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Quick Start Guide

STM32Cube expansion software package for
STM32 enabling IOTA Distributed Ledger
Technology (DLT) functions
(X-CUBE-IOTA1)

Version 2.1 (December, 2021)



B-L4S5I-HOT01A Discovery kit for IoT Node

Agenda

1 Hardware and Software overview

2 Setup & Demo Examples

3 Documents & Related Resources

4 STM32 Open Development Environment: Overview

1- Hardware and Software overview

STM32L4+ Discovery kit for IoT node (B-L4S5I-IOT01A)

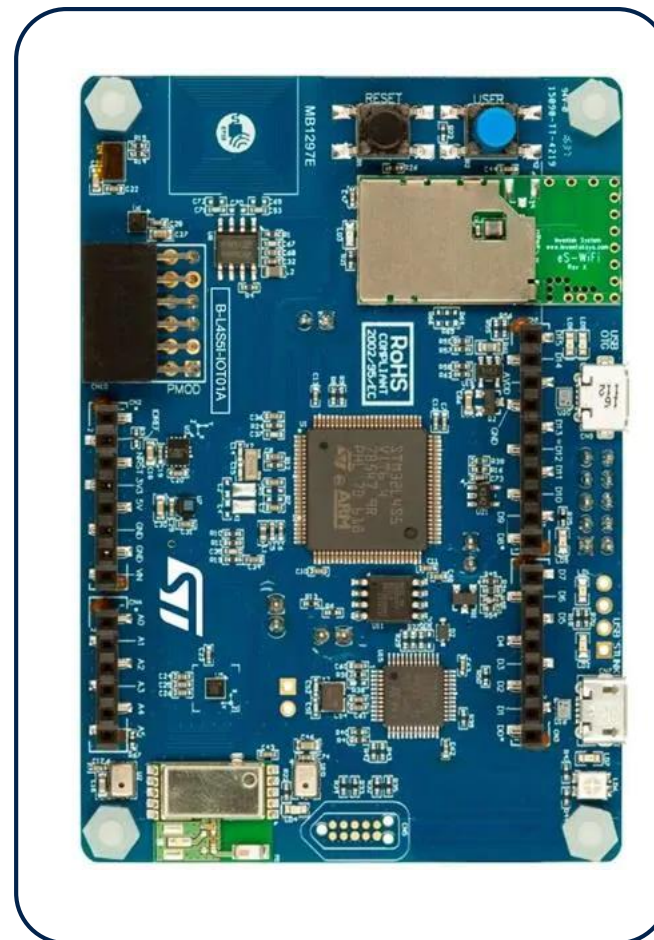
Hardware Overview

B-L4S5I-IOT01A Hardware Description

With the B-L4S5I-IOT01A Discovery kit for IoT node, users develop applications with direct connection to cloud servers. The Discovery kit enables a wide diversity of applications by exploiting low-power communication, multiway sensing and Arm® Cortex®-M4 core-based STM32L4+ Series features. The support for ARDUINO® Uno V3 and Pmod™ connectivity provides unlimited expansion capabilities with a large choice of specialized add-on boards.

Key Product on board

- Ultra-low-power STM32L4+ Series STM32L4S5VIT6 microcontroller based on the Arm® Cortex®-M4 core with 2 Mbytes of Flash memory and 640 Kbytes of RAM in LQFP100 package
- Bluetooth® 4.1 module (SPBTLE-RF) from STMicroelectronics
- 802.11 b/g/n compliant Wi-Fi® module (ISM43362-M3G-L44) from Inventek Systems
- Dynamic NFC tag based on ST25DV04K with its printed NFC antenna
- 2 digital omnidirectional microphones (MP34DT01) from STMicroelectronics
- Capacitive digital sensor for relative humidity and temperature (HTS221) from STMicroelectronics
- High-performance 3-axis magnetometer (LIS3MDL) from STMicroelectronics
- 3D accelerometer and 3D gyroscope (LSM6DSL) from STMicroelectronics
- 260-1260 hPa absolute digital output barometer (LPS22HB) from STMicroelectronics
- Time-of-flight and gesture-detection sensor (VL53L0X) from STMicroelectronics
- Highly-secure solution (STSAFE-A110) from STMicroelectronics
- 2 push-buttons (user and reset) Flexible power-supply options: ST-LINK, USB V_{BUS} or external sources
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: mass storage, Virtual COM port, and debug port



Latest info available at www.st.com
B-L4S5I-IOT01A



X-CUBE-IOTA1 Software Description

The X-CUBE-IOTA1 expansion software package for STM32Cube runs on the STM32 and includes middleware to enable the IOTA Distributed Ledger Technology (DLT) functions.

