Eval kits and Development Platforms for MEMS Sensors: A Comprehensive Environment for Fast Go-to-Market

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Technology Tour 2019

Anaheim, CA | March 26

This session will explore:

- ✓ IoT Discovery Kit
- ✓ SensorTile Development Kit
- ✓ BlueNRG-Tile: Bluetooth LE-enabled sensor node development kit
- ✓ STM32 Nucleo Expansion boards
- ✓ Professional MEMS tool: ST MEMS adapter motherboard

ST: Products & Ecosystem
to Match IoT Market Trends

Market Trends

Smart Things	Smart Home	Smart City	Smart Industry
			
Ultra-low power, Form Factor, Sensors Performance…	Wifi, BTLE, sub-GHz, Sensors, Audio, Touch, Graphics…	LTE, Sub-GHz, Motion Sensors	Longevity, Certification, motion sensors…

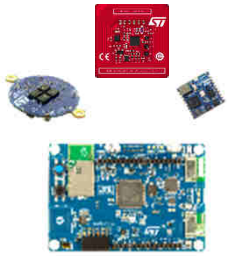
ST Offering

Broad Technology Offer

Ecosystem for application development

STM32 Nucleo development kits

STM32 Nucleo expansion boards for connectivity, sensing, actuating



Starter Kits and Form Factor Boards

STM32 Cube

STM32 Open Development Environment

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Partner Program

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…but Their Needs are the Same

	Processing & Security	Sensing & Actuating	Connectivity	Signal Conditioning & Protection	Power & Energy Management
Smart Things Smart Home Smart City Smart Industry	Ultra-Low Power to High Performance Scalable Security solutions	Full range of sensors and actuators	10 cm to 10 km	Nano Amps to Kilo Amps	Nano Watt to Mega Watt

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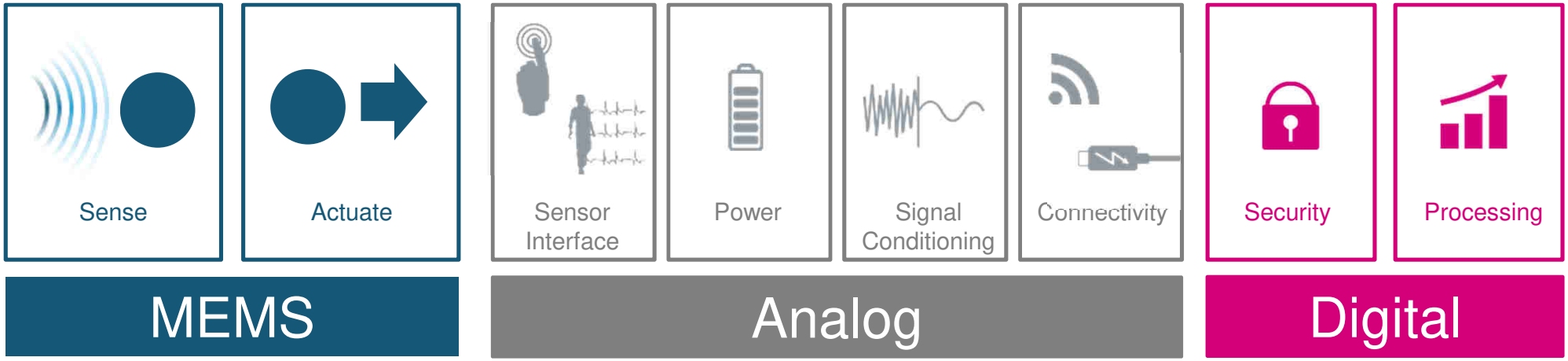
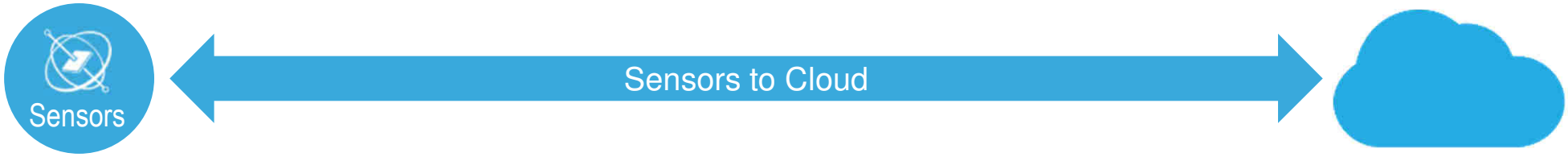
MEMS and Analog Empower the IoT





Today only a tiny portion of the sensory data that would be useful is captured, stored and analyzed

…and even smaller part of that is used to carry out actions through actuators

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Supporting the IoT Movement

Connect

Translate

Move
Actuate

Power

Secure

Process

Sense

SensorTile

BlueNRG-Tile

ProfiMEMS

Discovery Kit IoT Node

STM32 Nucleo Development
& Expansion boards

Pre-integrated SW for vertical applications

Smart Things

Smart Home

Smart City

Smart Industry

Development Ecosystem

Code generators

Prototyping software

IDE
Development environments

Debug solutions

Simulation and analysis tools

On-line design tools

ST Community

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Partner Program

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>150 Partners… and Counting

Cloud | Components and Modules | Embedded Software | Engineering Services | Hardware Development Tools | Software Development Tools | Training

IoT Discovery Kit

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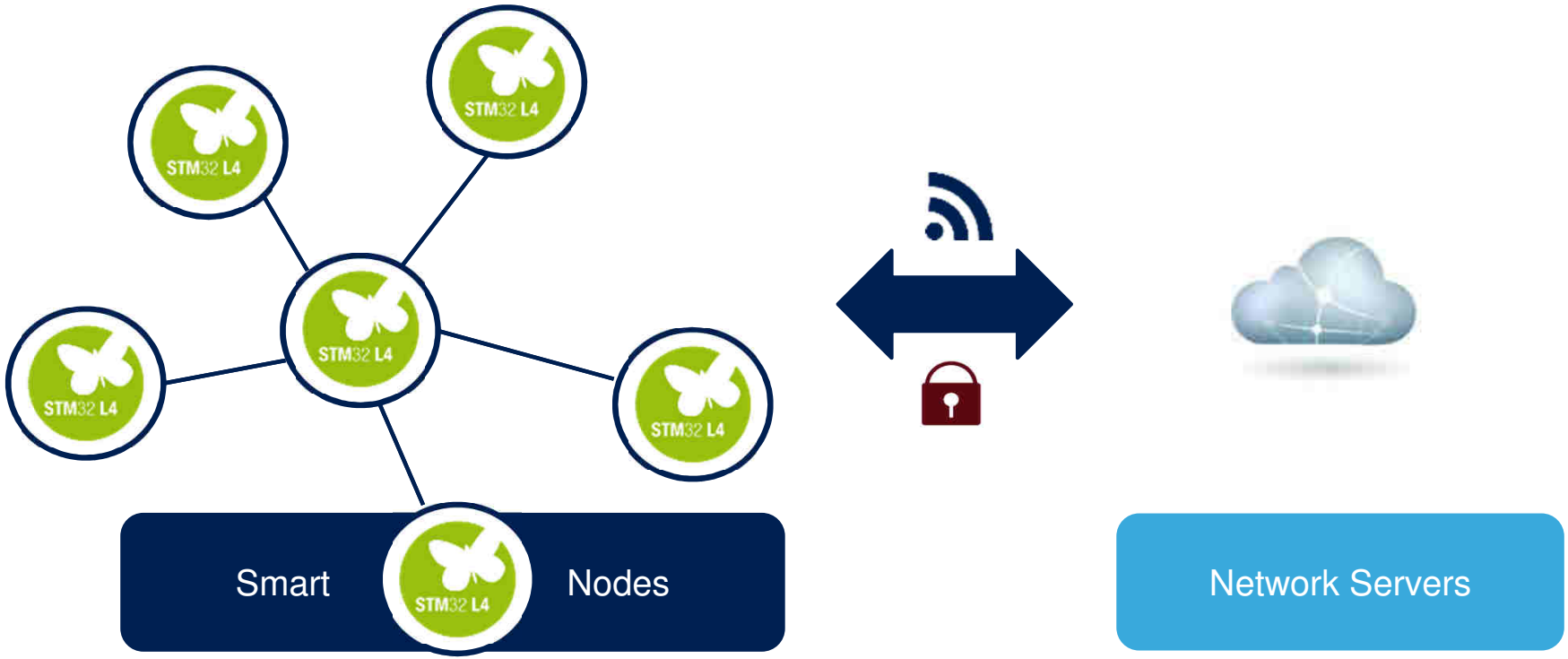
STM32L4 Discovery Kit IoT Node

Get connected seamlessly!



