Quick Start Guide
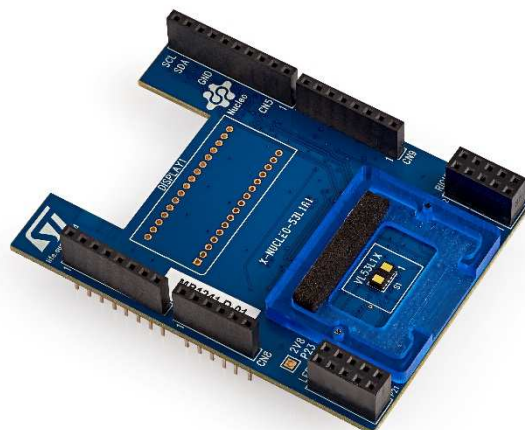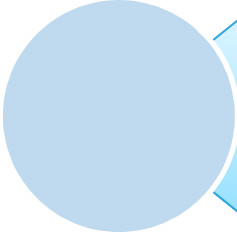
Long distance ranging ToF sensor expansion board based on
VL53L1X for STM32 Nucleo
(X-NUCLEO-53L1A1)
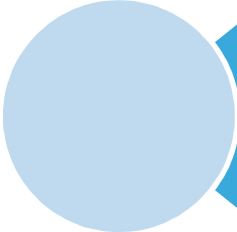
Version (February 20, 2018)

X-NUCLEO-53L1A1: Long distance ranging ToF sensor expansion board
Hardware and Software overview

Hardware & Software installation
Documents & Related Resources

STM32 Open Development Environment: Overview

X-NUCLEO-53L1A1 Hardware Description

- The X-NUCLEO-53L1A1 is a long distance ranging sensor evaluation and development board designed around the VL53L1X sensor based on ST FlightSense™ Time-of-Flight technology.

- The VL53L1X communicates with the STM32 Nucleo developer board host microcontroller through an I2C link available on the Arduino UNO R3 connector.
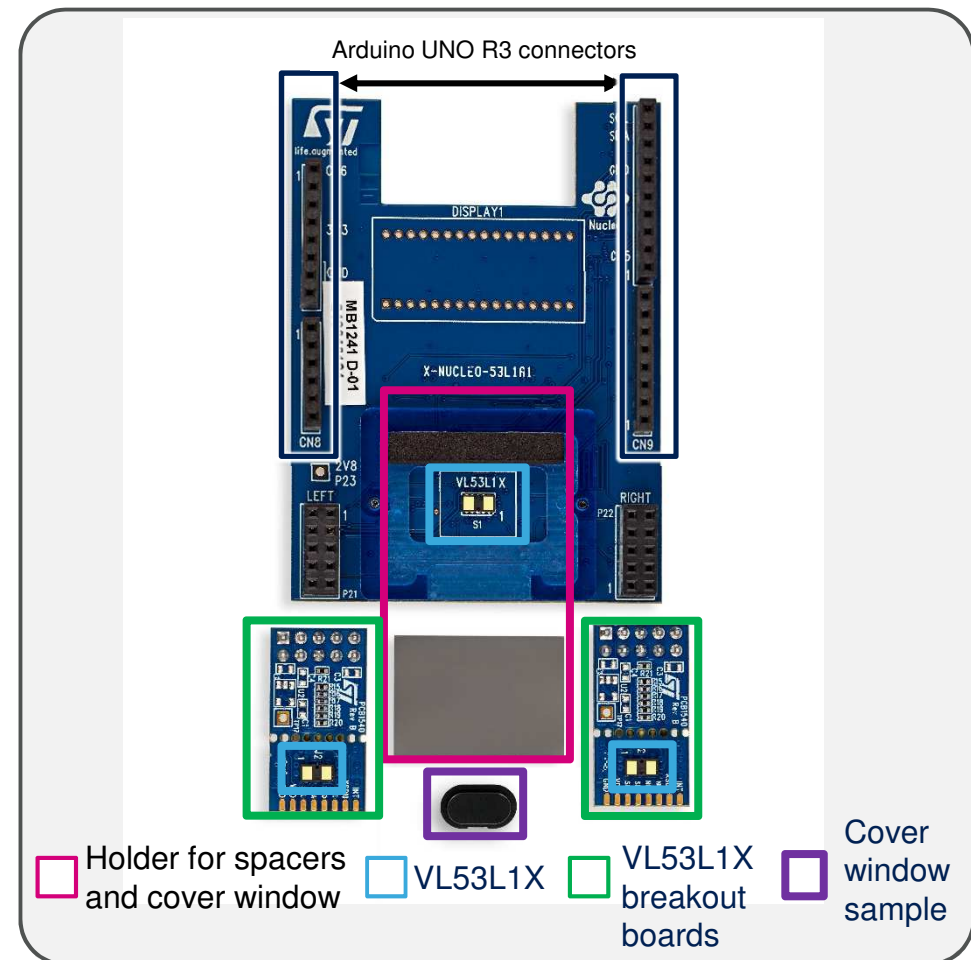
Key Products on board

VL53L1X long distance ranging and gesture detection sensor module

0.25, 0.5 and 1mm spacers to simulate air gaps, with the **cover glass**

Cover window (made by Hornix) sample with low cross-talk ready to use / clipable on VL53L1X

2x VL53L1X breakout boards

Latest info available at www.st.com
X-NUCLEO-53L1A1

Remove the protective film on the VL53L1X sensor

Arduino UNO R3 connectors

Holder for spacers and cover window　VL53L1X　VL53L1X breakout boards　Cover window sample

Order Code: **X-NUCLEO-53L1A1**

Remove the protective film
on the VL53L1X sensor

- X-NUCLEO-53L1A1 expansion board

  - To help integrate multiple VL53L1X devices in custom applications, up to 2 external VL53L1X breakout boards can be connected to the expansion board.

  - The breakout boards are delivered with the **X-NUCLEO-53L1A1**.