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. This technology even makes micro-payments possible without the need of a trusted intermediary of any kind.

The expansion is built on STM32Cube software technology to ease portability across different STM32microcontrollers.

The current version of the software runs on the B-L4S5I-IOT01A Discovery kit for IoT node and connects to the Internet through the attached WiFi® interface.

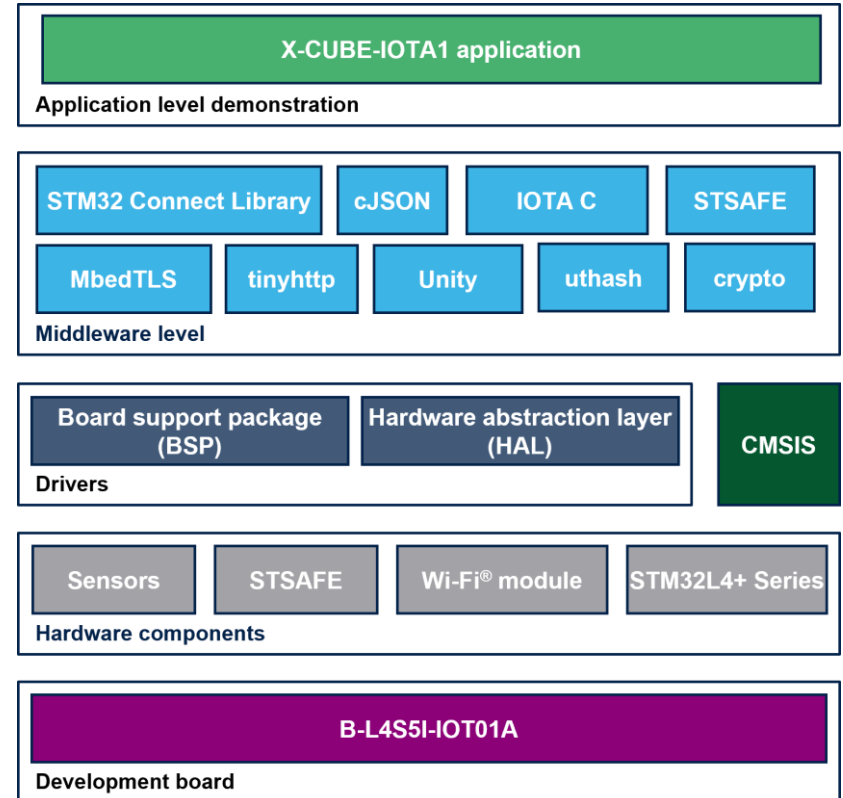
Key features

- Complete firmware to build IOTA DLT applications for STM32-based boards
- Middleware libraries featuring STSAFE secure element to have a secure hardware root of trust; WiFi management; encryption, hashing, message authentication and digital signing (Cryptolib); transport-level security (MbedTLS); IOTA Client API for interacting with the Tangle
- Complete driver to build applications accessing Motion and Environmental sensors
- Examples to help understanding how to develop an IOTA DLT Client application
- Example to help understand how to build and send to the Tangle an encrypted, authenticated message stream based on L2Sec, a Layer 2 lightweight security protocol designed for embedded IoT devices
- Easy portability across different MCU families, thanks to STM32Cube
- Free, user-friendly license terms



X-CUBE-IOTA1 Software Overview

Overall Software Architecture



Latest info available at www.st.com
X-CUBE-IOTA1

2- Setup & Demo Example

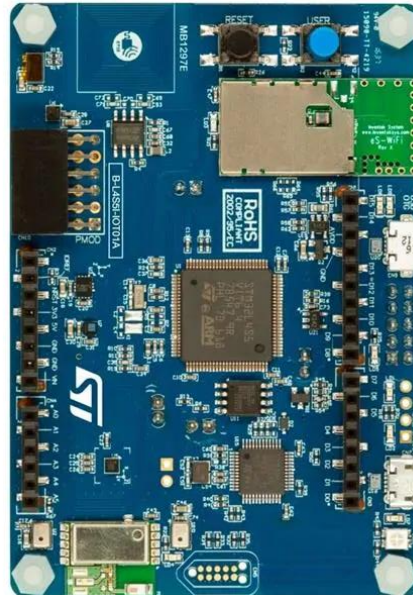
Setup & Application Examples

HW prerequisites for B-L4S5I-IOT01A

- 1x B-L4S5I-IOT01A discovery kit
- Laptop/PC with Windows 7, 8 or 10
- 1 x microUSB cable
- WiFi Router or access to a WiFi network