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STM32L4 Discovery Kit IoT Node

Open the door to remote services

- Direct connection to cloud servers
- Low-power long-range communication
- Environmental awareness: humidity, pressure, temp
- Detection hub: motion, proximity, audio

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IoT Discovery Kit

All-in-One IoT Development Platform

- Motion sensors
- Environmental sensors
- MEMS Microphones
- Proximity sensor
- Dynamic NFC Tag
- Low Power MCU
- Sensors Fusion
- Bluetooth Low Energy
- Sub 1GHz
- Wi-Fi

B-L475E-IOT01A

STM32 L4

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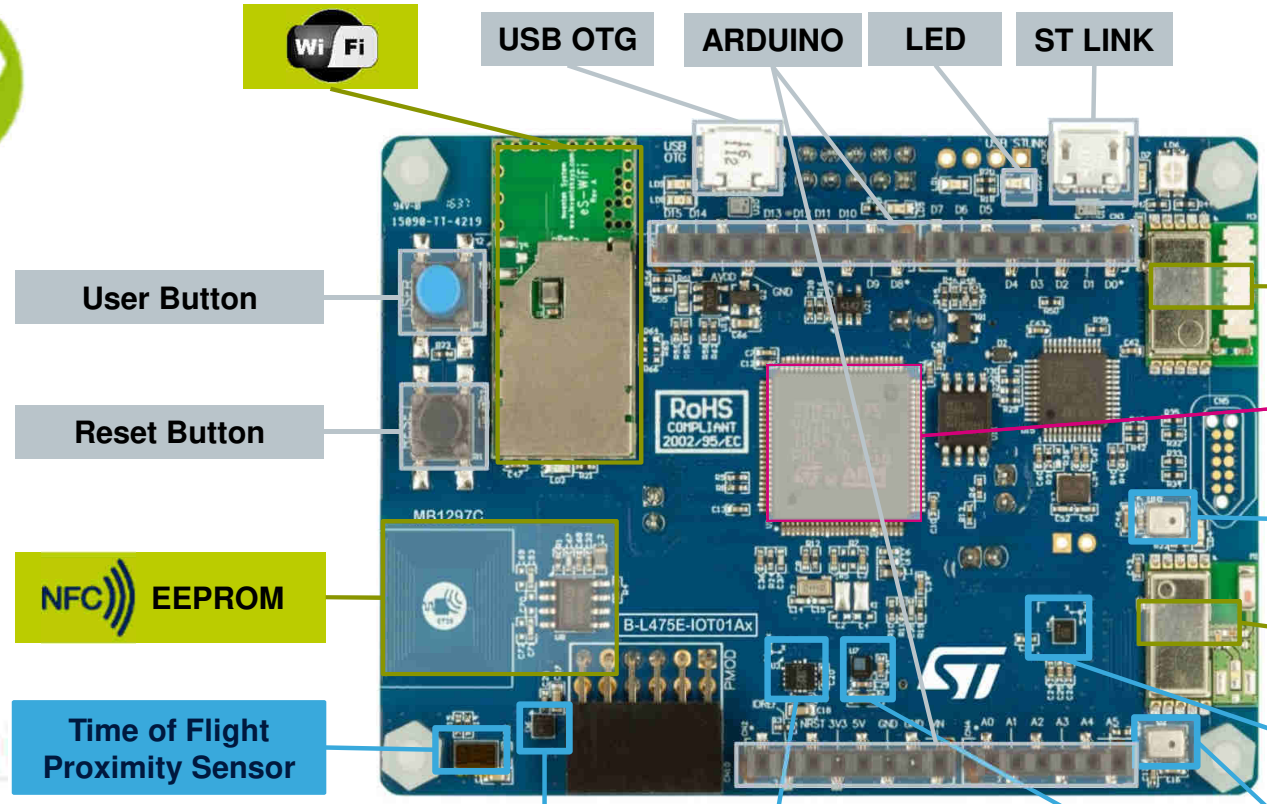
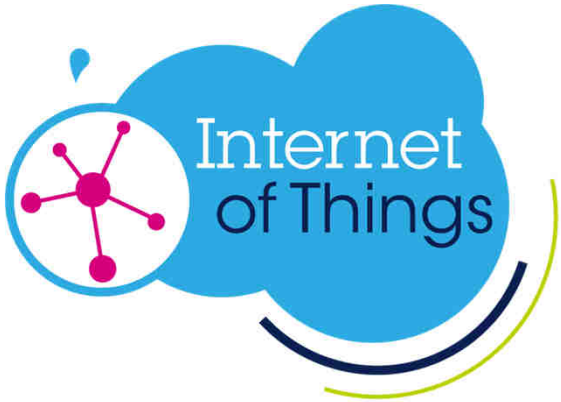
STM32L475 Discovery Kit IoT Node



Cloud Connected IoT Sensor Nodes

- Amazon AWS IoT
  - X-CUBE-AWS
  - FP-CLD-AWS and Web Dashboard
  - Amazon FreeRTOS
- Microsoft Azure IoT
  - FP-CLD-AZURE1
  - STM32ODE IoT Web Dashboard
  - X-CUBE-AZURE
- Google Cloud IoT Platform
  - X-CUBE-GCP
- IBM Watson IoT
  - X-CUBE-WATSON
  - FP-CLD-WATSON1



ST provides device kit and FW packages to connect to the major Cloud providers

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aws

Microsoft

Google

IBM

SensorTile

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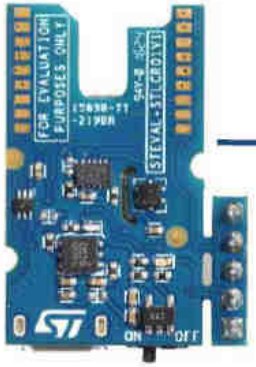
SensorTile Kit

SensorTile
Core System
STLCS01V1

SensorTile
Cradle Board
STLCR01V1



SensorTile
Cradle eXpansion
STLCX01V1

STEVAL-STLKT01V1

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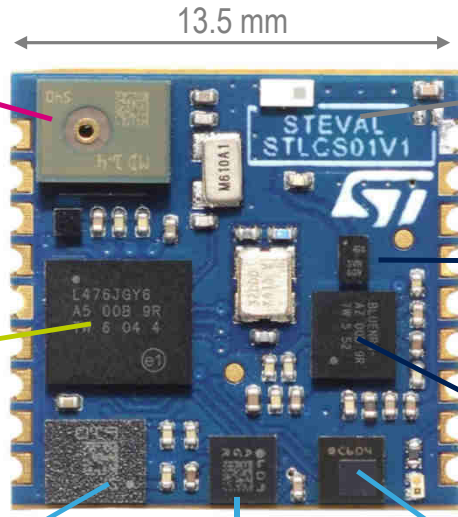
SensorTile