- X-NUCLEO-53L1A1 is also available as a NUCLEO Pack (P-NUCLEO-53L1A1)

  - The X-NUCLEO-53L1A1 expansion board can also be ordered on www.st.com as part of a NUCLEO Pack with expansion board and STM32 NUCLEO board.

  - Order code: **P-NUCLEO-53L1A1**:
    X-NUCLEO-53L1A1 expansion board and NUCLEO-F401RE full features board.

- VL53L1X breakout boards can also be ordered separately

  - Order code: **VL53L1X-SATEL**
    Two breakout boards are included.
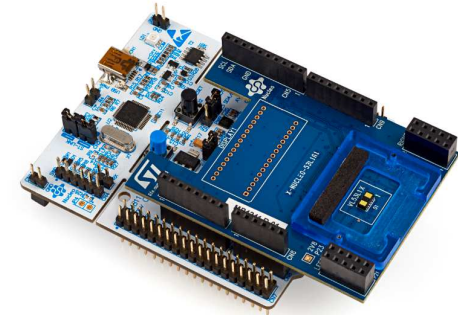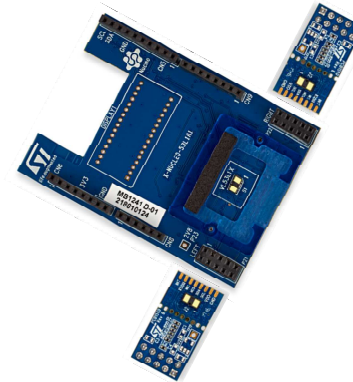
Long distance ranging ToF sensor expansion board
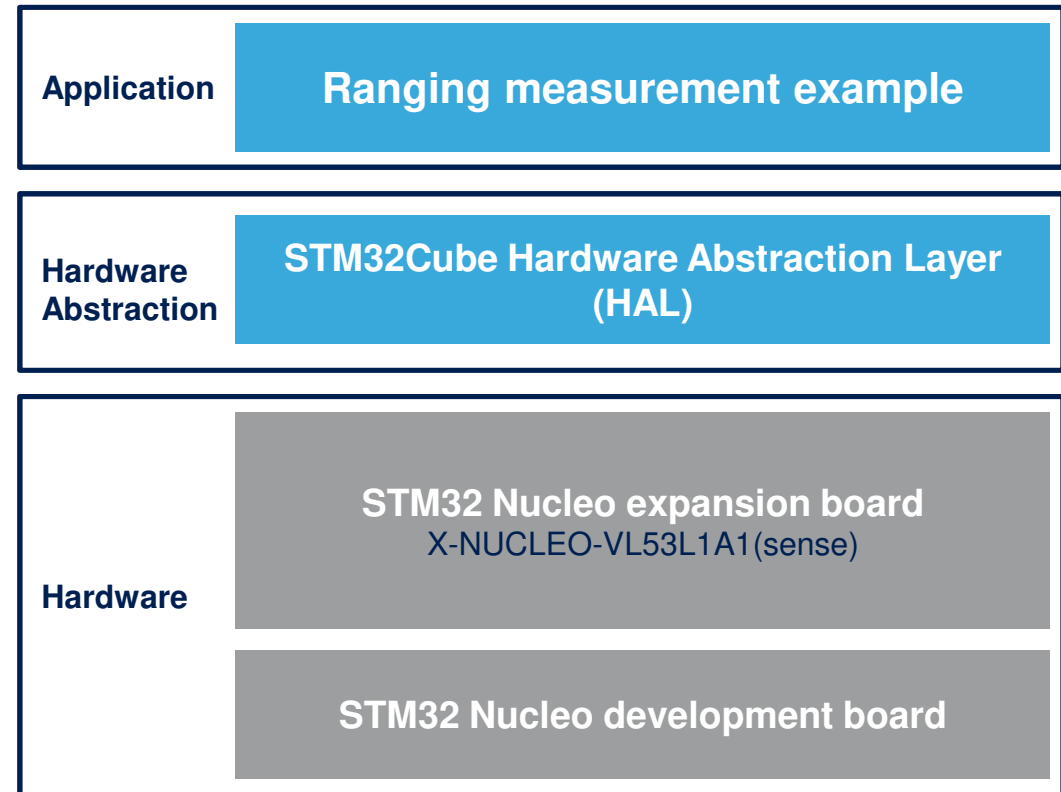## STM32Cube Software Overview

X-CUBE-53L1A1 software description

- The X-CUBE-53L1A1 software package is an STM32Cube expansion for the X-NUCLEO-53L1A1 expansion board for STM32. The source code is based on STM32Cube to ease portability and code sharing across different STM32 MCU families. An sample implementation is available for the STM32 Nucleo ranging sensor expansion board (X-NUCLEO-53L1A1) plugged on top of an STM32 Nucleo development board (NUCLEO-F401RE or NUCLEO-L476RG).
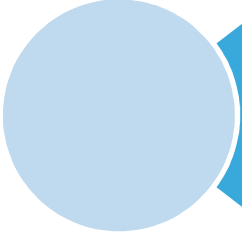
Key features

- Driver layer (VL53L1X API) for complete management of the VL53L1X ranging sensor integrated in the X-NUCLEO-53L1A1 expansion board.
- Easy portability across different MCU families, thanks to STM32Cube.
- Free, user-friendly license terms.
- Sample code for ranging measurement.

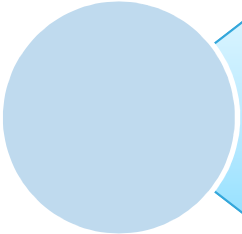| Application	**Ranging measurement example**
Hardware Abstraction	**STM32Cube Hardware Abstraction Layer (HAL)**
Hardware	**STM32 Nucleo expansion board** X-NUCLEO-VL53L1A1(sense)
	STM32 Nucleo development board

Latest SW available at www.st.com
X-CUBE-53L1A1

Quick Start Guide Contents

X-NUCLEO-53L1A1: Long distance ranging ToF sensor expansion board
Hardware and Software overview

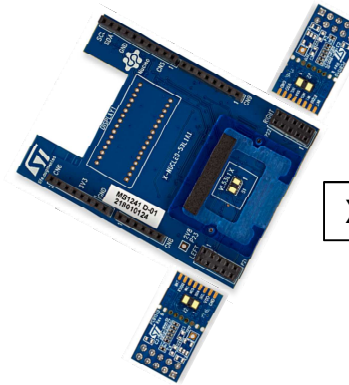Hardware & Software installation
Documents & Related Resources

STM32 Open Development Environment: Overview

Setup & Demo Examples
HW prerequisites

- 1x Ranging sensor expansion board based on VL53L1X (**X-NUCLEO-53L1A1**).