MicroUSB



B-L4S5I-IOT01A



MicroUSB Cable



Setup & Application Examples

Software and Other prerequisites

- **STM32 ST-Link Utility**
 - Download and install [STSW-LINK004](#) from www.st.com
- **X-CUBE-IOTA1**
 - Download the [X-CUBE-IOTA1](#) package from www.st.com, copy the .zip file contents into a folder on your PC. The package contains binary and source code with project files ([Keil](#), [IAR](#), STM32CubeIDE) based on B-L4S5I-IOT01A.
- **Serial line monitor**, e.g. TeraTerm (<https://ttssh2.osdn.jp/>)

X-CUBE-IOTA1. Sample application

Start coding in just a few minutes



1 www.st.com/stm32code

2

Select expansion package:
X-CUBE-IOTA1

3

Download & unpack

X-CUBE-IOTA1 package structure

- _htmresc
- Documentation
- Drivers
- Middlewares
- Projects
- README.md
- Release_Notes.html

Docs

BSP, HAL drivers

IOTA, Connect lib,
MbedTLS,
STSAFE

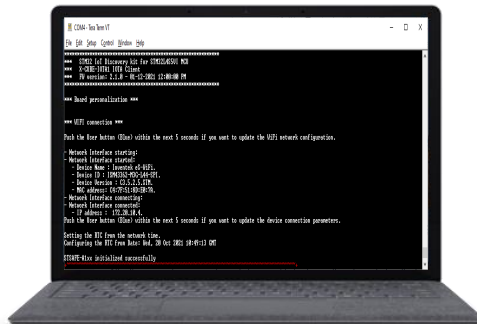
IOTA Client
application, binary

4



6

Evaluate using serial line terminal



5

Build/Flash and run the project

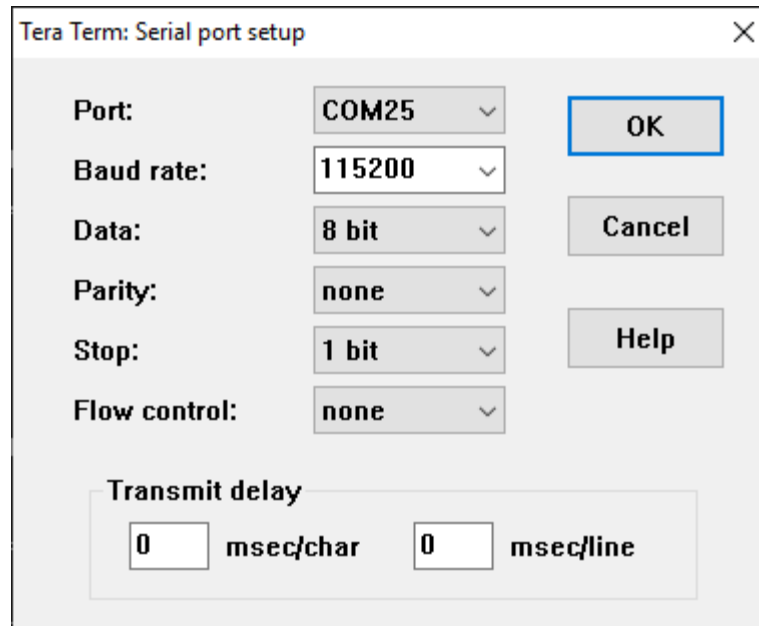


2.1- Test X-CUBE-IOTA1

X-CUBE-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



Tera Term: Serial port setup

Port: COM25

Baud rate: 115200

Data: 8 bit

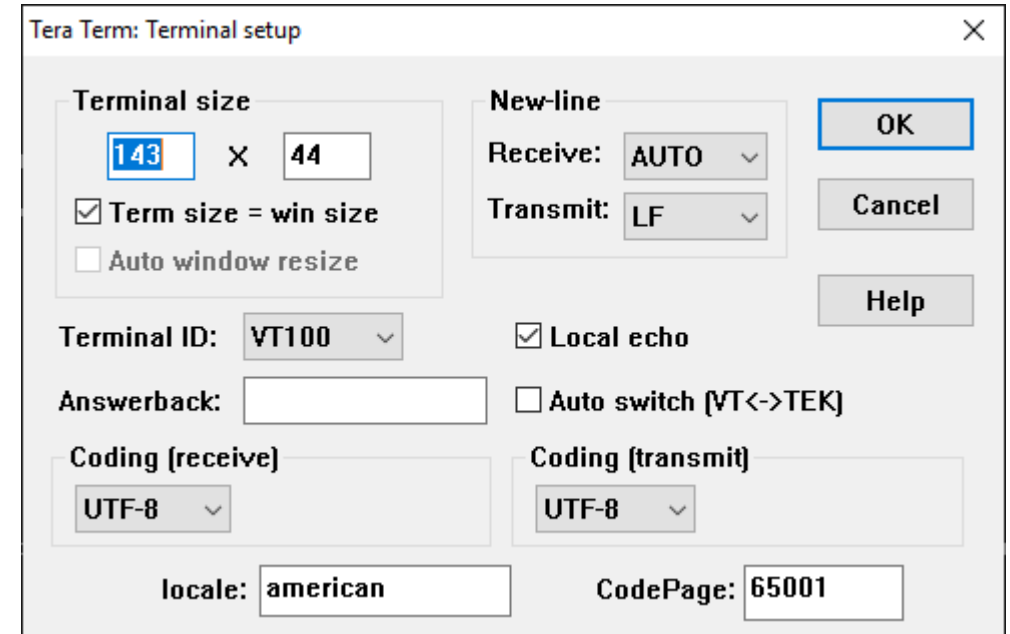
Parity: none

Stop: 1 bit

Flow control: none

Transmit delay: 0 msec/char 0 msec/line

Buttons: OK, Cancel, Help



Tera Term: Terminal setup

Terminal size: 143 X 44

Term size = win size

Auto window resize

New-line: Receive: AUTO, Transmit: LF

Terminal ID: VT100

Local echo

Auto switch [VT<->TEK]

