Introduzione al Progetto TALENTIS

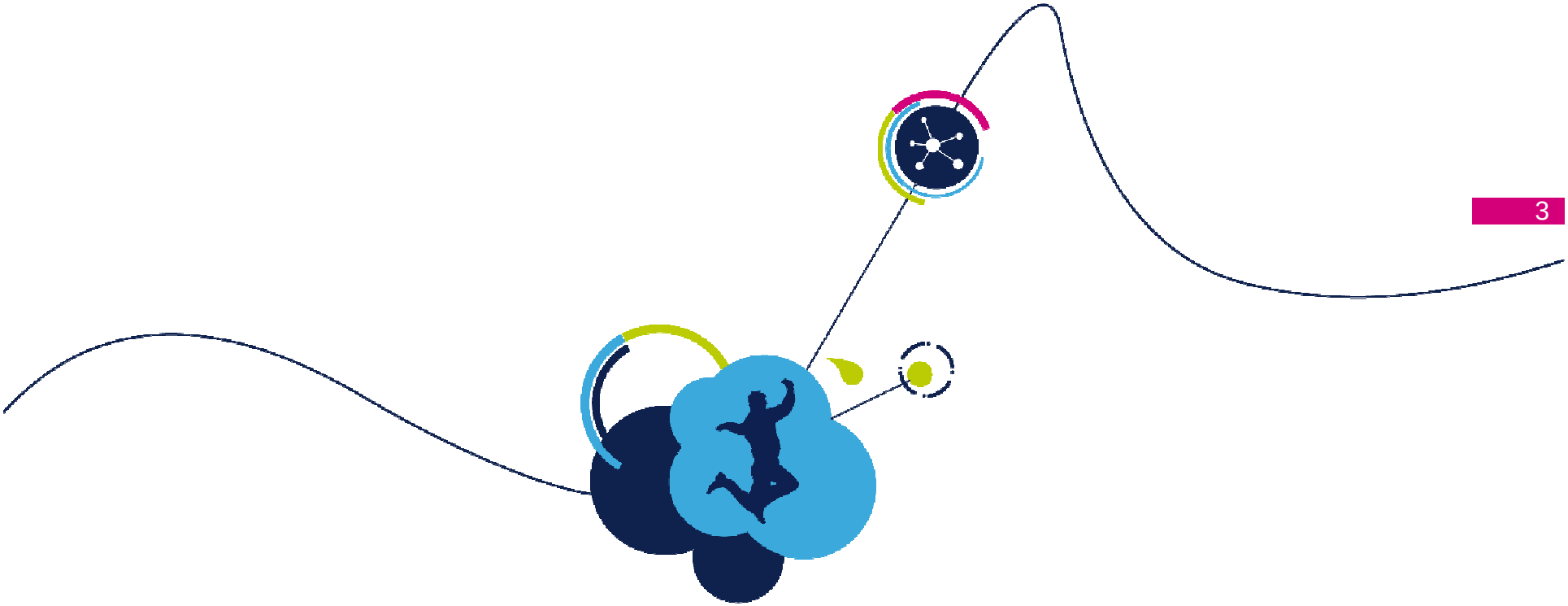
Releasing your creativity

life.augmented

Catania, 27 Marzo 2018

Agenda

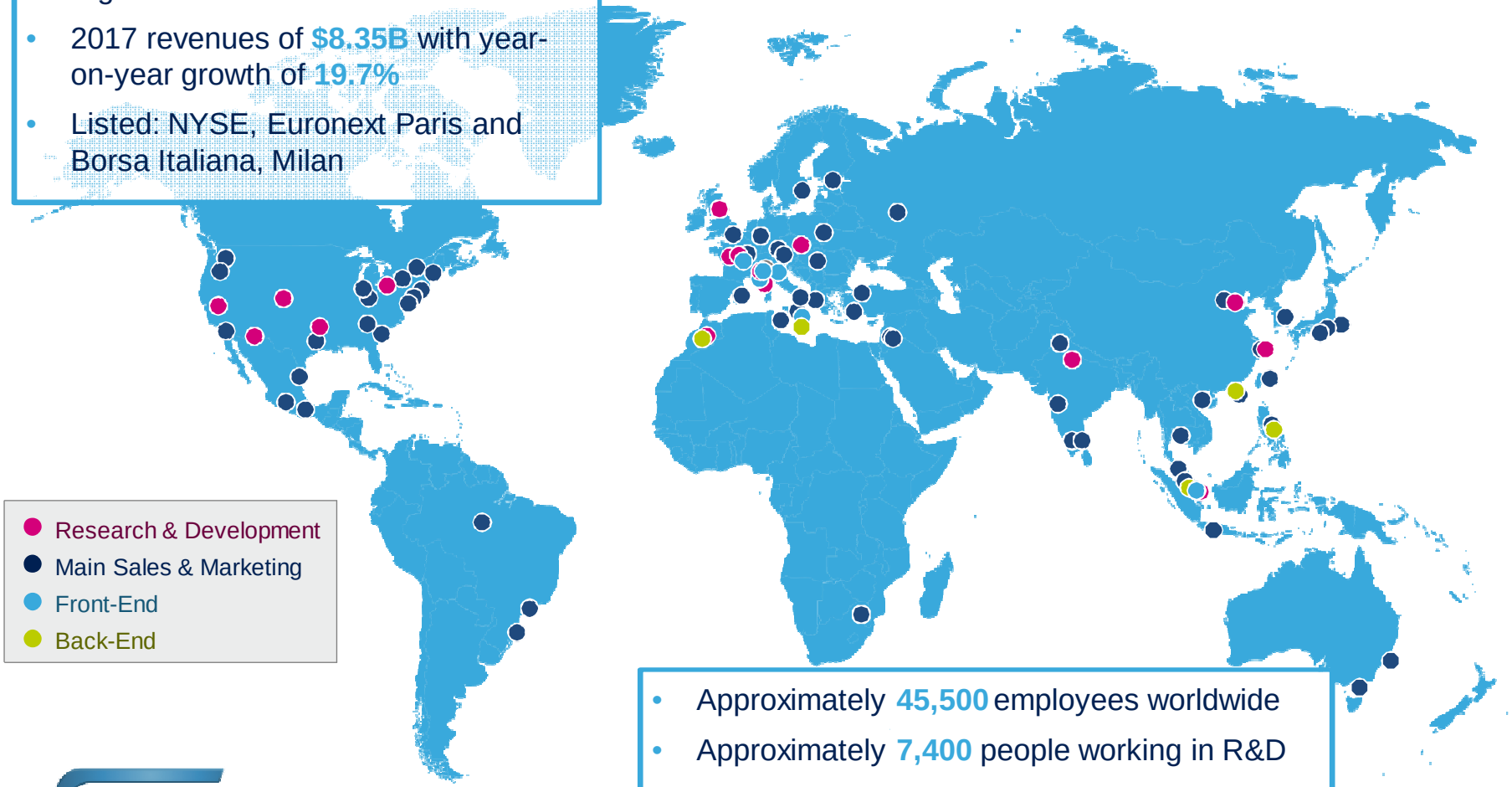
- STMicroelectronics Company Overview
- STM32 Microcontroller
  - STM32 Portfolio
  - STM32 Ecosystem
- ST Portfolio behind STM32...
  - Sensors
  - Microphones
  - Connectivity
  - Motor Control
- STM32 Open Development Environment
- Proposal for Projects
- Questions and Answers



Company Presentation

Who We Are

- A global semiconductor leader
- 2017 revenues of **$8.35B** with year-on-year growth of **19.7%**
- Listed: NYSE, Euronext Paris and Borsa Italiana, Milan



- Approximately **45,500** employees worldwide
- Approximately **7,400** people working in R&D
- **11** manufacturing sites
- Over **80** sales & marketing offices

As of December 31, 2017

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Where You Find Us

Making **driving** safer, greener and more connected

Making **homes** smarter, for better living, higher security, and less waste

Making everyday **things** smarter, connected and more aware of their surroundings

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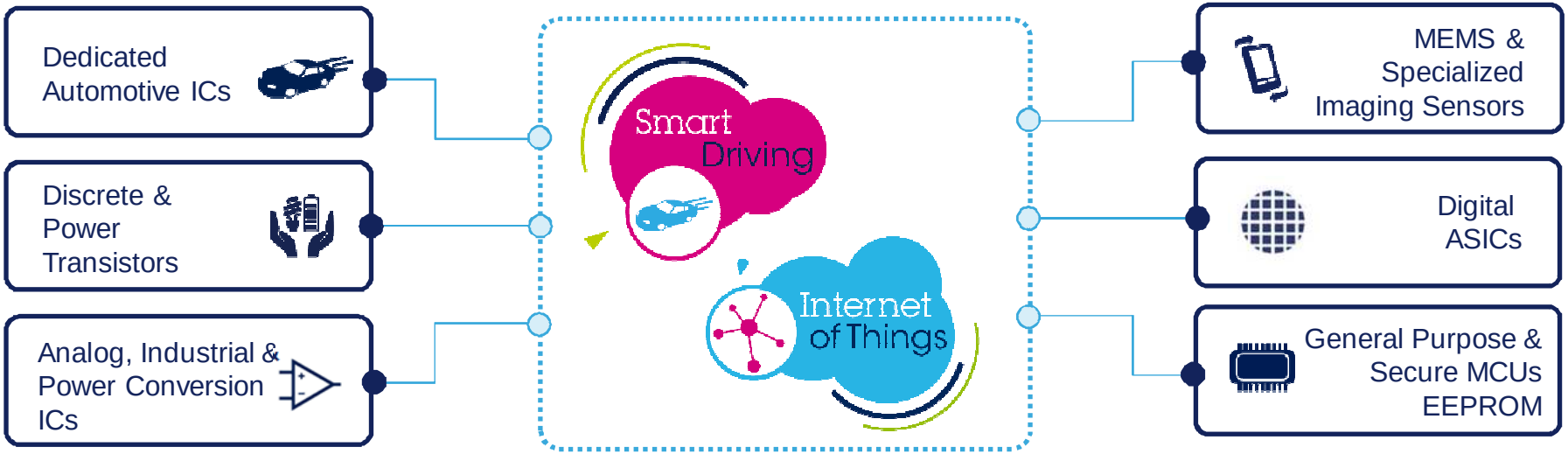
Enabling the evolution of **industry** towards smarter, safer and more efficient factories and workplaces

Enabling **cities** to make more of available resources

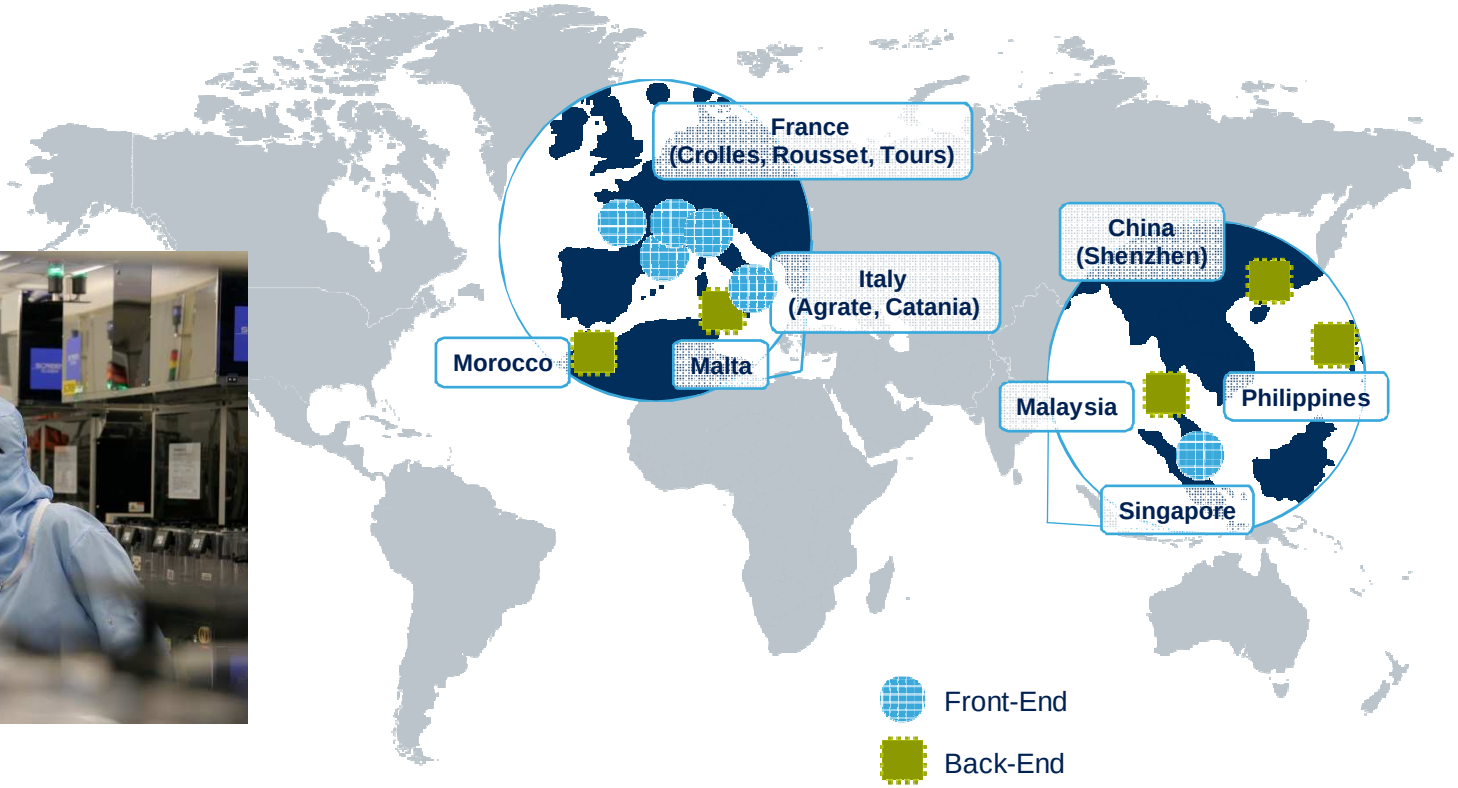
Product Family Focus

The leading provider of products and solutions
for Smart Driving and the Internet of Things

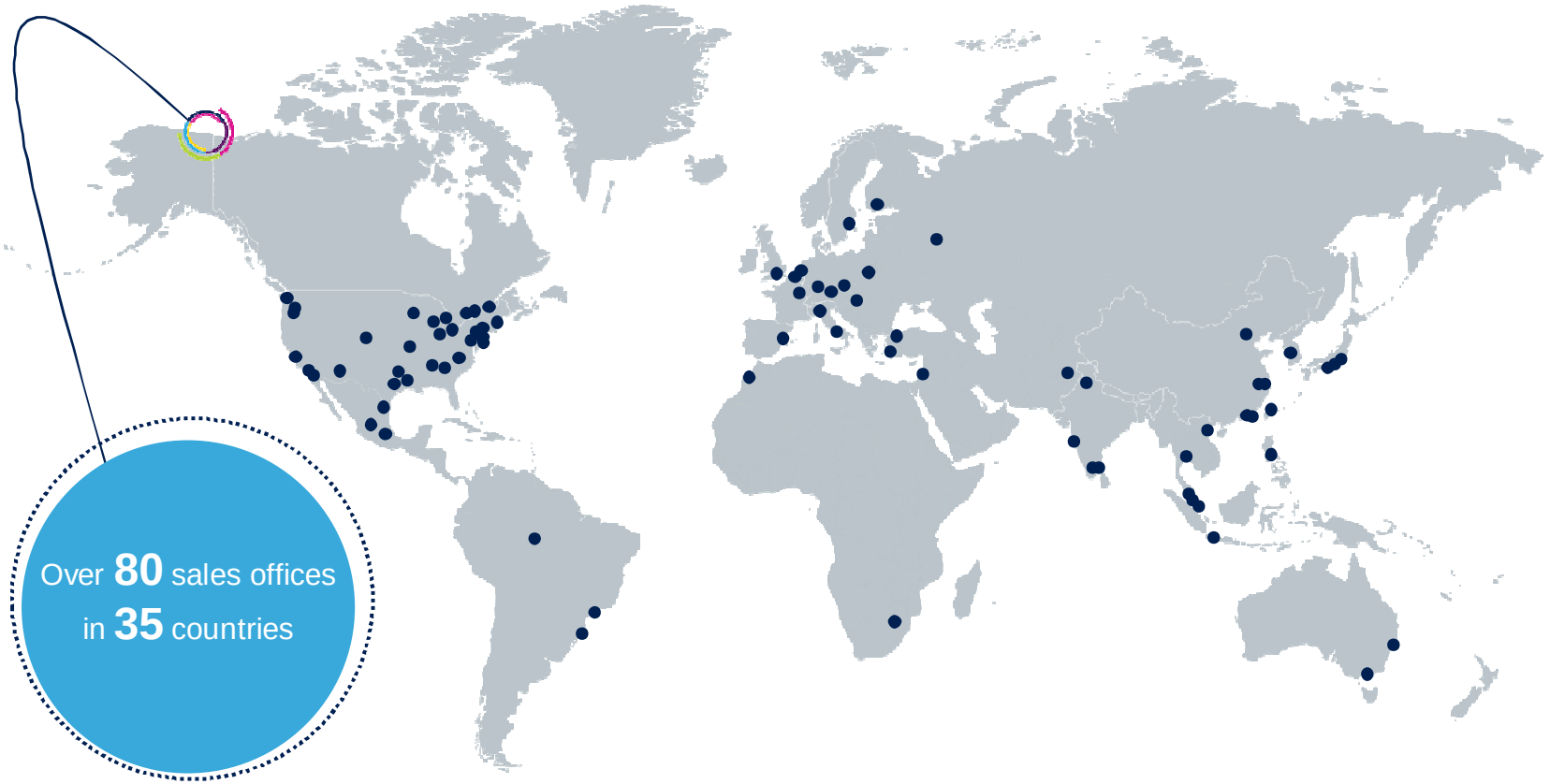


Portfolio delivering complementarity for target end markets, and synergies in R&D and manufacturing

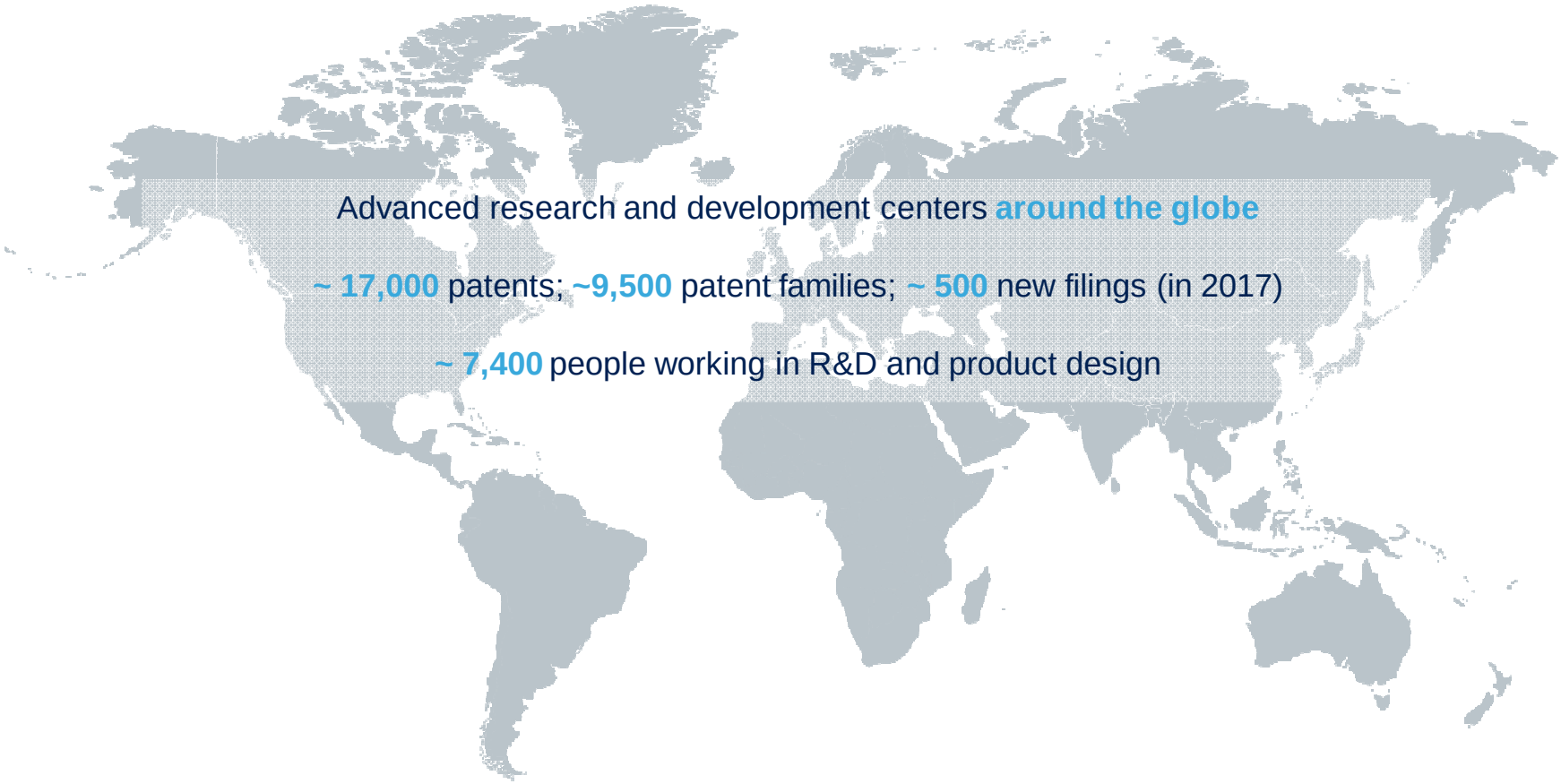
Flexible & Independent Manufacturing



Partners with Our Customers Worldwide



An Unwavering Commitment to R&D



Advanced research and development centers **around the globe**

~ 17,000 patents; **~9,500** patent families; **~ 500** new filings (in 2017)

~ 7,400 people working in R&D and product design

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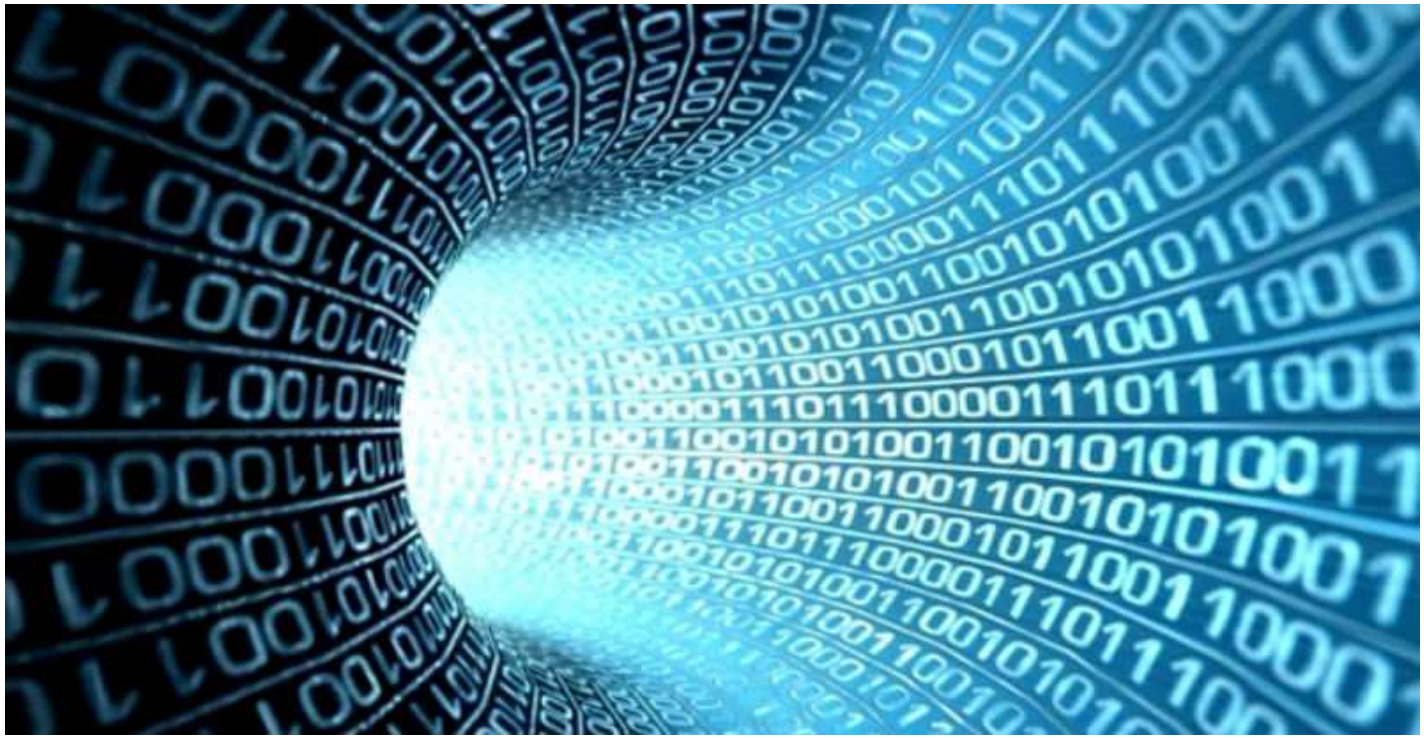
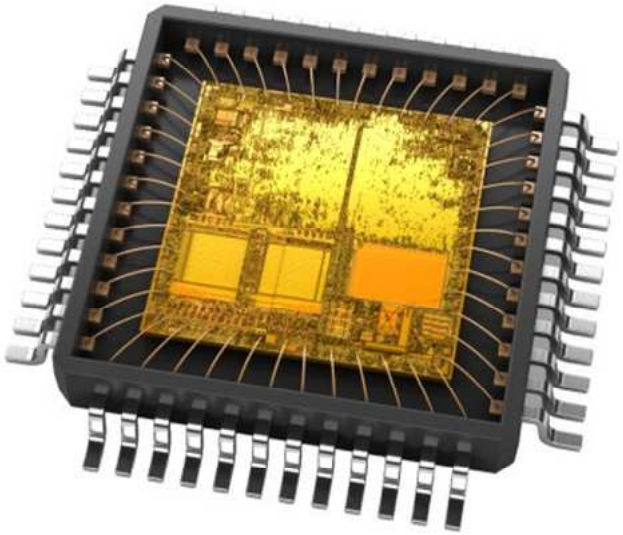
As of December 31, 2017

The world Today



Washing machines, Eletric curtains, Door lock, Gaz Meter… rely on a MICROCONTROLLER

Microcontrollers



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STM32 ?

STM32 introduced in 2007

What are the reasons for STM32 success?

Computing History

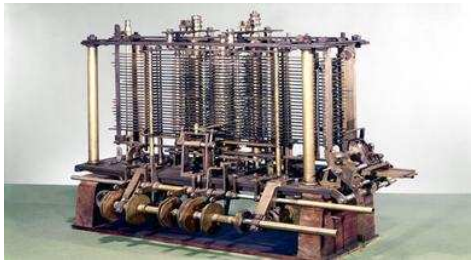
17s Century

Blaise Pascal (1623-1662)
Machine de Marguerite Périer

Musée Henri-Lecoq, Clermont-Ferrand

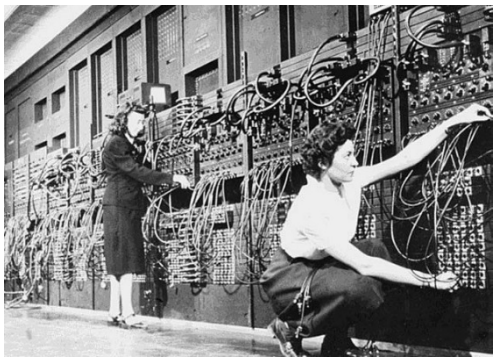
Calculator

19s Century



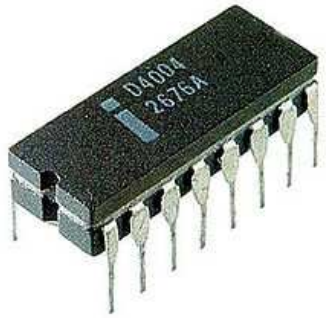
Analitycal engine

194x



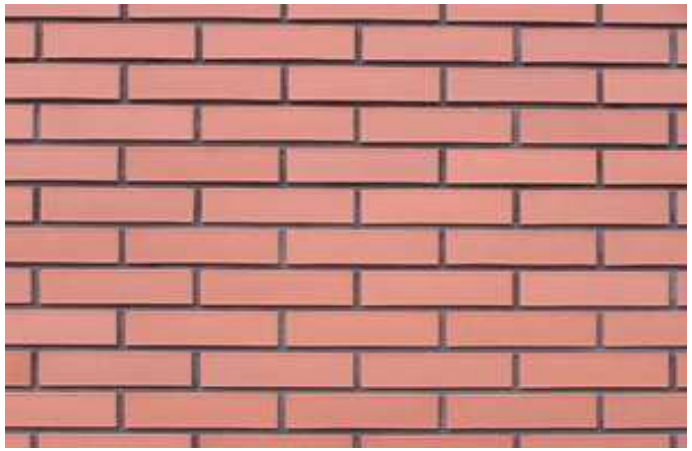
Computer

1971

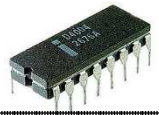


Microprocessor

A Standard is born!