Sensors, MCU, Connectivity

SensorTile Development Kit: STEVAL-STLKT01V1



MEMS Microphone

STM32 L4

STM32
Low power MCU

Accelerometer & Gyroscope
LSM6DSL

Accelerometer + Magnetometer
LSM303AGR

Antenna
Clearance Area

Balun Filter

Bluetooth Low
Energy processor

Barometer
LPS22HB

Bottom View

BlueNRG

Bluetooth SMART

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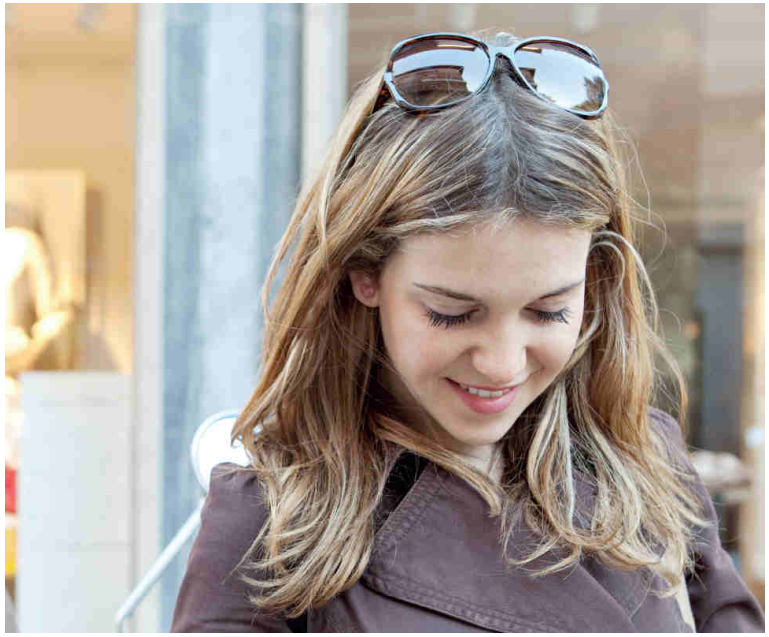
Sense

LSM6DSL / LSM6DSM

High performance 6-axis IMUs



- 3D accelerometer and 3D gyroscope
- “Always-on” experience with <0.7mA
- Smart features: FIFO, Sensor hub, Pedometer, Motion detection etc.

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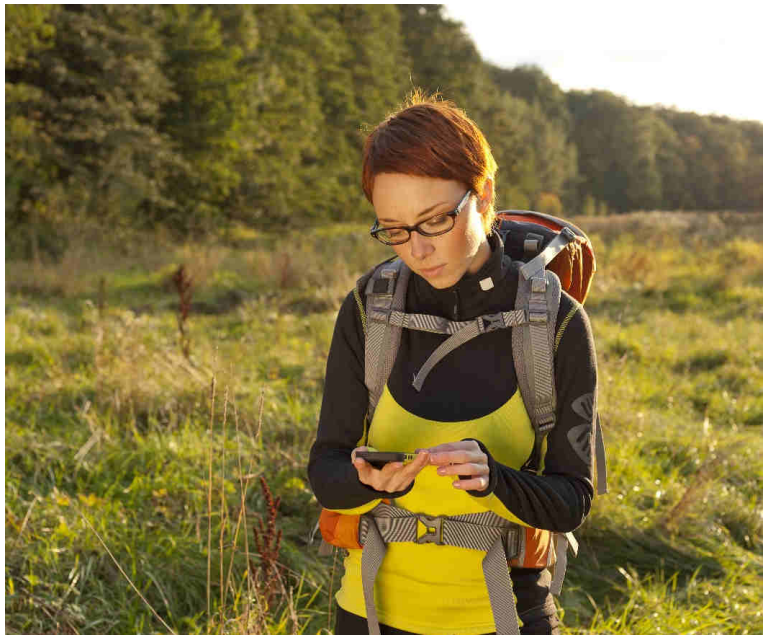
LSM6DSL and LSM6DSM enabling always-on low-power features for an optimal motion experience for the user.
It is a system-in-package featuring 3D accelerometer and 3D gyroscope performing at 0.65 mA in high-performance mode.

Sense

LSM303AGR / LIS2MDL

Ultra-high accurate e-compass / magnetometer



- Extended dynamic range: 50Gauss
- Low power: 200µa @20hz
- Very low noise: 2.5mGauss

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LSM303AGR and LIS2MDL enabling high performance Magnetic field measurement by offering High Full Scale Magnetometer, Flexibility resolution vs. power consumption, Magnetic offset cancellation embedded in a standard pinout 2 x 2 mm package

LPS22HB

High accuracy barometric sensor

- Low noise: down to 20µbar & 7.5µbar (LPF)
- High accuracy: 6cm with OPC
- Reduced current consumption: 12µA (low noise) to 3µA (low power) @1Hz
- High stability vs Temperature: Embedded Quadratic Temperature compensation

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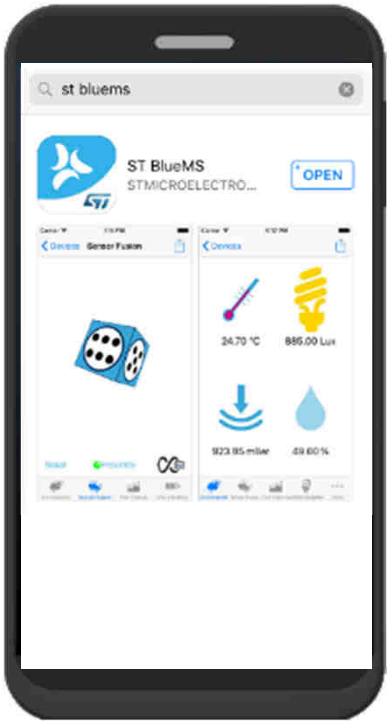
LPS22HB enabling high performance pressure measurement by offering Low noise, High accuracy, Reduced current consumption & High stability vs Temperature in a 2 x 2 x 0.76mm package

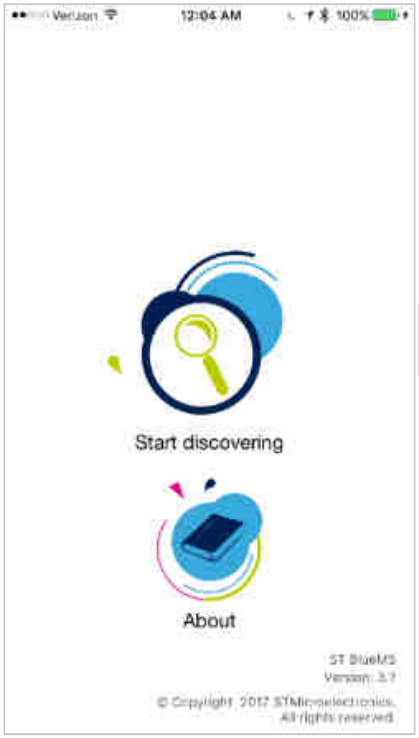
SensorTile & ST BLE Sensor App

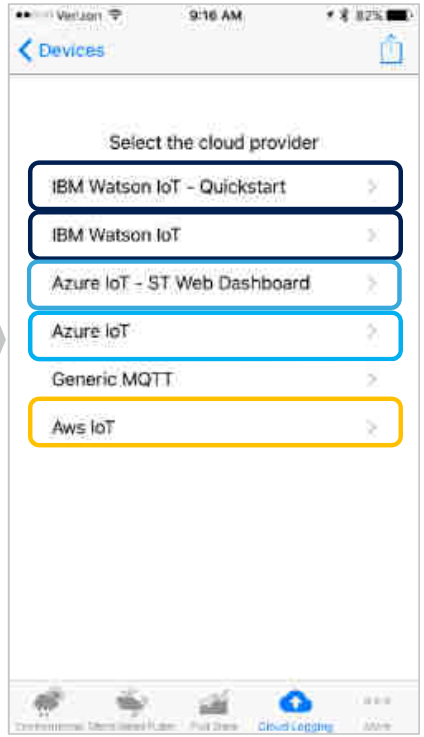


Download on the App Store

GET IT ON Google Play

ST BLE Sensor
(previously ST BlueMS)
STMICROELECTRONICS INC





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BlueNRG-Tile

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BlueNRG-Tile

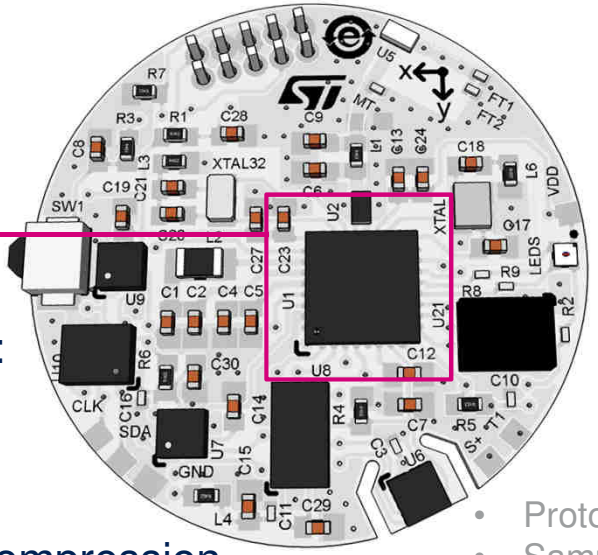
STEVAL-BCN002V1B

BlueNRG

BlueNRG SoC

Sensing, processing and streaming

2.5 cm



Ultra-low-power software libraries for:

