# E3020 Systèmes embarqués

## CM2-CARACTÉRISTIQUES D'UN MICROCONTRÔLEUR

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# Objectifs

1. Evaluer l'ensemble des modules/fonctions insérables dans un microcontrôleur

2. Pour chaque fonction déterminer les données caractéristiques

3. Sélectionner un microcontrôleur pour une application

4. Evaluer les suites logiciels mises à disposition

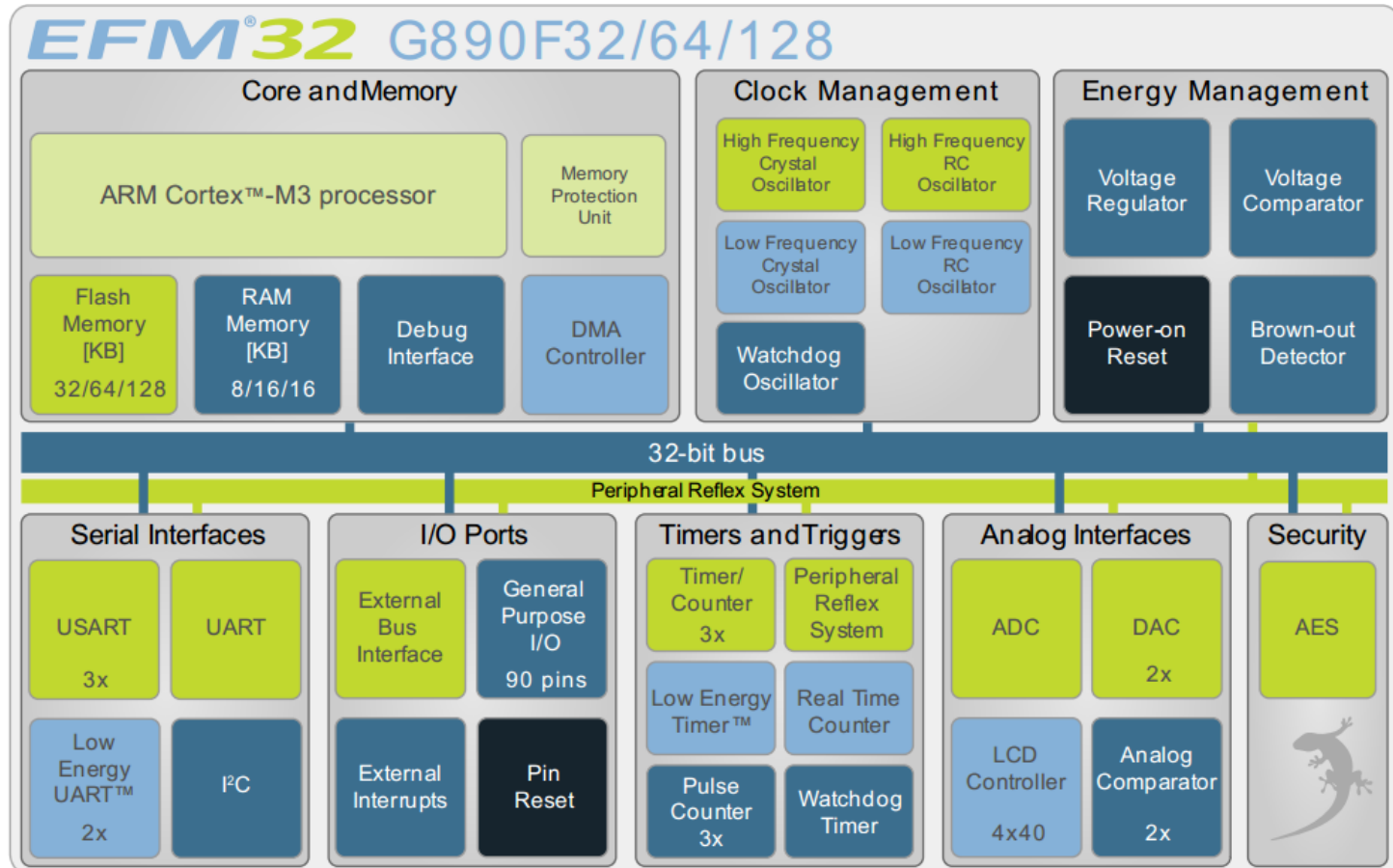# Quelles sont les modules/le cœur d'un microcontrôleur?

