Quick Start Guide

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

Version 3.0 (December, 2022)

B-U585I-IOT02A Discovery kit for IoT Node

Agenda

1- Hardware and Software overview

STM32U5 Discovery kit for IoT node (B-U585I-IOT02A)
Hardware Overview

B-U585I-IOT02A Hardware Description

The B-U585I-IOT02A Discovery kit provides a complete demonstration and development platform for the STM32U585AI microcontroller, featuring an Arm® Cortex®-M33 core with Arm® TrustZone® and Armv8-M mainline security extension, 2 Mbytes of Flash memory and 786 Kbytes of SRAM, as well as smart peripheral resources.

The B-U585I-IOT02A Discovery kit leverages the STM32U5 Series key assets to enable prototyping for a variety of wearable or sensor applications in fitness, metering, industrial, or medical, with state-of-the-art energy efficiency and higher security.

Key Product on board

- Ultra-low-power STM32U585AII6Q microcontroller based on the Arm® Cortex®-M33 core with Arm® TrustZone®, 2 Mbytes of Flash memory and 786 Kbytes of SRAM, and SMPS in UFBGA169 package
- 512-Mbit Quad-SPI Flash memory, 64-Mbit Octo-SPI PSRAM, 256-Kbit I2C EEPROM
- USB FS, Sink and Source power, 2.5 W power capability
- 802.11 b/g/n compliant Wi-Fi® module from MXCHIP
- Bluetooth® Low Energy from STMicroelectronics
- MEMS sensors from STMicroelectronics
    - 2 digital microphones
    - Relative humidity and temperature sensor
    - 3-axis magnetometer
    - 3D accelerometer and 3D gyroscope
    - Pressure sensor, 260-1260 hPa absolute digital output barometer
    - Time-of-flight and gesture-detection sensor
- Ambient-light sensor

- Authentication and security for peripherals and IoT devices from STMicroelectronics
- 2 user LEDs
- User push-button
- Reset push-button
- Board connectors
    - USB Type-C®
    - ARDUINO® Uno V3 expansion connectors
    - Camera module expansion connector
    - 2× STMod+ expansion connectors
- Pmod™ expansion connector
- Flexible power-supply options: ST-LINK USB VBUS, USB connector, or external sources
- On-board STLINK-V3E debugger/programmer with USB re-enumeration capability: mass storage, Virtual COM port, and debug port
- Comprehensive free software libraries and examples available with the STM32CubeU5 MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE

Latest info available at www.st.com
B-U585I-IOT02A

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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-U585I-IOT02A Discovery kit for IoT node and connects to the Internet through the attached WiFi® interface.

The software is also available on GitHub, where users can signal bugs and propose new ideas through [**Issues**] and [**Pull requests**] tabs.

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 (sodium/mbedCrypto); Azure RTOS ThreadX and NetXDuo; 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