Remove the protective film on the VL53L1X sensor

X-NUCLEO-53L1A1

- 1x STM32 Nucleo development board (**NUCLEO-F401RE** or **NUCLEO-L476RG**)

- 1x Laptop/PC with MS Windows

- 1x USB type A to Mini-B USB cable

NUCLEO-F401RE or NUCLEO-L476RG

- If you don't have an STM32 Nucleo development board, you can order a Nucleo pack (**P-NUCLEO-53L1A1**):
  - X-NUCLEO-53L1A1 expansion board and NUCLEO-F401RE full features board delivered together.
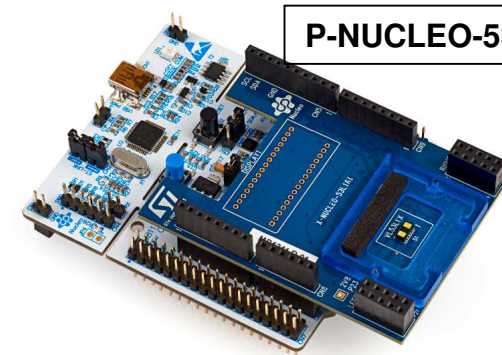
P-NUCLEO-53L1A1

- **STSW-LINK009**: ST-LINKV2-1 USB driver

- **STSW-LINK007**: ST-LINKV2-1 firmware upgrade

- **STSW-IMG008**: P-NUCLEO-53L1A1 Graphical User Interface (GUI) on Windows 7, 8 and 10

- **X-CUBE-53L1A1**: P-NUCLEO-53L1A1 software expansion. Copy the .zip file content into a folder on your PC; the package will contain the API software driver, a simple ranging source code example (Keil, IAR, STM32 System Workbench) based on NUCLEO-F401RE or NUCLEO-L476RG for STM32Cube, and all the necessary documentation.

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1. Install the PC USB port driver to detect the Nucleo board
   - Called **STSW-LINK009**, downloaded from www.st.com
   - Unzip, extract the docs, and install "stlink_winusb_install.bat"
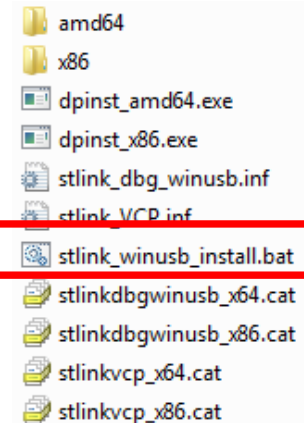
1. Connect the Nucleo pack to the PC through USB
   - Wait for the board to be recognized;
     the drivers are installed automatically)
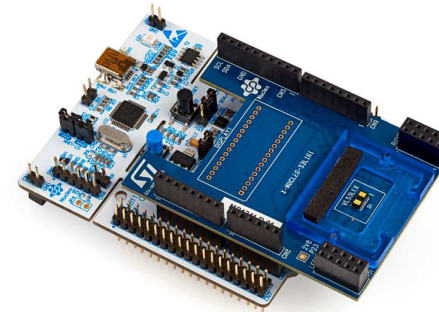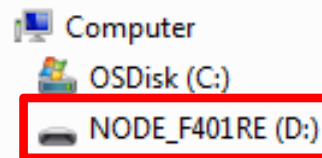
1. Upgrade ST-link firmware
   - Called **STSW-LINK007**, downloaded from www.st.com
   - Unzip, extract the docs, go to "Windows" folder
     and install "**ST-linkUpgrade.exe**"
   - Launch **ST-LinkUpgrade.exe**, press Device Connect, then Yes

=> VL53L1X NUCLEO Kit is ready for GUI installation

VL53L1X GUI software installation

GUI is generally the first step to evaluate the device

- Perform HW installation and connect the VL53L1X NUCLEO pack
  (X-NUCLEO-53L1A1 expansion board + STM32 Nucleo board) to the PC

- Install the GUI SW for VL53L1X Demo and configuration settings
  - Called **STSW-IMG008**, downloaded from www.st.com
  - Unzip, extract the docs, and install "**VL53L1X_setup.exe**"
  - Run the installer with Admin privileges or change default installation directory

The Graphical User Interface can:

- Perform calibration phases (offset and xTalk with cover glass)
- Change key parameters of VL53L1X
- Display real time key ranging data (distance, signal rate),
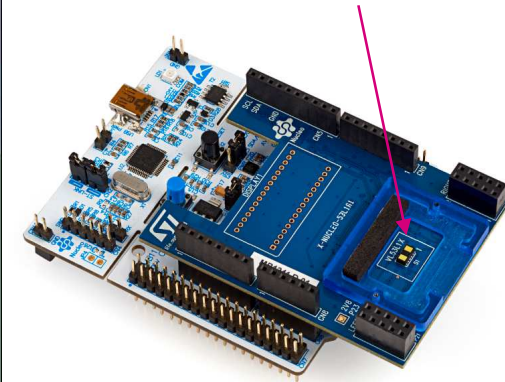- Get data logging (.csv file)

Remove the protective film on the VL53L1X sensor

X-CUBE-53L1A1 software installation

- Perform HW installation and connect the NUCLEO kit (P-NUCLEO-53L0A1) to the PC

- Install the X-CUBE-53L1A1 SW package
  - Called **X-CUBE-53L1A1**, downloaded from www.st.com
  - Unzip, extract the docs, and the **STM32CubeExpansion_Vx.y.z** folder directory appears