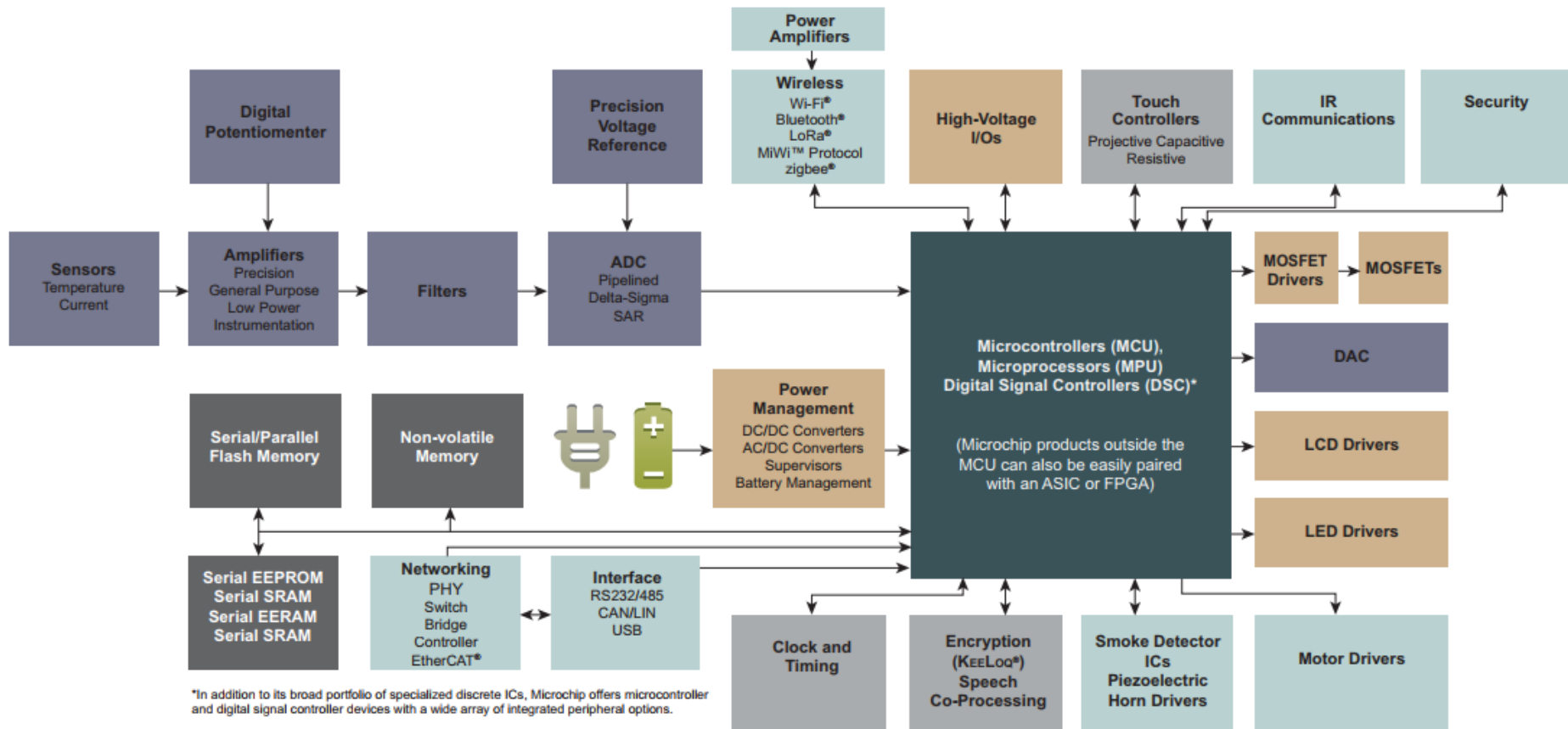# Quelles sont les modules/le cœur d'un microcontrôleur?