Motion Algorithms:

- Gesture and Activity recognition

Voice over BLE:

- High quality voice capturing and compression

BLE Mesh:

- Range-extending networks with duplex communication

- Prototypes available
- Samples in Q3 2018
- Production in Q4 2018

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BlueNRG-Tile

32KHz XTAL to enable ultra-low-power BLE sleep mode

L2 bead to enable low-power BLE active mode

Wake-up button

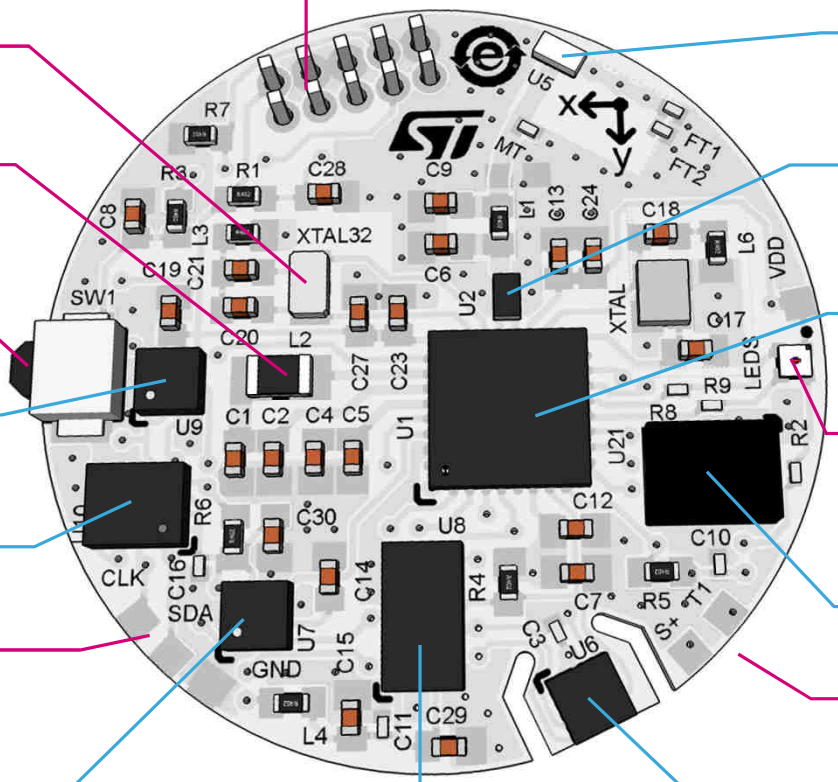
Pressure Sensor
LPS22HH

Accelerometer + Gyroscope
LSM6DSO

I²C for expansion

Magnetometer
LIS2MDL

Debug & Program Interface



High efficiency
Chip Antenna

Balun
BALF-NRG-02D3

Bluetooth Low Energy SoC
BlueNRG-232

RGB LED

Microphone
MP34DT05-A

CR2032 battery holder (Bottom)

Humidity + Temperature
HTS221

Time of Flight
VL53L1X

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BlueNRG-2 and MEMS Sensors

Ready-to-go Software Libraries for Voice and Motion

Mic

VOICE CAPTURE

Voice over BLE

High quality voice capturing and compression (ADPCM)
More codec supported through external host
(Speex, Opus, …)

Sensors

MOTION CAPTURE

Motion Algorithms

Lightweight 6 or 9 axis sensor fusion (up to 50Hz ODR)
and gesture recognition algorithms

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STM32 Nucleo Expansion

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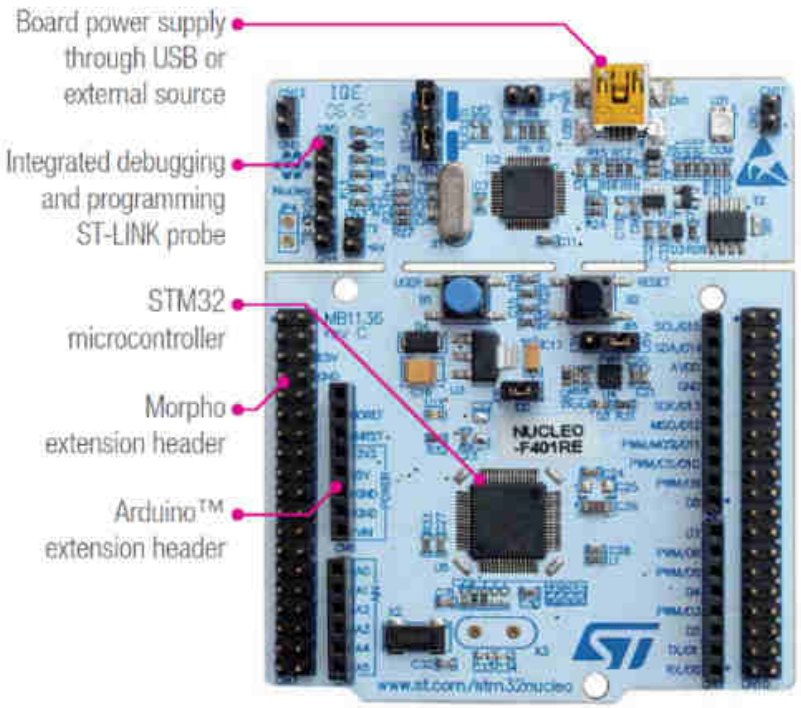
STM32 Nucleo Development Boards

27 development boards and growing… in two flavors (Processing & Security)



STM32 Nucleo

STM32 complete product range
from ultra-low power to high performance

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

STM32 L0 STM32 L1 STM32 L4 STM32 H7

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STM32 Nucleo Expansion Boards

38 expansion boards and growing… covering all the key functions

Sense (5)	Connect (10)	Power Drive (3)	Move Actuate (16)	Translate (4)
Motion & environmental sensors	BLE	Power management	Motor drive	Audio amplifier
Proximity sensor	Sub-GHz	LED boost	Actuator	OpAmp
Microphone	NFC			

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An Application-Oriented Approach

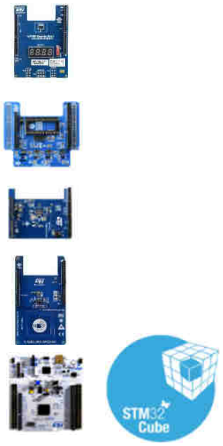
Your need

- Sensors
- Connectivity
- Translate
- Motor drivers
- Power
- Processing

The building blocks

Processor boards (Nucleo 64)
Expansion boards (X-NUCLEO)

- Motion
- Environmental
- Bluetooth LE
- Sub-1GHz
- NFC
- Op Amp
- Motor controller
- Power manager
- Microcontroller



Our answer

Function Packs (FP)

Application software and development tools

Integrated Development Environment and middleware

Ready-to-use application-oriented package

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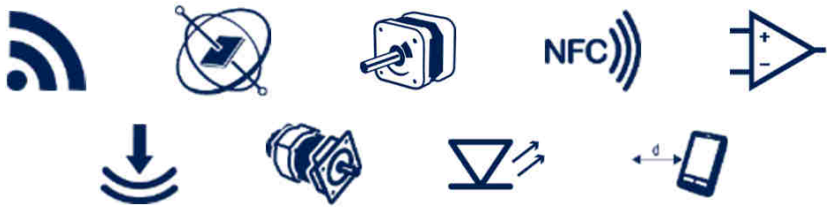
All the Software Needed