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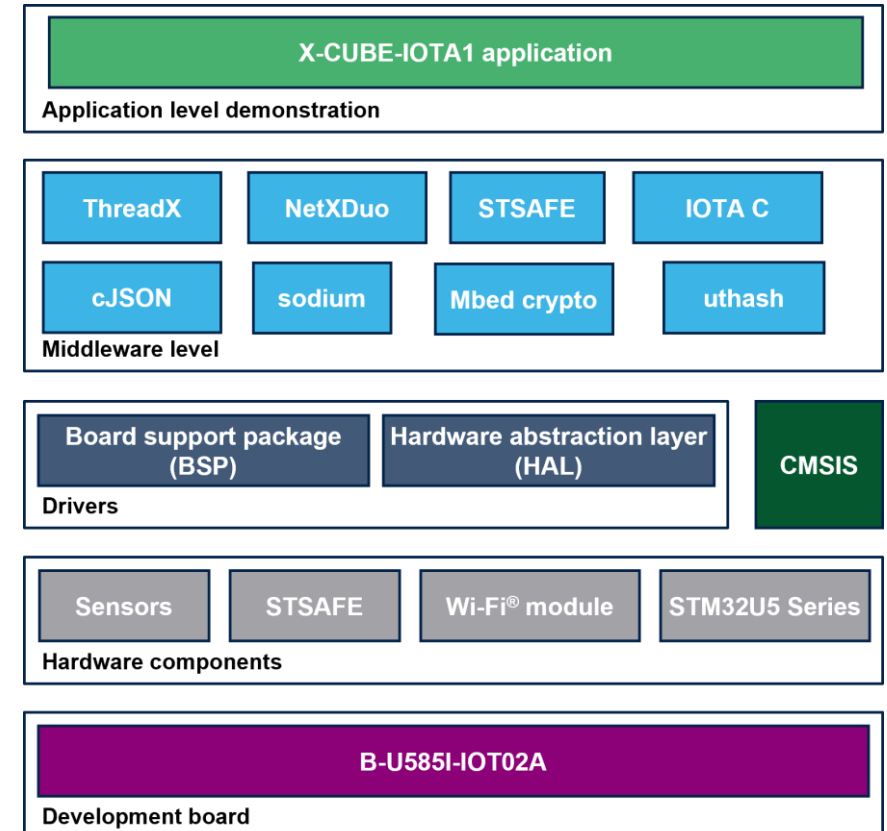
Latest info available at www.st.com
X-CUBE-IOTA1

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2- Setup & Demo Example

- 1x B-U585I-IOT02A discovery kit

- Laptop/PC with Windows 7, 8 or 10

- 1 x microUSB cable

- WiFi Router or access to a WiFi network

MicroUSB

MicroUSB Cable

B-U585I-IOT02A

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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-U585I-IOT02A.

- **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/stm32ode

2 Select expansion package:
X-CUBE-IOTA1

3 Download & unpack

X-CUBE-IOTA1 package structure

- 📁 _htmresc
- 📁 Documentation
- 📁 Drivers
- 📁 Middlewares
- 📁 Projects
- 🌐 Package_License.html
- 📄 Package_License.md
- 📄 README.md
- 🌐 Release_Notes.html
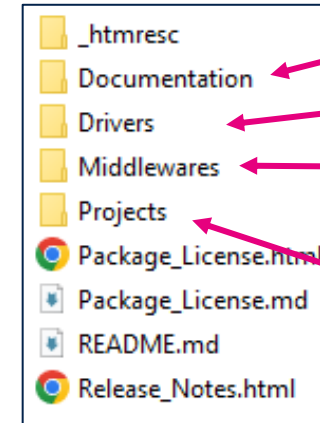
Docs

BSP, HAL drivers

STSAFE, IOTA, Mbed crypto, sodium

IOTA Client application

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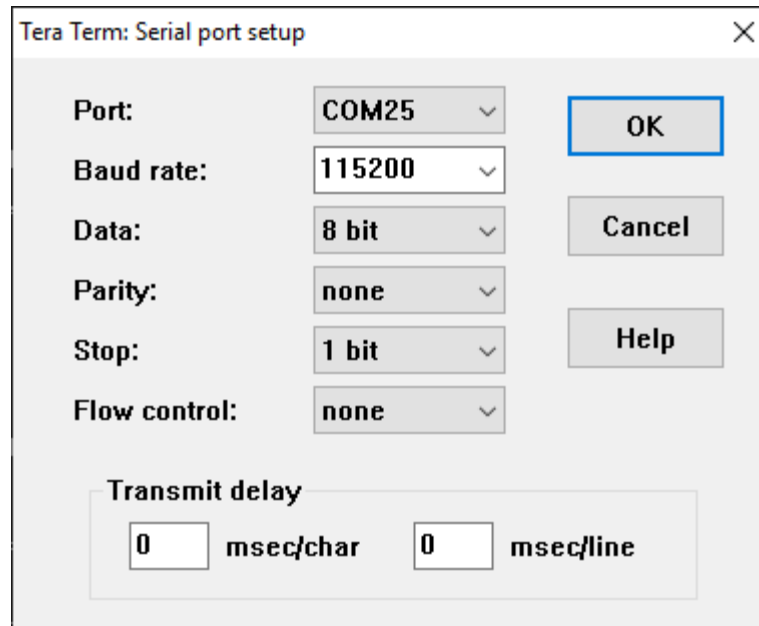**6** Evaluate using serial line terminal
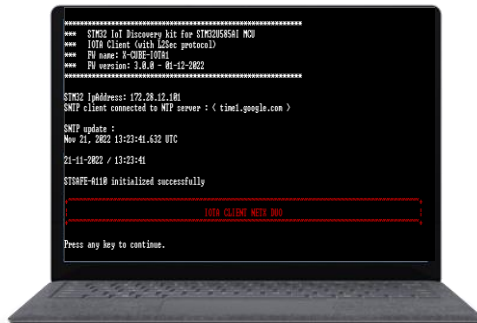
5 Build/Flash and run the project