1971



2007

X86 architecture dominating the PC

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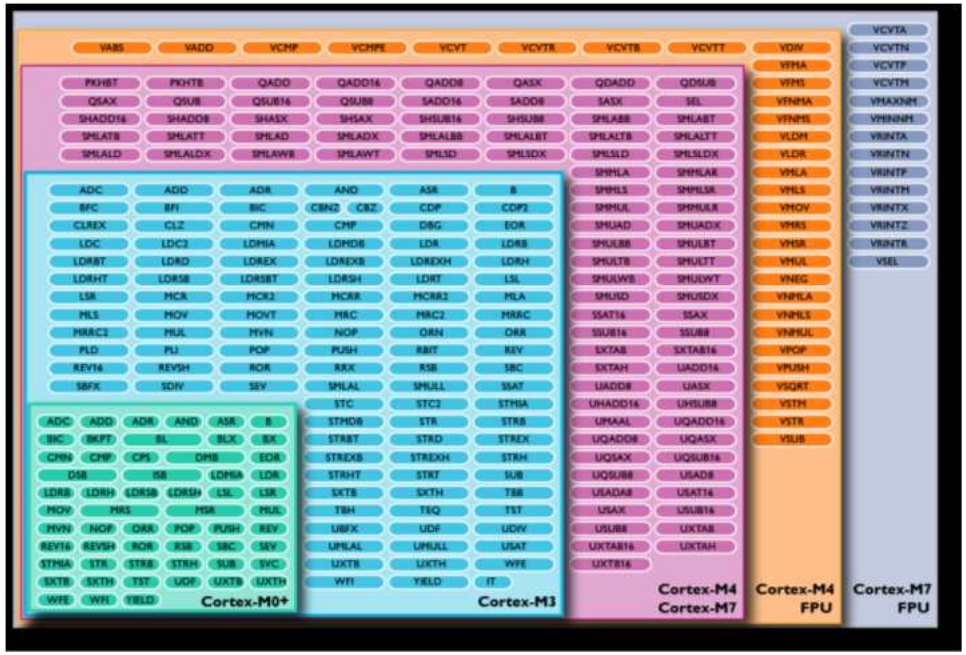
STM32 are based on Cortex®-M cores

ARM CORTEX
Processor Technology



Binary and tool compatible

STM32 portfolio is growing fast

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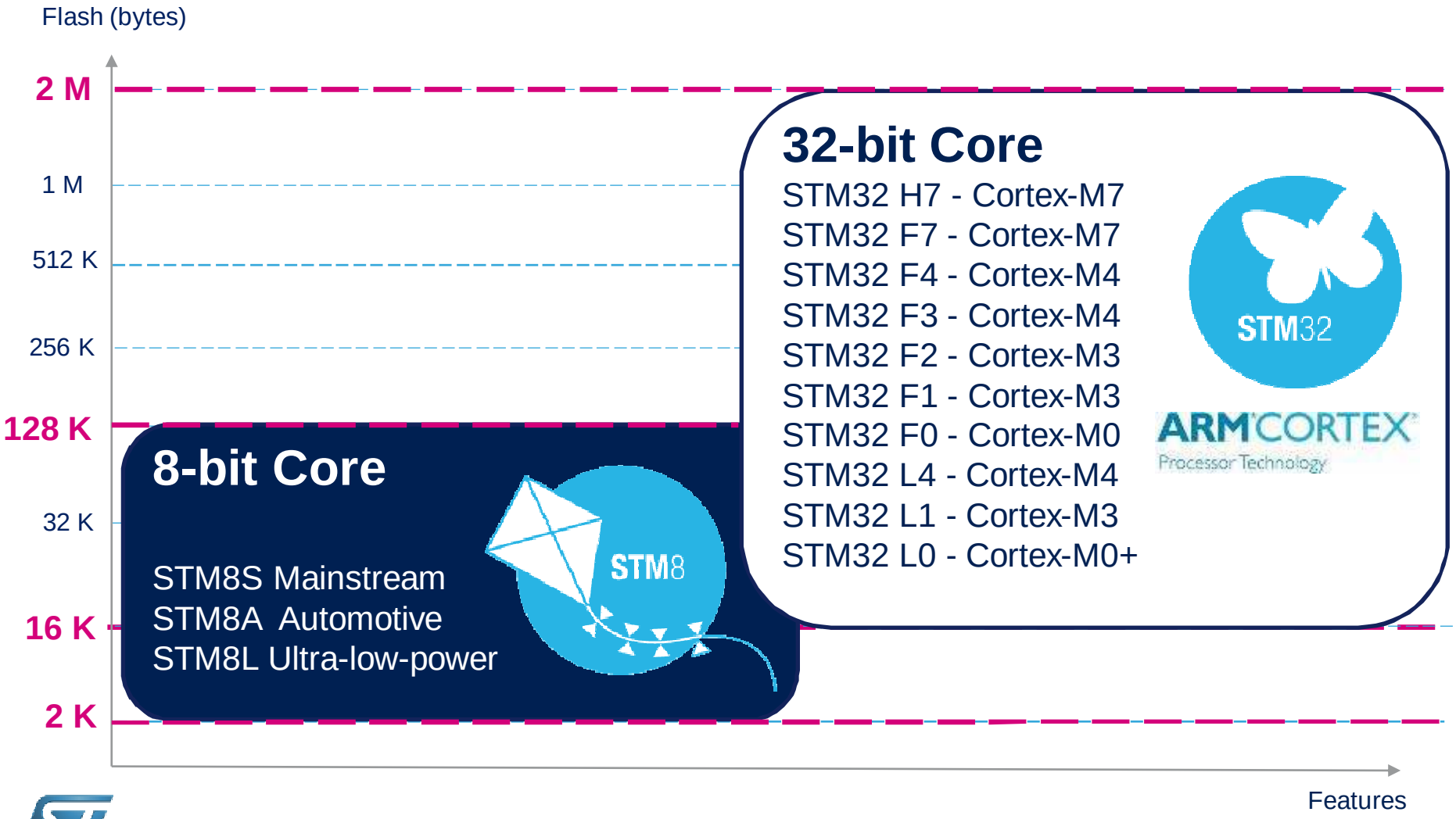
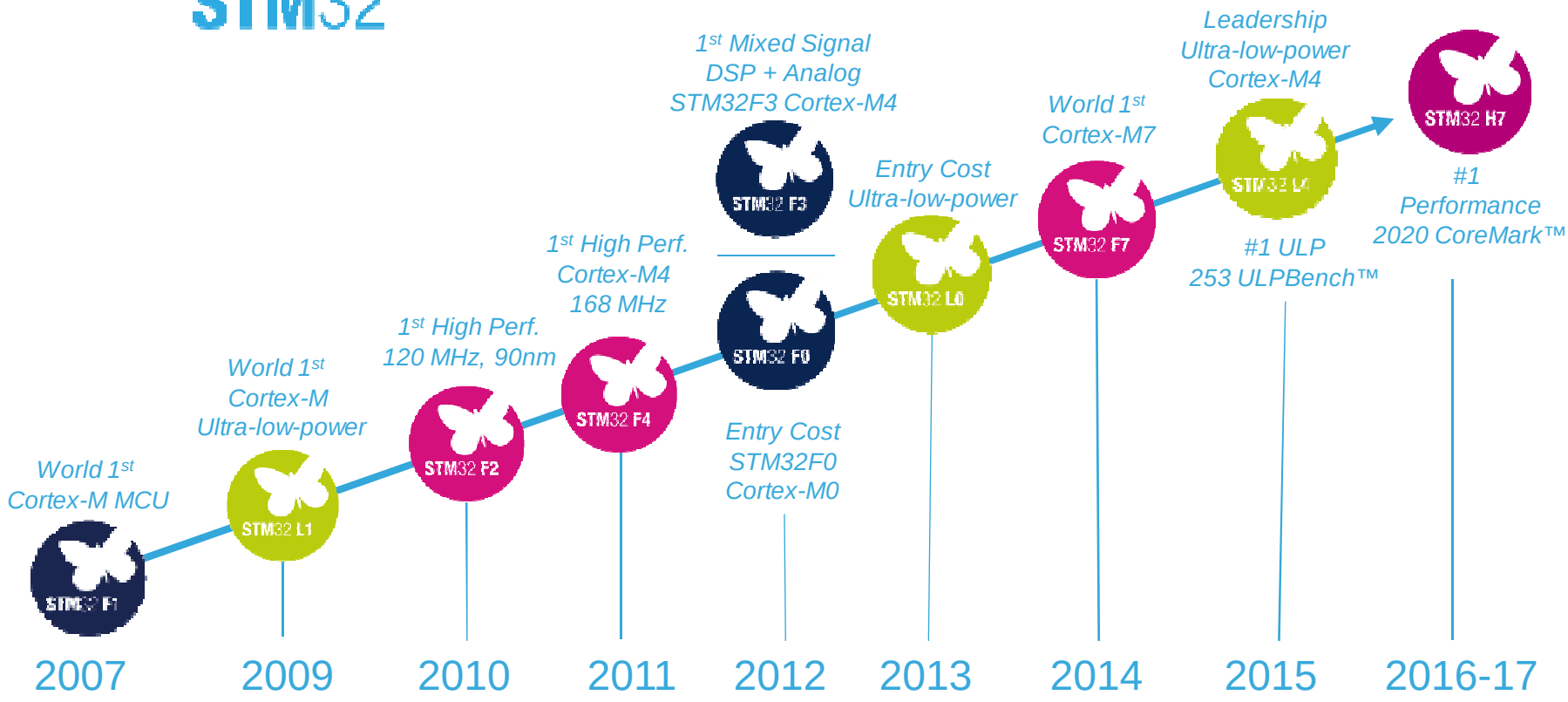
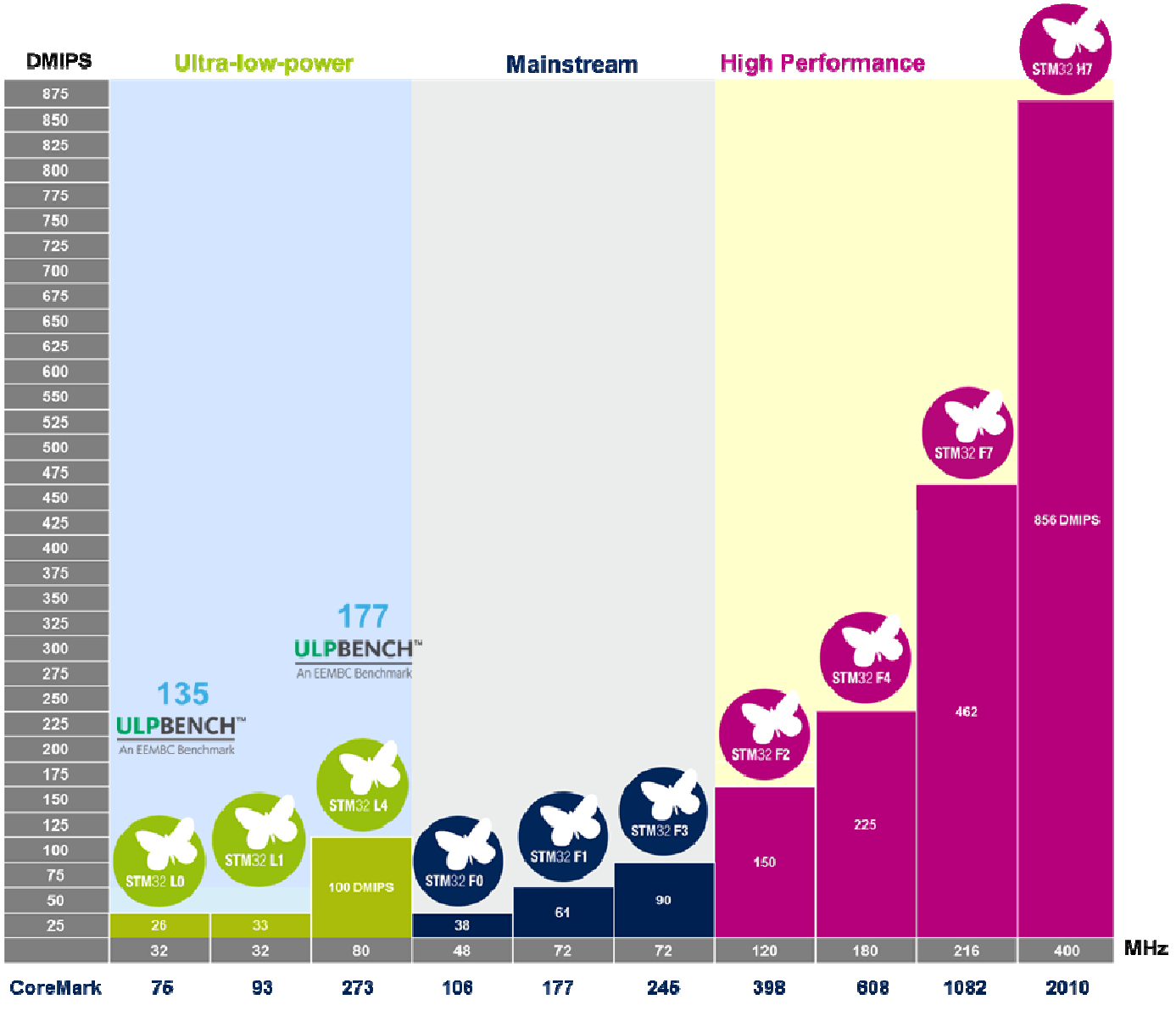
MCUs portfolio



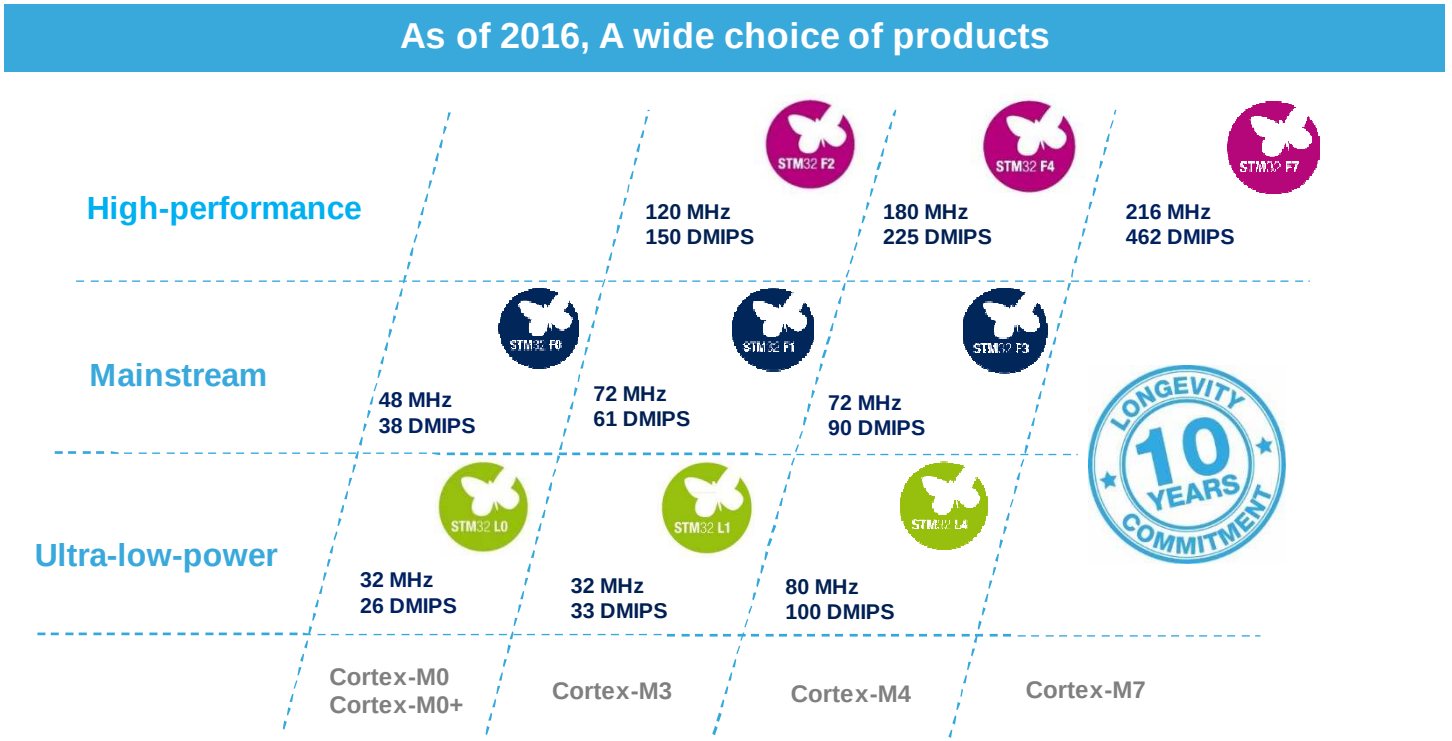
Key Milestones to Remember



Broadest 32-bit MCU product portfolio



STM32 portfolio : Rich , Affordable , Structured



STM32H7x3 – Block diagram

High integration, high performance with large memory size, 3 x power domains and compatible with the STM32F7 (non-DSI) on common packages

Cortex-M7
400 MHz
DP-FPU
MPU
ETM
2x16KB Cache

Master DMA, 2 x DMA and BDMA

Security

Crypto/Hash(*) TRNG, anti tamper, ROP, PC-ROP, Security services(**)

Debug

ETF, DAP

Amb.Temp. range
- ***-40 + 85C (standard)***

Embedded memories

Up to 2-Mbyte Flash Dual Bank

Up to 864KB byte RAM

4KB Bckup RAM

4KB Debug RAM

192KB RAM TCM

Analog

3 x 16-bit ADC,
2 x comparators, 2 x op amp
1 x temperature sensor

Timers

22 timers including:
2 x 32-bit advanced timers
5 x 16-bit LP timers
1 x High Res. TIM
12 x 16-bit TIM
2 x W/D

Memory Interfaces

FMC (SDRAM, NOR, NAND)

Q-SPI

2xSD/SDIO/MMC

Display/Graphic

TFT LCD Controller

Chrom-ART Accelerator™

JPEG codec

Audio

4xSAI, DFSDM (8 ch./4filters), 3xI2S (Mux w/ SPI), SPDIF-Rx, 2 x 12-bit DAC

DMA

I/Os

Up to 168 I/Os

Backup

RTC, Tamper

Power Supply

LDO, USB reg, backup

Connectivity

2xUSB OTG (1xHS, 1xFS), 6xSPI, 4xI²C, 1xTT/FD-CAN, 1xFD-CAN 4xUART+ 1xULP UART, 4xUSART, Ethernet, MDIO, HDMI-CEC, SWP, DCMI (camera)

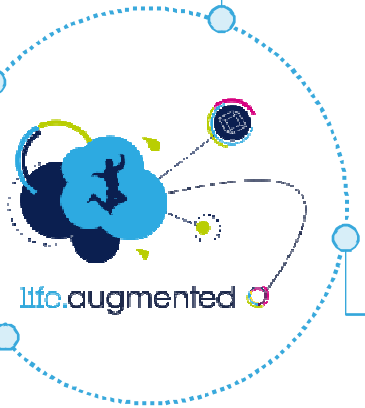
(*) : optional – dedicated CPN, STM32F753
(**) available in 2018

Where You Find Us

Making **driving** safer, greener and more connected

Making **homes** smarter, for better living, higher security, and less waste

Making everyday **things** smarter, connected and more aware of their surroundings



Enabling the evolution of **industry** towards smarter, safer and more efficient factories and workplaces

Enabling **cities** to make more of available resources

Our Vision

ST stands for

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Everywhere microelectronics make a positive contribution to people's lives, ST is there

Application Strategic Focus

The leading provider of products and solutions
for Smart Driving and the Internet of Things

Smart Driving

Safer

More connected

Greener

Internet of Things

Smart Industry

Smart Home

Smart City

Smart Things

STM32 Microcontroller

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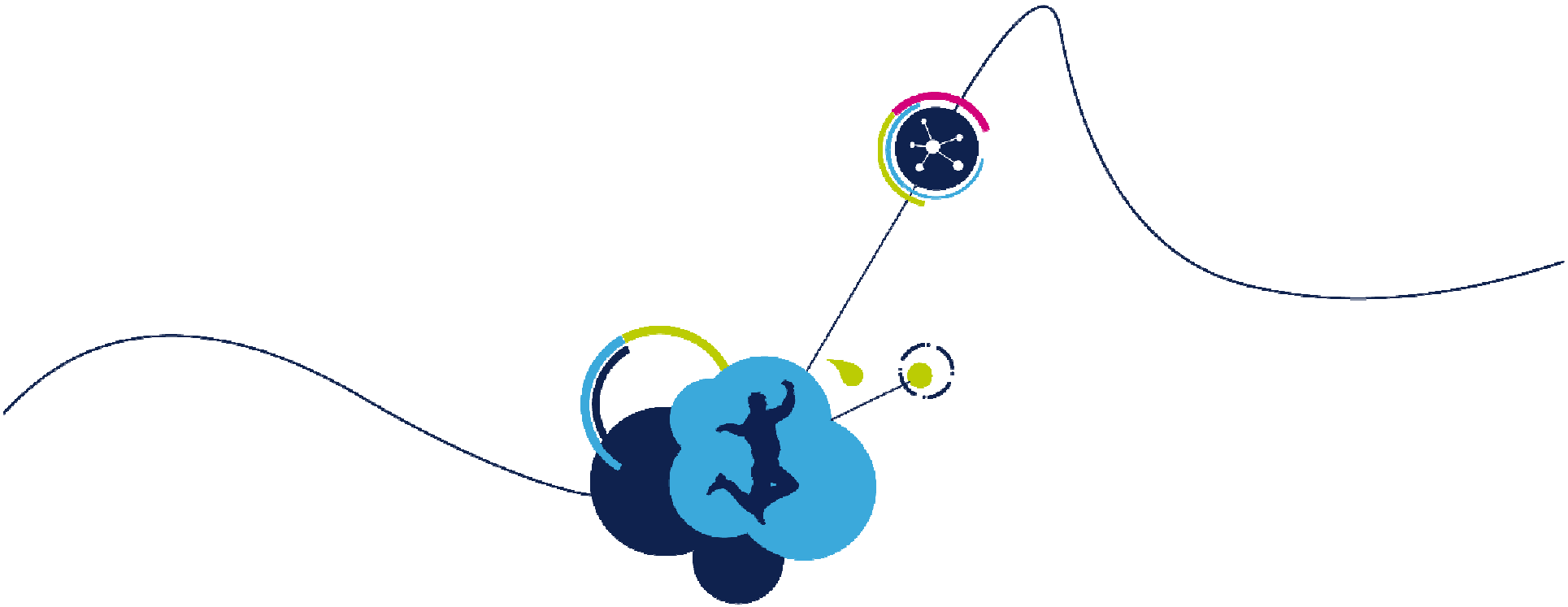
Success with an open Platform

- > 2 Billions STM32
- > 700 000 kits in the Field
- > 100 000 yearly STM32CubeMx download

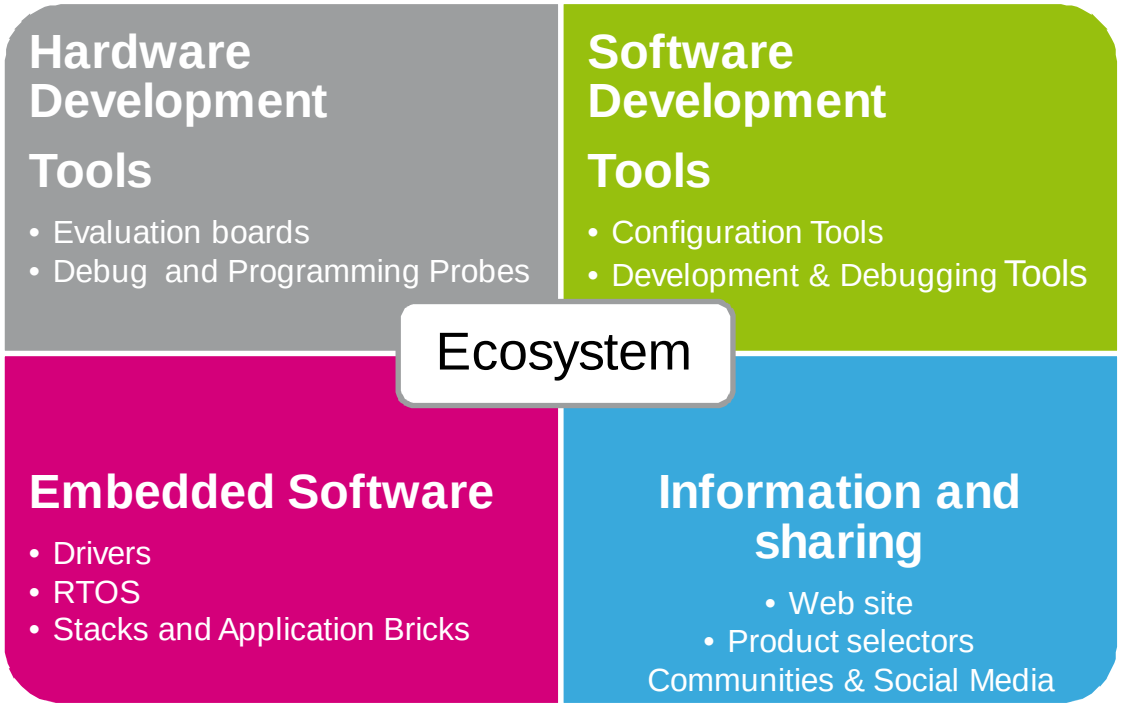
- Open source
  - Robust, Tested, Field proven , Maintained and OPEN source Firmware
- The most permissive and protecting licenses
- A vast choice of Development Environment
- Open Hardware → ARM based



STM32 Ecosystem

What is MCU Ecosystem ?