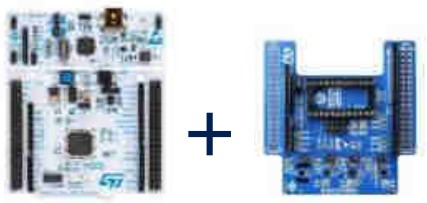
to Start Application Coding from Day One

STM32Cube Expansion SW

- Prototype with a single expansion board

Sample applications

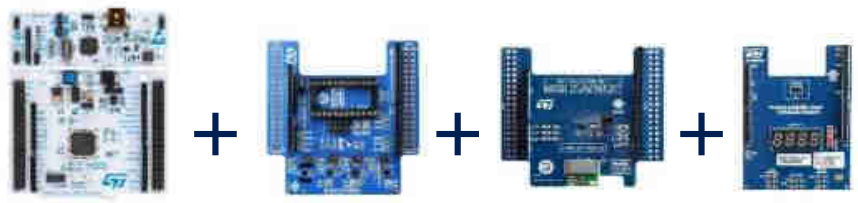




STM32 ODE Function Pack

- Create advanced use cases based on multiple expansion boards

Pre-integrated application example



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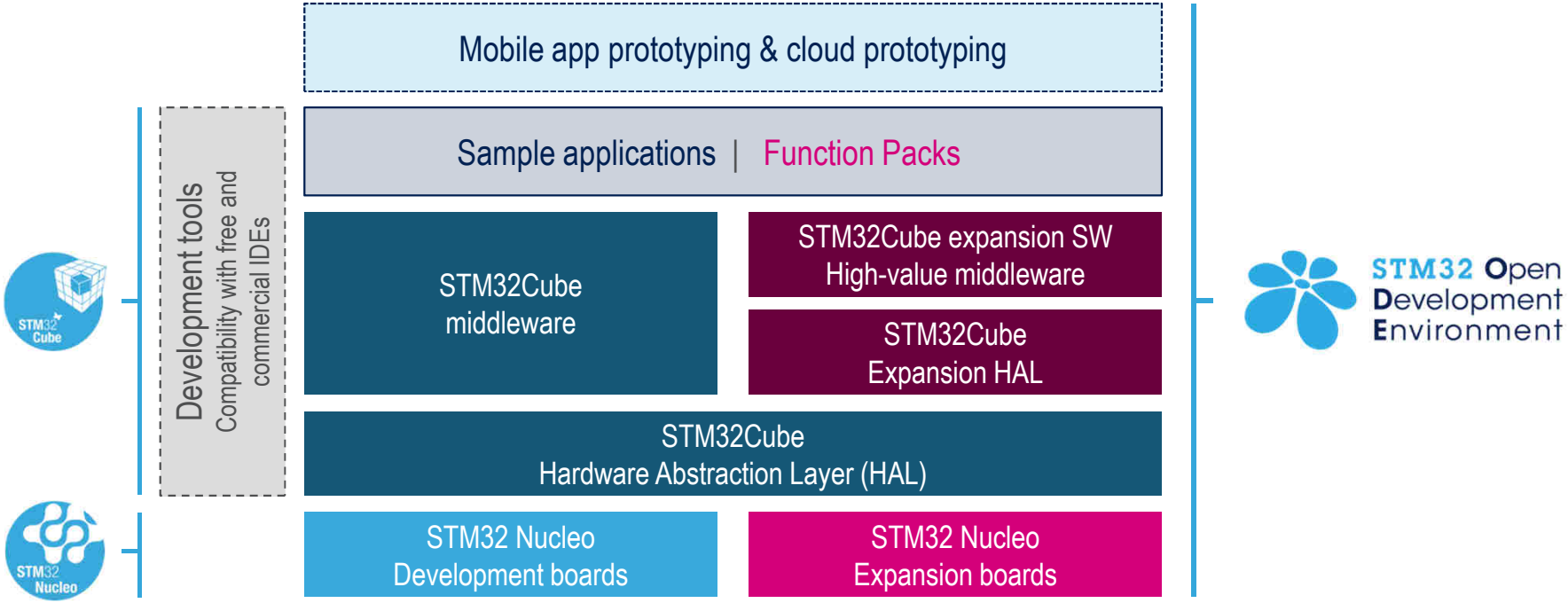
Development Software Architecture



X-NUCLEO-IKS01A2

Motion MEMS and environmental sensor expansion board for STM32 Nucleo

- It is compatible with the Arduino UNO R3 connector layout

Key products on board:

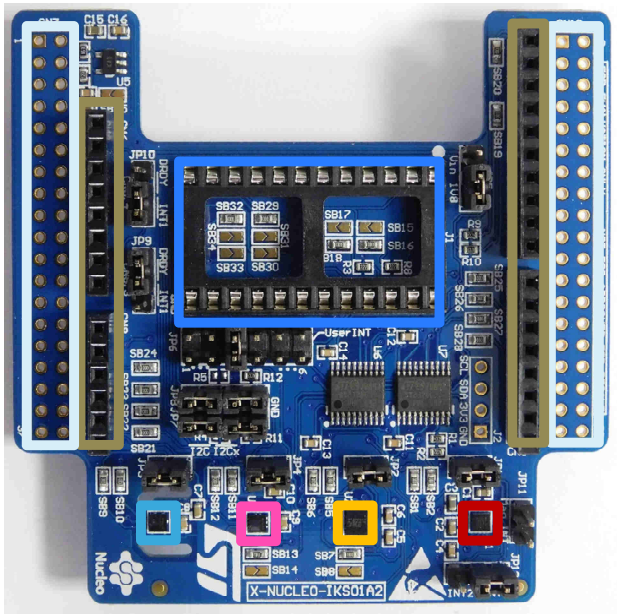
LSM6DSL: MEMS 3D accelerometer (±2/±4/±8/±16 g) + 3D gyroscope (±245/±500/±2000 dps)

LSM303AGR: MEMS 3D magnetometer (±50 gauss) + 3D accelerometer (±2/±4/±8 g /±16 g)

LPS22HB: MEMS pressure sensor, 260-1260 hPa absolute digital output barometer

HTS221: Capacitive digital relative humidity and temperature

DIL 24-pin: Socket available for additional MEMS adapters and other sensors



HTS221 LSM6DSL ST Morpho connector**
LPS22HB LSM303AGR Arduino UNO R3 connector
DIL 24-pin

** Connector for the STM32 Nucleo Board

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Info available at
X-NUCLEO-IKS01A2

Graphical User Interface

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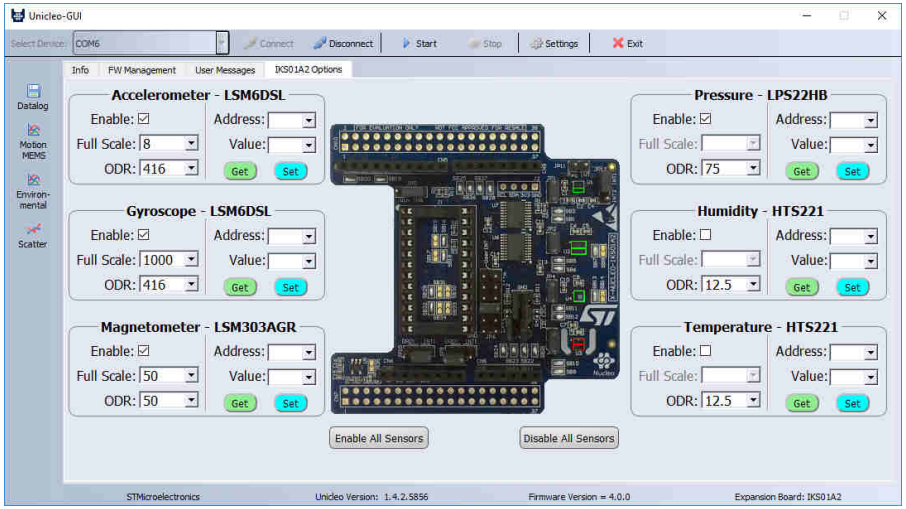
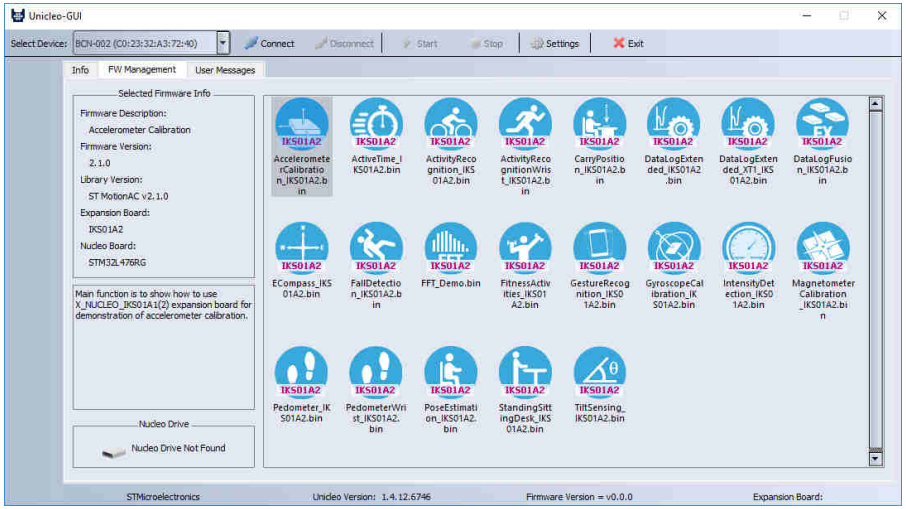
Unicleo-GUI