2.1- Test X-CUBE-IOTA1

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
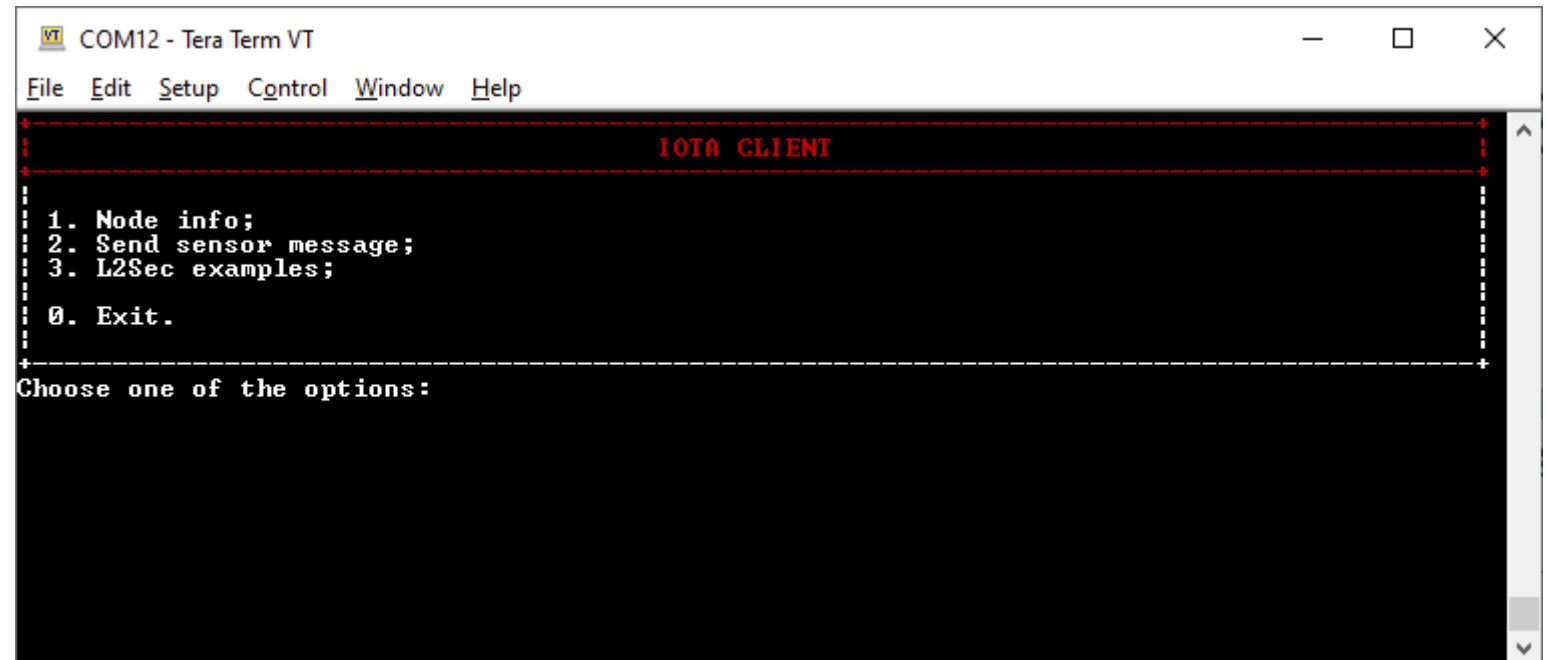 - No flow control

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In order to make the program work, you must do the following: functionalities.