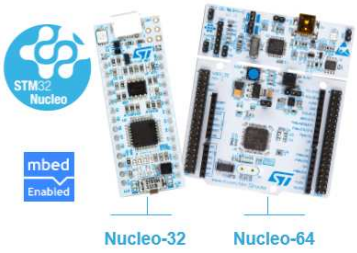
All collaterals required to develop with an MCU



STM32 ecosystem

Hardware tools

STM32 Nucleo boards



Flexibility prototype

Discovery kits

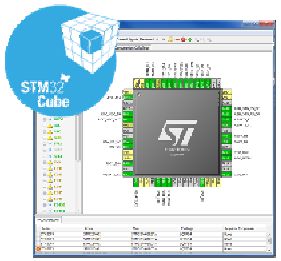
Creative demos

Evaluation boards

Full-feature evaluation

Software tools

STM32CubeMX

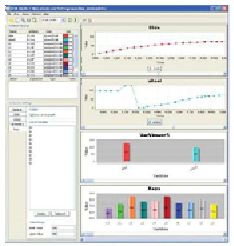


Configure and generate code

Partners IDEs

Compile and debug

STMStudio



Monitor

Embedded software

STM32Snippets*

High integration
low portability

STM32Cube and Std libraries

Average optimization
STM32 portability

CMSIS and mbed SDK

Low optimization
ARM portability

Virtual machine and models

STM32Java

Low optimization
large portability

Note * Available on STM32F0 and STM32L0 only

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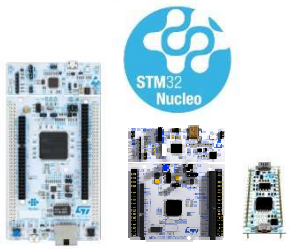
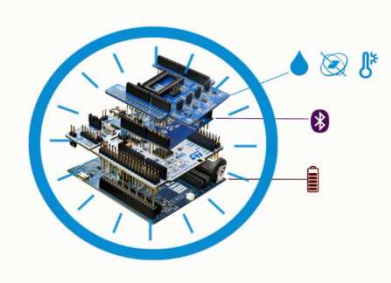
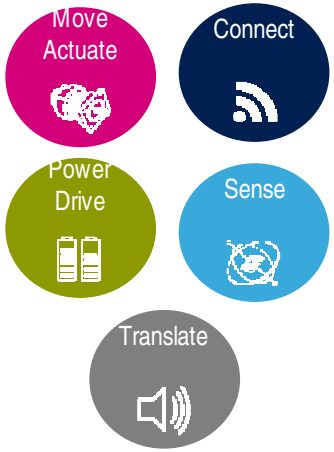
Development tools Overview





STM32 Nucleo	Discovery kits	Evaluation boards	STM32 Nucleo expansion	Third-party boards
Flexible prototyping	Key feature prototyping	Full feature evaluation	Functionality add-on	From full evaluation to open hardware
www.st.com/stm32nucleo	www.st.com/stm32discovery	www.st.com/stm32evaltools	www.st.com/x-nucleo	



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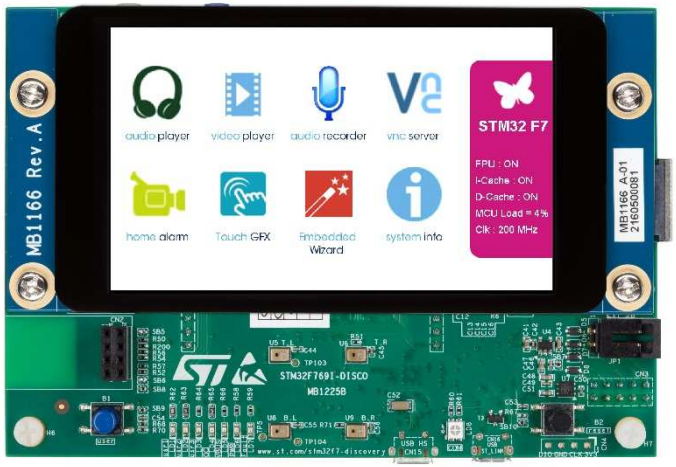
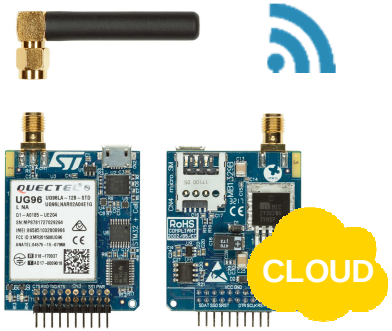
Latest Discovery kits

STM32L4R9I-DISCO

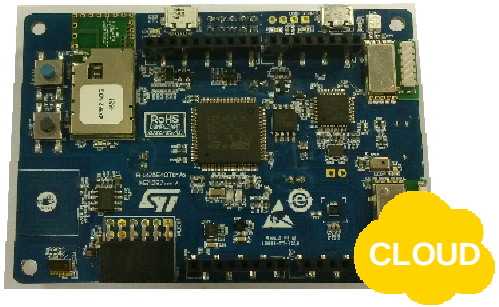
STM32F413H-DISCO



STM32F769I-DISCO



B-L496G-CELL01A



B-L475E-IOT01A

B-L072Z-LRWAN1

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Discovery kits portfolio

Part number	MCU	USB	Audio	Display	Connect	Expansion	arm MBED Enabled
32F0308DISCOVERY	STM32F030					Proprietary	Mbed
STM32F0DISCOVERY	STM32F051					Proprietary	
32F072BDISCOVERY	STM32F072	*				Proprietary	
STM32VLDISCOVERY	STM32F100					Proprietary	
STM32F3DISCOVERY	STM32F303	*				Proprietary	
32F3348DISCOVERY	STM32F334					Proprietary	Mbed
32L0538DISCOVERY	STM32L053	*		E-paper		Proprietary	
32L100CDISCOVERY	STM32L100					Proprietary	
32L152CDISCOVERY	STM32L152			LCD		Proprietary	
32L476GDISCOVERY	STM32L476	OTG	*	LCD		Proprietary	Mbed OS
32L496GDISCOVERY	STM32L496	OTG	*	Color LCD 240x240	Add-on (optional)	Arduino Uno, Pmod, STmod+, MikroBus, Grove	
32L4R9IDISCOVERY	STM32L4R9	OTG	*	Color Amoled 360x360	Add-on (optional)	Arduino Uno, Pmod, STmod+, MikroBus, Grove	

www.st.com/stm32discovery

Discovery kits portfolio

Part number	MCU	USB	Audio	Display	Connect	Expansion	arm MBED Enabled
STM32F4DISCOVERY	STM32F407	OTG	*			Proprietary	
32F411EDISCOVERY	STM32F411	OTG	*			Proprietary	
32F412GDISCOVERY	STM32F412	OTG	*	Color LCD 240x240	Add-on (optional)	Arduino Uno	
32F413HDISCOVERY	STM32F413	OTG	*	Color LCD 240x240	WiFi	Arduino Uno	Mbed OS
32F429IDISCOVERY	STM32F429	OTG		Color LCD QVGA	Add-on (optional)	Arduino Uno	Mbed OS
32F469IDISCOVERY	STM32F469	OTG	*	Color LCD 800x480	Add-on (optional)	Arduino Uno	Mbed OS
32F723EDISCOVERY	STM32F723	OTG HS	*	Color LCD 240x240	Add-on (optional)	Arduino Uno, Pmod, STMod+, MikroBus, Grove	
32F746GDISCOVERY	STM32F746	OTG HS	*	Color LCD 480x272	Ethernet	Arduino Uno	Mbed OS
32F769IDISCOVERY	STM32F769	OTG HS	*	Color LCD 800x480	Ethernet	Arduino Uno	Mbed OS

www.st.com/stm32discovery

Discovery kits portfolio

Part number	MCU	Description	Key features	Expansion	arm MBED Enabled
B-L072Z-LRWAN1	STM32L072	All-in-one low-power wireless node	LoRa, Sigfox, WMbus AAA-battery operation	Arduino Uno, ST Morpho	Mbed OS
B-L475E-IOT01A	STM32L475	All-in-one IoT node with low-power connectivity & multiway sensing	BLE, SubGHz, NFC, WiFi, Sensors (digital microphone, 9-axis navigation, pressure, humidity, temperature, proximity/gesture detection)	Arduino Uno, Pmod	Mbed OS
P-L496G-CELL01	STM32L496	Worldwide Cellular IoT node 2G/3G pentaband	7.2Mbps downlink, 5.76Mbps uplink, eSIM and MicroSIM, 3-month dataplan included	Arduino Uno, Pmod, STmod+, MikroBus, Grove	
P-L496G-CELL02	STM32L496	Worldwide Cellular IoT node LTE cat M1 / cat NB1 / EGPRS pentaband	300Kbps downlink, 375Kbps uplink, eSIM and MicroSIM, 3-month dataplan included	Arduino Uno, Pmod, STmod+, MikroBus, Grove	

I-CUBE-LRWAN	LoRaWAN-compliant software expansion for STM32Cube
X-CUBE-SFOX	Sigfox-compliant software expansion for STM32Cube
X-CUBE-CLOUD	Cloud connectors as expansion for STM32Cube (Amazon Web Services, Microsoft Azure, IBM Watson)

www.st.com/stm32app-discovery

Evaluation boards portfolio

STM32072B-EVAL	STM32F072	STM32L073Z-EVAL	STM32L073	STM3220G-EVAL	STM32F207	STM32746G-EVAL	STM32F746
STM32091C-EVAL	STM32F091	STM32L152D-EVAL	STM32L152	STM3221G-EVAL	STM32F217	STM32756G-EVAL	STM32F756
STM32100E-EVAL	STM32F100	STM32L476G-EVAL	STM32L476	STM3240G-EVAL	STM32F407	STM32F769I-EVAL	STM32F769
STM3210E-EVAL	STM32F103	STM32L4R9I-EVAL	STM32L4R9	STM3241G-EVAL	STM32F417	STM32F779I-EVAL	STM32F779
STM3210C-EVAL	STM32F107			STM32429I-EVAL	STM32F429	STM32H743I-EVAL	STM32H743
STM32303E-EVAL	STM32F303			STM32439I-EVAL	STM32F439	STM32H753I-EVAL	STM32H753
STM32373C-EVAL	STM32F373			STM32446E-EVAL	STM32F446		
				STM32479I-EVAL	STM32F479		

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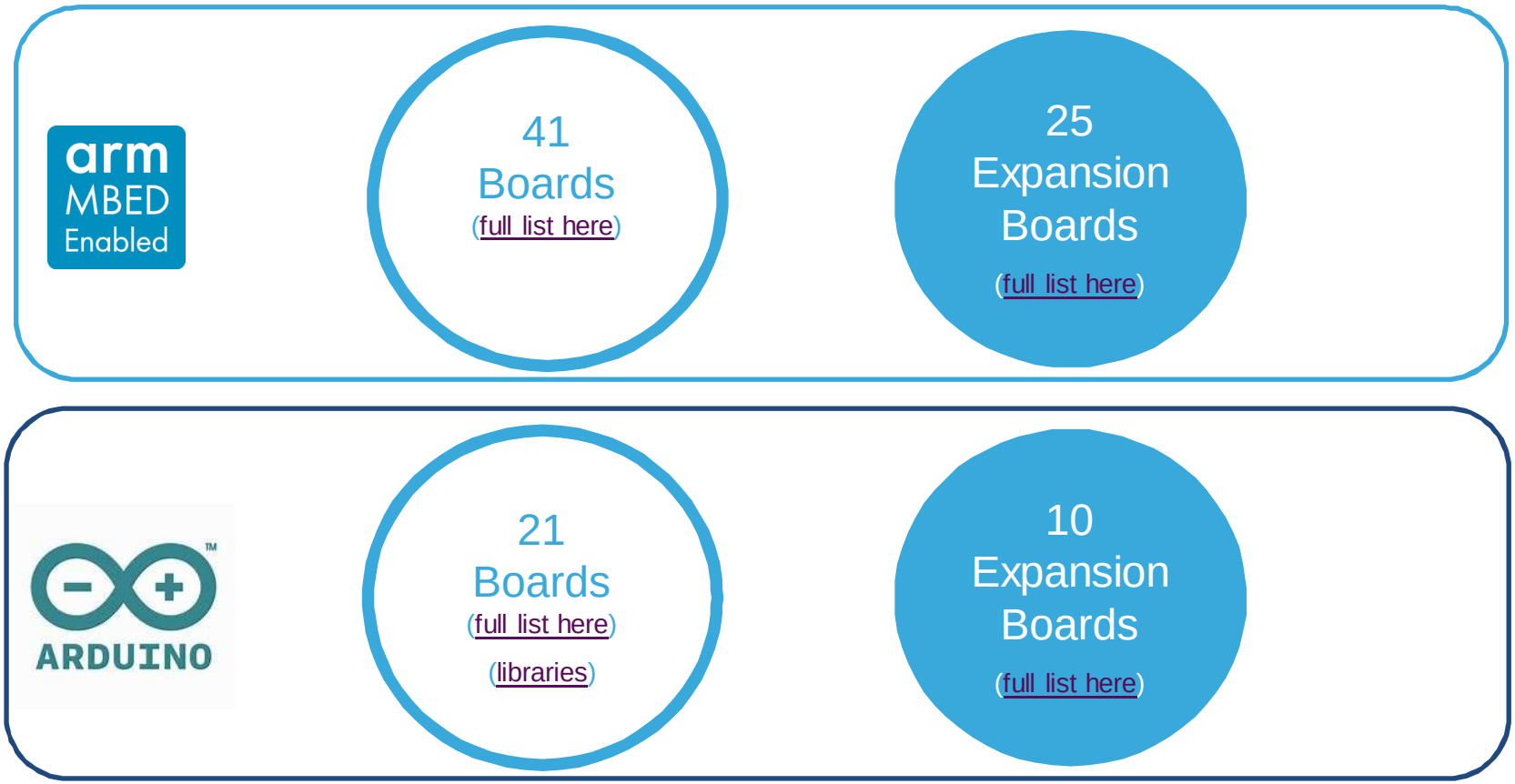
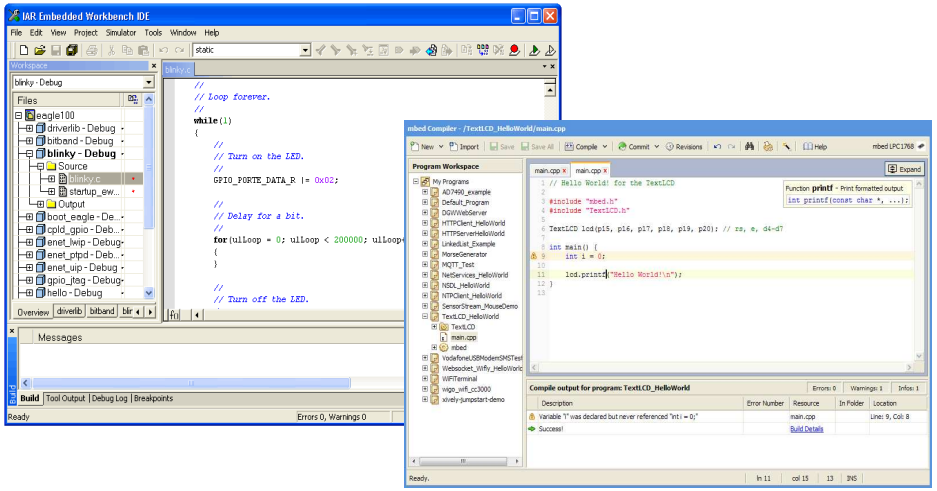
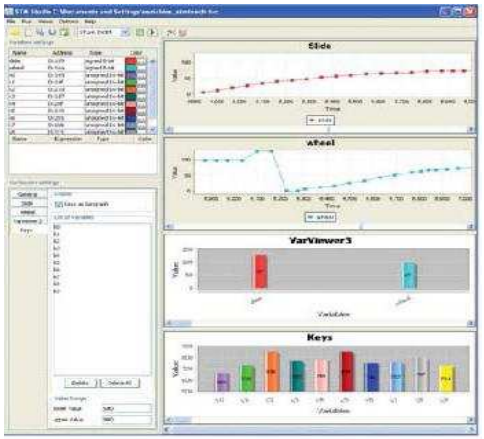
www.st.com/stm32evaltools

STM32 Boards contribute to Communities



Software tools





Partner IDEs

Compile & Debug

STMStudio

Monitor

IAR SYSTEMS
atollic
TRACE SYSTEM
EMPROG
TASKING
KEILABS
SEGGER Embedded Studio
ARM KEIL Microcontroller Tools
CooCox
ARM mbed
ac6 Assistance Conseil Systèmes

Free IDE

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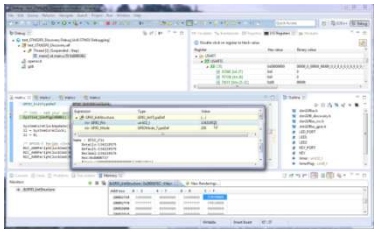
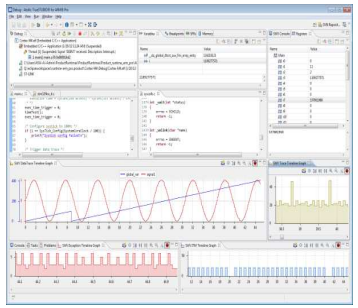
Free software tools

Eclipse-based toolset SW4STM32
www.openSTM32.org



Microsoft

Premium toolset TrueSTUDIO
www.atollic.com



Microsoft

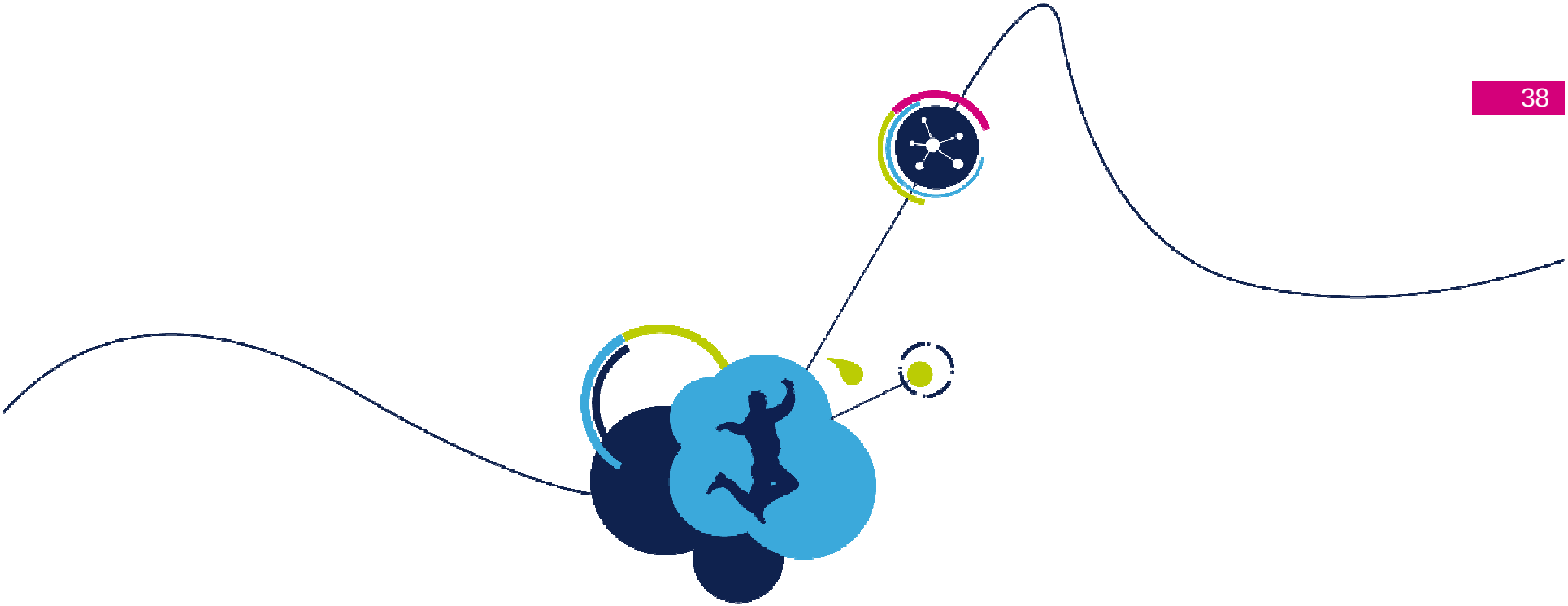
Online development & community
www.mbed.com

Microsoft

Premium toolset MDK-ARM
www.keil.com/st

Free licenses for
STM32F0 / L0
(no code size limit)

Microsoft

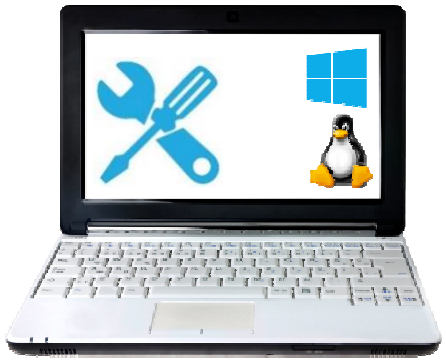


STM32CubeMX

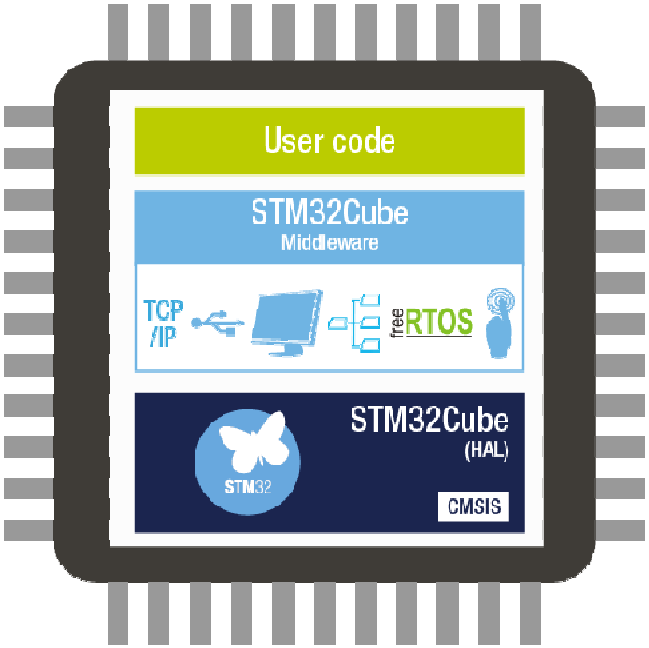
STM32Cube

- STM32Cube, a 100% free solution to ease your life, that combines:
  - A PC software configuration tool
  - STM32 embedded software bricks
  - Deployed on whole STM32 portfolio

STM32CubeMX
Configuration tool on PC

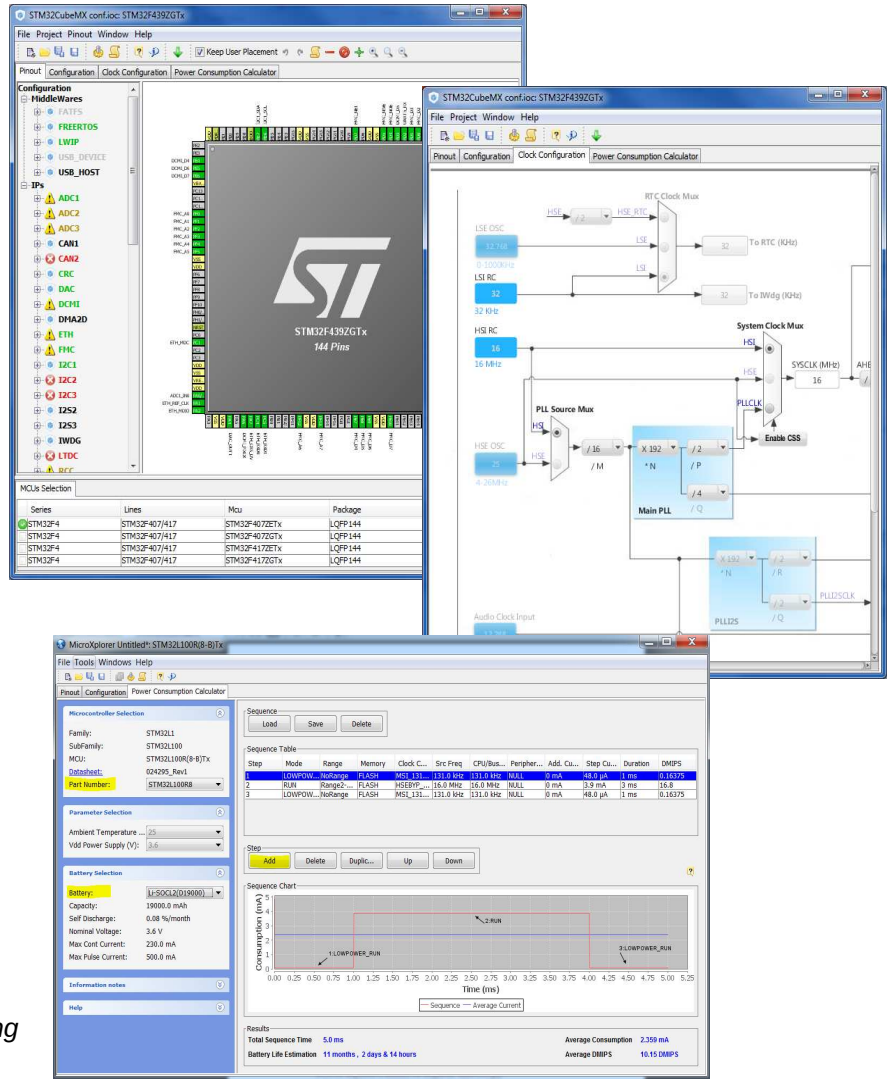


C code generation
for initialization,
according to user choices



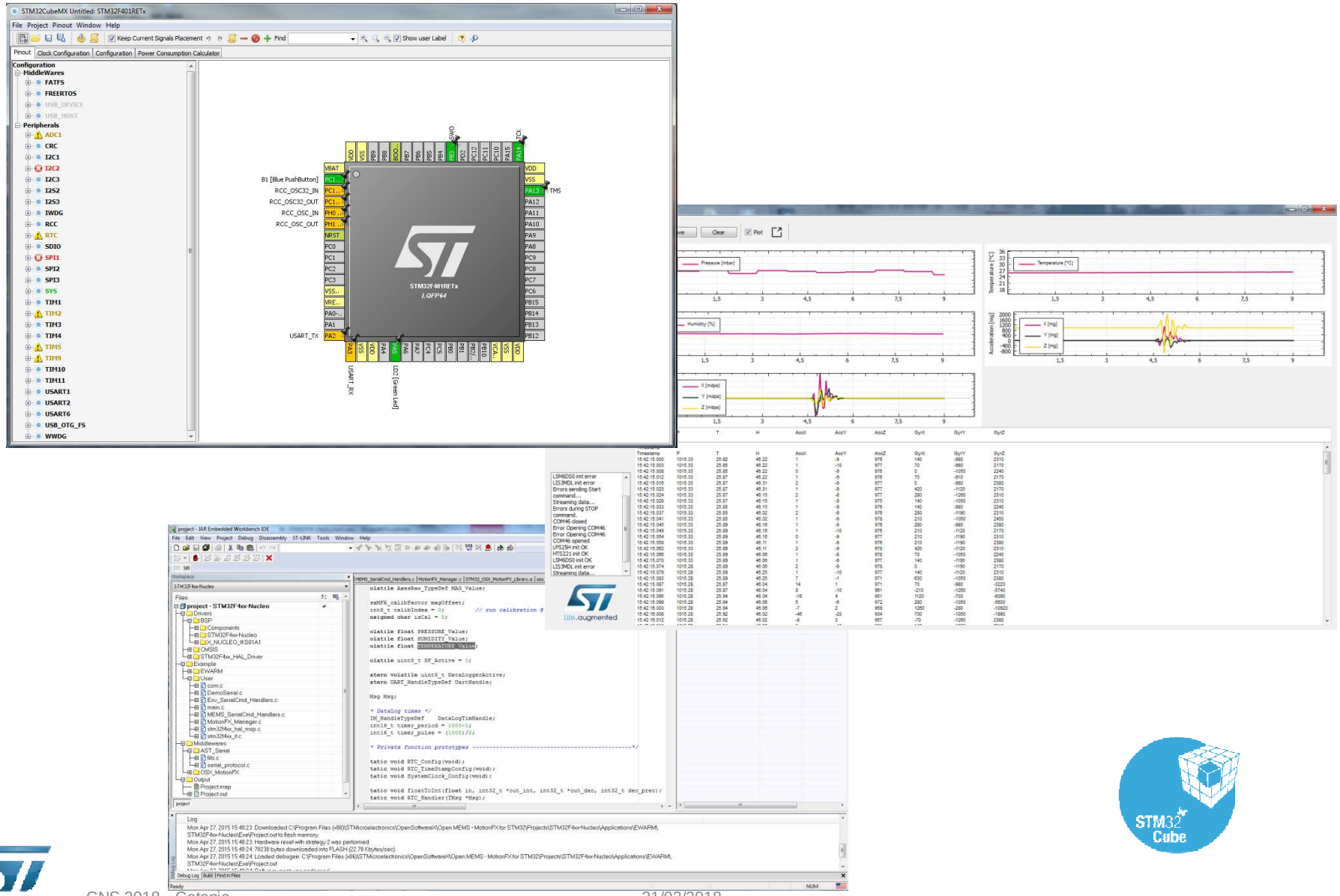
STM32CubeMX

- STM32CubeMX, microcontroller configuration, step-by-step
  - Step 1: Select the microcontroller
    - Through easy filtering capabilities
  - Step 2: Configure the microcontroller
    - Pinout wizard
    - Clock tree wizard
    - Peripherals and middleware wizards
    - Power consumption wizard[1]
  - Step 3: Initialization code generation
    - Generates[1] code for your favorite IDE
    - Works with STM32Cube Embedded software offer !