X-CUBE-MEMS1

Key features:

- Display output data from connected sensors in various views (**X-NUCLEO-IKS01A1**, **X-NUCLEO-IKS01A2**)
- Display outputs from algorithms
- Save data to comma separated (CSV) or tab separated (TSV) files
- Configure sensor output data rate and full scale
- Direct read from and writes to sensor registers
- Program NUCLEO board with selected FW
- Available also for Sensor Tile & Blue Tile





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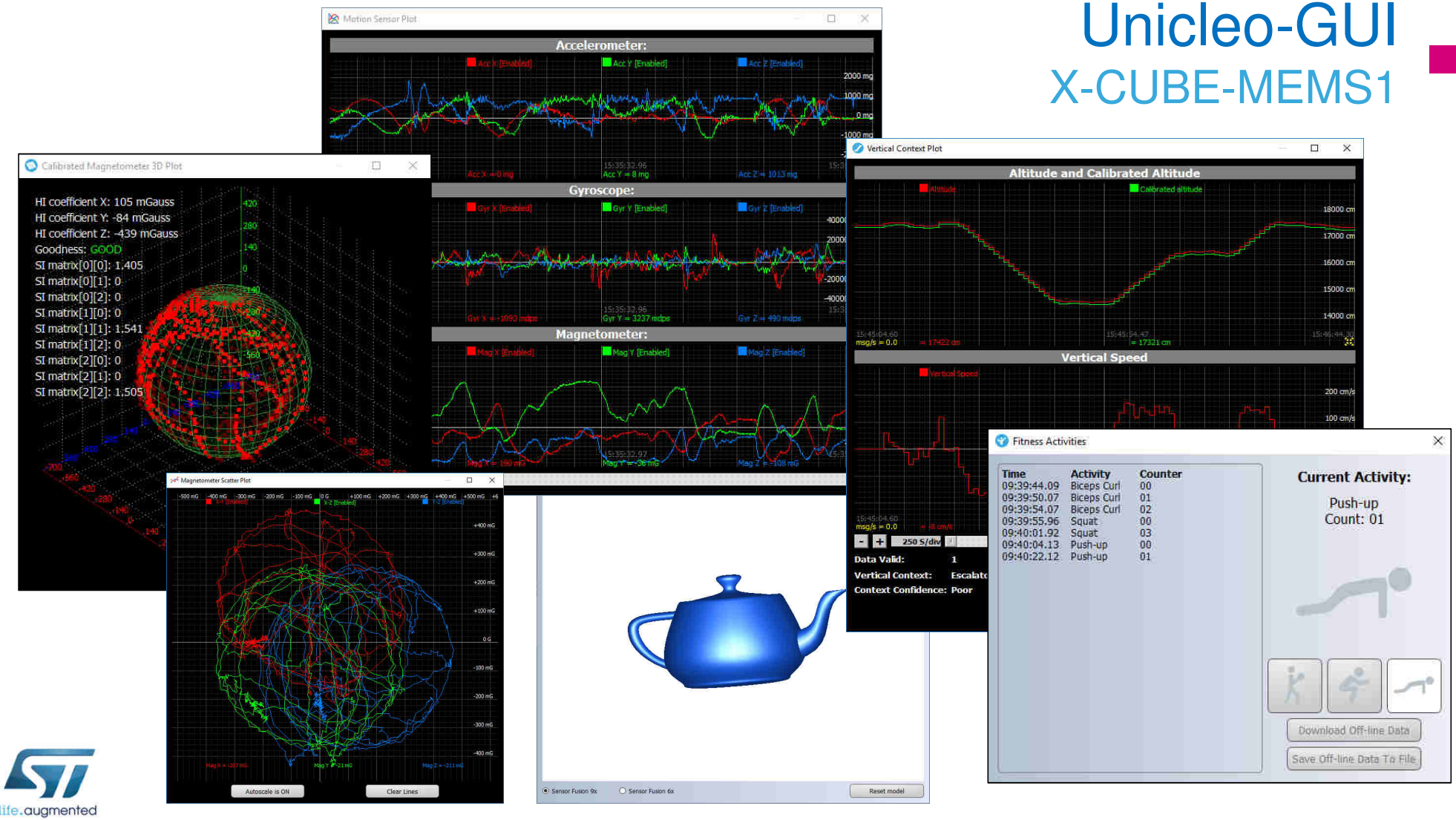
Unicleo-GUI

X-CUBE-MEMS1



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Vibration monitoring tools

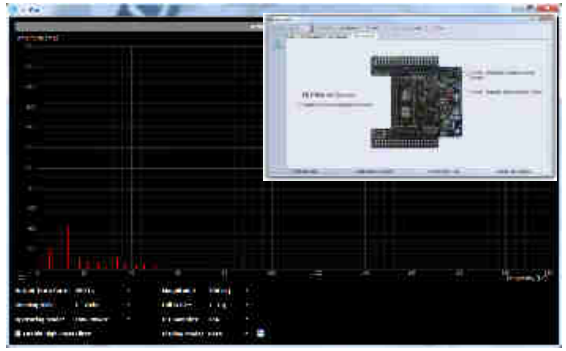
- Hardware

STM32 Nucleo + X-NUCLEO-IKS01A2

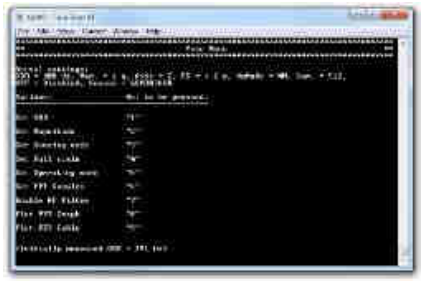
(optional DIL24 adapter)

- Software
  - X-CUBE-MEMS-XT1 package
    - MotionSP middleware – including both time and frequency analysis
    - FFT Demo example

- Windows application: Unicleo-GUI



- Serial terminal



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Tilt measurement tools

- Hardware

STM32 Nucleo + X-NUCLEO-IKS01A2

(optional DIL24 adapter)

- Software
  - X-CUBE-MEMS-1 package
    - MotionTL middleware – including both tilt calculation and 6-point calibration

- Unicleo-GUI
  - Tilt calculation

  - 6-point accelerometer calibration

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Sensor fusion tools

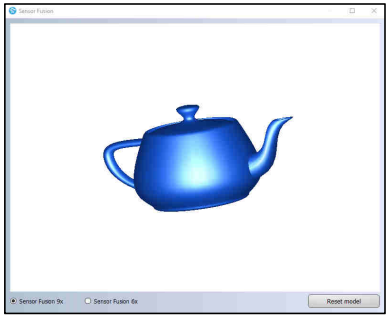
- Hardware

STM32 Nucleo + X-NUCLEO-IKS01A2

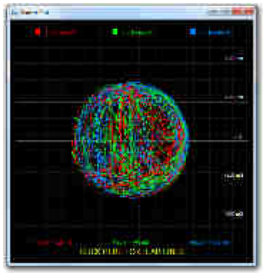
(optional DIL24 adapter)