X-CUBE software package contents: API SW + SW examples

```
▲ 📁 STM32CubeExpansion_VL53L1X_V1.0.0
    📁 _htmresc
    📁 Documentation        ← Generic Nucleo & SW installation guide
  ▷ 📁 Drivers              ← VL53L1X API driver
  ▲ 📁 Projects
    ▲ 📁 Multi
      ▲ 📁 Examples
        ▲ 📁 VL53L1X
          ▷ 📁 SimpleRangingExamples   ← VL53L1X project examples for single sensor ranging:
                                           -  pre-compiled binary files to evaluate the sensor
                                           -  STM32 IDE with projects on STM32 Workbench, Keil and IAR
```
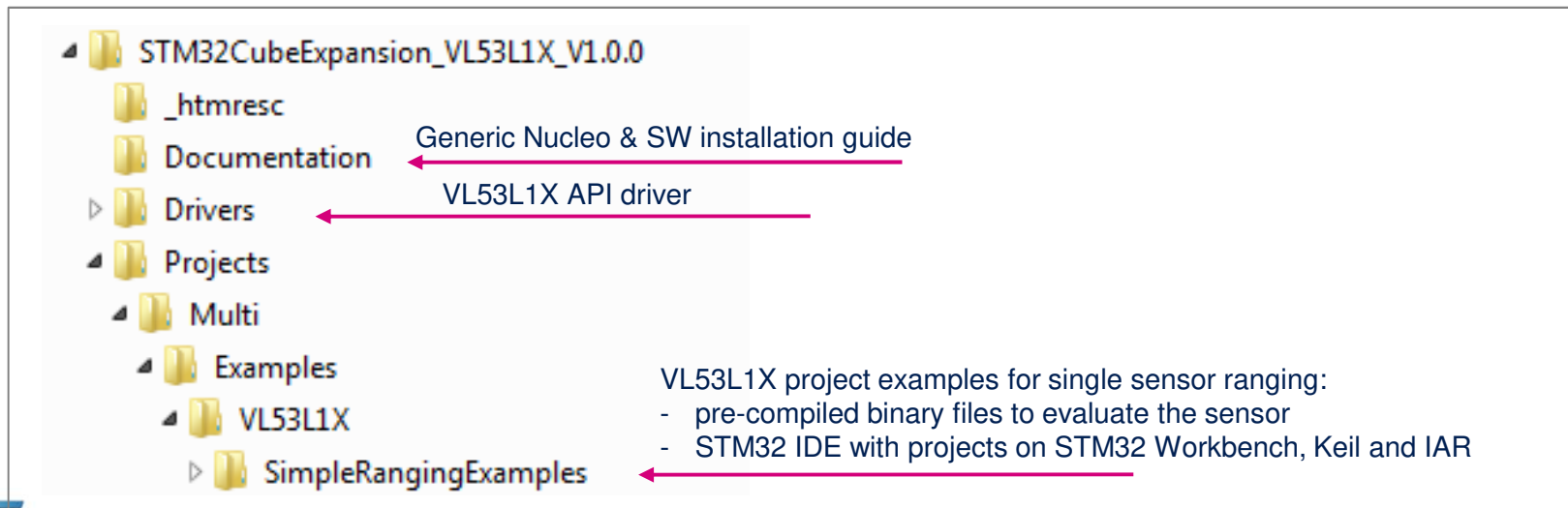
VL53L1X long distance ranging ToF sensor expansion board
Evaluation code example (.bin) using X-CUBE-53L1A1 and a NUCLEO Pack
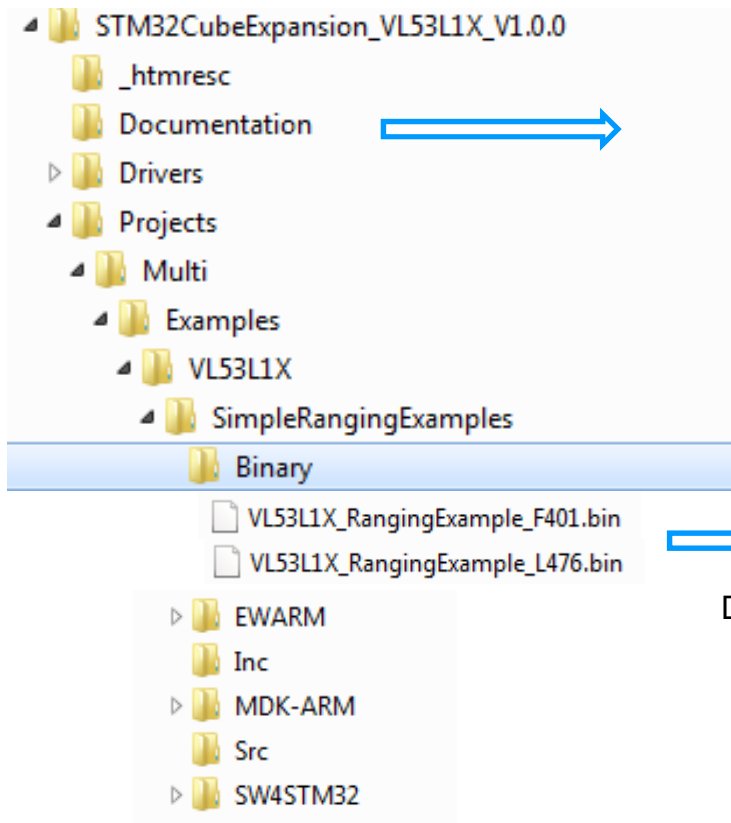
Open: **UM2371** (Getting started with VL53L1X ranging sensor software expansion for STM32Cube) and follow the instructions

Load STM32 firmware (Binary code file)
VL53L1X_RangingExample_F401.bin
Or
VL53L1X_RangingExample_L476.bin