Coding (receive): UTF-8, Coding (transmit): UTF-8

locale: american, CodePage: 65001

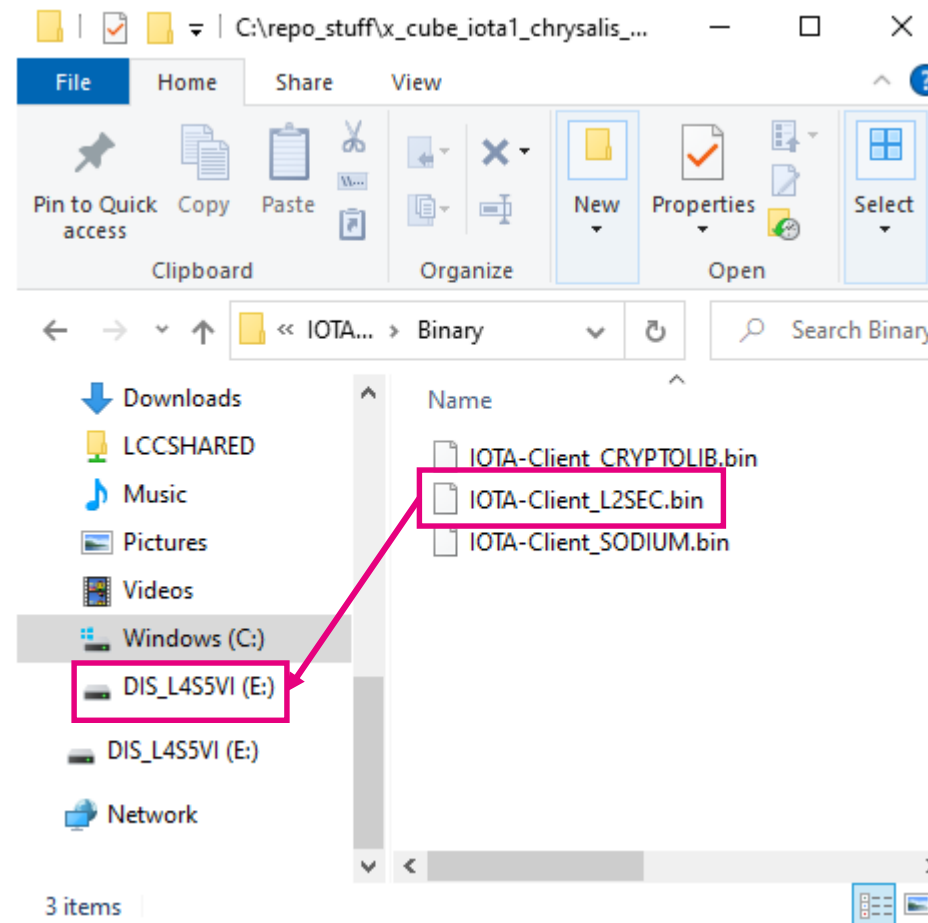
Buttons: OK, Cancel, Help

X-CUBE-IOTA1. Step by step setup

Launch sample application. Use pre-compiled binary

- The pre-compiled binary is in folder:
 - `Projects\B-L4S5I-IOT01A\Applications\IOTA-Client\Binary\IOTA-Client_L2SEC.bin`

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



X-CUBE-IOTA1. Step by step setup

Configure WiFi network parameters

- Open a serial terminal to visualize the log of messages
- Enter your WiFi network configuration (SSID, Security Mode, and password)
- Set the TLS root CA certificates:
 - Copy-paste the contents of Projects\B-L4S5I-IOT01A\Applications\IOTA-Client\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

```
COM4 - Tera Term VT
File Edit Setup Control Window Help
*****
***  STM32 IoT Discovery kit for STM32L4S5UI MCU
***  X-CUBE-IOTA1 IOTA Client
***  FW version: 2.1.0 - 01-12-2021 12:00:00 PM
*****

*** Board personalization ***

*** WIFI connection ***

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

- Network Interface starting:
- Network Interface started:
  - Device Name : Inventek eS-WiFi.
  - Device ID : ISM43362-M3G-L44-SPI.
  - Device Version : C3.5.2.5.STM.
  - MAC address : C4:7F:51:8D:E0:7A.
- Network Interface connecting:
- Network Interface connected:
  - IP address : 172.20.10.4.
Push the User button <Blue> within the next 5 seconds if you want to update the device connection parameters.

Setting the RTC from the network time.
Configuring the RTC from Date: Wed, 20 Oct 2021 10:49:13 GMT

STSAFE-A1xx initialized successfully