- Open your preferred toolchain
- On Core/Inc/mx_wifi_conf.h, edit your WiFi Settings (WIFI_SSID,WIFI_PASSWORD)
- Rebuild all files and load your image into target memory

After the initialization is complete, press any key to refresh the screen with the list of the main functions.

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.iota.org).

- *Get node info*
- *Send an indexation message including sensor data*
- *Enter the L2Sec example submenu*

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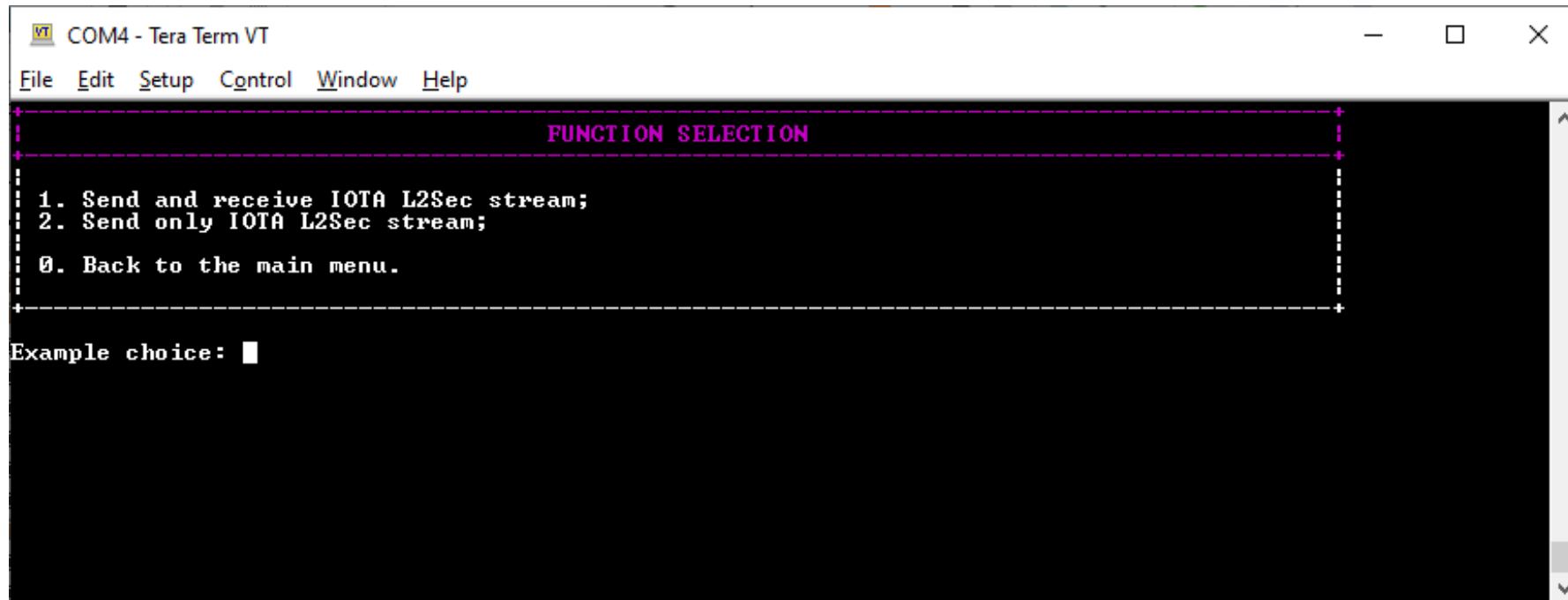
The *L2Sec example* allows to execute the L2Sec protocol, a lightweight message stream security protocol native for IOTA Chrysalis and suitable for constrained IoT devices.