Drag and drop to

VL53L1X Long distance ranging ToF sensor expansion board
Start programming with code examples using X-CUBE-53L1A1 and a NUCLEO Pack
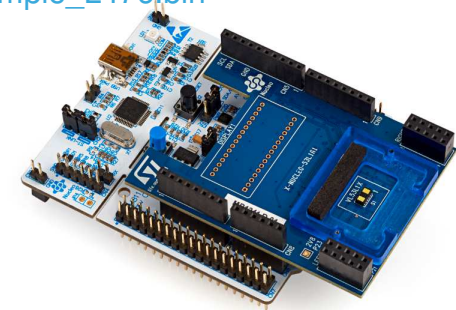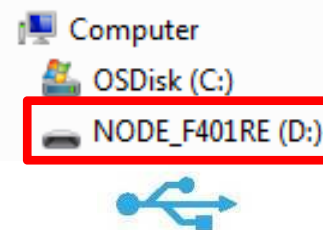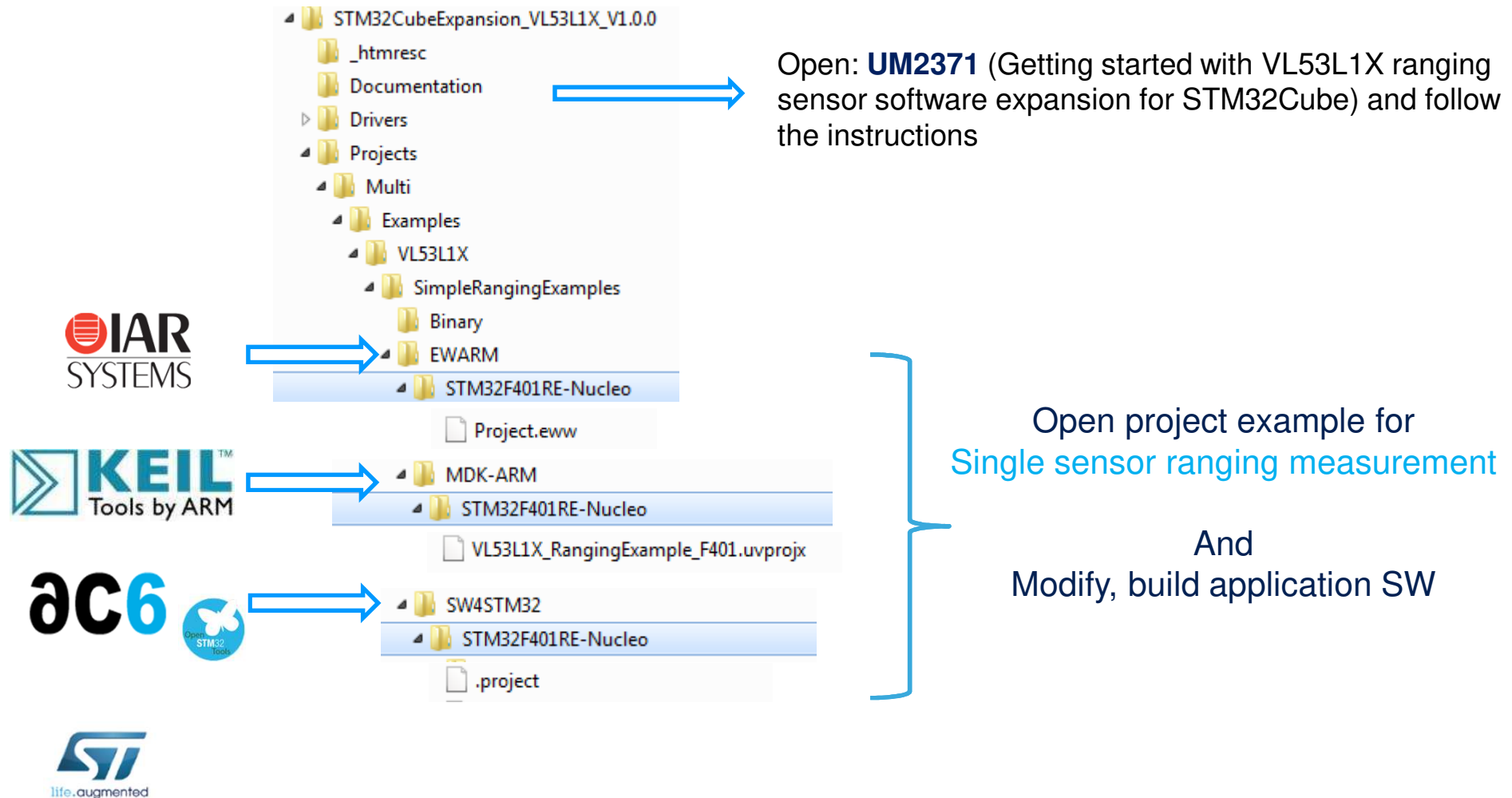
Open: **UM2371** (Getting started with VL53L1X ranging sensor software expansion for STM32Cube) and follow the instructions

Open project example for
Single sensor ranging measurement

And
Modify, build application SW

Documents & Related Resources

Go to www.st.com/VL53L1X

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

VL53L1X: Product Folder

- **DS12385**: A new generation, long distance and fast ranging sensor - **data sheet**

X-NUCLEO-53L1A1: Product Folder

- **DB2901**: VL53L1X Time-of-Flight ranging sensor expansion board – **data brief**

- **X-NUCLEO-53L1A1 Quick start guide :** Long distance ranging sensor expansion board **-** (this document)

- **UM2359:** BOM and electrical schematic of the expansion board X-NUCLEO-53L1A1 - **user manual**

P-NUCLEO-53L1A1: Product Folder

- **DB3477**: VL53L1X NUCLEO Pack with X-NUCLEO-53L1A1 expansion board – **data brief**

STSW-IMG008: Graphical User Interface (GUI) Folder

- **DB3508**: P-NUCLEO-53L1A1 pack PC graphical user interface (GUI) – **data brief**