```

X-CUBE-IOTA1. Step by step setup

Main Menu

After the network parameters have been configured, press any key to refresh the screen with the list of main functionalities*.

The IOTA-Client application implements the IOTA protocol version 1.5 (Chrysalis). For details about Chrysalis, please refer to the official IOTA Documentation website (<https://chrysalis.docs.iota.org/>).

- *Get node info*
- *Get a message payload*
- *Get a message payload*
- *Send a generic indexation message*
- *Send an indexation message including sensor data*
- *Send an encrypted indexation message*
- *Enter the L2Sec example submenu*
- *Enter the STASFE example submenu*
- *Other test functions*



```
VT COM4 - Tera Term VT
File Edit Setup Control Window Help
IOTA CLIENT
1. Node info;
2. Get data message;
3. Send data message;
4. Send sensor message;
5. Send encrypted data;
6. L2Sec examples;
7. STSAFE examples;
8. Test functions;
0. Exit.
Choose one of the options:
```

*The functionality list depends on the project configuration.

The picture shows full list related to L2SEC configuration.

X-CUBE-IOTA1. Step by step setup

L2Sec Send/Recv menu

The *L2Sec example* allows to execute the L2Sec protocol, a lightweight message stream security protocol native for IOTA Chrysalis and suitable for constrained IoT devices.

Enter the number of messages to be sent, otherwise a default number (defined by the constant *N_MESSAGES* in the *l2sec_example.c* source file) is used.

Each message contains the following application data:

[<DeviceName>,<timestamp>,<temperature>,<humidity>]

Refer to [[UM2606](#)] for more details about the L2Sec protocol.