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.

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3- Documents & Related Resources

Documents & Related Resources

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-U585I-IOT02A:

- **MB1551** – **Bill of Materials**
- **MB1551 – Board Schematic**
- **DB4410:** Discovery kit for IoT node with STM32U5 Series – **databrief**
- **UM2839:** Discovery kit for IoT node with STM32U5 Series – **user manual**

STSAFE-A110:

- **AN5435:** STSAFE-A110 generic sample profile description – **application note**

X-CUBE-SAFEA1:

- **DB4064:** STSAFE-A110 software package – **databrief**
- **UM2646:** Getting started with the X-CUBE-SAFEA1 software package – **user manual**

Consult www.st.com for the complete list

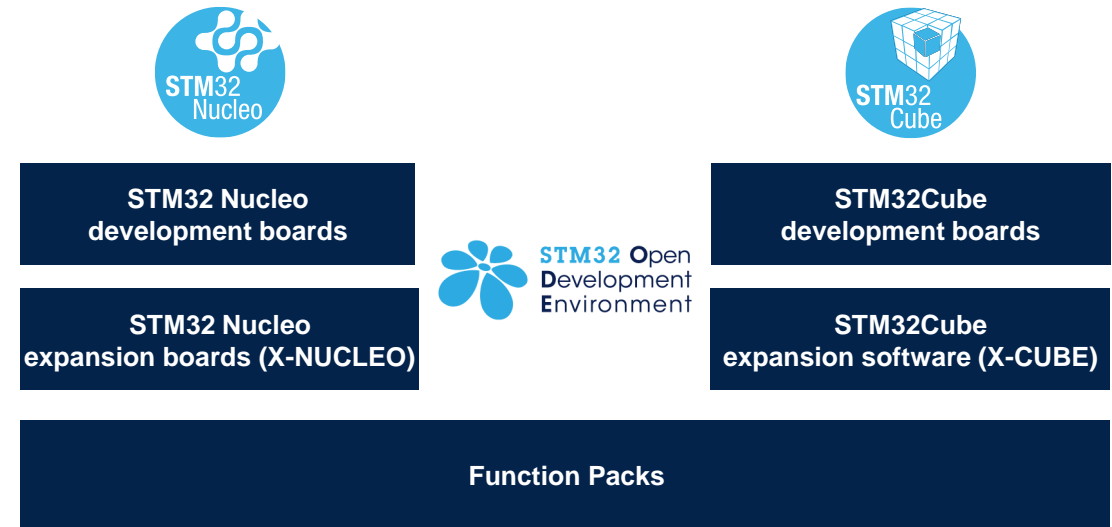# 4- STM32 Open Development Environment: Overview

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:

o 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

o 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

o 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

o STM32Cube expansion software. Expansion software provided free of charge for use with STM32 Nucleo expansion boards, and compatible with the STM32Cube software framework

o 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.

STM32 Nucleo

STM32 Cube

STM32 Nucleo development boards

STM32 Open Development Environment

STM32Cube development boards

STM32 Nucleo expansion boards (X-NUCLEO)

STM32Cube expansion software (X-CUBE)