1: Today on STM32F0, F2, F3, F4 and L0. Deployment ongoing

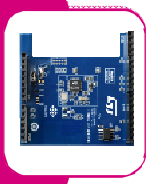
STM32Cube


STM32CubeMX Untitled: STM32F401RETx
STM32F401RETx
LQFP64
B1 [Blue PushButton]
RCC_OSC32_IN
RCC_OSC32_OUT
RCC_OSC_IN
RCC_OSC_OUT
USART_TX
SWO
SCL
TMS
OSM_TX
I2C1_SCL [uA]
life.augmented

STM32 Open Development Environment

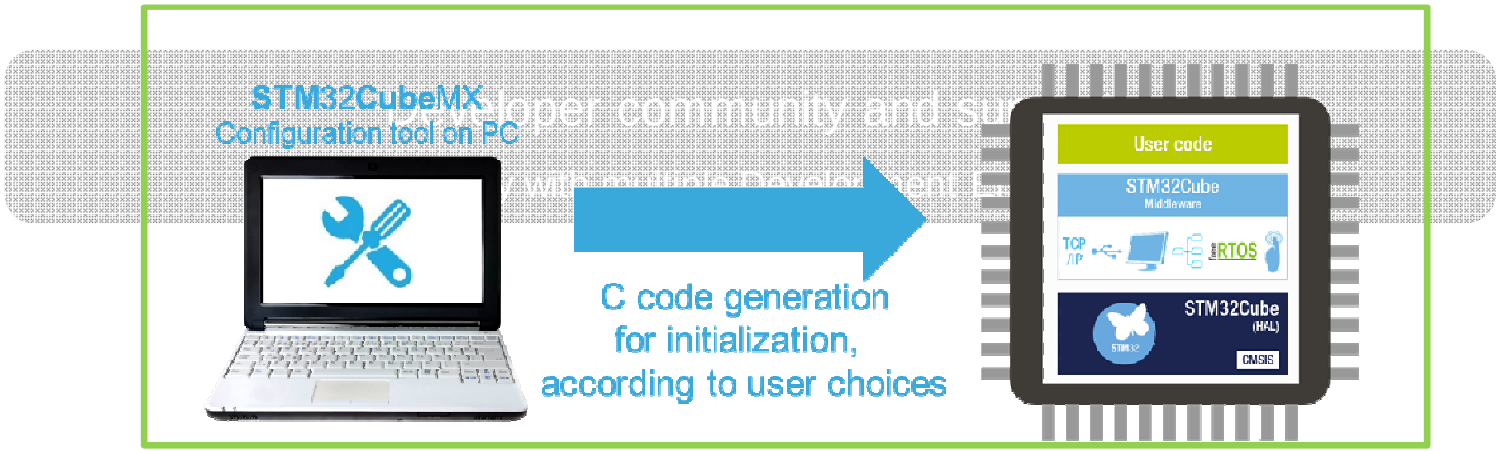
STM32 Nucleo development boards

STM32 Nucleo expansion boards



STM32Cube software

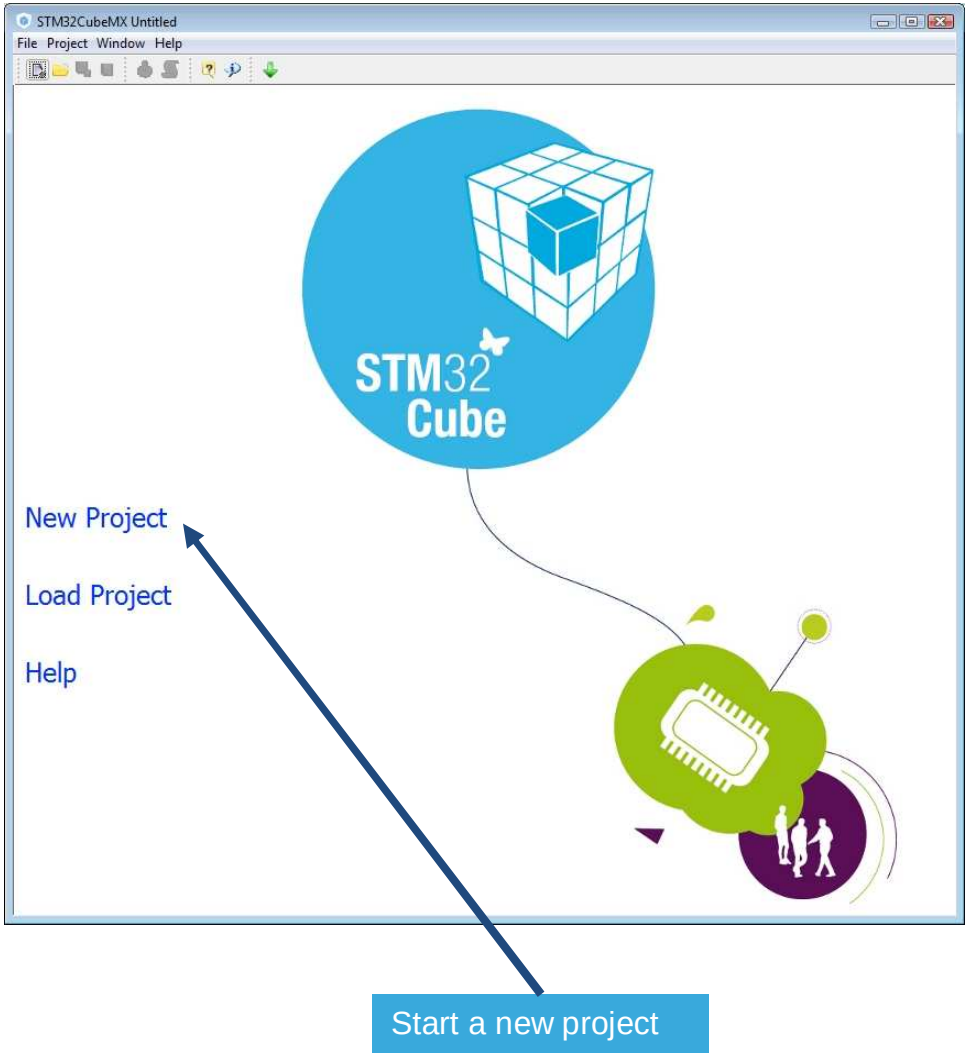
STM32Cube expansion software



STM32Cube: STM32CubeMX

Step by step:

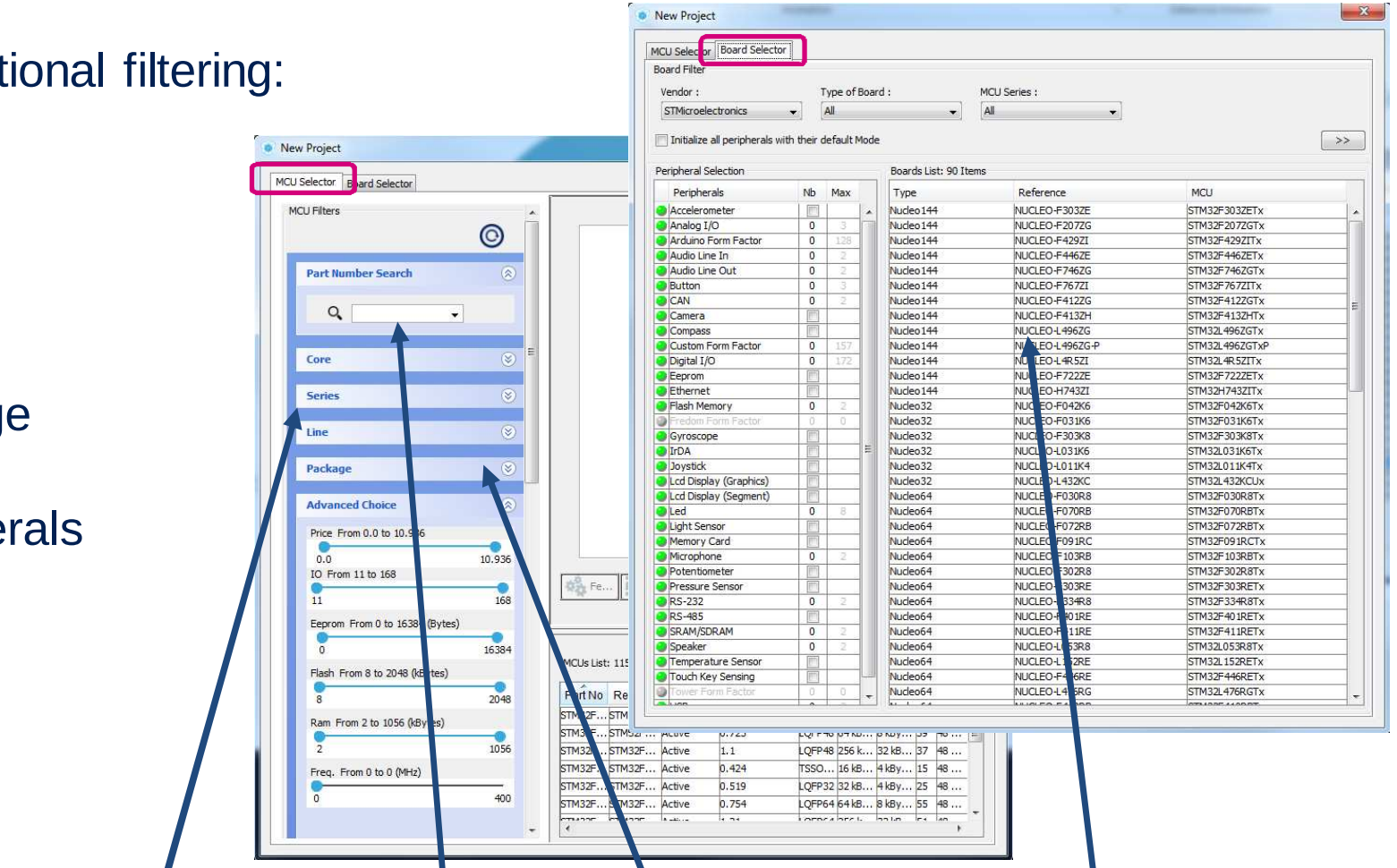
- MCU selector
- Pinout configuration
- Clock tree initialization
- Peripherals and middleware parameters
- Code generation
- Power consumption calculator



STM32CubeMX: MCU Selector

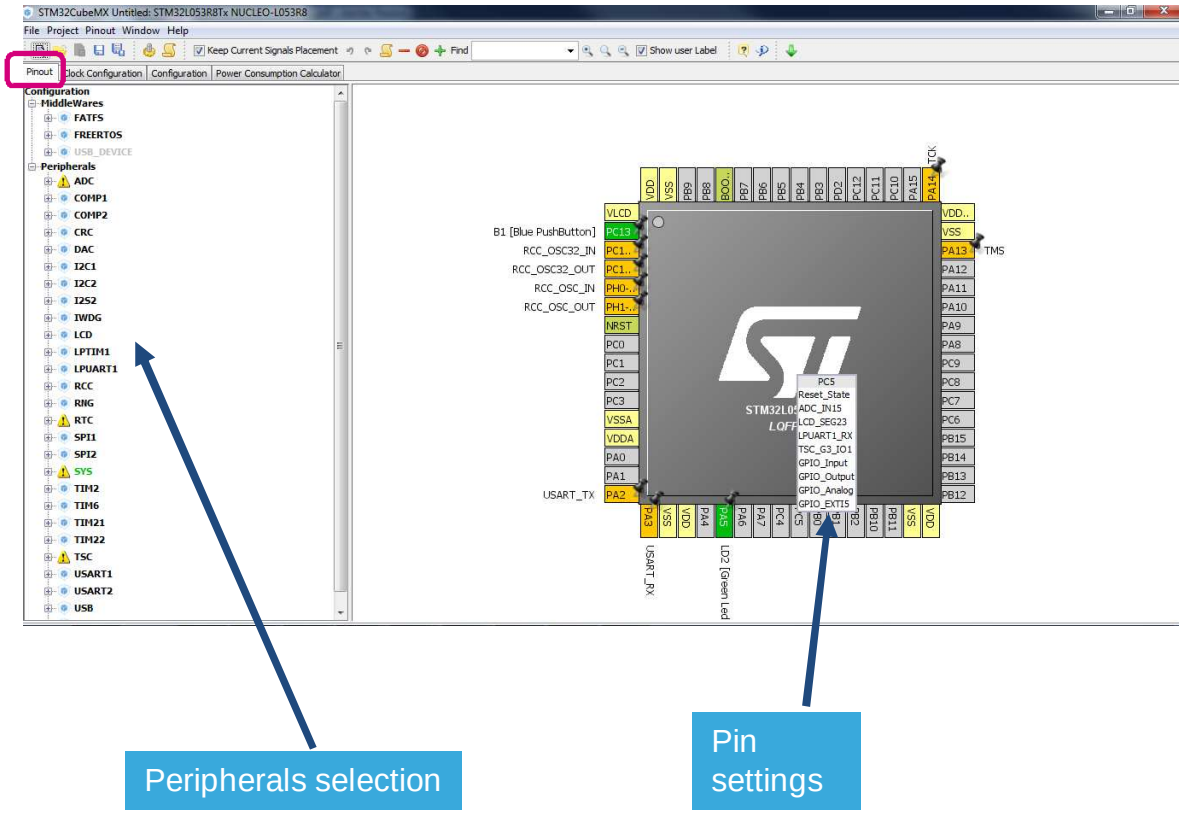
Easy Optional filtering:

- Series
- Line
- Package
- Peripherals



STM32CubeMX: Pinout configuration

- Pinout from:
  - Peripheral tree
  - Manually
- Automatic signal remapping
- Management of dependencies between peripherals and/or middleware

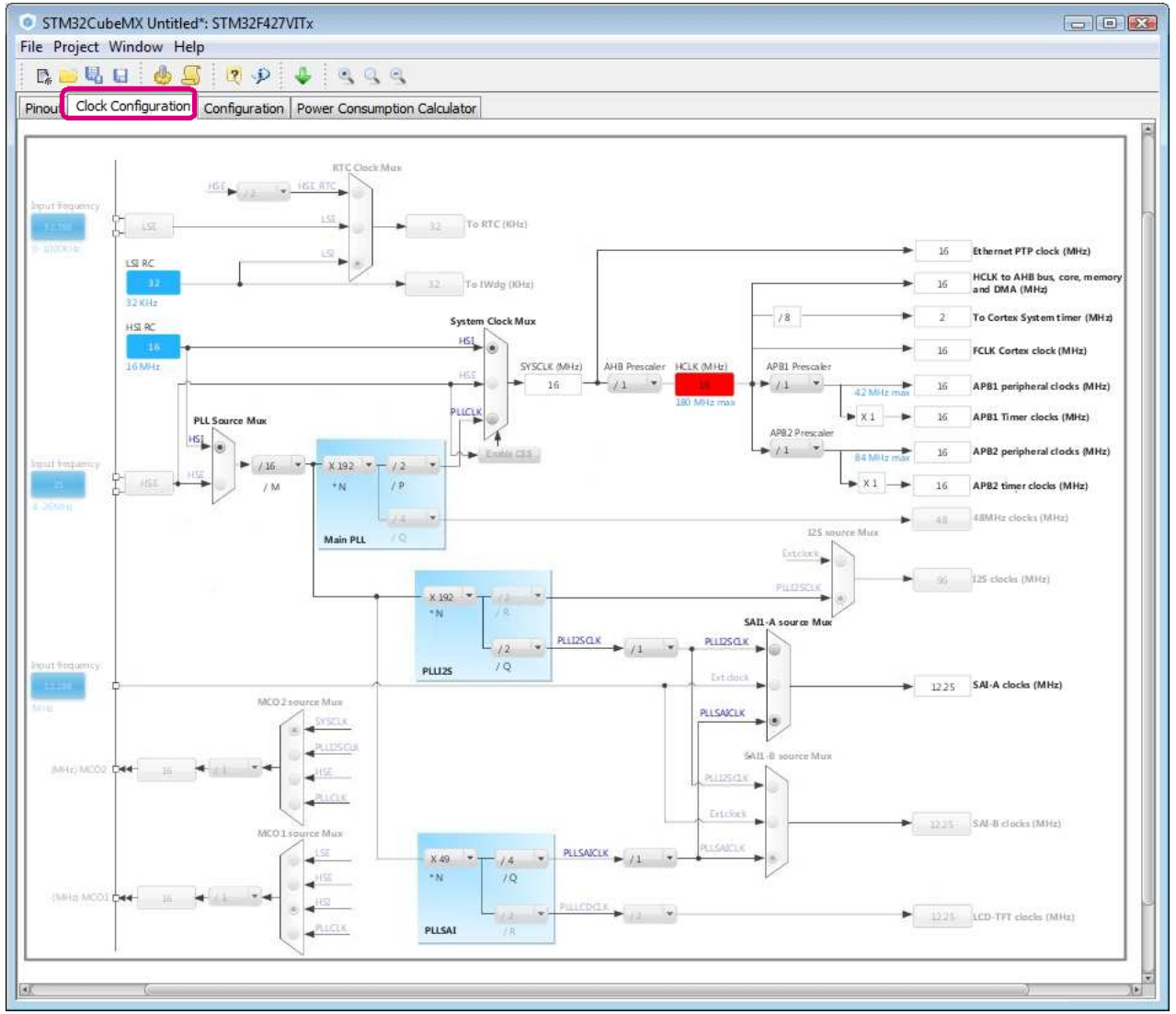


STM32CubeMX: Pinout configuration

- Different possible states for a peripheral modes
  - Dimmed: the mode is not available because it requires another mode to be set (just put the mouse on top of the dimmed mode to see why)
  - Red: Signals required for this mode can't be mapped on the pinout (see tooltip to see conflicts)
- Keep User Placement renamed to Keep Current Signal Placement and is unchecked by default
- Signals can be set/moved directly from the pinout view
  - Click on the pin to see the list of possible signals and select one
  - To see alternate pins for a signal Ctrl+Click on the signal, you can then drag and drop the signal to the new pin (keep pressing the Ctrl key)

STM32CubeMX: Clock tree

- Immediate display of all clock values
- Management of all clock constraints
- Highlight of errors

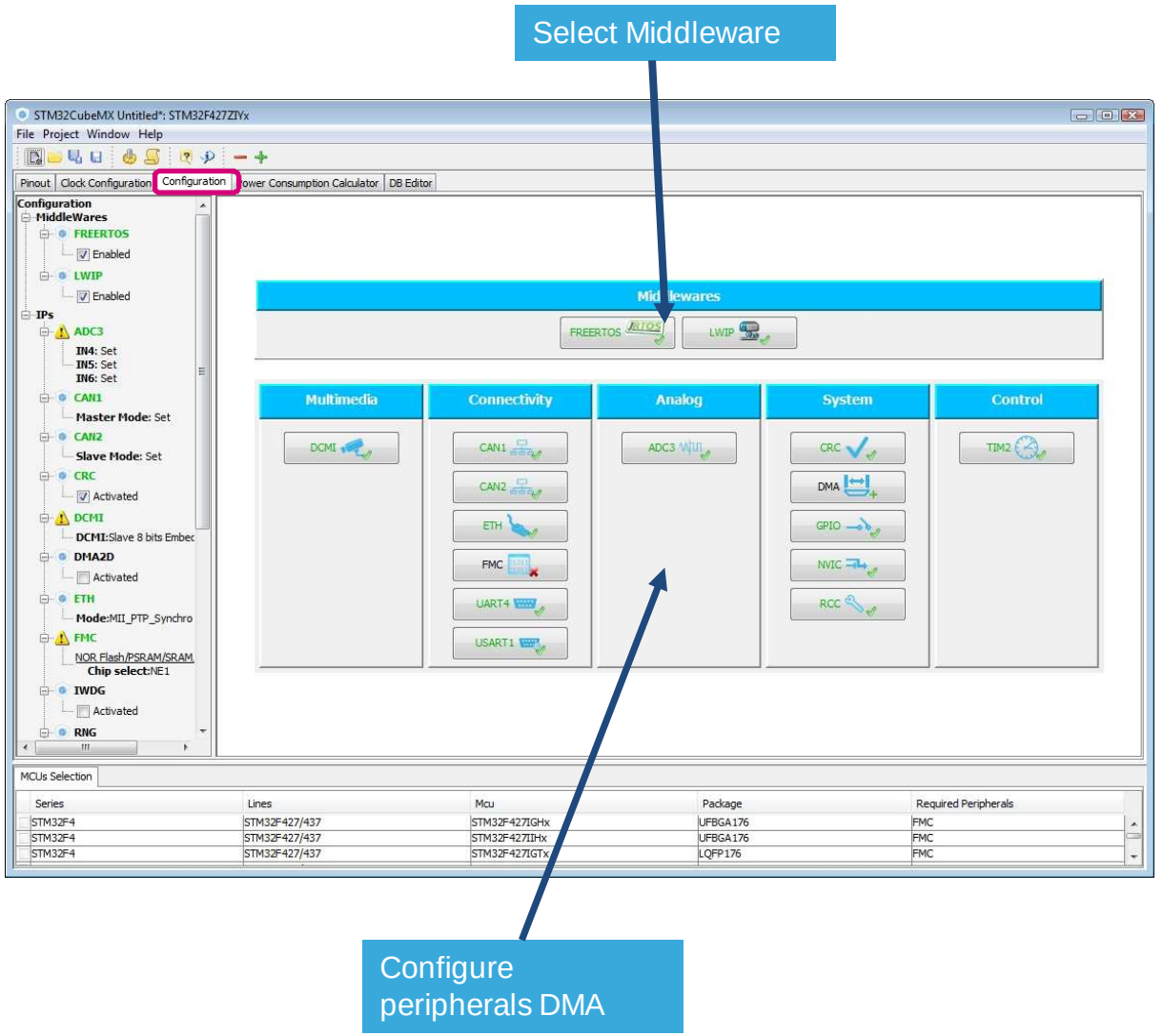


STM32CubeMX: Clock tree

- First choose in the pinout view the desired external clock
- Enter the values in the light blue areas
- Wrong values are highlighted in red and a tooltip describes the reason
- If you have an unused peripheral or input in the clock tree the corresponding area will be dimmed

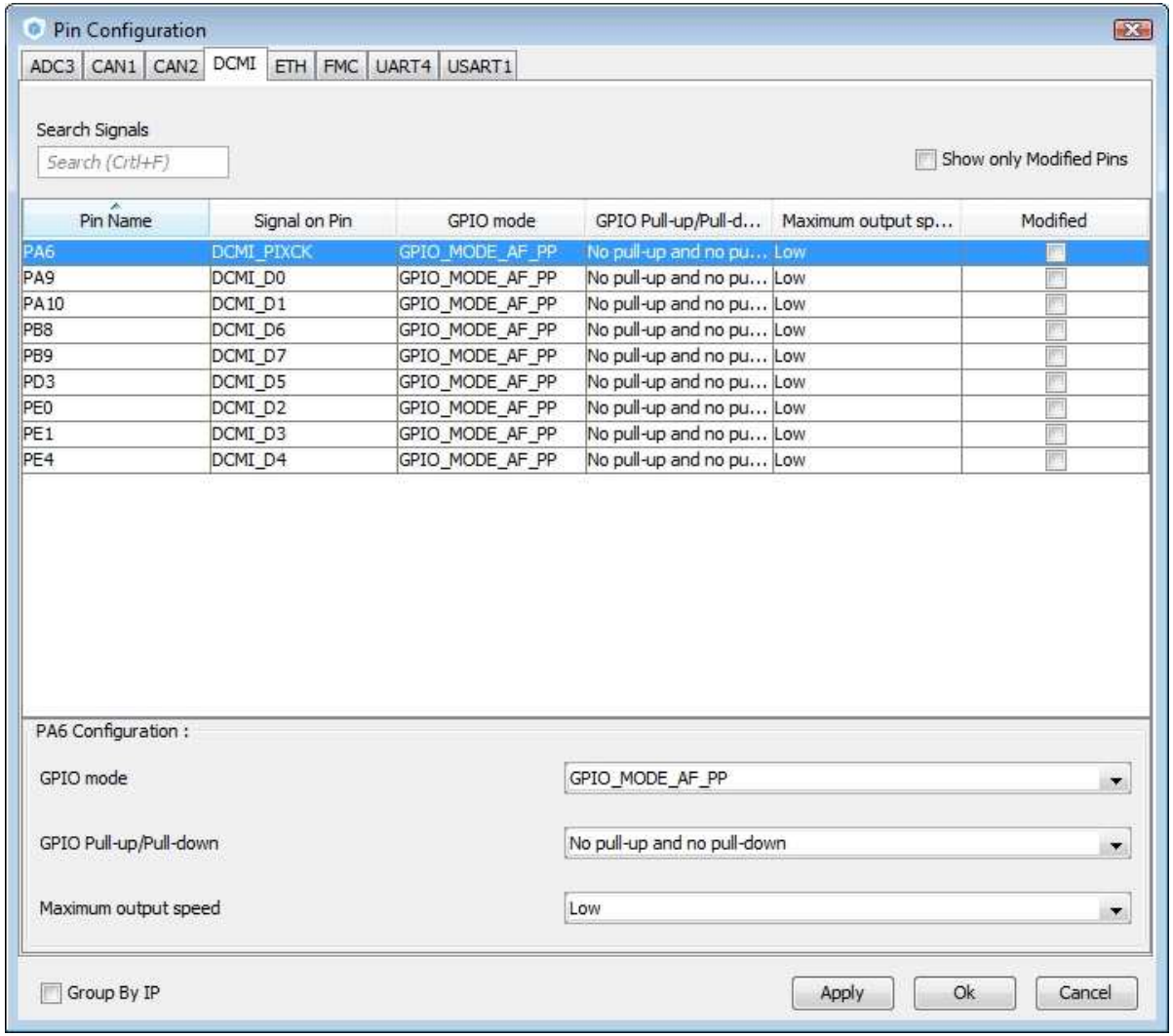
STM32CubeMX: Peripheral and middleware configuration

- Global view of used peripherals and middleware
- Highlight of configuration errors
  - + Not configured
  - v OK
  - x Error
- Read only tree view on the left with access to IPs / Middleware having no impact on the pinout



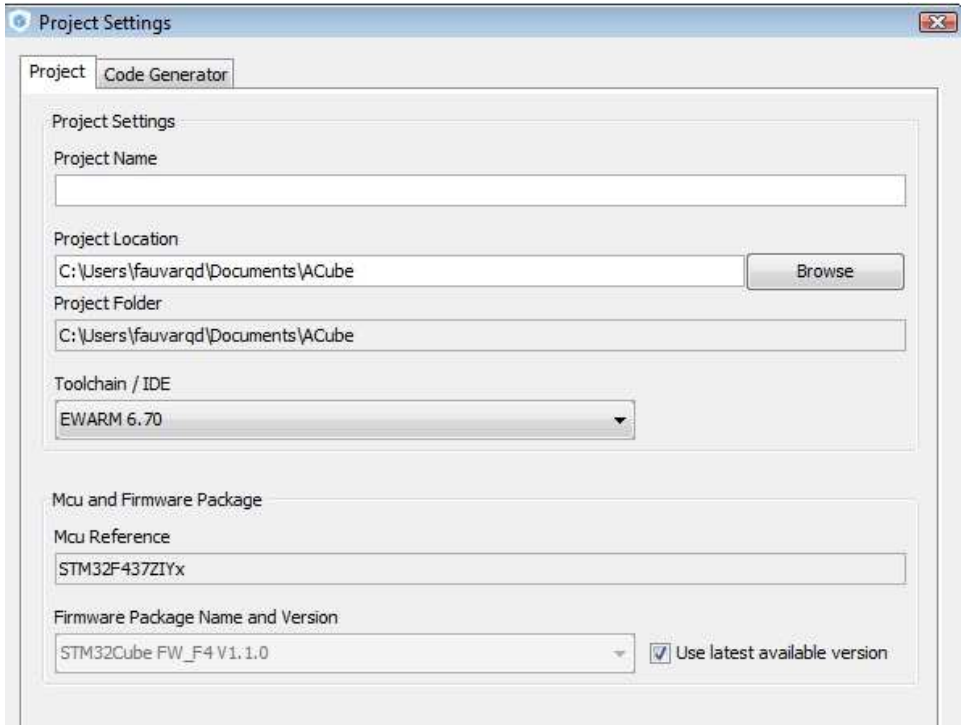
GPIO Panel

- Most of the GPIO parameters are set by default to the correct value
- You may want to change the maximum output speed
- You can select multiple pin at a time to set the same parameter