- **Software setup file**

STSW-IMG007: Application programming Interface (VL53L1X software driver API) folder
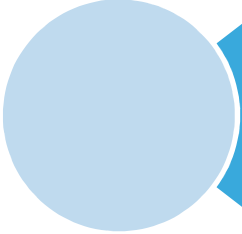
- **DB3510**: VL53L1X long-distance ranging sensor application programming interface (API) – **data brief**

- **UM2356**: VL53L1X long-distance ranging sensor application programming interface (API) – **user manual**

X-CUBE-53L1A1: Software package for STM32Cube
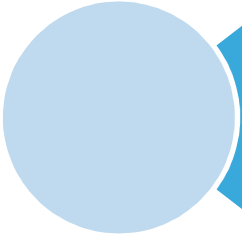
- **DB3523:** VL53L1X ranging and gesture detection sensor software expansion for STM32Cube – **data brief**

- **UM2371:** Getting started with X-CUBE-53L1A1; ranging sensor software expansion for STM32Cube – **user manual**

- **Software setup file**

Quick Start Guide Contents
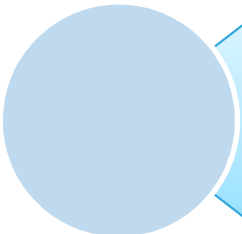
X-NUCLEO-53L0A1: Long distance ranging ToF sensor expansion board
Hardware and Software overview

Setup & Demo Examples
Documents & Related Resources

STM32 Open Development Environment: Overview

STM32 Open Development Environment
Fast, affordable Prototyping and Development

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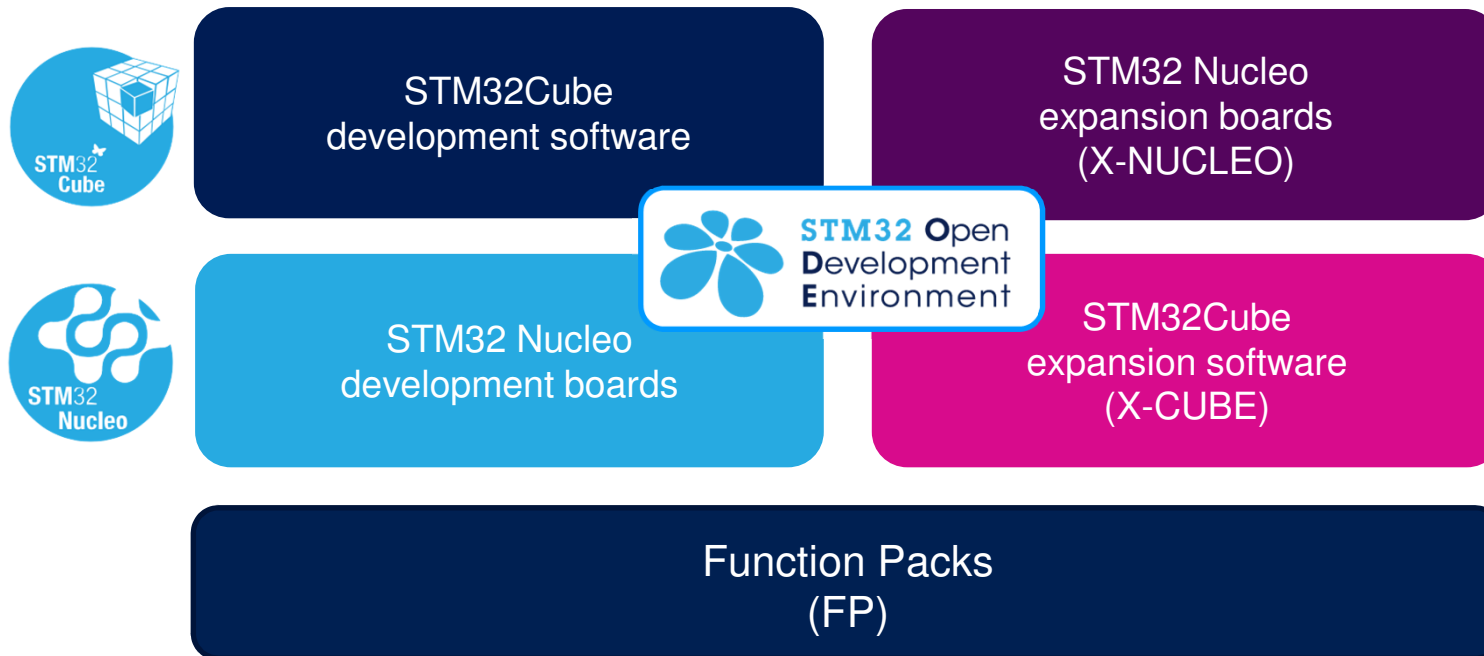
- A comprehensive range of affordable development boards for all the STM32 microcontroller series, with unlimited unified expansion capabilities and integrated debugger/programmer functionality.