Liste :

- 1

- 2

- 3

- 4

# EFM32G890F128 de chez EnergyMicro

# Microchip Block Diagram Support



**Power Amplifiers**

**Wireless**
Wi-Fi®
Bluetooth®
LoRa®
MiWi™ Protocol
zigbee®

**High-Voltage I/Os**

**Touch Controllers**
Projective Capacitive
Resistive

**IR Communications**

**Security**

**Digital Potentiomenter**

**Precision Voltage Reference**

**Sensors**
Temperature
Current

**Amplifiers**
Precision
General Purpose
Low Power
Instrumentation

**Filters**

**ADC**
Pipelined
Delta-Sigma
SAR

**Microcontrollers (MCU), Microprocessors (MPU) Digital Signal Controllers (DSC)***

(Microchip products outside the MCU can also be easily paired with an ASIC or FPGA)

**MOSFET Drivers**

**MOSFETs**

**DAC**

**Serial/Parallel Flash Memory**

**Non-volatile Memory**

**Power Management**
DC/DC Converters
AC/DC Converters
Supervisors
Battery Management

**LCD Drivers**

**LED Drivers**

**Serial EEPROM Serial SRAM Serial EERAM Serial SRAM**

**Networking**
PHY
Switch
Bridge
Controller
EtherCAT®

**Interface**
RS232/485
CAN/LIN
USB

**Clock and Timing**

**Encryption**
(KEELOQ®)
**Speech Co-Processing**

**Smoke Detector ICs Piezoelectric Horn Drivers**

**Motor Drivers**

*In addition to its broad portfolio of specialized discrete ICs, Microchip offers microcontroller and digital signal controller devices with a wide array of integrated peripheral options.

# Première définition *(wikipedia)*

A **microcontroller** (or **MCU** for *microcontroller unit*) is a small [computer](#) on a single [integrated circuit](#). In modern terminology, it is similar to, but less sophisticated than, a [system on a chip](#) or SoC; an SoC may include a microcontroller as one of its components. A microcontroller contains one or more [CPUs](#) (processor cores) along with [memory](#) and programmable [input/output](#) peripherals. Program memory in the form of [ferroelectric RAM](#), [NOR flash](#)or [OTP ROM](#) is also often included on chip, as well as a small amount of [RAM](#). Microcontrollers are designed for [embedded](#) applications, in contrast to the [microprocessors](#) used in [personal computers](#) or other general purpose applications consisting of various discrete chips.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other [embedded systems](#). By reducing the size and cost compared to a design that uses a separate [microprocessor](#), memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. [Mixed signal](#) microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

Some microcontrollers may use four-bit [words](#) and operate at frequencies as low as 4 kHz, for low power consumption (single-digit milliwatts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a [digital signal processor](#) (DSP), with higher clock speeds and power consumption.

# Quelles différences entre :

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| | Bus de données | Freq. Max | Mémoire ROM |
|---|---|---|---|
| | 8 bits | 2 MHz | 32 kB |
| | 32 bits | 60 MHz | 18 MB |
| | 64 bits | 2,34GHz | 256 GB |
| | 64 bits | 3,10GHz | TB |

# BeagleBone Black
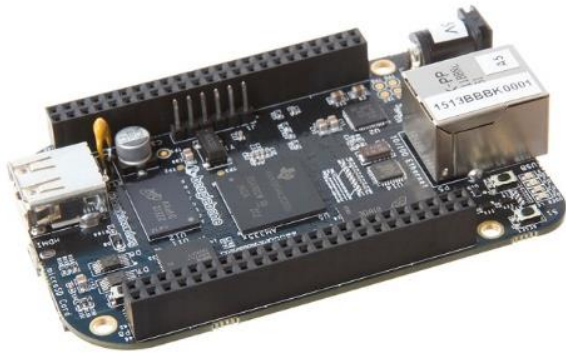
Caractéristiques :

- ~50€
- RAM : 512MB
- Fréquence : 1GHz
- Flash : 4GB

# Caractéristiques de chaque module ?

Fonctionnement d'une PWM
(Partie avec comparateur omise)

Caractéristiques

# Sélectionner un microcontrôleur

Liste des constructeurs :

- Microchip
- Motorola
- ST-micro
- NEC
- ATMEL
- Sunplus
- Hitachi
- Fujitsu

- NXP
- Toshiba
- Intel
- Zilog
- EnergyMicro
- Texas Instrument
- Analog device
- …

# Critère de sélection

Aptitude de la puce à faire le travail ( une seule puce nécessaire?)