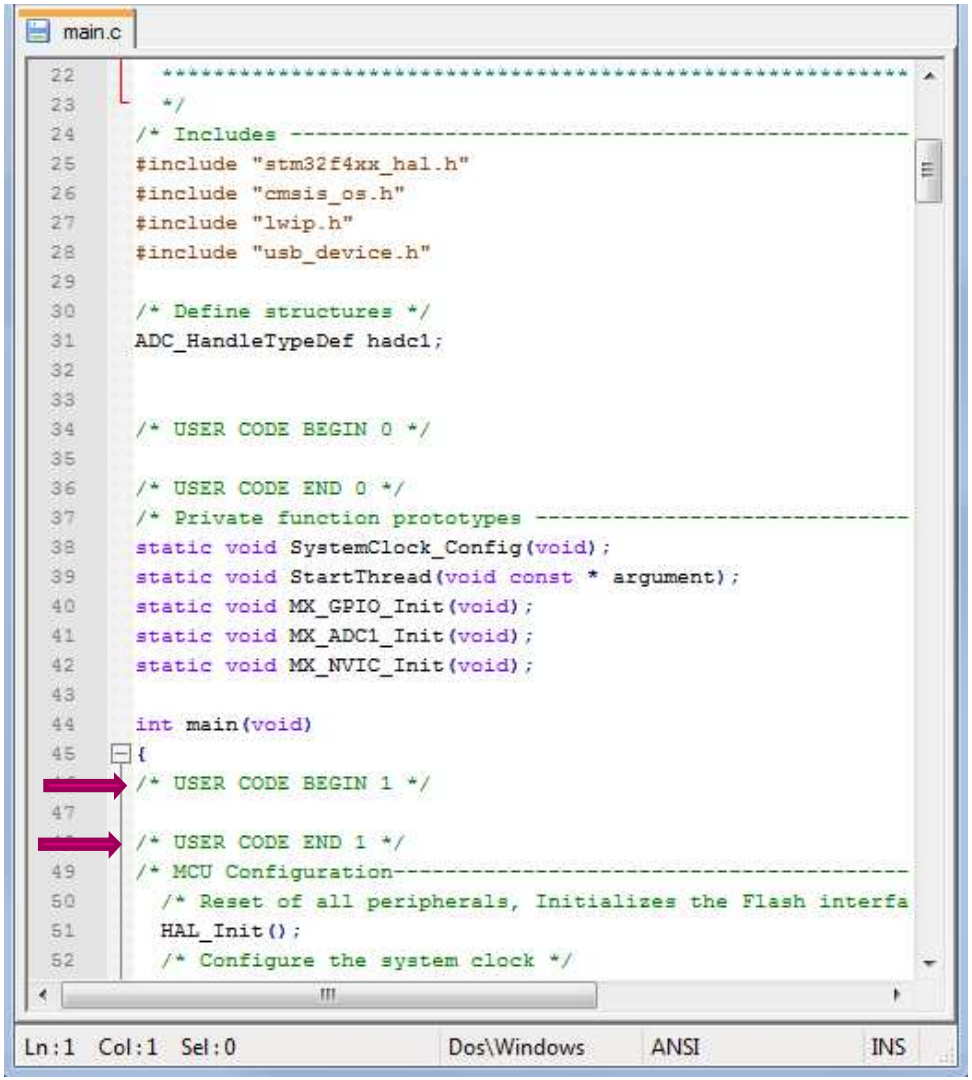
STM32CubeMX: Project settings

- Project -> Settings
  - Set project name and location
  - A full folder will be created named with the project name.
  - Inside this folder you'll find the saved configuration and all the generated code
  - Select toolchain (Keil, IAR, Atollic)
  - You can choose to use the latest version of the firmware library or a specific one



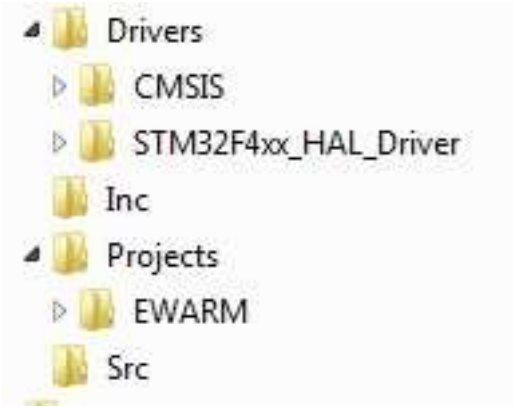
STM32CubeMX: Code generation

- Generation of all the C initialization code
- Automatic integration with partners toolchains
- User code can be added in dedicated sections and will be kept upon regeneration
- Required library code is automatically copied or referenced in the project (updater)



STM32CubeMX: Generated code

- By default:
  - main.c:
    - GPIO configuration
    - Clock configuration
    - The main() function calling all the initialization code
  - stm32f4xx_hal_msp.c:
    - Initialization code for all Ips
  - Middlewares are in separated files
  - stm32f4xx_it.c:
    - Management of the interrupts

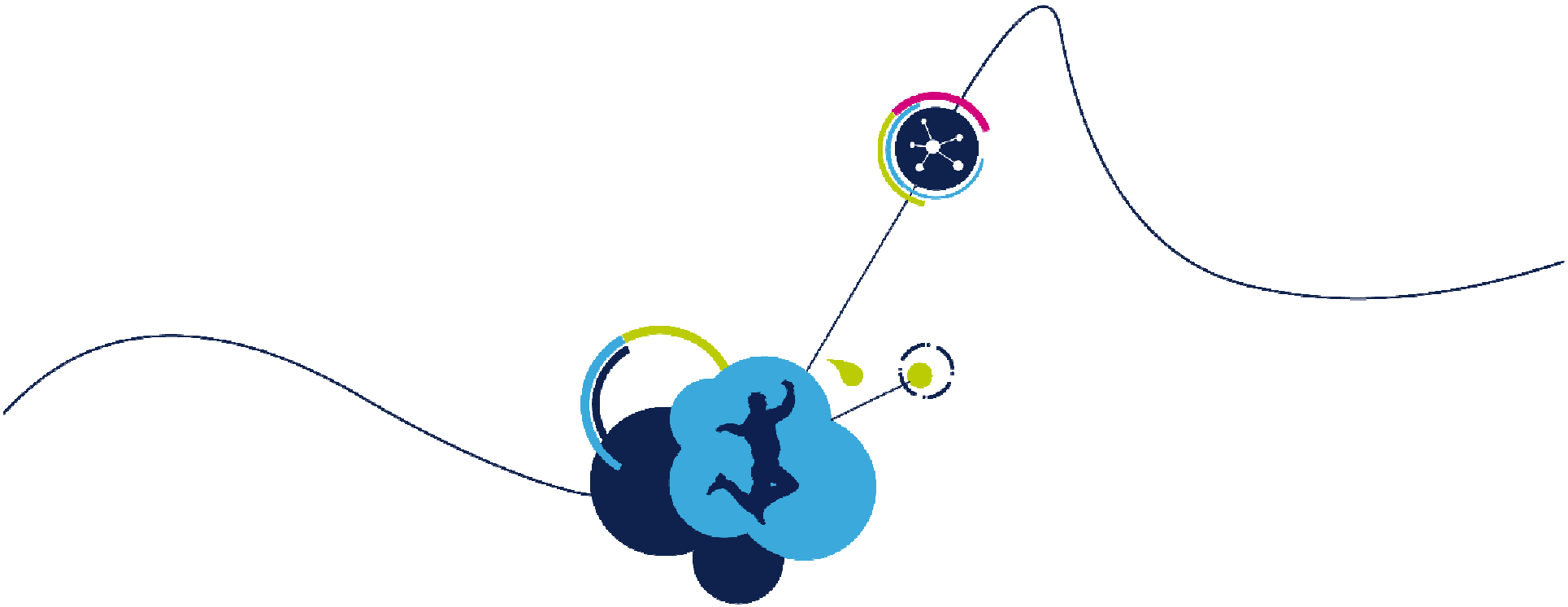


- User code can be put inside:

  /* USER CODE BEGIN 1 */

  /* USER CODE END 1 */

  The code will be kept upon generation



ST Portfolio behind STM32...

ST means also ...

GNSS Teseo III

Time of Flight Sensor

Gyroscope

Pressure sensor

STSPIN

Smart 6-axis IMU

Battery Charger

Microphone

Wireless Charging

Magnetic sensor

VIPerPlus

STDRIVE
(with/without
galvanic Isolation)

Power Management

STNRG

Accelerometer + Pedometer

Piezo Actuator

Bluetooth Low Energy

STLUX

LDO

SubGHz

Touchscreen Controllers

Op Amps

Wi-Fi

AMOLED DC-DC controllers

MOSFETs

HVLED

Internet of Things

Smart Driving

Consumer

Industrial

Automotive

ST Sensors

ST offers the widest range of MEMS and sensors covering a full spectrum of applications from low-power devices for IoT and battery-operated applications to high-end devices for accurate navigation and positioning, Industry 4.0, augmented virtual reality components and smartphones.

Temperature sensors

Use in a wide range of applications: industrial, consumer, medical and computer market segments.

View products

Touch sensors

Provide true multi-touch capability, supporting unlimited simultaneous touches.

View products

Proximity sensors

FlightSense technology can be used in a host of application areas where accurate ranging is required.

View products

Accelerometers

Advanced power-saving features that make them the ideal choice for ultra-low-power applications.

View products

Automotive sensors

Include digital accelerometers with low and high g full scale, and digital 3-axis gyroscopes.

View products

Gyroscopes

Analog and digital gyroscopes offer superior stability over time and temperature.

View products

e-Compasses

Include embedded self-test and smart power functionalities to minimize current consumption.

View products

Humidity sensors

A planar capacitance technology that integrates humidity & temp. sensors in the sensing element.

View products

iNEMO inertial modules

Offer more compact, robust, and easy-to-assemble solutions compared to discrete MEMS products.

View products

MEMS microphones

For all audio applications where small size, high sound quality, reliability & affordability are required.

View products

Pressure sensors

Innovative MEMS techno to provide extremely high pressure resolution, in ultra-compact & thin packages.

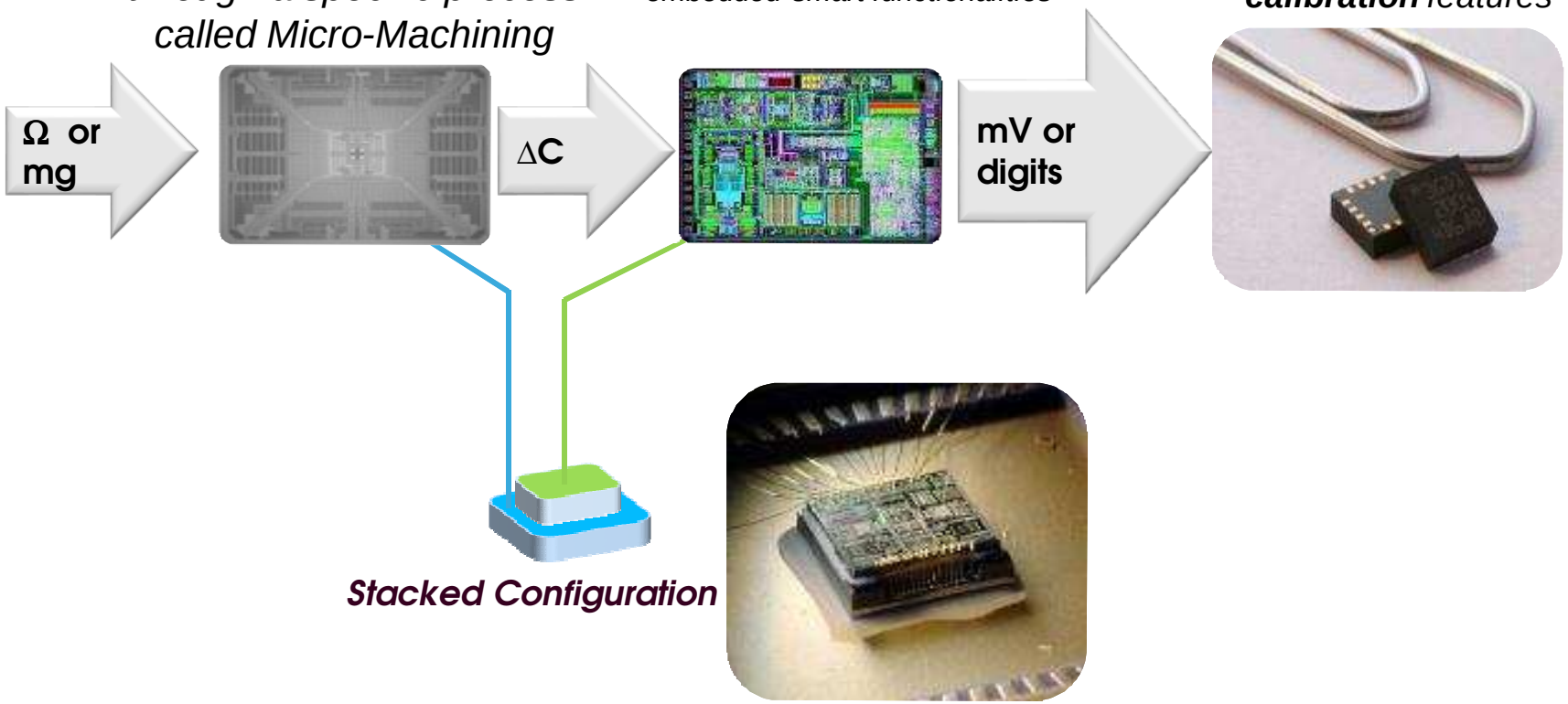
View products

Motion Sensors at a glance

Micro Mechanical
Micron-sized Transducer *realized through a specific process called Micro-Machining*

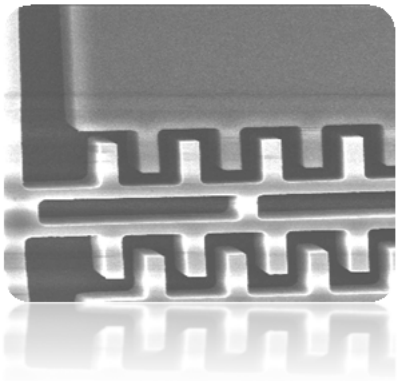
ASIC
(ADC + Signal Processing)
Advanced HCMOS Chip *with embedded smart functionalities*

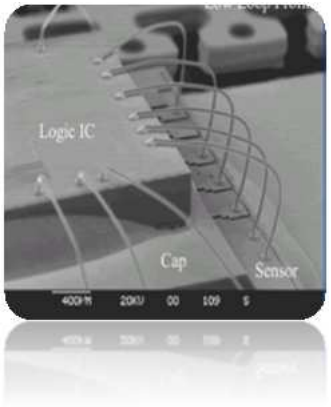
MEMS
Dedicated ***package*** *and* ***calibration*** *features*



What are MEMS…

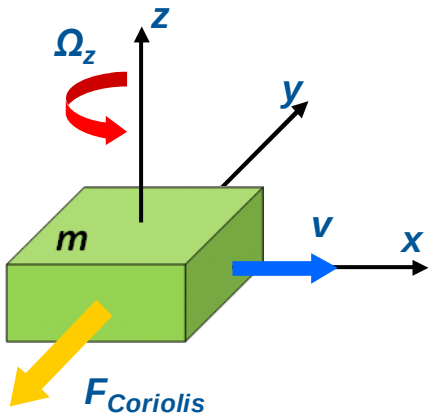
- **MEMS** stands for Micro Electro Mechanical Systems
- They contain 3-Dimensional structures realized through a specific process called Micro-Machining
- They are micron-sized devices that interact with the external world for sensing and actuation
- *In MEMS* **not only electrons are moving!**



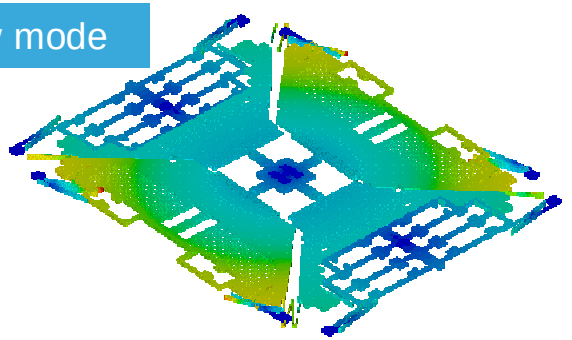


…MEMS gyroscopes sense and drive

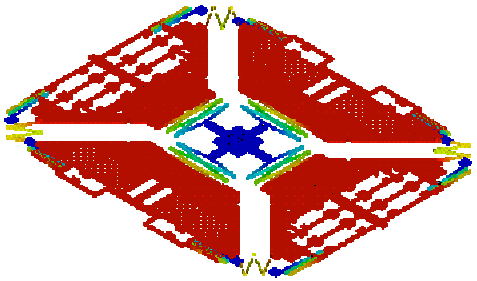
3-axis digital gyroscope



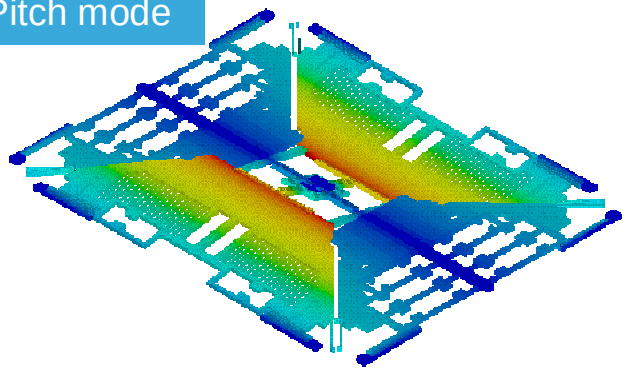
Yaw mode

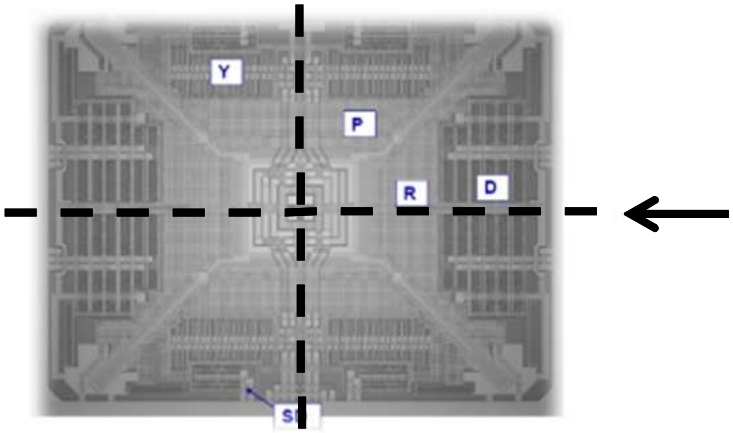


Drive mode



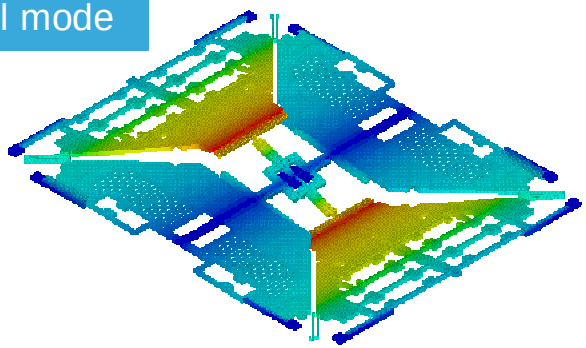
Pitch mode





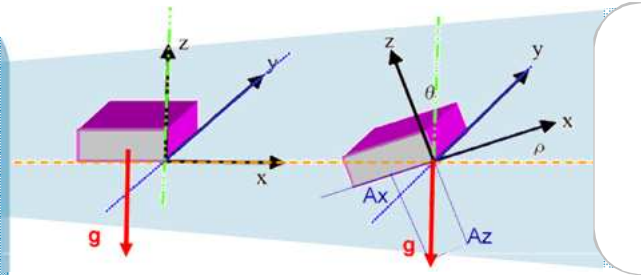
Single driving Mass

Roll mode

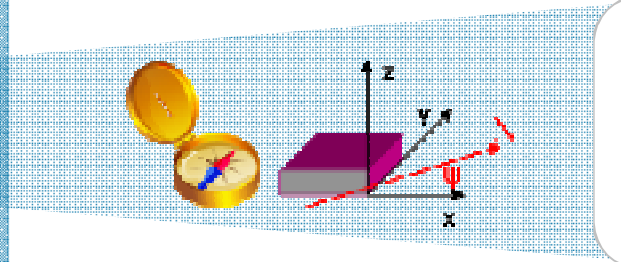


- ST 3x gyroscope

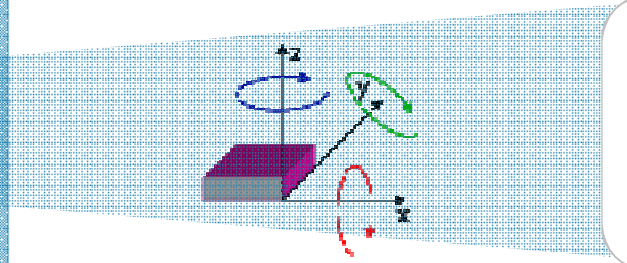
Motion Sensor for 3D space orientation



- The **accelerometer** senses the linear acceleration.
- In **static** conditions, the projection of gravity on the three axes allow to compute **tilt angles**

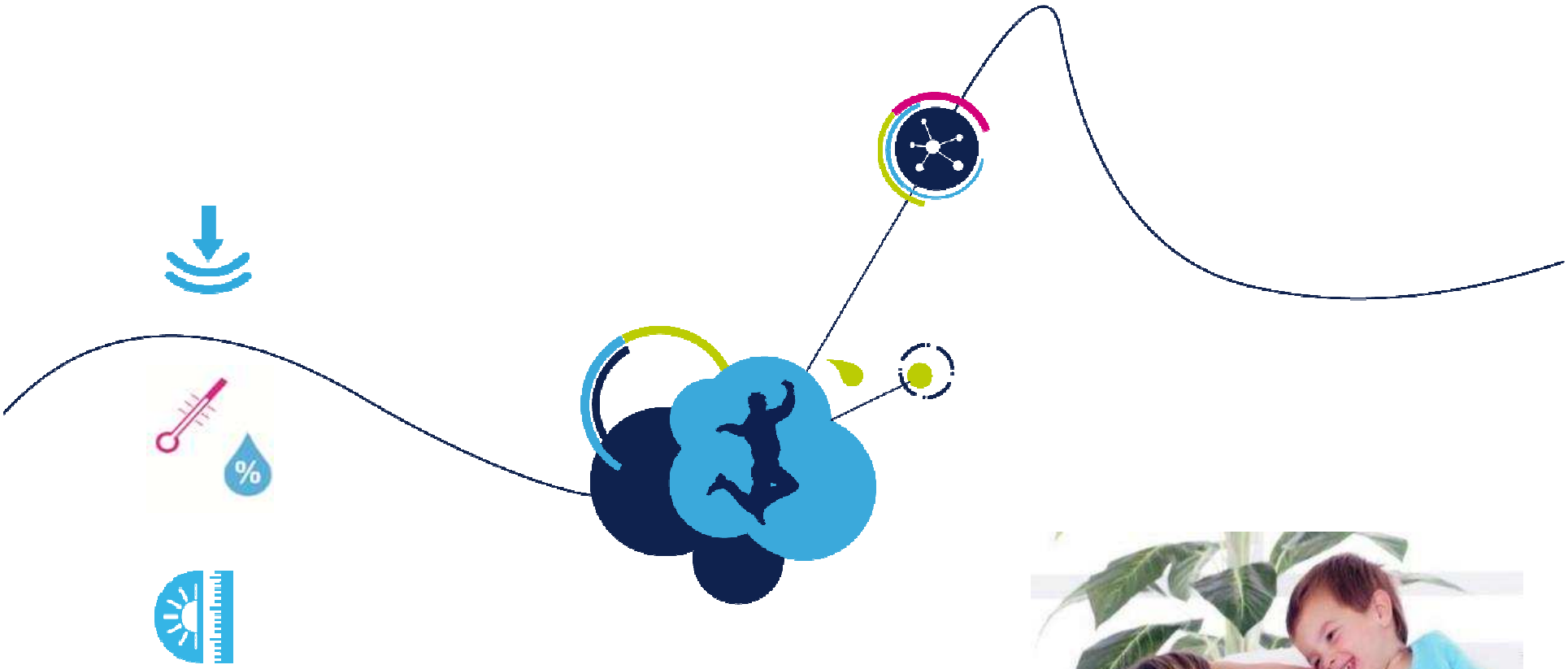


- The **magnetometer** senses the magnetic field.
- In **static** conditions, the projection of geomagnetic field on the three axes allows to compute heading angle



- The **Gyroscope** measures the angular rate applied to the device
- In **dynamic** conditions, by integration of the 3 axis angular rate the 3D orientations can be computes

iNEMO inertial modules allows sensor fusion and opens new application



Environmental Sensors

life.augmented

Environmental Sensors

- Pressure sensor (mbar)
  - **LPS22HB / LPS33HW** are **barometric** sensors with High accuracy pressure measurement, low power consumption and water resistant / proof Applications
  - Pressure sensor can be used for absolute pressure monitoring, altimeter: It complete a IMU solution to detect floor level changes in outdoor navigation
  - Applications: **Weather station, Smart Watch/Glasses, Altimeter, Vacuum Cleaner**

- Humidity sensor (% RH range)
  - **HTS221** is **humidity** sensor with temperature sensor embedded
  - Humidity sensor help to improve air quality or prevent electronics from water exposure
  - Applications: **Weather station, Smart home, Smart Watch/Glasses, Home Appliances**

- Temperature sensor (℃)
  - **STTS751** can be used if humidity or pressure sensors is not required

Microphones

life.augmented

Main Acoustic Parameters

Sensitivity

- Electrical response to a given standard acoustic input (1kHz sine at a 94 dBSPL)
- **The narrower the spread is from part to part, the better it is.**
- Typ spread is ±3dB.