Power supply through USB or external source

STM32 microcontroller

STM32 F0 STM32 F1 STM32 F2 STM32 F3 STM32 F4 STM32 F7

STM32 L0 STM32 L1

Complete product range
from ultra-low power to high-performance

Integrated debugging and programming ST-LINK probe

MB1136 rev. C

www.st.com/stm32nucleo

STM32 Nucleo

ST morpho extension header

Arduino™ UNO R3 extension headers

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www.st.com/stm32nucleo

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

Sense

Connect

Power

Move/Actuate

Interact

Motion MEMS sensors

Environmental sensors

DIL24 support for new devices
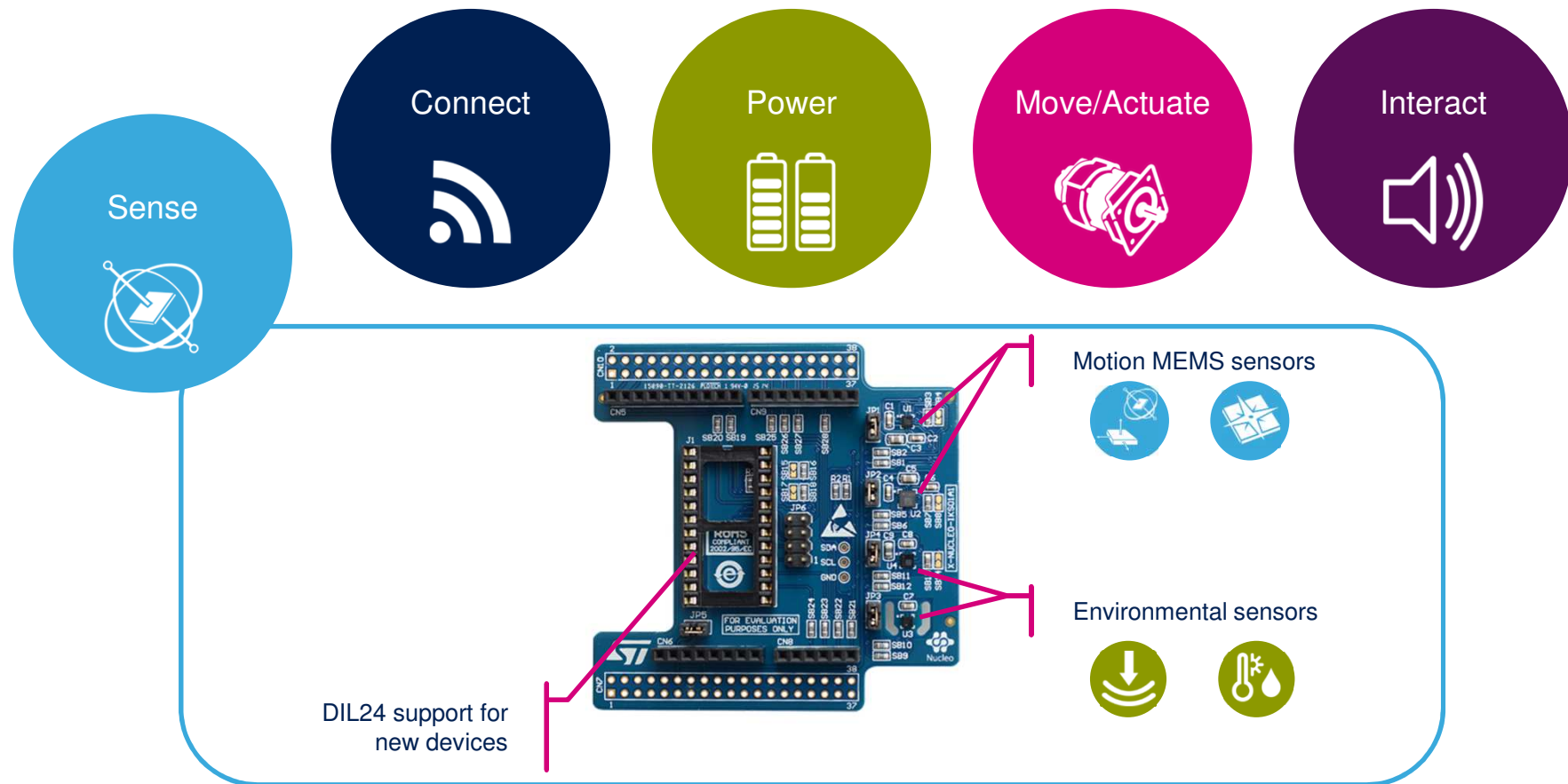
Example of STM32 expansion board (X-NUCLEO-IKS01A1)

www.st.com/x-nucleo

life.augmented

- **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.

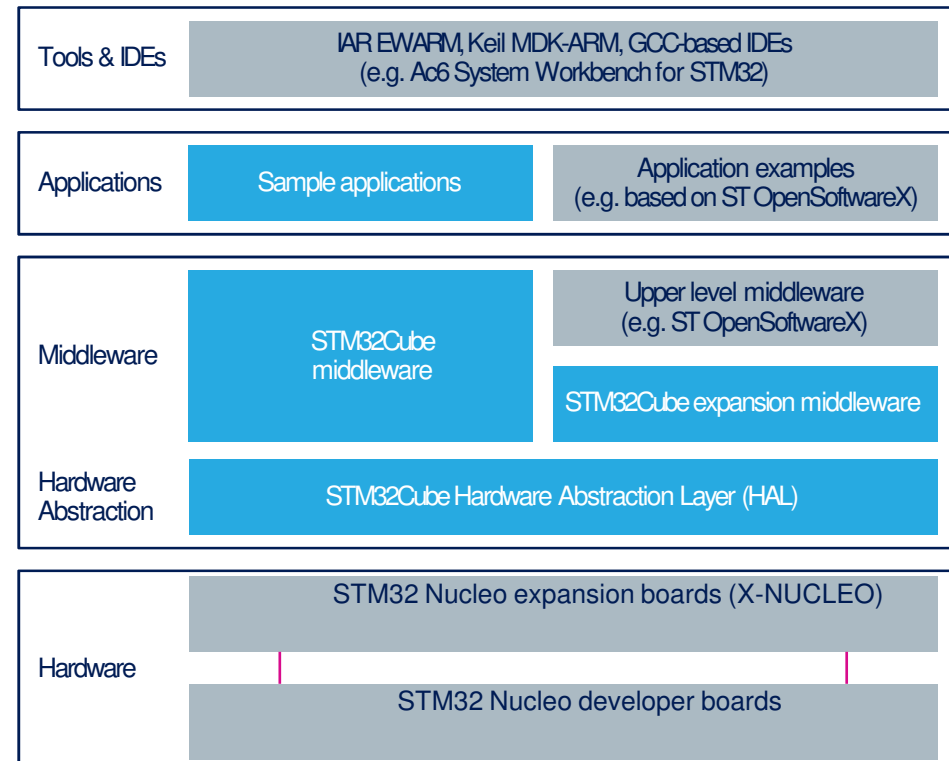- **STM32Cube expansion software (X-CUBE)** - Expansion software provided free for use with the STM32 Nucleo expansion board and fully compatible with the STM32Cube software framework. It provides abstracted access to expansion board functionality through high-level APIs and sample applications.