- Software
  - X-CUBE-MEMS-1 package
    - MotionFX middleware – 6 / 9 axis sensor fusion and gyroscope and magnetometer calibration

- Unicleo-GUI
  - Orientation in 3D space



  - Magnetometer calibration



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X-CUBE-MEMS1

Ready-to-go Software Libraries for Voice and Motion

Calibration Algorithms


Magnetometer Calibration


Gyroscope Calibration


Accelerometer Calibration

Position Tracking

Sensor Fusion

eCompass

Tilt Sensing

Activity Tracking for Mobile Devices


Activity Recognition


Carry Position


Gesture Recognition


Pedometer


Fall Detection

Activity Tracking for Wrist Devices


Activity Recognition for Wrist


Pose Estimation


Motion Intensity Detection


Standing vs Sitting Desk Detection


Fitness Activities


Active Time


Pedometer


Sleep Monitoring

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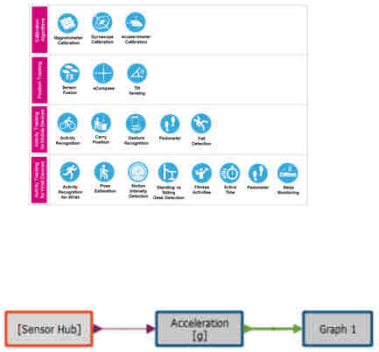
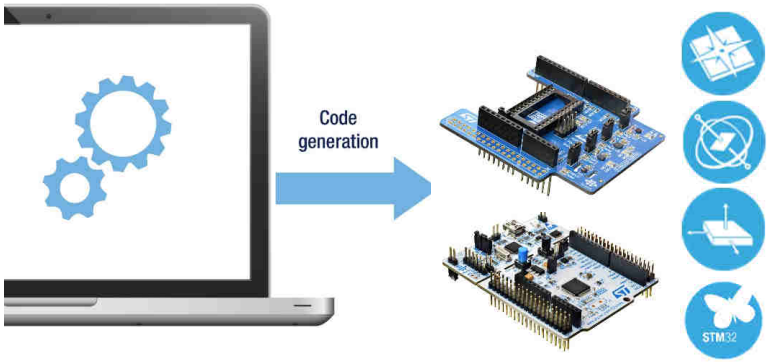
Web Page

AlgoBuilder

An application for the graphical design and testing of algorithms



Existing algorithms
User-defined data processing blocks
Additional functionalities



GUI quickly elaborates proto applications
for
MEMS sensors
and
STM32 microcontrollers

AlgoBuilder
eases the process of
implementing
proof of concept
without writing the code

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Web Page

Professional MEMS tool

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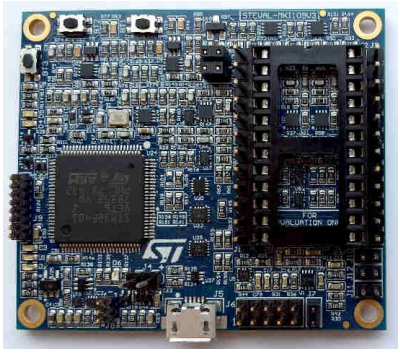
STEVAL-MKI109V3

Professional MEMS tool

- Professional MEMS tool (STEVAL-MKI109V3) motherboard is a complete, ready-to-use platform for the evaluation of STMicroelectronics MEMS products.
- It includes a high-performance 32-bit microcontroller which functions as a bridge between the sensors and a PC, on which you can download and run the graphical user interface (GUI) Unico or dedicated software routines for customized applications



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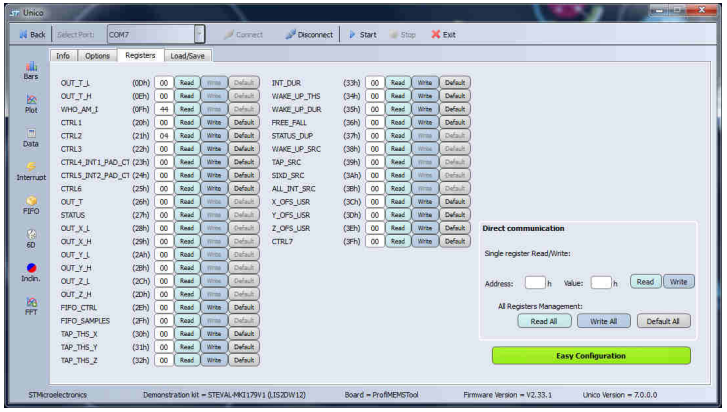
DIL 24 adapter

Professional MEMS tool (STEVAL-MKI109V3)



Unico – GUI for Windows PC (STSW-MKI109W)

Part Number	Manufacturer	Description
STEVAL-MKI105V1	ST	LIS3DH adapter board for standard DIL 24 socket
STEVAL-MKI106V1		LSM303DLHC adapter board designed to be plugged into a standard DIL24 socket
STEVAL-MKI107V2		L3GD20 adapter board for a standard DIL 24 socket
STEVAL-MKI122V1		LSM330DLC adapter board for standard DIL24 socket
STEVAL-MKI135V1	ST	LIS2DH adapter board for standard DIL24 socket
STEVAL-MKI137V1	ST	LIS3MDL adapter board for standard DIL24 socket
STEVAL-MKI159V1	ST	LSM9DS1 adapter board for standard DIL24 socket
STEVAL-MKI160V1	ST	LSM6DS3 adapter board for standard DIL24 socket
STEVAL-MKI161V1	ST	LSM6DS0 adapter board for standard DIL24 socket
STEVAL-MKI163V1	ST	LSM303C adapter board for standard DIL24 socket
STEVAL-MKI164V1	ST	LIS2HH12 adapter board for a standard DIL24 socket
STEVAL-MKI165V1	ST	LPS25HB adapter board for a standard DIL 24 socket
STEVAL-MKI172V1	ST	LSM303AGR adapter board for a standard DIL 24 socket
STEVAL-MKI173V1	ST	LSM303AH adapter board for standard DIL24 socket
STEVAL-MKI174V1	ST	LIS2DS12 adapter board for standard DIL24 socket
STEVAL-MKI186V1	ST	IIS3DHHC adapter board for a standard DIL 24 socket
STEVAL-MKI188V1	ST	L20G20IS adapter board for a standard DIL 24 socket
STEVAL-MKI192V1	ST	LPS22HH adapter board for a standard DIL24 socket