AOP

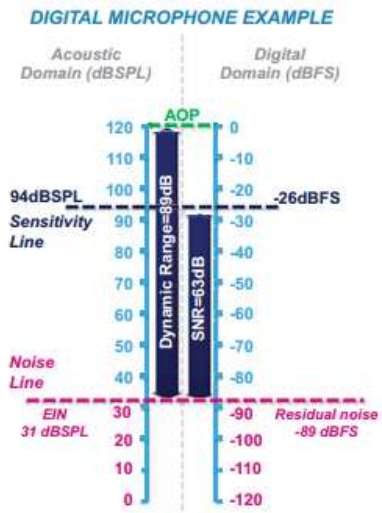
- **A**coustic **O**verload **P**oint is the highest acoustic sound pressure level the microphone can tolerate with a THD <10%
- **The higher, the better.**
- Typ 120dBSPL

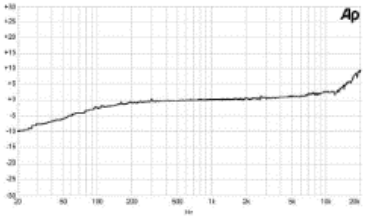
SNR

- Ratio of a reference signal to the noise level at the microphone output
- **The Higher, the better**
- Typ 63/64dB

Frequency response

- Is the microphone sensitivity plot in a given frequency range normalized at the sensitivity to a reference signal.
- **Usually, the flatter, the better**

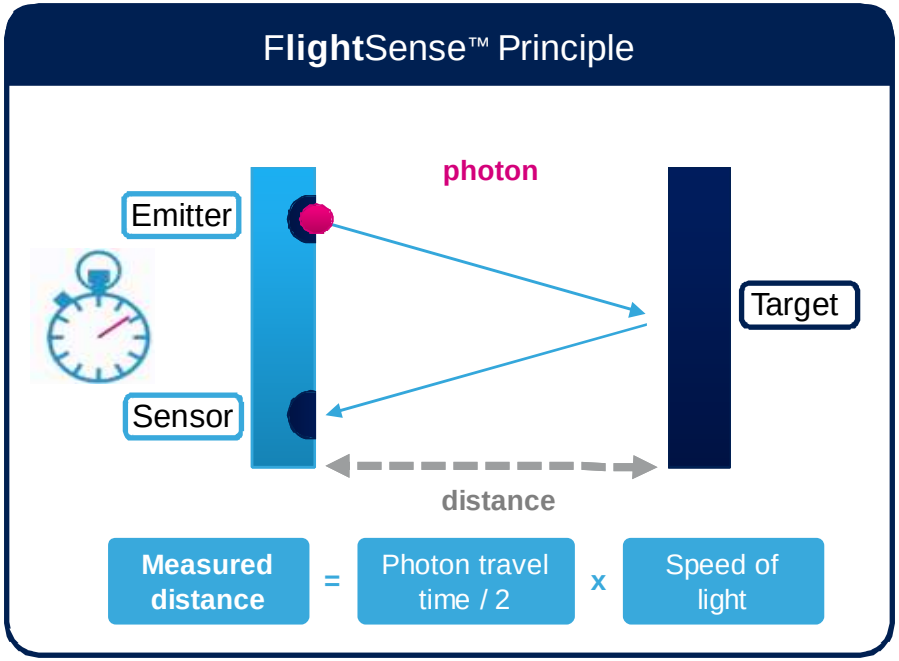




Analog or Digital Microphones?

- This choice is mainly driven by Application architecture !
  - Electrical connections, System architecture, legacy products?…
- Few questions/tips to help choice :
  - Do I need a very high SNR (ex : far field acquisition) ?
    - Analog Microphone are currently offering a higher SNR
  - Will my application run some SW algorithm on µC (STM32) ?
    - Digital MEMS well fit digital format used by audio algorithms.
  - BoM as low as possible ?
    - Direct connection between Digital MEMS and µC (STM32).

FlightSense™ Distance Sensor



Fully Integrated Time of Flight Module
ST #1 World Wide Supplier

True distance measurement
Independent of target size, color & reflectance

Measurement at the speed of light ! 1cm round-trip at 67ps

VL6180X

Product highlights

MP : now

OLGA **4.8 x 2.8 x 1mm**

- **Proven technology**.
  Family products have shipped >100Mu to date !
- **Fully integrated** (near IR 850nm VCSEL emission, filters, SPAD receiving array, advanced microcontroller)
- Range up to **60cm in 60ms**
- **Highly efficient ALS embedded**
- **Low power** (stdby 5uA, active <20mW at 10Hz)
- FoV : 25°
- Laser Class1 device (eye safe)
- Works with coverglass
- Complete API package and **Android driver**

Applications

Selfie AF assist

- Nice selfies even in low light, no blur image
- Ideal for visio conference
- Basic gesture

Proximity detection

Reliably detect user presence to safely power off screen during call

Ambient Light Sensing

Adjust the brightness of the display subject to the ambient light level detected

VL53L0X

Product highlights

MP : now

OLGA **4.4 x 2.4 x 1mm**

- **Fully integrated** (IR 940nm Vcsel emission, filters, SPAD receiving array, advanced µC)
- Range up to **200cm in less than 30ms**
- **High accuracy (typ. 5%)**
- **Low power** (stdby 5uA, active <20mW at 10Hz)
- FoV : 25°
- Laser Class1 device (eye safe)
- Excellent ambient light robustness (**940nm**)
- Works with cover glass
- Complete API package and **Android driver**

Applications

Laser AF

VL53L0 is #1 solution worldwide
Focus in < 30ms

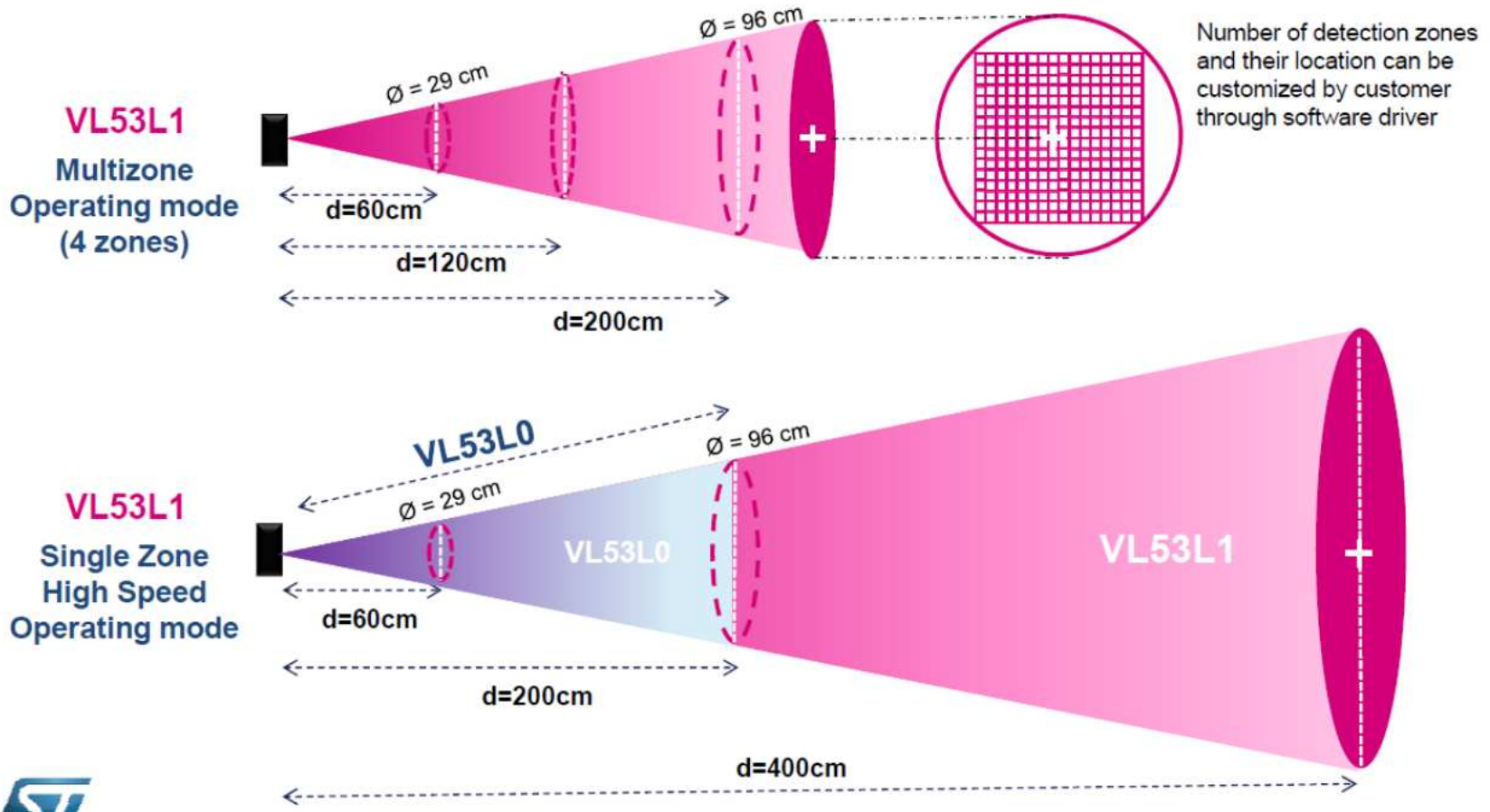
Drones

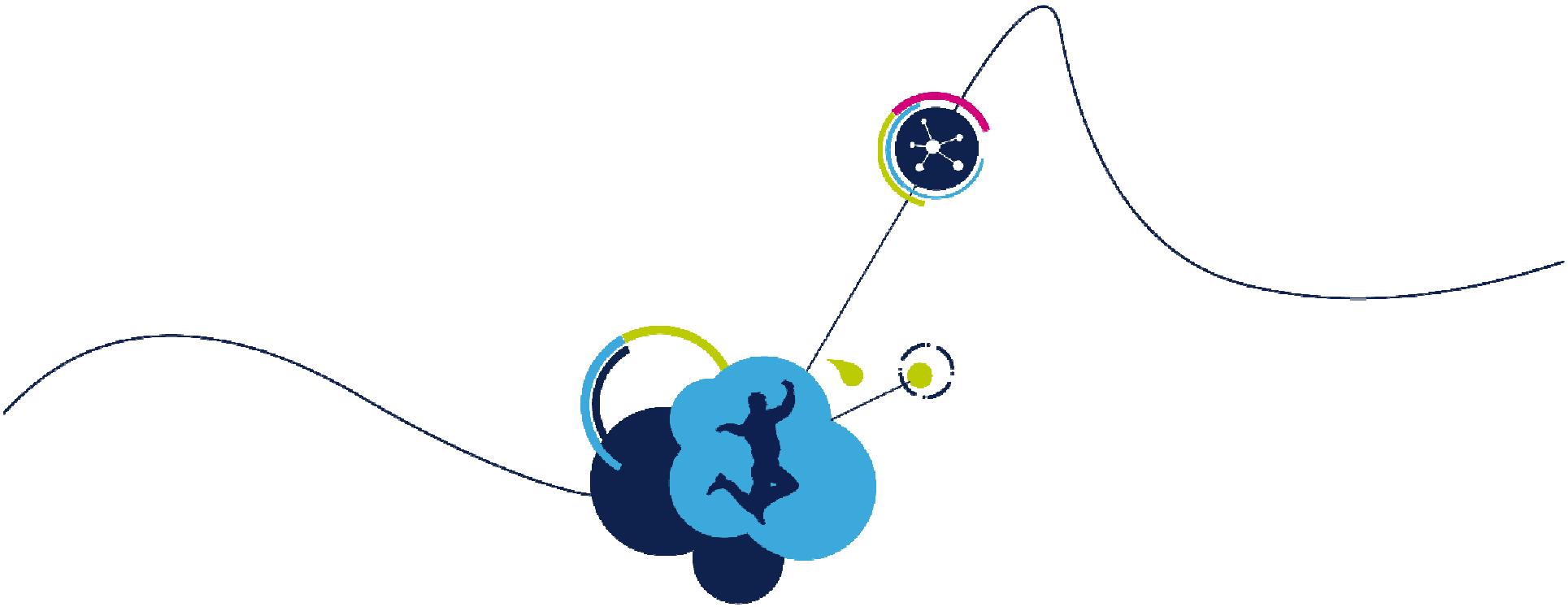
Take-off and landing assist
Ceiling detection

Human Occupancy Detection & Smart Interaction

Security – screen lock
Power saving – screen off
Basic gesture – volume, zoom

System Field of View (FOV) : 27° (Emitter & Receiver cones)





Connectivity

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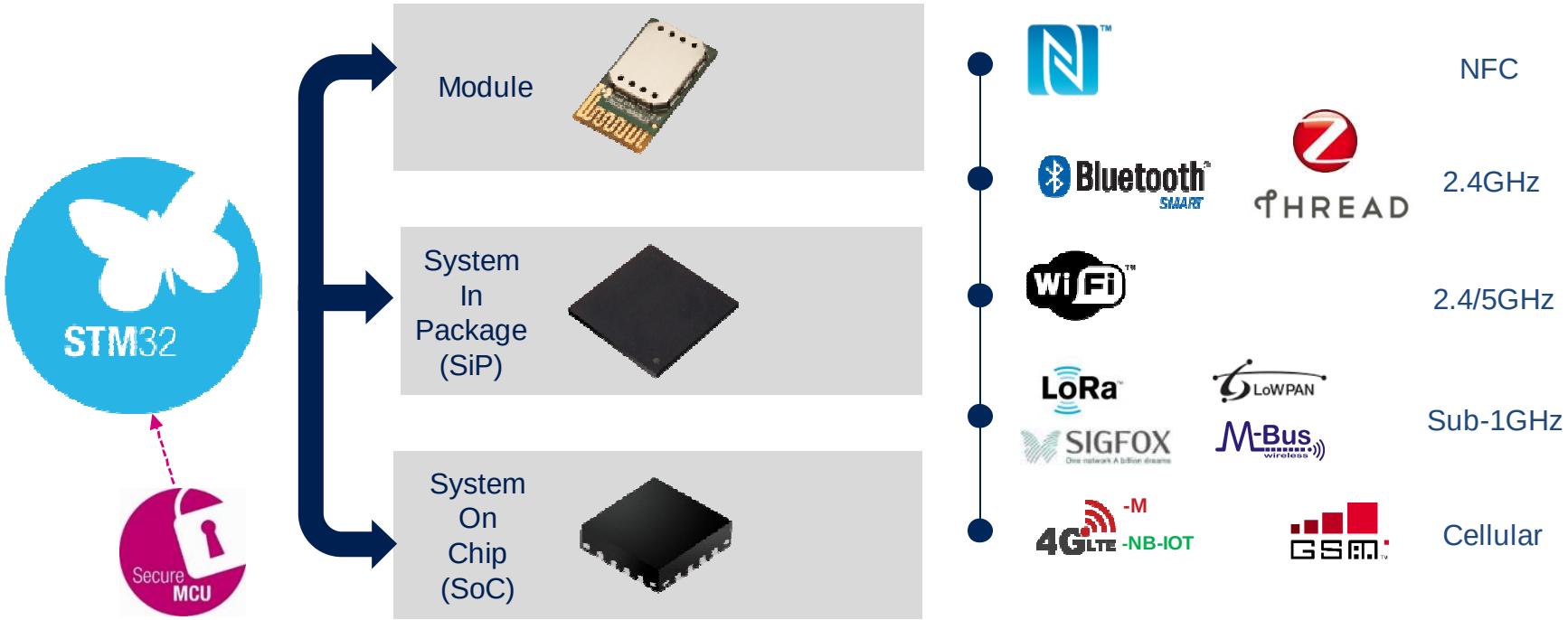
Communication powered by the ST

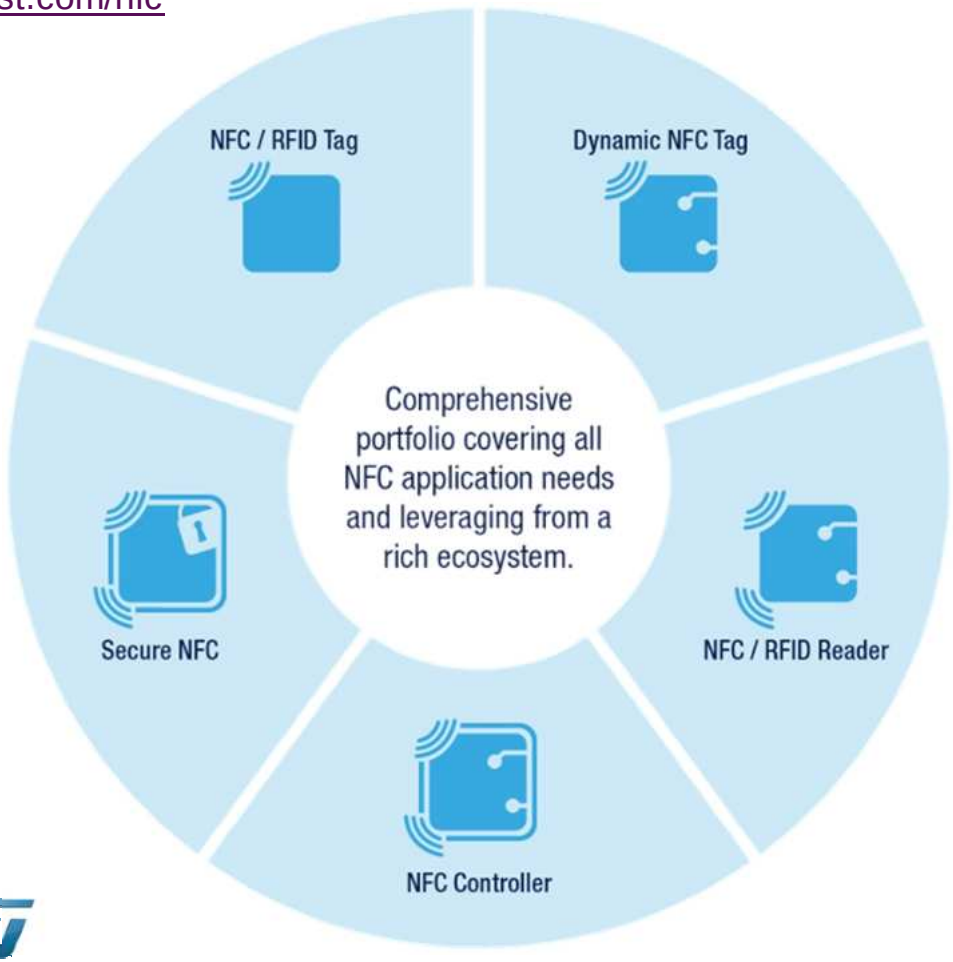
From Module to Integrated Solutions
Meeting requirements for time-to-market and volume



ST NFC porfolio

Covering all NFC application needs and leveraging a rich ecosystem

www.st.com/nfc



NFC FORUM
PROUD MEMBER

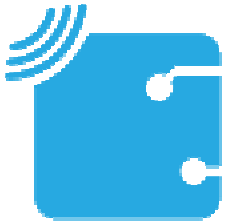
ST is a proud Sponsor Member of the NFC Forum

ST25 NFC/RFID portfolio

Tags

New ST25TA
tag on any object.
New brand protection

Dynamic Tags



New ST25DV
with Fast Transfer Mode
and SW upgrade

Readers

New ST25R HF
for Access control,
POS, and Automotive

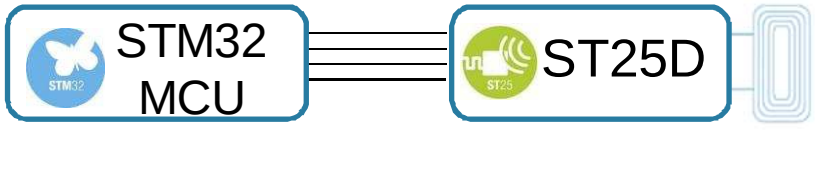
ST25 : NFC comprehensive solutions

Ticketing, Gaming, Medical, Brand protection, Access control, …

NFC Tags

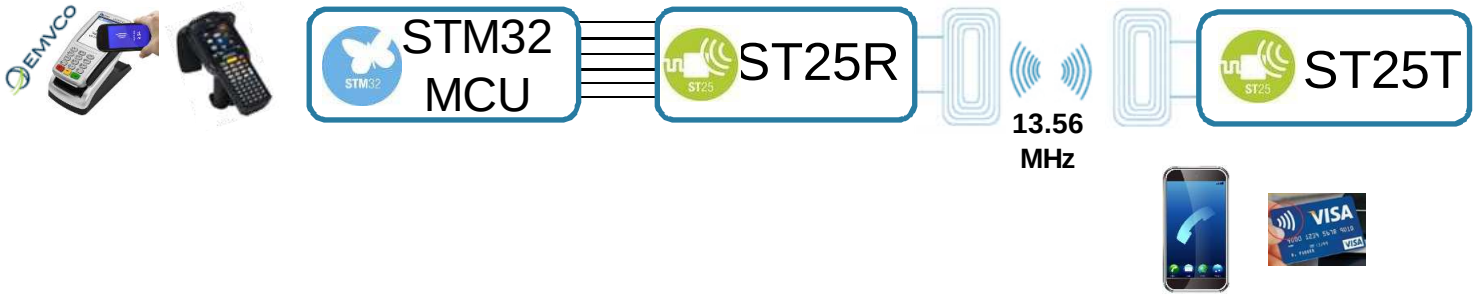
Industrial, Consumer, Metering, Appliance, …

NFC Dynamic Tags



POS & mPOS Terminals, Gaming, Medical, Brand protection, Access control, …

Readers



ST25 series enriching our lives!
Key applications targeted

Bluetooth Low Energy Family

Internet of Things

BlueNRG Family

- Ultra Low Power ARM-Based Bluetooth Processors
- Native Bluetooth 4.2
- Security, robustness & reliability
- Ultra small packages

Wearable | Beacon / Retail | Diagnostic | Medical | Toys / Gaming

Automotive | ePayment | Smart Home | Tags and Finders | Industrial

CHIPS AND MODULES

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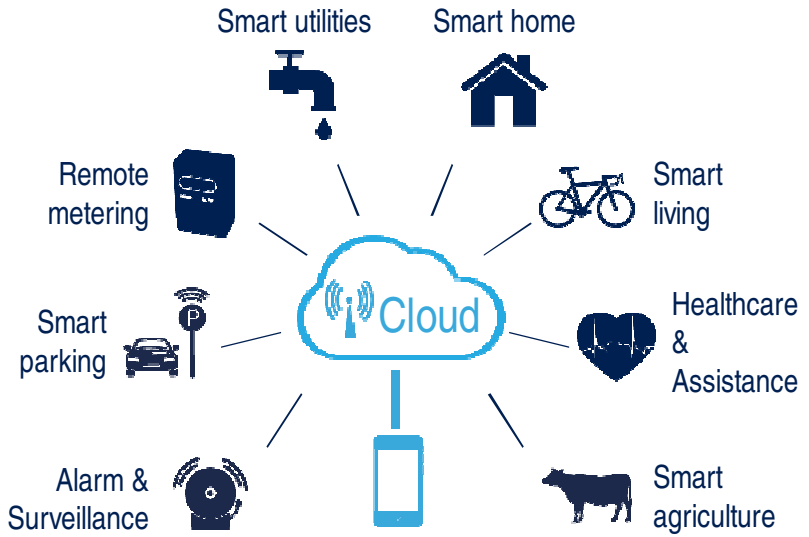
Sub-1GHz for Sensor to Cloud

Sensor to Cloud



CHIPS AND MODULES

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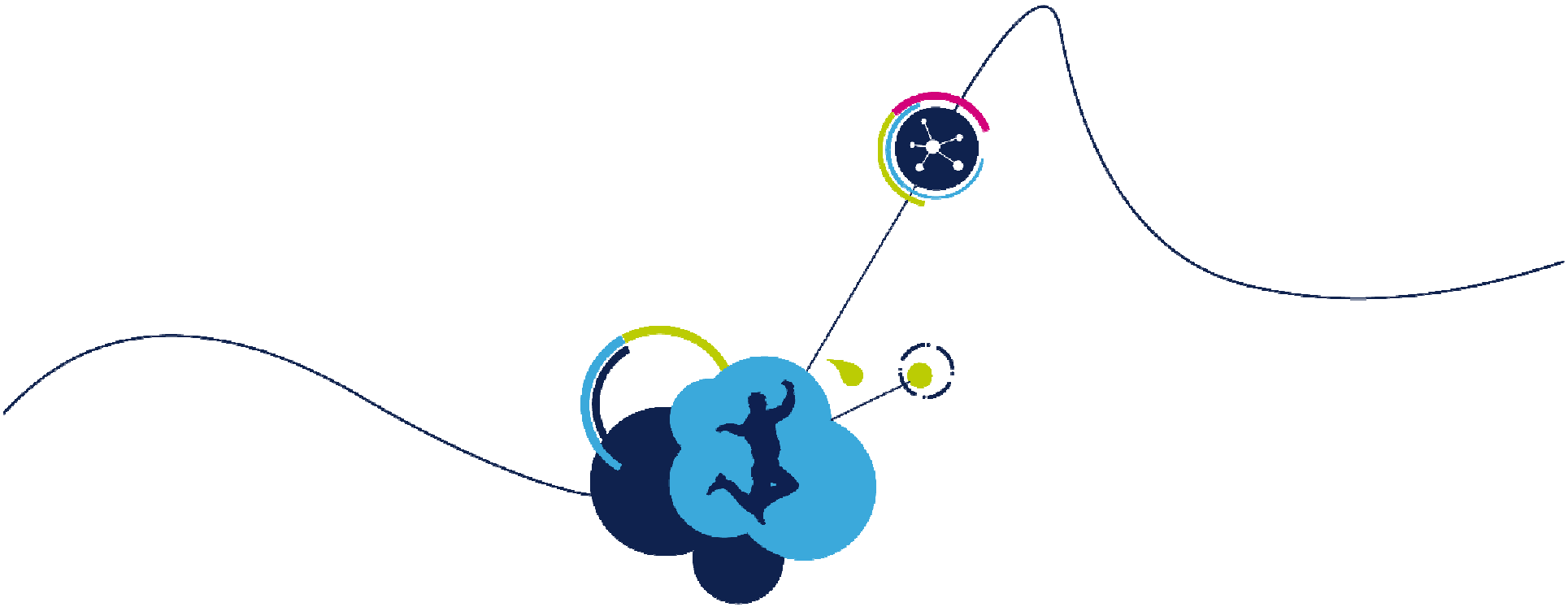

Motor Control ICs

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Size, Power & Simplicity

Motor control for the IoT

Internet of Things

Power Transistors

Motor Control

STM32

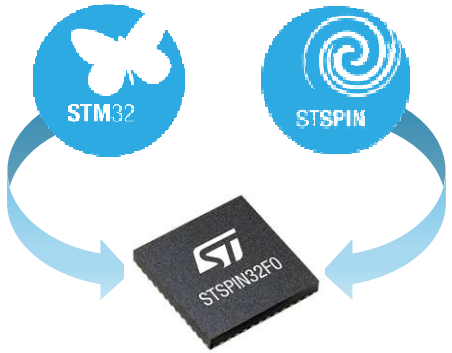
Microcontroller

World's Smallest Motor Drivers to Streamline Design and Boost Runtime of Battery-Powered Devices for the Internet of Things

STSPIN

- Tiny 3mm x 3mm package
- Standby current of less than 80nA
- Down to 1.8V operating voltage for ultra low

Power and Simplicity in Intelligent Motion-Control Device for Smart Industry and High-End Consumer Electronics



- Highly integrated system-in-package 7mm x 7mm
- Powerful ST ecosystem comprising tools and

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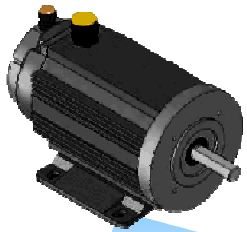
ST Motion Control Ecosystem

A Hardware and Software Suite to drive Your Motor at Best

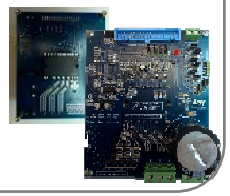
Ready-to-use ST Solution for Motion Control



ST MC Workbench

PC SW GUI
Full customization and real time communication

HW & FW tools



Wide range of algorithms for specific applications (FOC – 6step)

Technical Support (at World Wide level)

ST Motor Control Workbench and Motor Profiler

- The Motor Profiler tool embedding sophisticated algorithm able to measure automatically all the essential electrical characteristics of three phase Motors.

- It can be used to run an unknown motor from scratch in **less than a minutes.** The Motor Profiler determines the correct motor parameters configuring the STM32 Field Oriented Control firmware library.