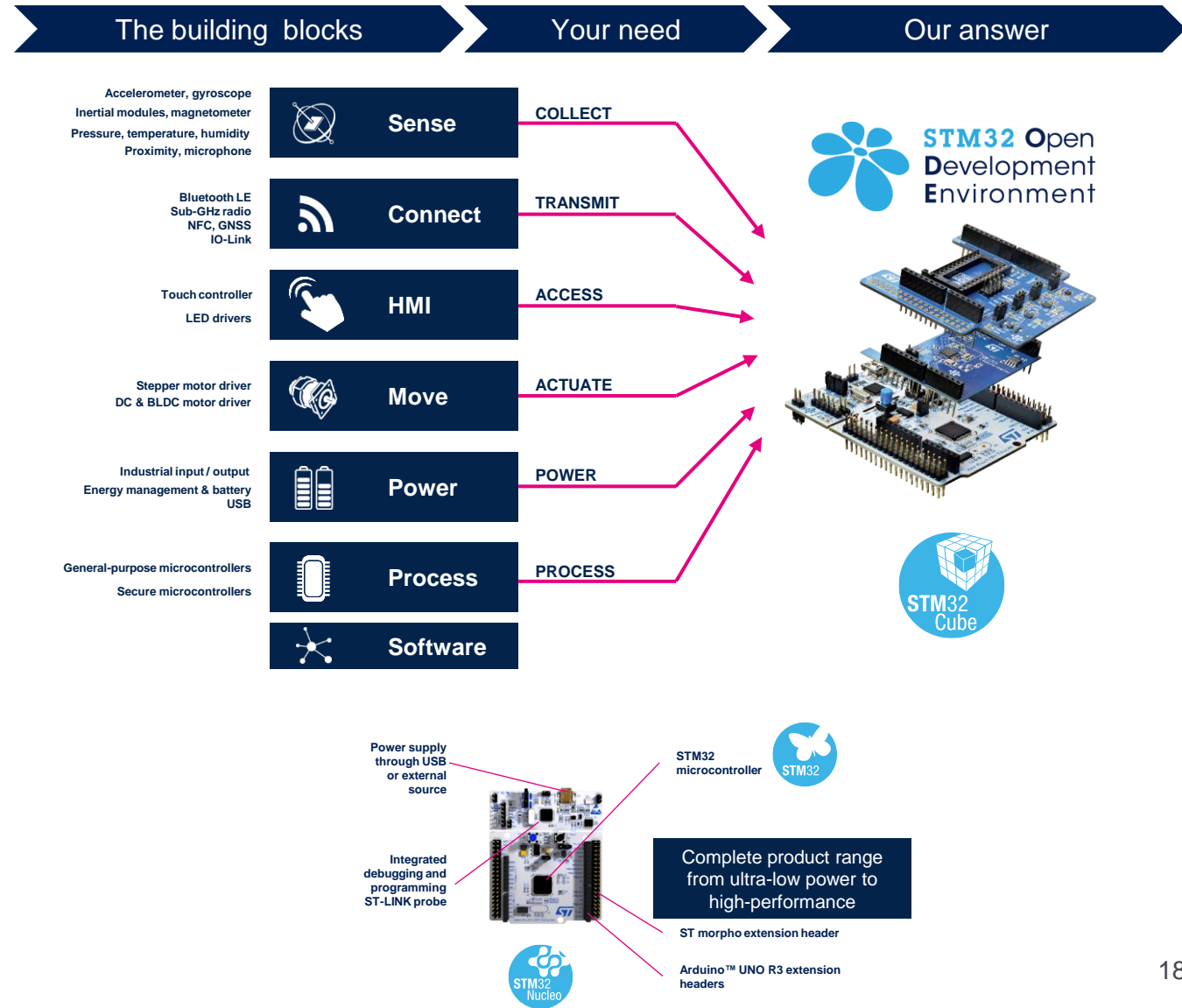**Function Packs**

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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 and end product design using the same commercial ST components, or components from the same family as those found on the STM32 Nucleo boards.

The building blocks	Your need	Our answer

Sense — COLLECT
Accelerometer, gyroscope
Inertial modules, magnetometer
Pressure, temperature, humidity
Proximity, microphone

Connect — TRANSMIT
Bluetooth LE
Sub-GHz radio
NFC, GNSS
IO-Link

HMI — ACCESS
Touch controller
LED drivers

Move — ACTUATE
Stepper motor driver
DC & BLDC motor driver

Power — POWER
Industrial input / output
Energy management & battery
USB

Process — PROCESS
General-purpose microcontrollers
Secure microcontrollers

Software

STM32 **O**pen **D**evelopment **E**nvironment

STM32Cube

Power supply through USB or external source
STM32 microcontroller
Integrated debugging and programming ST-LINK probe
Complete product range from ultra-low power to high-performance
ST morpho extension header
Arduino™ UNO R3 extension headers

STM32 Nucleo

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Thank you

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