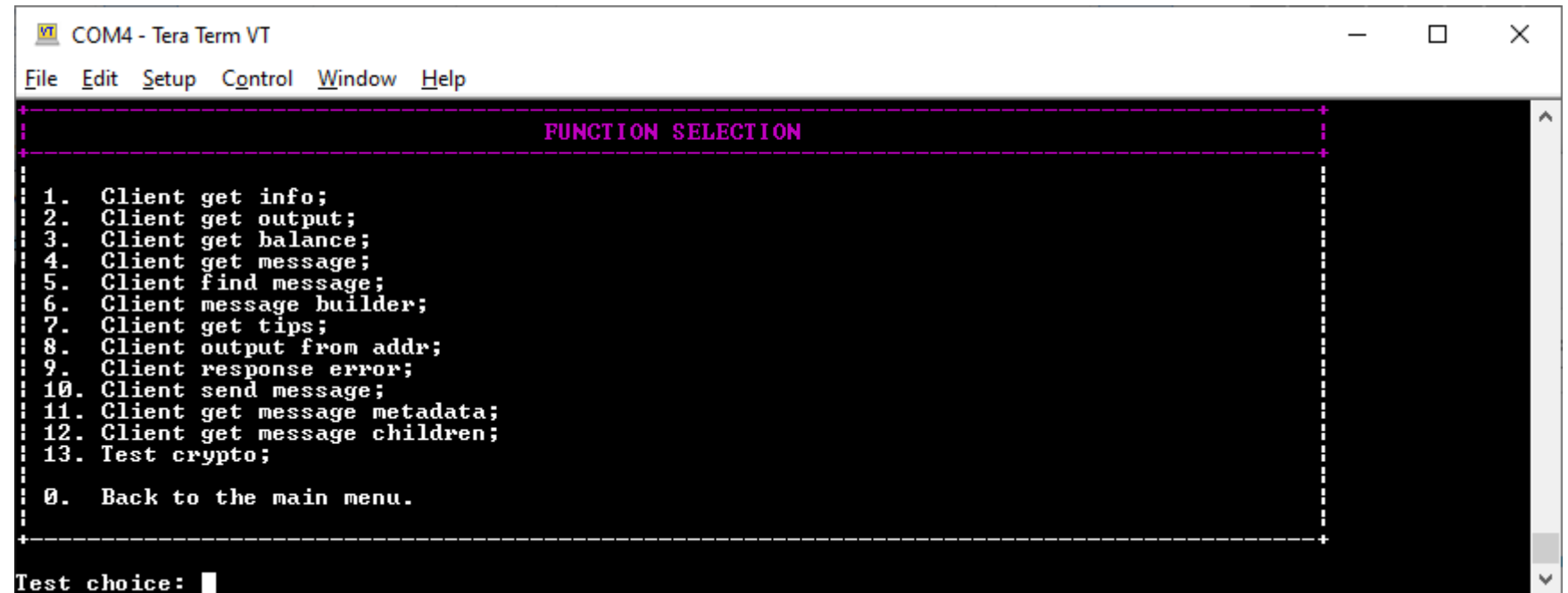
```
COM4 - Tera Term VT
File Edit Setup Control Window Help
FUNCTION SELECTION
1. Send and receive IOTA L2Sec stream;
2. Send only IOTA L2Sec stream;
0. Back to the main menu.
Example choice: █
```

X-CUBE-IOTA1. Step by step setup

Test functions

In the IOTA-Client application, the STM32 Discovery device also allows to test the following functionalities*:

- *Get node info*
- *Get output*
- *Get balance*
- *Get message*
- *Find message*
- *Message builder*
- *Get tips*
- *Outputs from address*
- *Test response error*
- *Send message*
- *Get message metadata*
- *Get message children*
- *Test crypto*



```
COM4 - Tera Term VT
File Edit Setup Control Window Help
FUNCTION SELECTION
1. Client get info;
2. Client get output;
3. Client get balance;
4. Client get message;
5. Client find message;
6. Client message builder;
7. Client get tips;
8. Client output from addr;
9. Client response error;
10. Client send message;
11. Client get message metadata;
12. Client get message children;
13. Test crypto;
0. Back to the main menu.
Test choice: █
```

* For details about API related to IOTA 1.5, please refer to the [IOTA C Client Documentation](#)
Search for messages, addresses, indexes on the IOTA explorer: <https://explorer.iota.org/>

3- Documents & Related Resources

Documents & Related Resources

All documents are available in the Documentation tab of the related product webpage

X-CUBE-IOTA1:

- **DB3959**: IOTA Distributed Ledger Technology software expansion for STM32Cube – [databrief](#)
- **UM2606**: Getting started with the X-CUBE-IOTA1 for IOTA Distributed Ledger Technology software expansion for STM32Cube – [user manual](#)
- [Release Notes and README within the expansion package](#)

B-L4S5I-IOT01A:

- **MB1297** – [Bill of Materials](#)
- **MB1297-L4S5VI-E02** – [Board Schematic](#)
- **MB1297-L4S5VI-E03** – [Board Schematic](#)
- **DB4184**: Discovery kit for IoT node, multi-channel communication with STM32L4+ Series – [databrief](#)
- **UM2708**: Discovery kit for IoT node, multi-channel communication with STM32L4+ Series – [user manual](#)

STSAFE-A110:

- **AN5435**: STSAFE-A110 generic sample profile description – [application note](#)

X-CUBE-SAFE1:

- **DB4064**: STSAFE-A110 software package – [databrief](#)
- **UM2646**: Getting started with the X-CUBE-SAFE1 software package – [user manual](#)

4- STM32 Open Development Environment: Overview



STM32 ODE Ecosystem

FAST, AFFORDABLE PROTOTYPING AND DEVELOPMENT

The STM32 Open Development Environment (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.

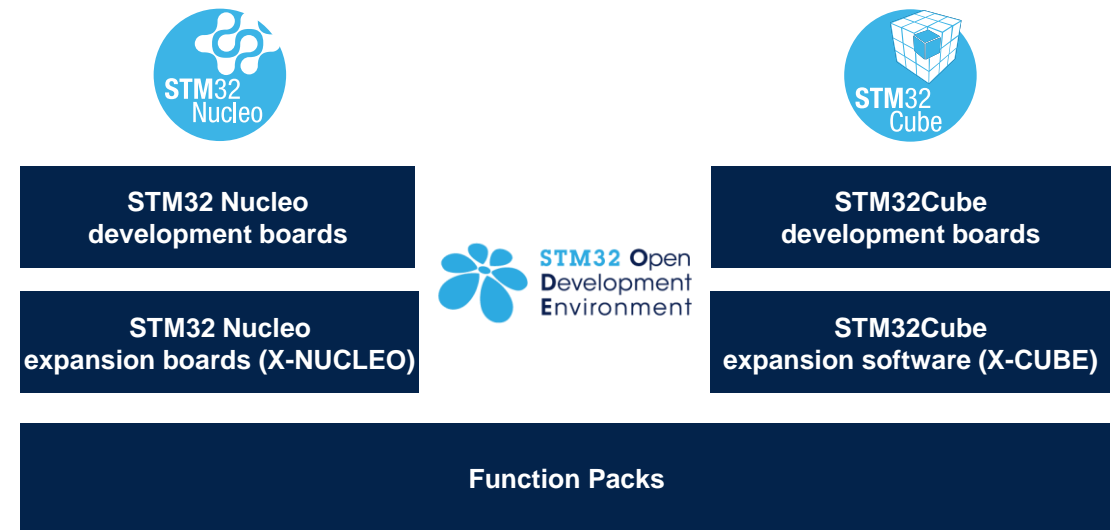
The STM32 ODE includes the following five elements:

- STM32 Nucleo development boards. A comprehensive range of affordable development boards for all STM32 microcontroller series, with unlimited unified expansion capability, and with integrated debugger/programmer
- STM32 Nucleo expansion boards. Boards with additional functionality to add sensing, control, connectivity, power, audio or other functions as needed. The expansion boards are plugged on top of the STM32 Nucleo development boards. More complex functionalities can be achieved by stacking additional expansion boards
- STM32Cube software. A set of free-of-charge tools and embedded software bricks to enable fast and easy development on the STM32, including a Hardware Abstraction Layer, middleware and the STM32CubeMX PC-based configurator and code generator
- STM32Cube expansion software. Expansion software provided free of charge for use with STM32 Nucleo expansion boards, and compatible with the STM32Cube software framework
- STM32 ODE Function Packs. Set of function examples for some of the most common application cases built by leveraging the modularity and interoperability of STM32 Nucleo development boards and expansions, with STM32Cube software and expansions.

The STM32 Open Development Environment is compatible with a number of IDEs including IAR EWARM, Keil MDK, mbed and GCC-based environments.