- Single/Dual simultaneous Motor Control (depending on the Hardware)
- Complete speed and torque control
- Different Current reading topology supported
- High End sensorless algorithm also for zero speed.
- Motor control algorithms implemented for specific applications like Maximum Torque Per Ampere (MTPA), Flux Weakening and more.
- Firmware ANSI C, MISRA compliant

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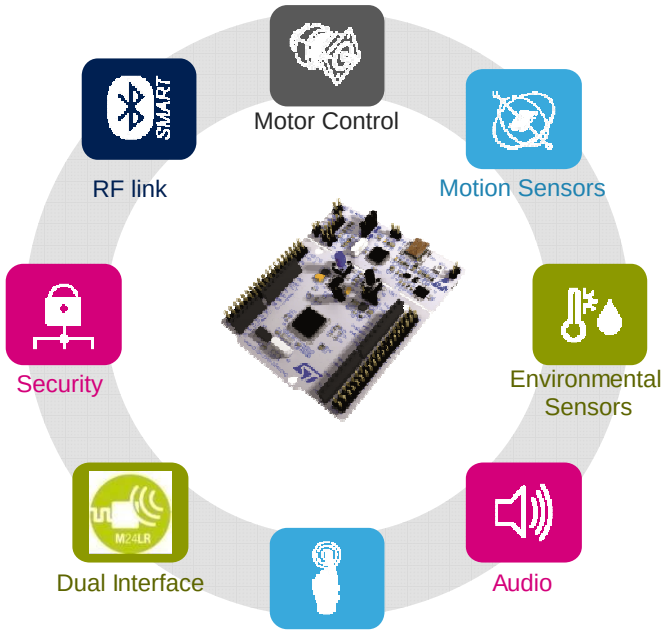
STM32 Open Development Environment

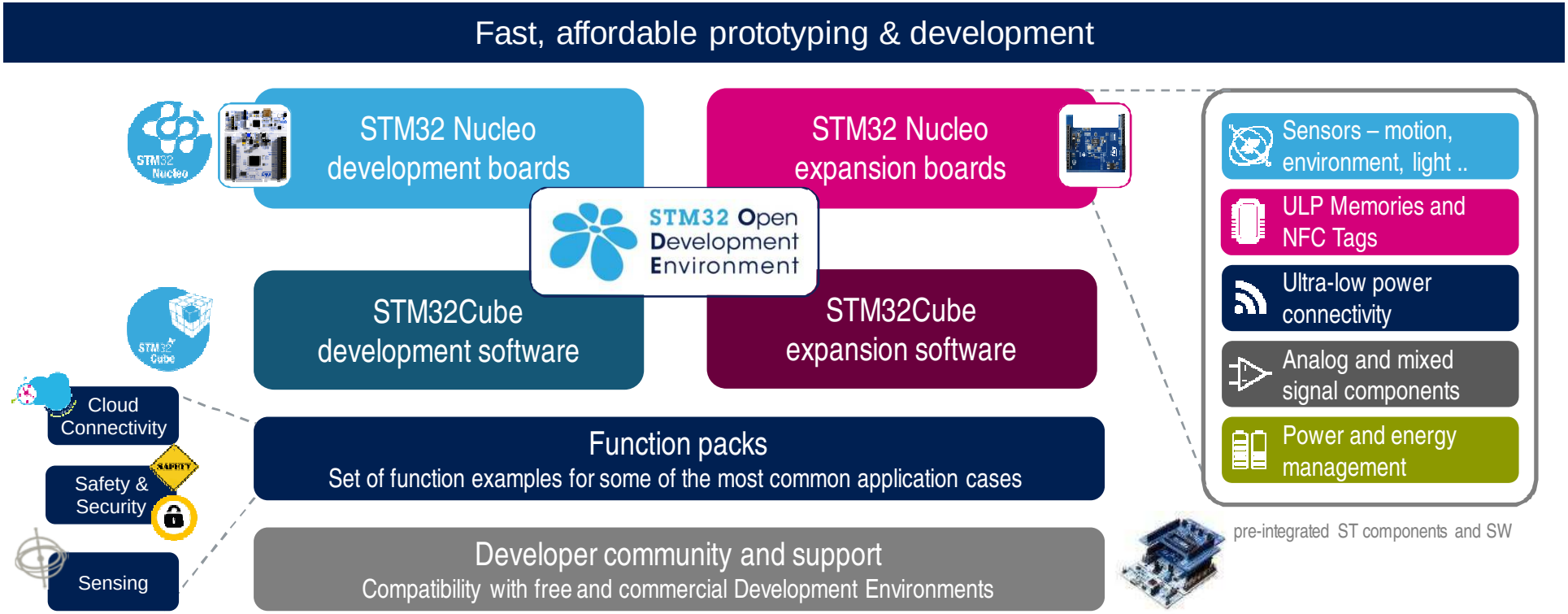
Fast, affordable development and prototyping

The needs of developers

- A microcontroller is usually the first choice of developers when designing a new application
  - Need to pick from low power to high performance microcontroller based on application needs
- A set of extra functions are keys to implement the system
  - Sensing, data conversion, processing, connectivity, power management, …
- Easy to use Integrated Development Environment to allow fast development and production
  - Support of multiple IDE
  - Free of charge tools and embedded software to enable fast and easy development



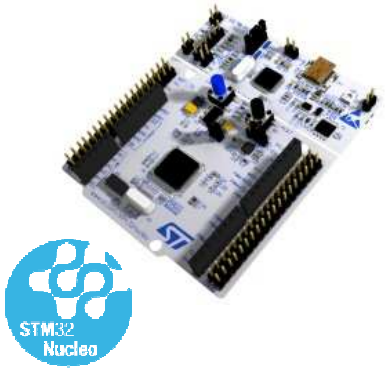
STM32 Open Development Environment



STM32 Open Development Environment
Hardware Components

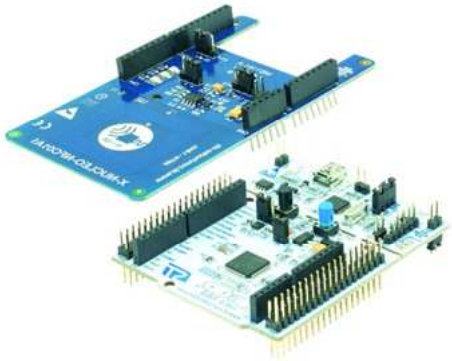
STM32 Nucleo Development Boards

- Based on ST's 32-bit ARM Cortex-M based STM32 microprocessors
- Development boards for all STM32 families available or planned



STM32 Nucleo Expansion Boards

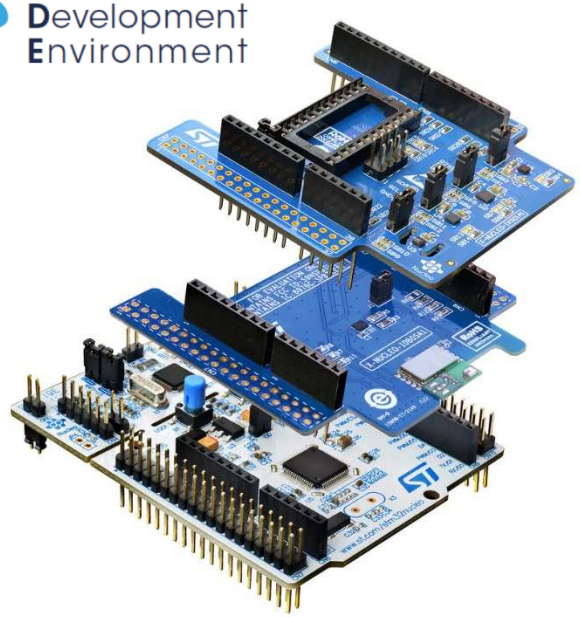
- Boards with additional functionality: sensing, connectivity, power, analog
- Plugged on top of the STM32 Nucleo developer board or stacked on top of other expansion boards
- Leverage ST wide product portfolio



Going beyond with the STM32 Open Development Environment

www.st.com/stm32ode
www.st.com/stm32ode-fp

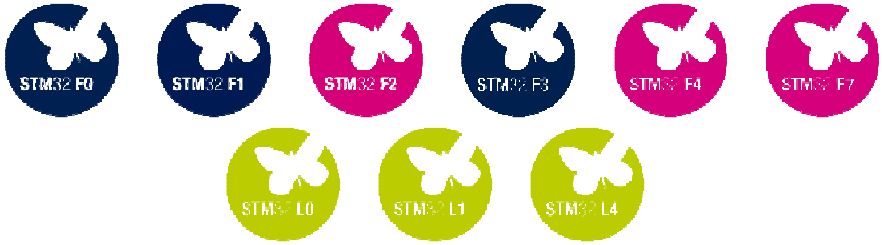
STM32 Open Development Environment



Several expansion boards covering all the key functions

Sense	Connect	Power Drive	Move Actuate	Translate
Motion & environmental sensors Proximity sensor Microphone	BLE Wi-Fi Sub-GHz NFC	Power management LED Boost	Motor drive Actuator	Audio OpAmp

12 processor boards from 9 families



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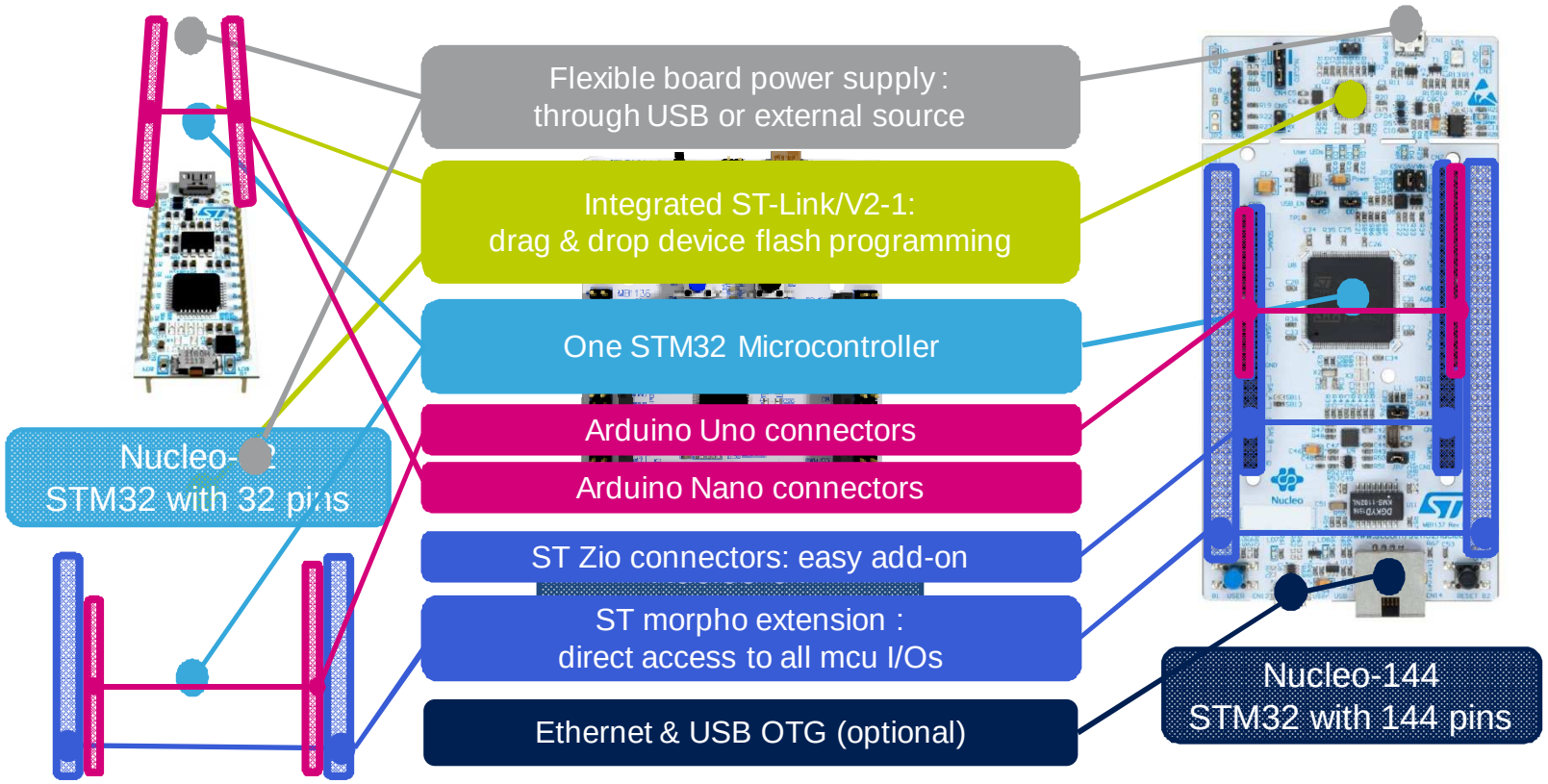
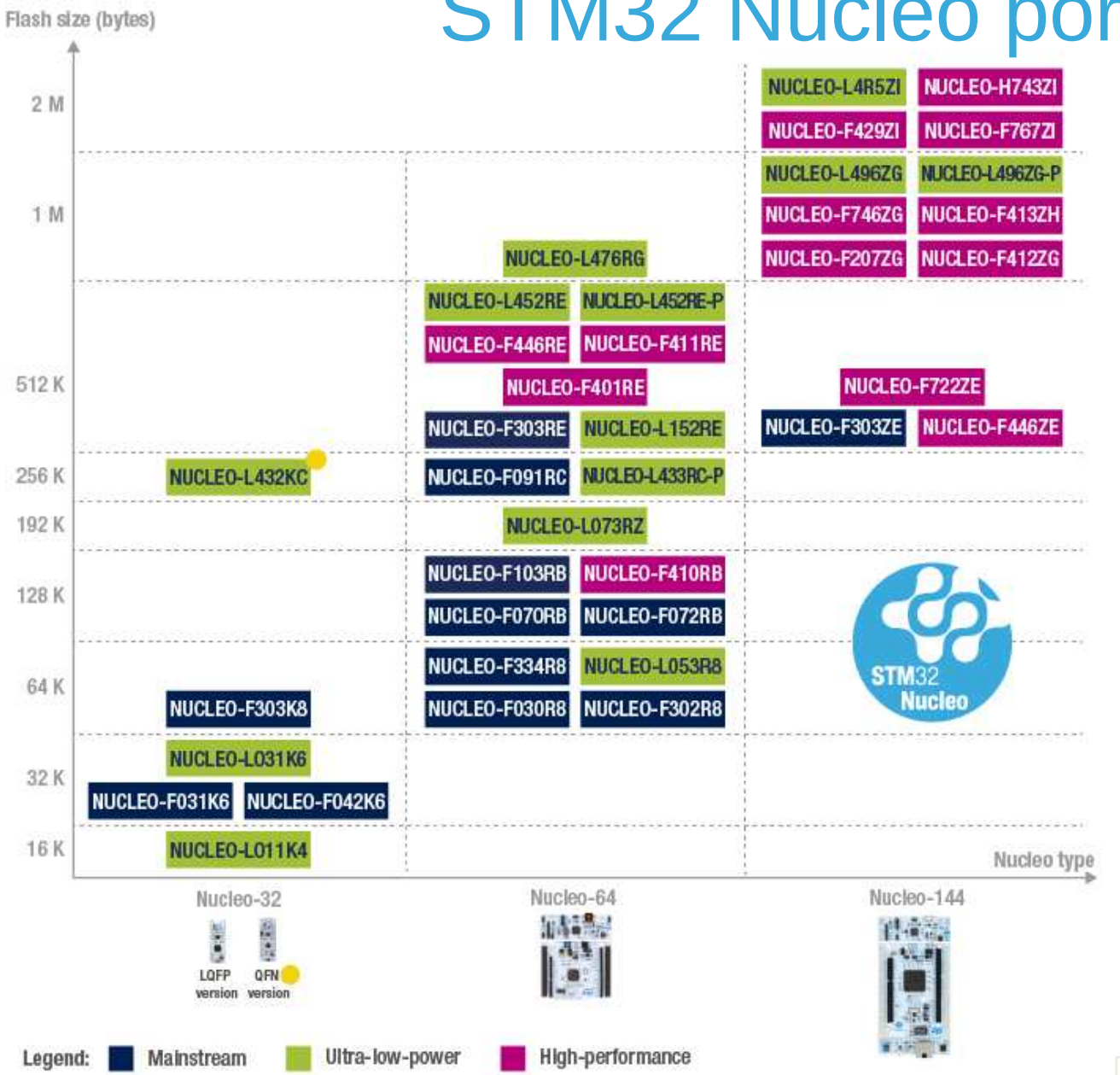
STM32Nucleo Boards

Enlarging the STM32Nucleo family to cover whole STM32 portfolio

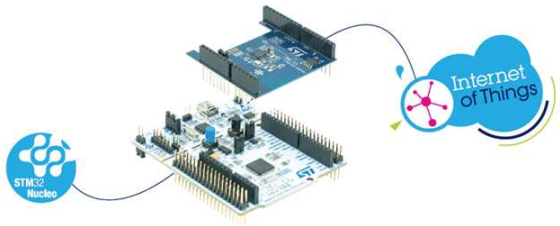


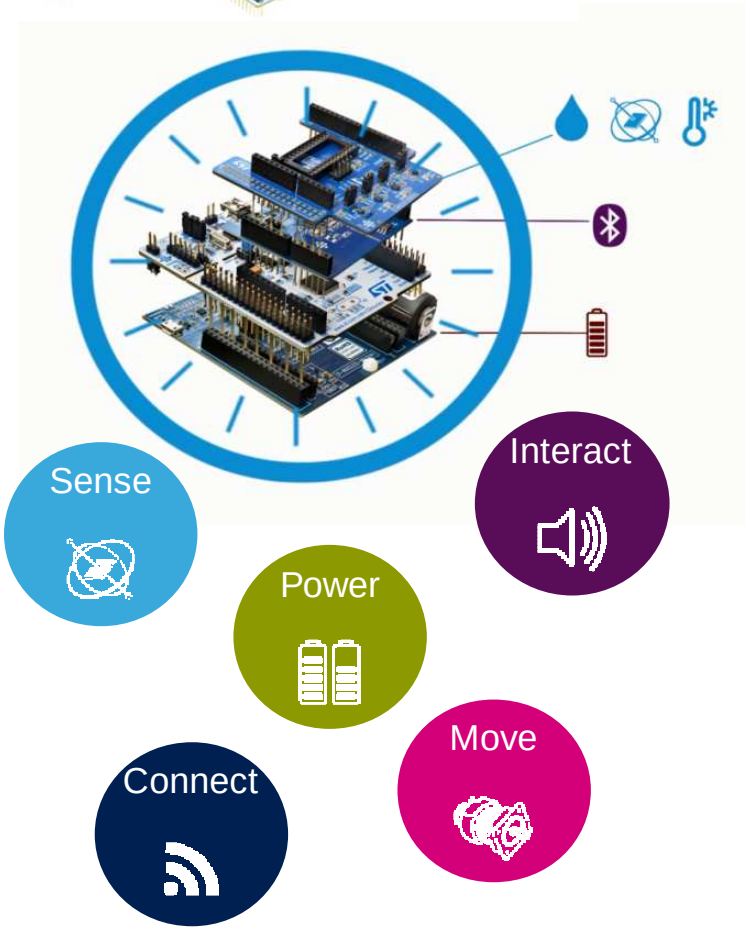
STM32 Nucleo portfolio



www.st.com/stm32nucleo

Association with shields





Specialized functionality add-on

Smooth integration with STM32Cube software library

Multiple IDEs (MBED, IAR, ARM…)

Nucleo expansion boards from ST

Sensors and analog

X-NUCLEO-IKS01A2
MOTION AND ENVIRONMENTAL SENSORS

X-NUCLEO-6180XA1
PROXIMITY AND AMBIENT LIGHT SENSOR

X-NUCLEO-53L0A1
PROXIMITY SENSOR

X-NUCLEO-CCA02M1
DIGITAL MICROPHONES

Communication

X-NUCLEO-IDB05A1
BLUETOOTH LOW ENERGY

X-NUCLEO-NFC04A1
DYNAMIC NFC TAG

X-NUCLEO-NFC05A1
NFC CARD READER

X-NUCLEO-PLM01A1
POWER LINE COMMUNICATION

X-NUCLEO-GNSS1A1
ASSISTED GNSS

Motor drive

X-NUCLEO-IHM01A1
STEPPER MOTOR DRIVER

X-NUCLEO-IHM07M1
STEPPER MOTOR DRIVER

X-NUCLEO-IHM02A1
TWO AXIS STEPPER MOTOR DRIVER

X-NUCLEO-IHM06A1
LOW VOLTAGE STEPPER MOTOR DRIVER

X-NUCLEO-IHM03A1
HIGH POWER STEPPER MOTOR DRIVER

X-NUCLEO-IHM05A1
BIPOLAR STEPPER MOTOR DRIVER

X-NUCLEO-IHM04A1
DUAL BRUSH DC MOTOR DRIVER

X-NUCLEO-IHM12A1
LOW VOLTAGE DUAL BRUSH DC MOTOR DRIVER

Translate

X-NUCLEO-IKA01A1
MULTIFUNCTIONAL EXPANSION BASED ON OPERATIONAL AMPLIFIERS

X-NUCLEO-CCA01M1
SOUND TERMINAL

X-NUCLEO-LED61A1
LED DRIVER

X-NUCLEO-IPS02A1
INTELLIGENT POWER SWITCH

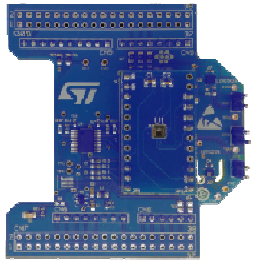
www.st.com/x-nucleo

More Nucleo expansion boards

BLE

WiFi 802.11 b/g/n

Dynamic NFC tag



Motion & Environmental sensors

Proximity & Light sensor

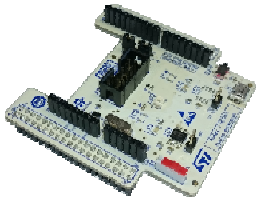
Audio Microphones

Motor driver

LED driver

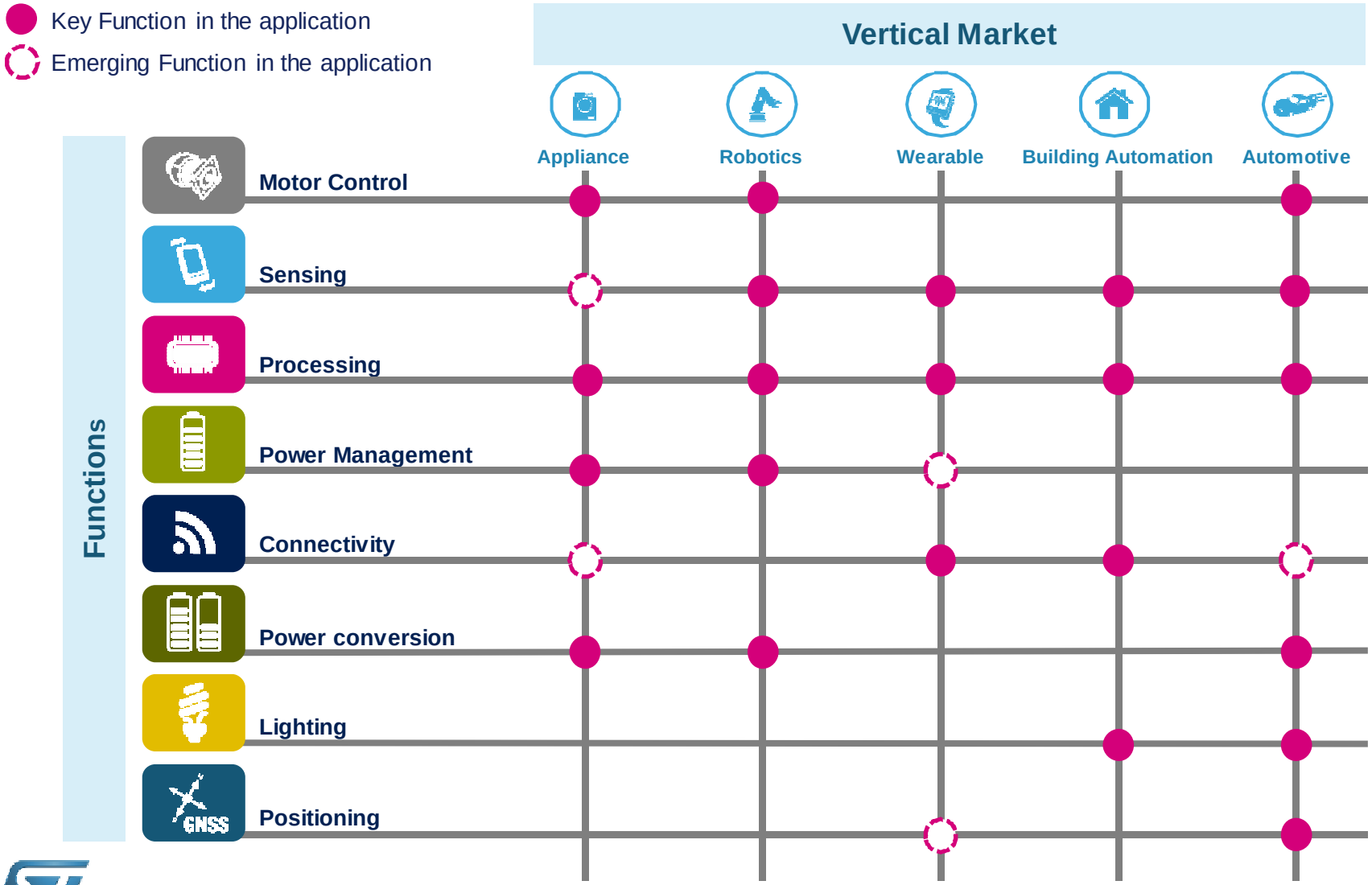
LoRa

Sub-1GHz

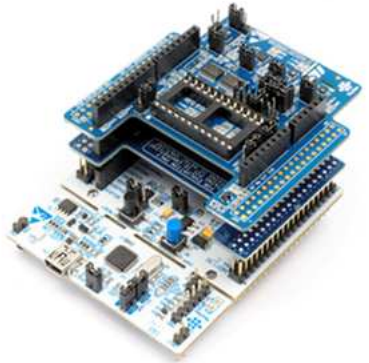


Security

Product offering organized by function



STM32 ODE function pack for IoT node with BLE connectivity and environmental and motion sensors
(FP-SNS-MOTENV1 *AKA BlueMicrosystem*)



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STM32 Open Development Environment

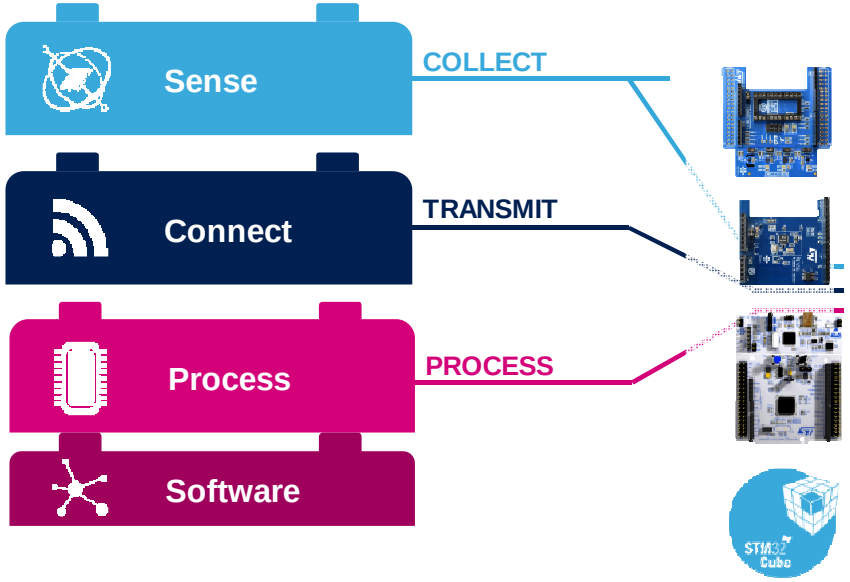
Building block approach

The building blocks | Your need | Our answer

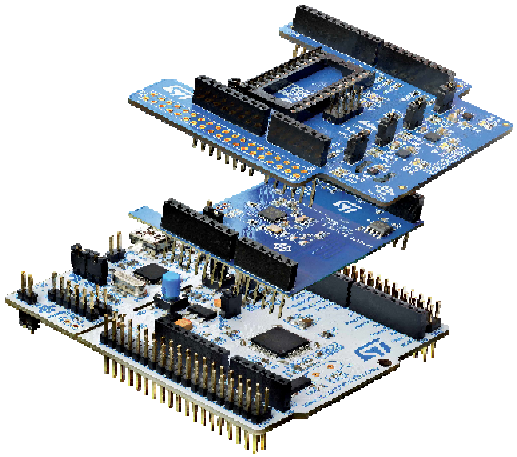
Accelerometer, gyroscope
Inertial modules, magnetometer
Pressure, temperature, humidity
Proximity, microphone