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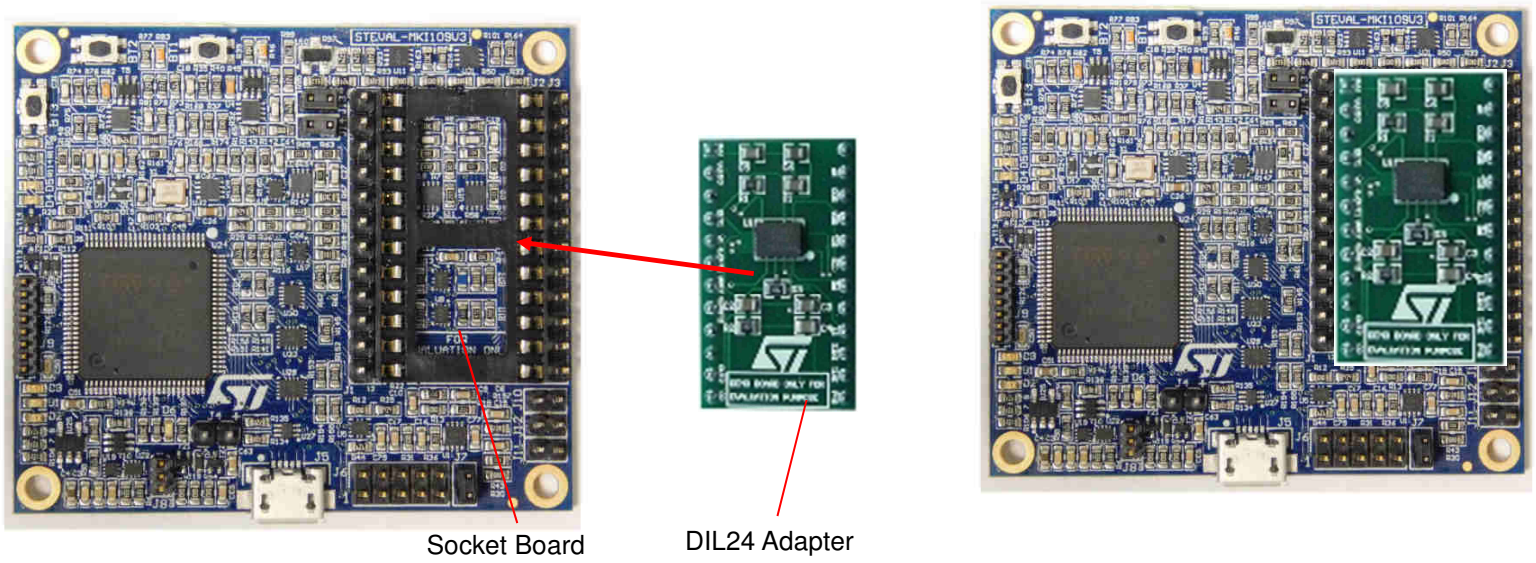
Info available at
STEVAL-MKI109V3
STSW-MKI109W

Professional MEMS Tools – DIL24 Adapter



All ST MEMS sensors are available with DIL24 adapter support
The DIL24 Adapter can be placed on socket board

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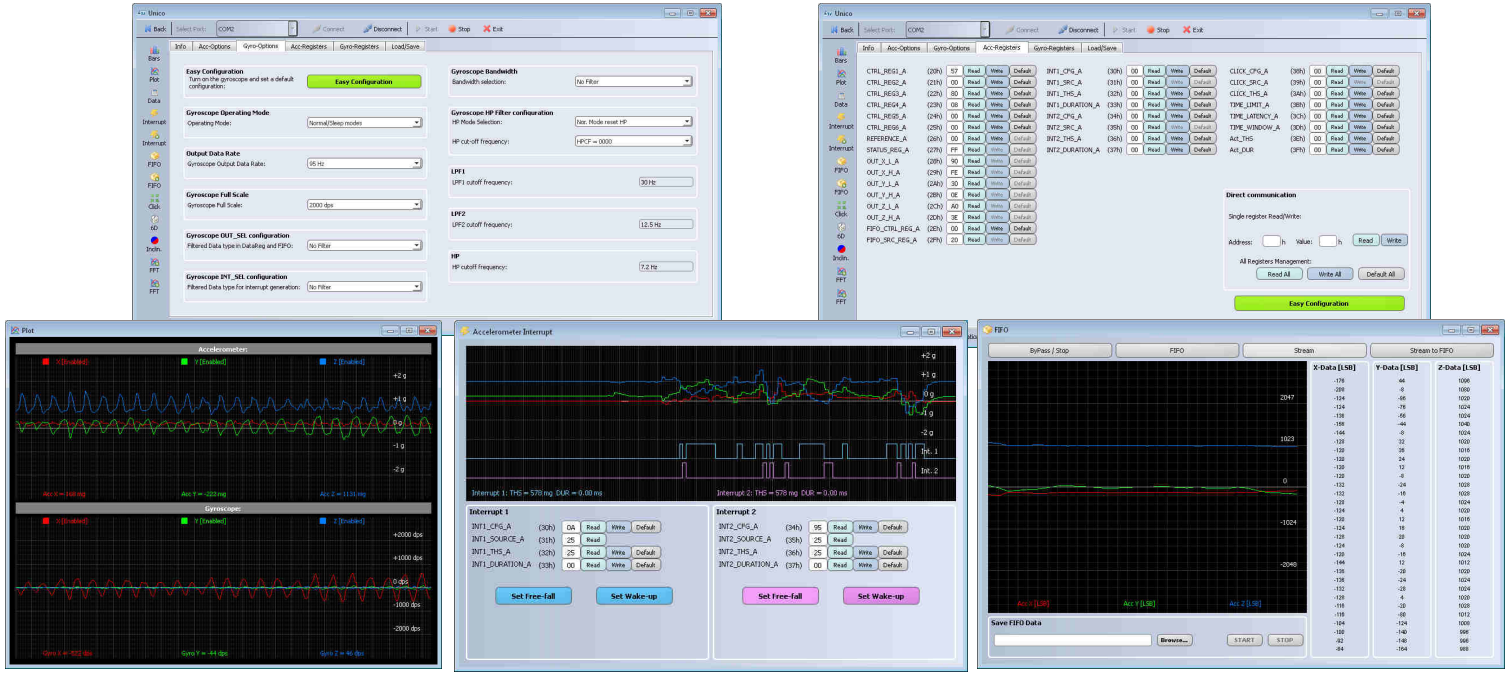
Professional MEMS Tool – UNICO GUI SW

Profi MEMS Tool connected with UNICO SW:

The STM32F401VE uses the STM32 microcontroller as a bridge between the sensor under test mounted on socket and the PC by USB cable.

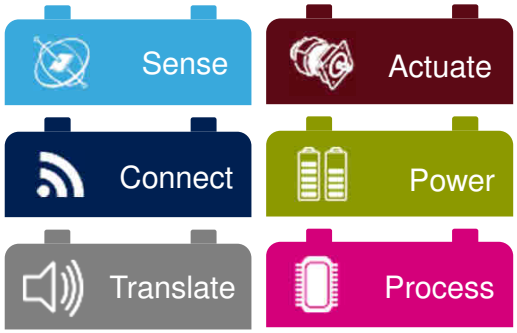
It Is possible to use the UNICO graphical user interface (GUI) or dedicated software routines for customized applications (Virtual Com Command Line Interface) to read/write all sensor registers, plot the data, manage FIFO, set and show interrupts, set easy configuration, etc.



Takeaways

ST Augmenting the Development

Hardware bricks



Software bricks

- Application Examples
- Middleware Libraries
- Board Support Package
- Hardware Abstraction Layer
- Various Dev. Environment

Cloud services

Microsoft Azure

amazon web services™

IBM Watson

Google Cloud

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ST's Solutions

INTEGRATION

Common SW platform

3 Cloud provider SDKs supported, enabling sensor-to-cloud platforms

135 SW packages from drivers to full application examples and mobile applications

STM32 Cube

STM32 Open Development Environment

Wearable | IoT Smart Things | Smart Home | Building automation

Modular hardware

27 STM32 Nucleo development boards
Covering the broad portfolio of STM32 MCU families

40 STM32 Nucleo expansion boards (X-NUCLEO)
Offering peripheral functions

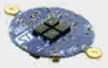
STM32 Nucleo

Form factor boards

ST & 3rd-party form-factor boards

NFC Sensor TAG

SensiBLE



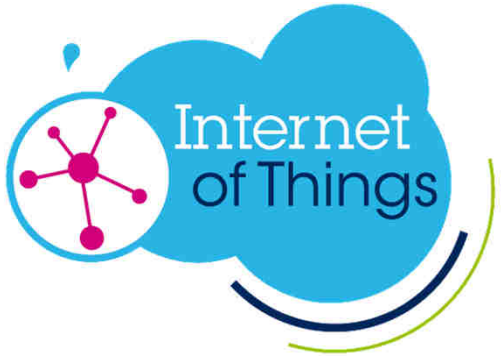
Bluecoin

IoT Discovery

Sensor Tile

Summary

- Internet of Things offers many opportunities for ST from Sensor to Cloud
- ST offers a wide range of development platforms such as:
  - IoT Discovery Kit
  - SensorTile Development Kit
  - BlueNRG-Tile: Bluetooth LE-enabled sensor node development kit
  - STM32 Nucleo Expansion boards
  - Professional MEMS tool: ST MEMS adapter motherboard
- Our constantly expanding development ecosystem makes design fast



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Thank You!

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