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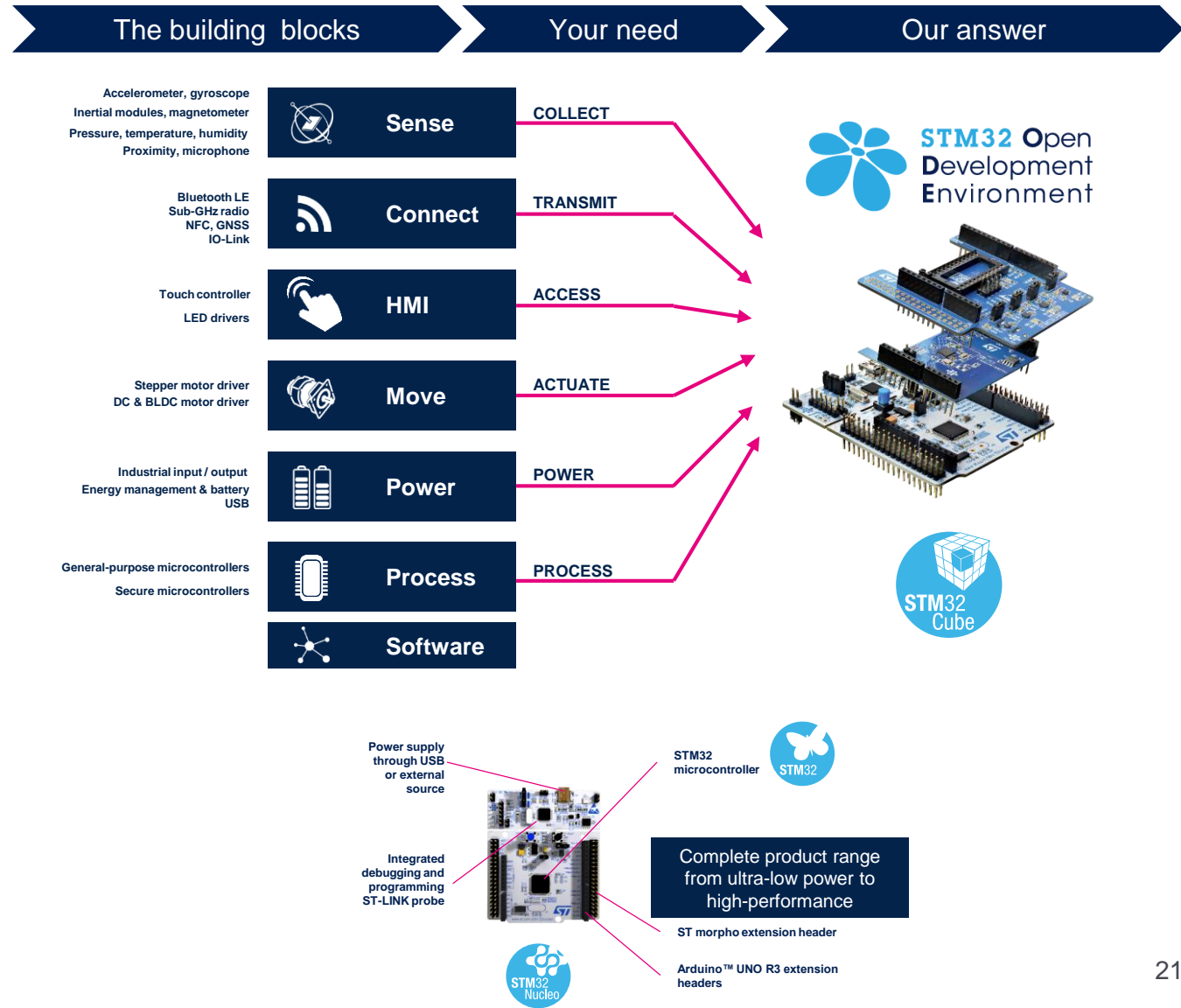
STM32 Open Development Environment: all that you need

The combination of a broad range of expandable boards based on leading-edge commercial products and modular software, from driver to application level, enables fast prototyping of ideas that can be smoothly transformed into final designs.

To start your design:

- Choose the appropriate STM32 Nucleo development board (MCU) and expansion (X-NUCLEO) boards (sensors, connectivity, audio, motor control etc.) for the functionality you need
- Select your development environment (IAR EWARM, Keil MDK, and GCC-based IDEs) and use the free STM32Cube tools and software.
- Download all the necessary software to run the functionality on the selected STM32 Nucleo expansion boards.
- Compile your design and upload it to the STM32 Nucleo development board.
- Then start developing and testing your application.

Software developed on the STM32 Open Development Environment prototyping hardware can be directly used in an advanced prototyping board or in an end product design using the same commercial ST components, or components from the same family as those found on the STM32 Nucleo boards.



Thank you

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