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

General-purpose microcontrollers
Secure microcontrollers



STM32 Open Development Environment



www.st.com/stm32ode

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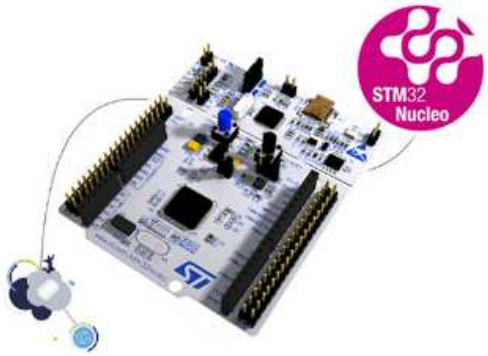
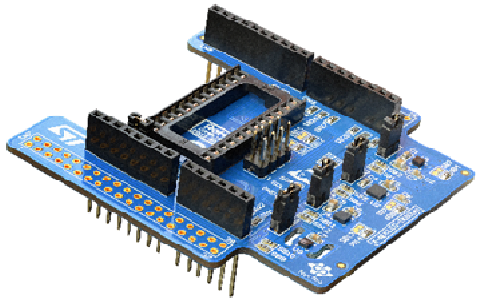
Hardware System

NUCLEO-F401
or
NUCLEO-L476RG



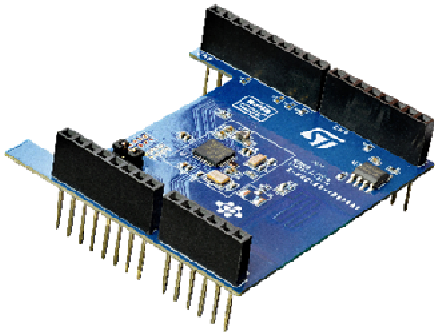
Microcontroller

X-NUCLEO-IKS01A2

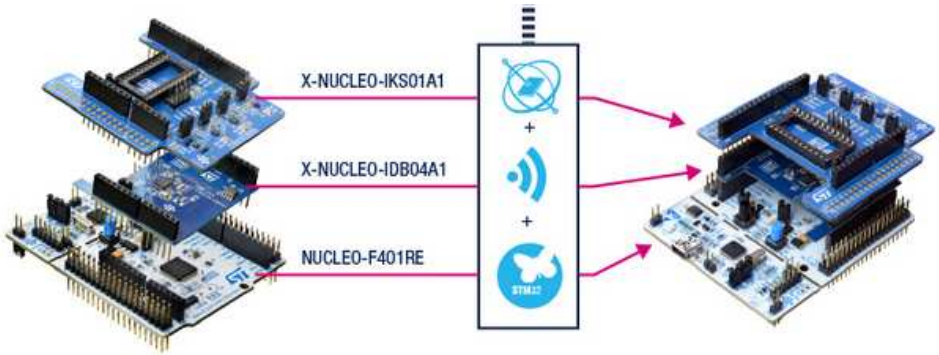


Motion MEMS and Environmental Sensors

X-NUCLEO-IDB05A1



Bluetooth Low Energy



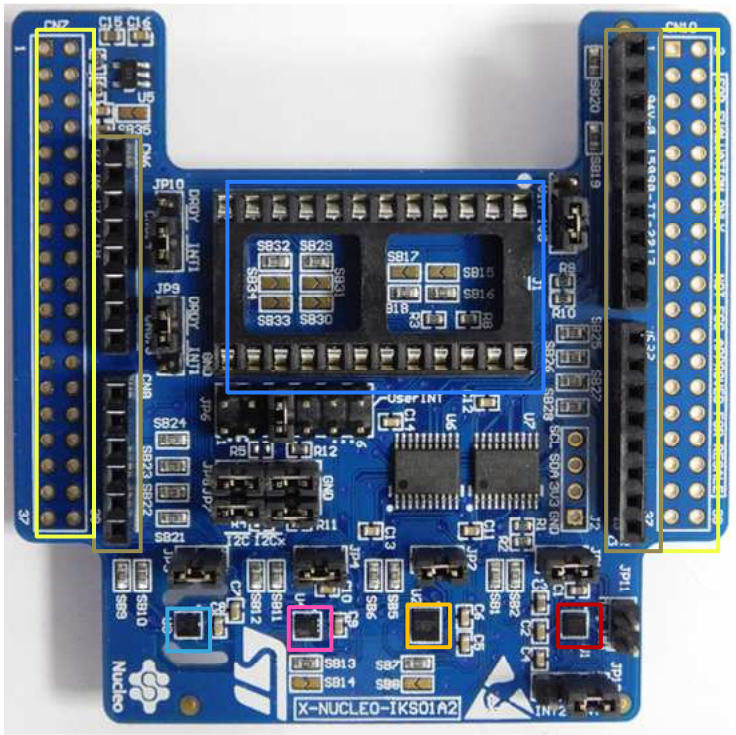
Motion MEMS and environmental sensors expansion board

X-NUCLEO-IKS01A2 Hardware Description

- The X-NUCLEO-IKS01A2 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

LSM6DSL
MEMS 3D accelerometer (±2/±4/±8/±16 g) + 3D gyroscope (±125/±245/±500/±1000/±2000 dps)
LSM303AGR
MEMS 3D magnetometer (±50 gauss) + MEMS 3D accelerometer (±2/±4/±8/±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 (UV index)



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

Latest info available at www.st.com
X-NUCLEO-IKS01A2

** Connector for the STM32 Nucleo Board

Bluetooth Low Energy Expansion Board

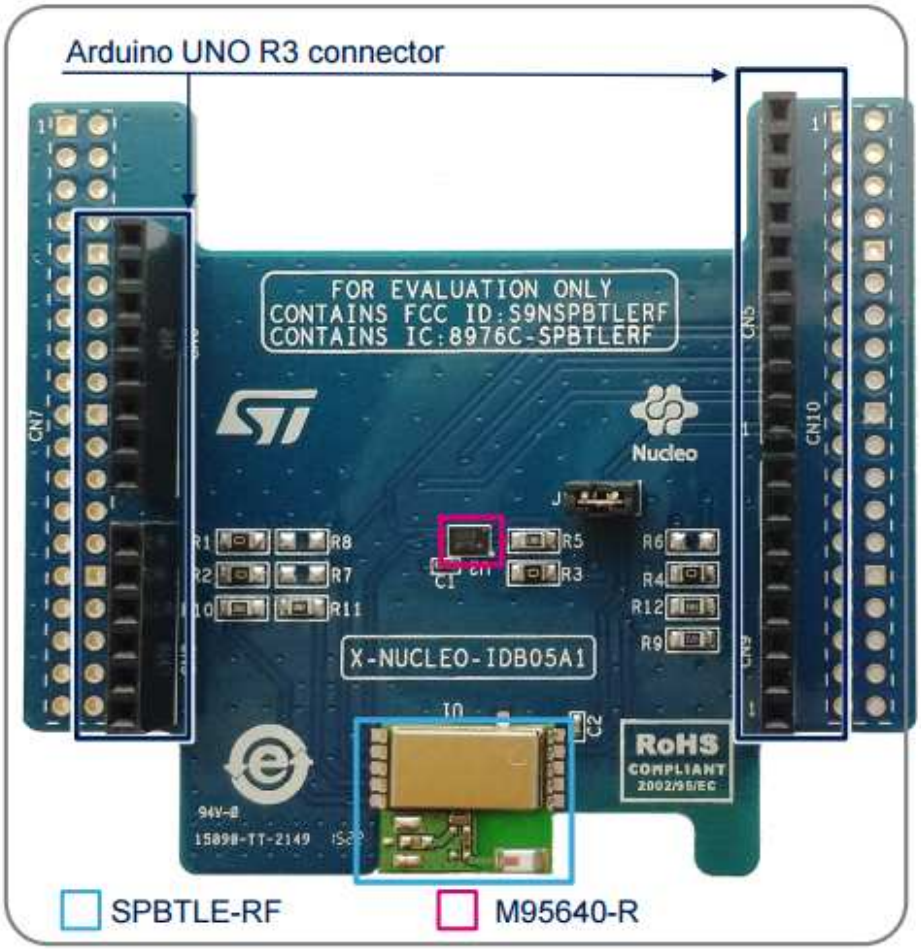
X-NUCLEO-IDB05A1 Hardware Description

- The X-NUCLEO-IDB05A1 is a Bluetooth Low Energy (BLE) evaluation and development board system, designed around ST's SPBTLE-RF Bluetooth Low Energy module based on BlueNRG-MS.
- The BlueNRG-MS processor hosted in the SPBTLE-RF module communicates with the STM32 Nucleo developer board host microcontroller though an SPI link available on the Arduino UNO R3 connector.

Key Products on board

SPBTLE-RF
Bluetooth Low Energy, FCC and IC certified, module based on Bluetooth® Low Energy wireless network processor BlueNRG-MS, BLE4.1 compliant. SPBTLE-RF integrates a BALF-NRG-01D3 balun and a chip antenna. It embeds 32 MHz and 32.768 kHz crystal oscillators for the BlueNRG-MS.

M95640-R
64-Kbit serial SPI bus EEPROM with high-speed clock interface



Latest info available at www.st.com
X-NUCLEO-IDB05A1

FP-SNS-MOTENV1

Software Overview

Software Description

The FP-SNS-MOTENV1 is an STM32 ODE function pack which let you connect your IoT node to a smartphone via BLE and uses a suitable Android™ or iOS™ like the BlueMS app to view real-time environmental sensor data, motion sensor data, and Gas Gauge level.

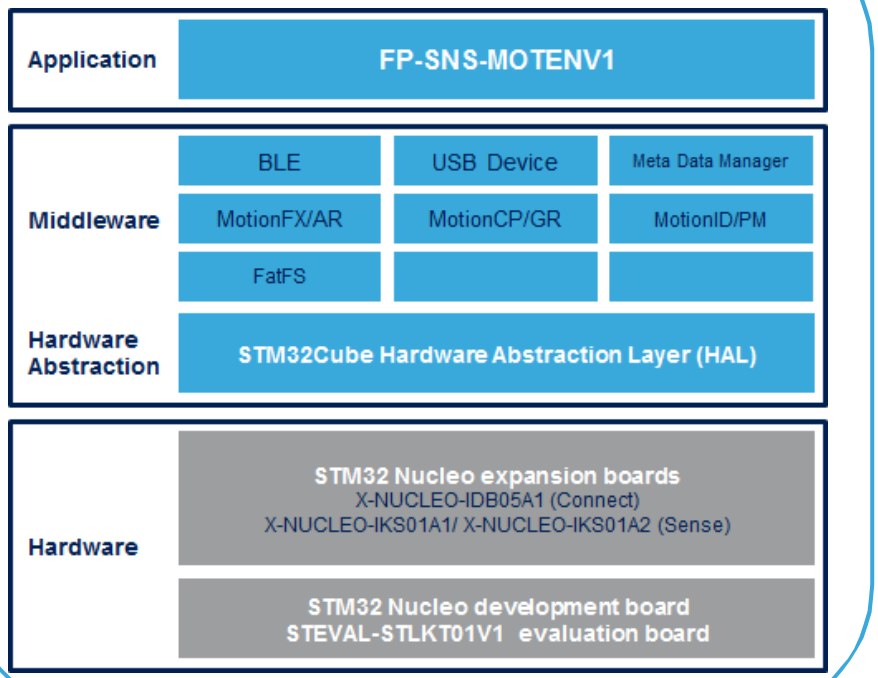
This package also enables advanced functionalities such as the sensor data fusion and accelerometer-based real-time activity recognition and MEMS sensor data logging on SD card.

This package, together with the suggested combination of the STM32 and ST devices, it can be used to develop specific wearable applications, or smart things applications in general.

Key features

- Complete firmware to develop an IoT node with BLE connectivity, environmental and motion sensors
- Middleware libraries for sensor data fusion and accelerometer-based real-time activity recognition, sd card data logging.
- Compatible with BlueMS applications for Android/iOS, to perform sensor data reading, motion algorithm features demo and firmware update (FOTA)
- Example implementation available for the STEVAL-STLKT01V1 board, X-NUCLEO-IKS01A1 (or X-NUCLEO-IKS01A2) and X-NUCLEO-IDB05A1 (or X- NUCLEO-IDB04A1) connected to a NUCLEO-F401RE or NUCLEO-L476RG or NUCLEO-L053R8 board
- Easy portability across different MCU families, thanks to the STM32Cube
- Free, user-friendly license terms

Overall Software Architecture



Latest info available at www.st.com
FP-SNS-MOTENV1

Bluetooth low energy and sensors software

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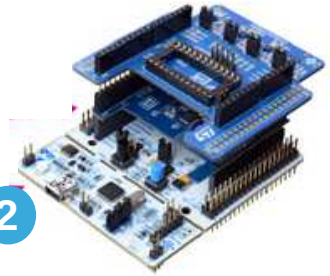
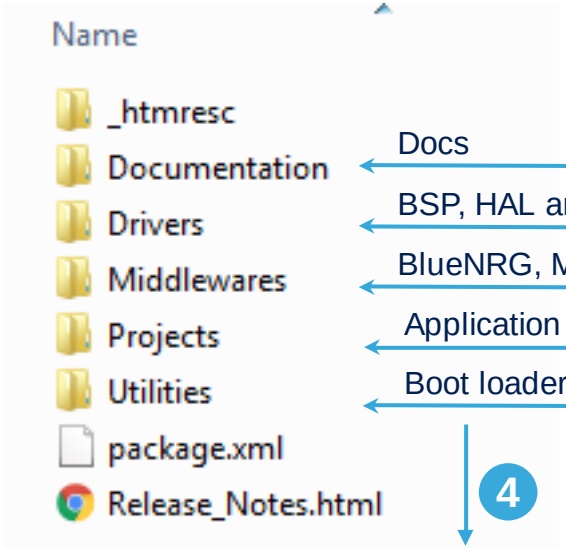
1 www.st.com/stm32ode-fp



2 Select FP-SNS-MOTENV1

3 Download & unpack

FP-SNS-MOTENV1 package structure



4 .\Projects\Multi\Applications\MOTENV1\EWARM\STM32F401RE-Nucleo

Android™/iOS™ smartphone and ST BlueMS application

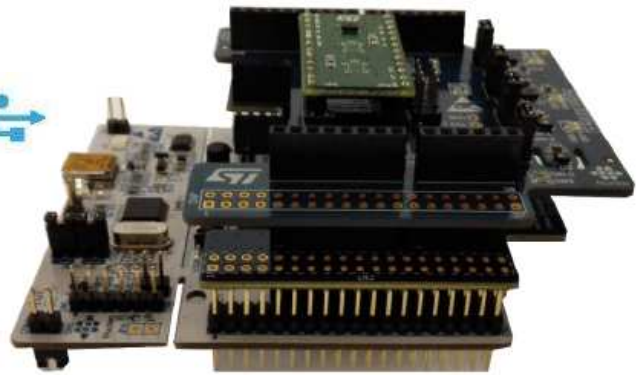
6

KEIL Tools by ARM

IAR SYSTEMS

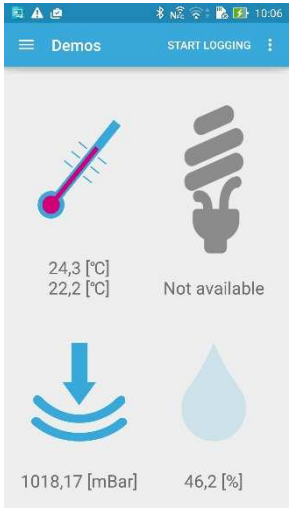
5 Compile/Flash and Run the project

IMPORTANT:
Read the chapter “The Boot Process” on User Manual for understanding how to install the Boot Loader on the board

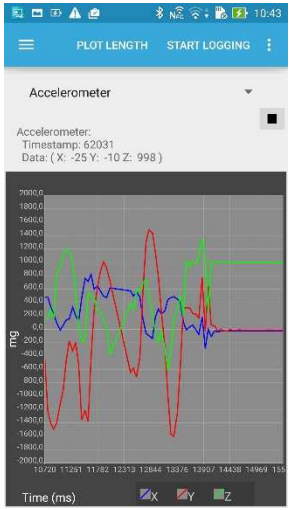


BlueMS Application for **Android/iOS (1/2)**

Hardware Features – Android Version

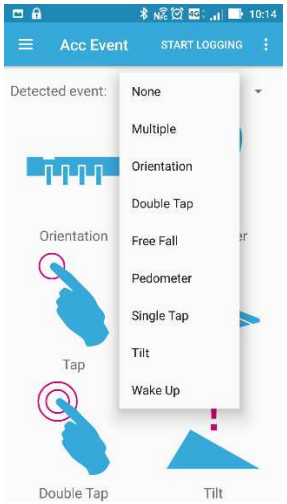


Environmental page

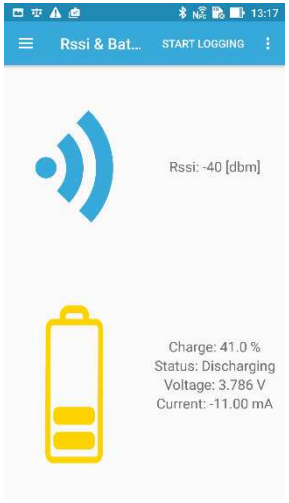


Accelerometer plot

Led Status

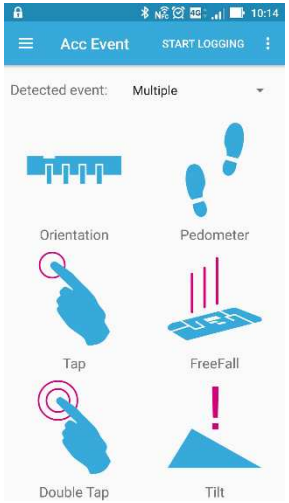


DS3/DSM/DSL Menu Events

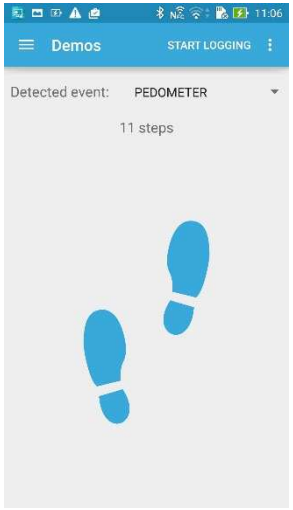


RSS & Battery Page

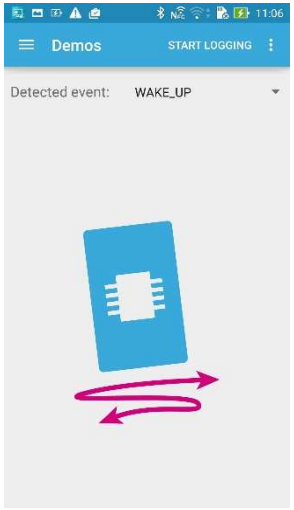
DS3/DSM/DSL Event



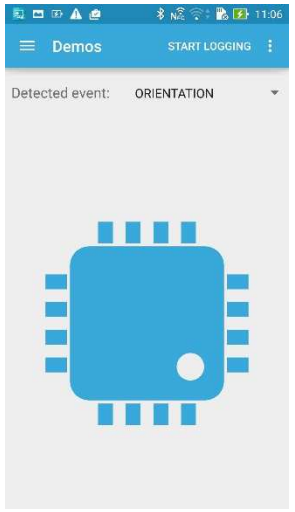
Multiple events page



Pedometer

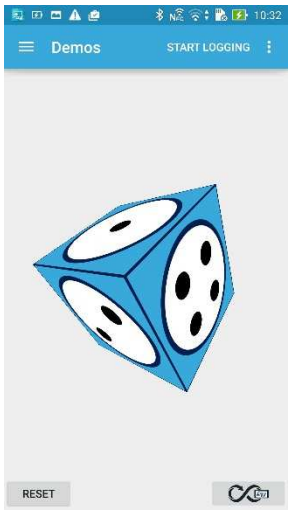


Wake Up

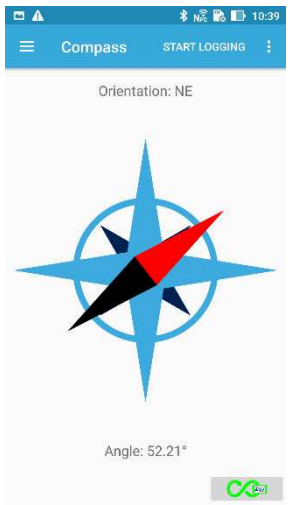


Orientation

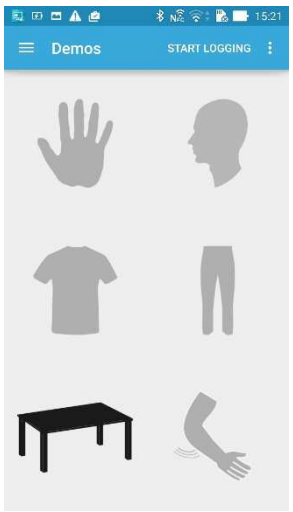
BlueMS Application for **Android/iOS (2/2)**



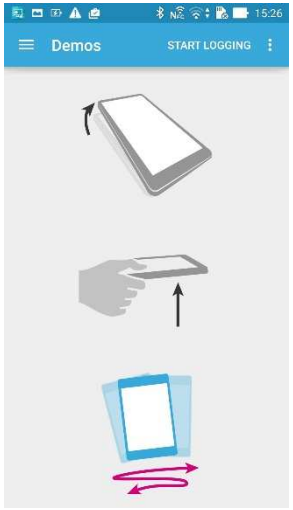
MotionFX sensor fusion page



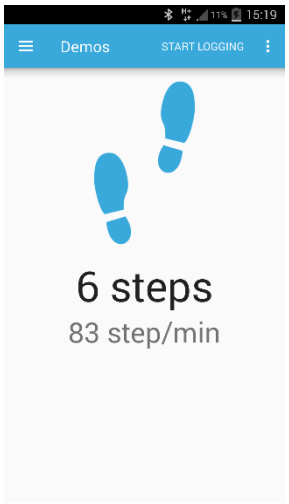
MotionFX - ecompass



MotionCP carry position recognition page

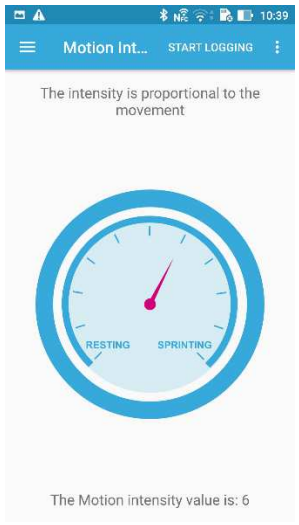


MotionGR gesture recognition page

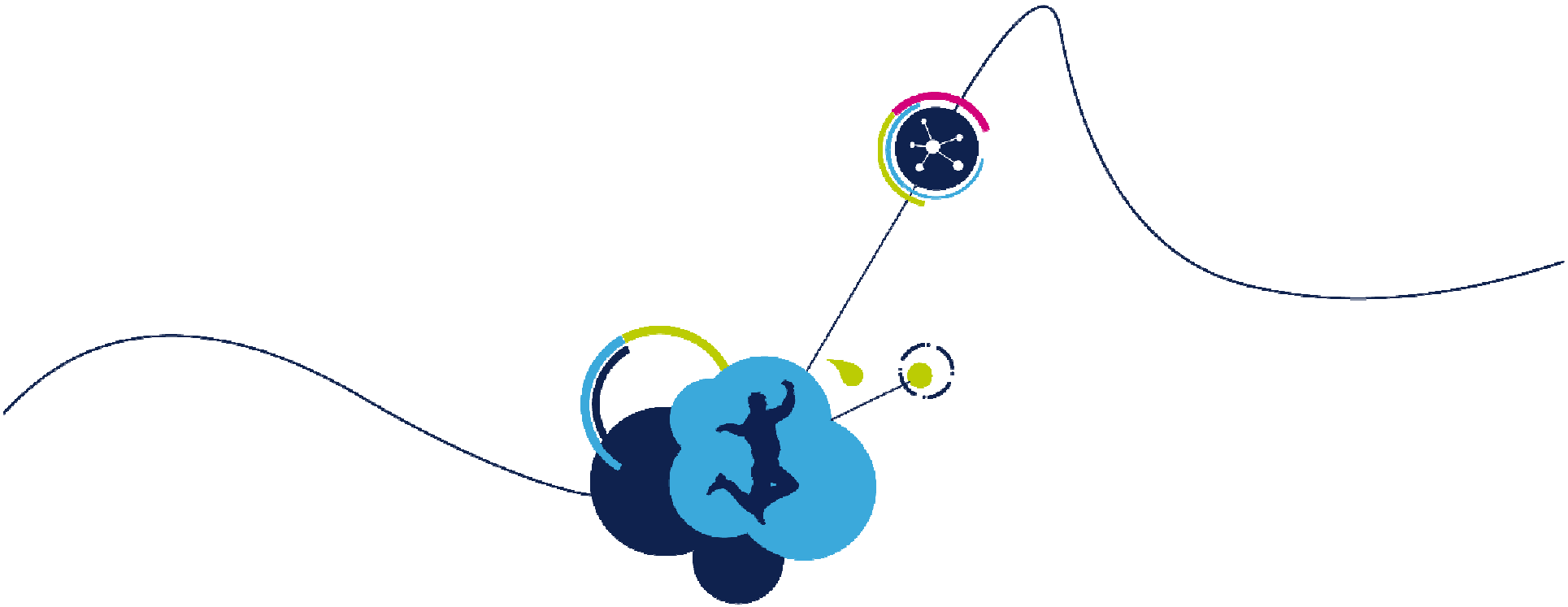


MotionPM Pedometer page

MotionAR activity recognition page



MotionID motion intensity page



Examples for Projects

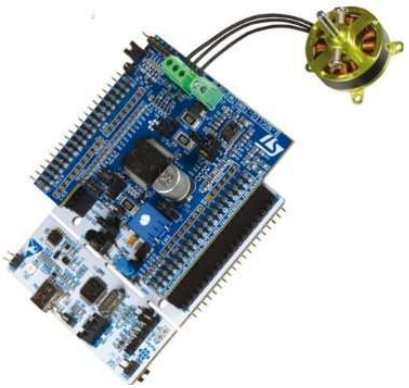
Duckietown

PERLATECNICA
NO PROFIT ORGANIZATION

- Spring 2016, MIT has a new class about the science of autonomy at the graduate level. This is a hands-on, project-focused course **focusing on self-driving vehicles and high-level autonomy**.
- University of Naples, PERLATECNICA (no profit organization) and BlueNet are working on **High School Program**

Proposal – Arm Robot

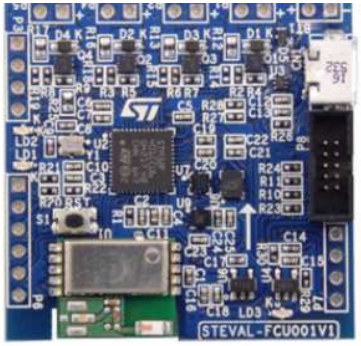
- 4 DoF 3D printable robotic arm
- Each joint has a different king of motor:
  - Std servo (hand)
  - Stepper motor
  - Brushless dc sensorless
  - Brushless dc sensored



- 12V operation (3S LiPO compatible and safe)
- **We did an example with Servo Motor!**

Drone Kit

4 x 65 mm - CW and CCW propellers



STEVAL-FCU001
Flight Control Unit

3.7 V, 500 mA 1-cell LiPo battery

this video will help you with a step-by-step guide on how to build the minidrone

Getting Started with
Drone Flight Control Unit


Thank you