Tools & IDEs	IAR EWARM, Keil MDK-ARM, GCC-based IDEs (e.g. Ac6 System Workbench for STM32)

Applications	Sample applications	Application examples (e.g. based on ST OpenSoftwareX)

Middleware	STM32Cube middleware	Upper level middleware (e.g. ST OpenSoftwareX)
		STM32Cube expansion middleware
Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)	

Hardware	STM32 Nucleo expansion boards (X-NUCLEO)
	STM32 Nucleo developer boards

- **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; they 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.

OPEN LICENSE MODELS: STM32Cube software and sample applications are covered by a mix of fully open source BSD license and ST licenses with very permissive terms.

www.st.com/stm32cube

www.st.com/x-cube
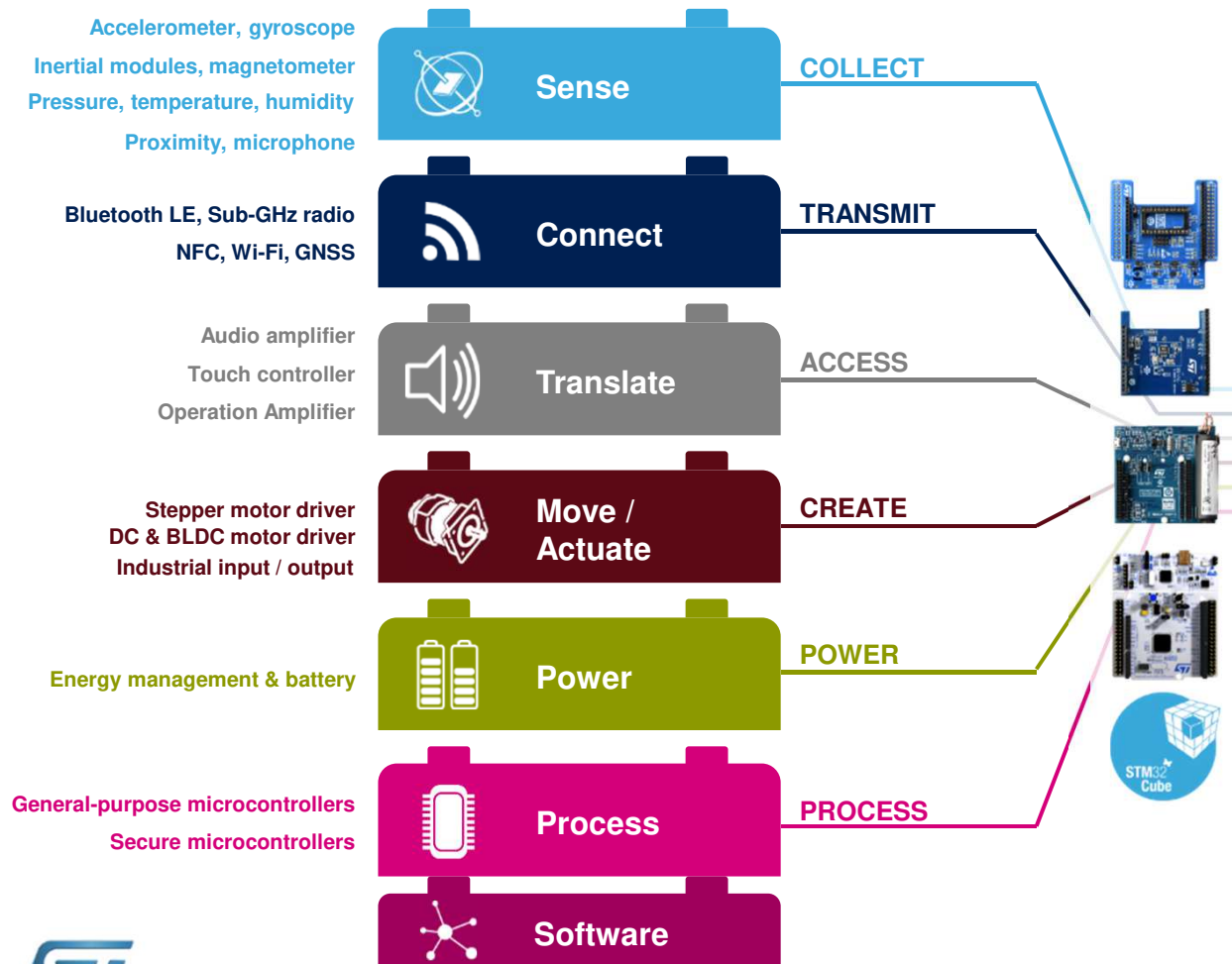
STM32 Open Development Environment
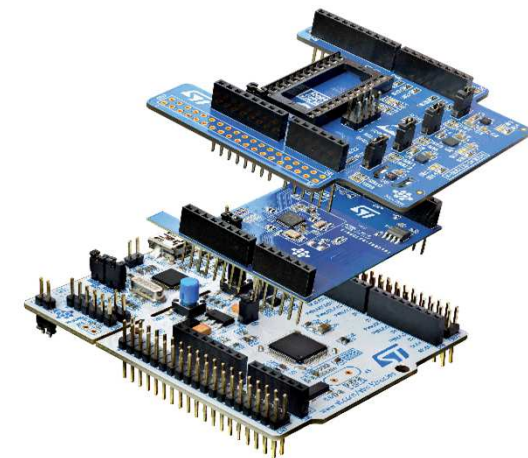## Building block approach

The building blocks → **Your need** → **Our answer**

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

COLLECT

Connect
- Bluetooth LE, Sub-GHz radio
- NFC, Wi-Fi, GNSS

TRANSMIT

Translate
- Audio amplifier
- Touch controller
- Operation Amplifier

ACCESS

Move / Actuate
- Stepper motor driver
- DC & BLDC motor driver
- Industrial input / output

CREATE

Power
- Energy management & battery

POWER

Process
- General-purpose microcontrollers
- Secure microcontrollers

PROCESS

Software

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

STM32 Cube

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