status of the transaction on the Tangle Explorer website searching by IOTA address, transaction, bundle, tag



3- Documents & Related Resources

Documents & Related Resources

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

FP-SNS-IOTA1:

- **DB4250:** STM32Cube function pack for IoT sensor node with cellular connectivity enabling IOTA Distributed Ledger Technology (DLT) functions – **databrief**
- **UM2744:** Getting started with the STM32Cube function pack for IoT sensor node with cellular connectivity enabling IOTA Distributed Ledger Technology (DLT) functions – **user manual**
- **Software setup file**

X-NUCLEO-IKS01A3:

- **Gerber files, BOM, Schematic**
- **DB3851:** Motion MEMS and environmental sensor expansion board for STM32 Nucleo – **databrief**
- **UM2559:** Getting started with the X-NUCLEO-IKS01A3 motion MEMS and environmental sensor expansion board for STM32 Nucleo – **user manual**

P-L496G-CELL02:

- **Gerber files, BOM, Schematic**
- **DB3530:** STM32 discovery pack for LTE IoT cellular to cloud – **databrief**
- **UM2052:** Getting started with STM32 MCU Discovery Kits software development tools – **user manual**
- **UM2365:** STM32 Discovery pack for LTE IoT cellular to cloud – **user manual**

X-CUBE-CELLULAR:

- **UM2567:** Getting started with the X-CUBE-CELLULAR cellular connectivity Expansion Package for STM32Cube – **user manual**
- **UM2426:** X-CUBE-CELLULAR cellular connectivity Expansion Package for STM32Cube – **user manual**

Consult www.st.com for the complete list

4- STM32 Open Development Environment: Overview

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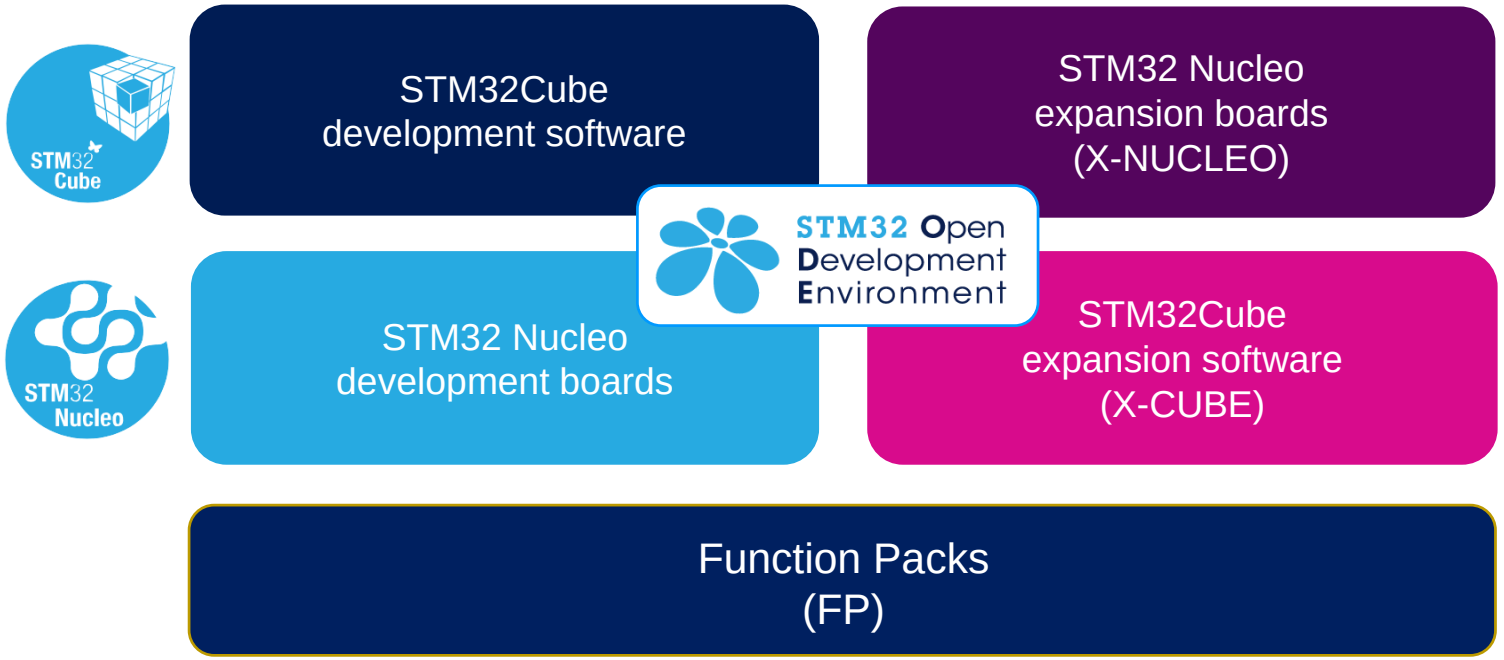
STM32 Open Development Environment
Fast, affordable Prototyping and Development

- The STM32 Open Development Environment (STM32 ODE) is an open, flexible, easy, and affordable way to develop innovative devices and applications based on the STM32 32-bit microcontroller family combined with other state-of-the-art ST components connected via expansion boards. It enables fast prototyping with leading-edge components that can quickly be transformed into final designs



For further information, please visit www.st.com/stm32ode

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Thank you

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