- Nbre d'entrées/sorties :
  - trop peu ne peut pas faire le job.
  - trop élevé, cela représente un surcoût
- Autres périphériques présents en nombre suffisants?
  - ADC – RAM – ROM – DAC – port série
  - Est-ce qu'il y en à d'autres qui ne sont pas nécessaire
- Rendement du CPU : puissance de calcul
  - Trop faible => ne marchera jamais
  - Trop élevé => gaspillage
- Prix du microcontrôleur est-il envisageable ?

# Critère de sélection

Disponibilité

- ◦ Quel est l'état du stock actuellement
- ◦ Est-il toujours en production
- ◦ Quels sont les productions futures

Support de développement disponible:

- ◦ Assemblage
- ◦ Compilateur
- ◦ Outils de debugging
- ◦ Exemples d'applications

# Mise en situation

Sélectionner un candidat parmi la suite Microchip pour …

# Mise en situation

Liens Microchip :

http://www.microchip.com/maps/main.aspx

http://www.microchip.com/ParamChartSearch/chart.aspx?branchID=1005



Where would you like to start?

- Analog
- Interface
- Memory
- MCUs & MPUs
- Wireless

Do you have a part number? Click this button to fi...

...obal Part Search



## 8-bit PIC® Microcontroller Peripheral Integration
Quick Reference Guide

| Product Family | Pin Count | Program Flash Memory (KB) | Data EE (B) | Peripheral Function Focus | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Intelligent Analog | | | | | | | | | Waveform Control | | | | | | Timing and Measurements[1] | | | | | | | Logic and Math | | Safety and Monitoring | | | Communications | | | | User Interface | | | Low Power and System Flexibility | | |
| | | | | ADC (# of bits) | Comp | HSComp | DAC (# of bits) | HC I/O (mA) | OPA | PRG | SlopeComp | ZCD | CCP/ECCP | 10-bit PWM | 16-bit PWM | COG | CWG | NCO | DSM | AngTMR | HLT (8-bit) | 16-bit PWM (16-bit) | NCO (20-bit) | SMT (24-bit) | RTCC | TEMP/TS | CLC | MULT | MathACC | CRC/SCAN | HLT | WWDT | EUSART/AUSART | UART with Protocols | I2C/SPI | USB with ACT | LIN Capable | mTouch® Sensing | HCVD | LCD | PPS | IDLE/DOZE/PMD | DMA/VI | DIA/MAP |
| PIC10(L)F3XX | 6 | 384–896 B | HEF | 8 | | | | | | | | | | ✓ | | | ✓ | ✓ | | | | | ✓ | | | ✓ | ✓ | | | | | | | | | | | | | ✓ | | | | |
| PIC16(L)F151X/2X | 28–64 | 3.5–28 | HEF | 10 | | | | | | | | | ✓ | | | | | | | | | | ✓ | | | | | | | | | | 2 | | 2 | | ✓ | ✓ | | | | | | |
| PIC12LF1552 | 8 | 3.5 | HEF | 10 | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | 2 | | | | | | ✓ | ✓ | | | |
| PIC16LF155X/6X | 14–20 | 7–14 | HEF | 10[2] | | | | | | | | | | | ✓ | | | | | | | | ✓ | | | | | | | | | | ✓ | | 2 | | ✓ | ✓ | ✓ | | | | | |
| PIC16(L)F145X | 14–20 | 14 | HEF | 10 | ✓ | | | | | | | | | | ✓ | | ✓ | | | | | | ✓ | | | | | | | | | | ✓ | | ✓ | ✓ | ✓ | ✓ | | | | | | |
| PIC1X(L)F157X | 8–20 | 1.75–14 | HEF | 10 | ✓ | | 5 | | | | | | | | ✓ | | ✓ | | | | ✓ | | | ✓ | | | | | | | | | ✓ | | | | ✓ | ✓ | | | ✓ | | | |
| PIC16(L)F153XX | 8–48 | 3.5–28 | HEF | 10 | ✓ | | 5 | | | ✓ | ✓ | 4 | | | ✓ | ✓ | | | ✓ | | ✓ | | | ✓ | ✓ | | | | ✓ | ✓ | 2 | | 2 | | | ✓ | | | ✓ | ✓ | | ✓ |
| PIC1X(HV)F752/53 | 8–14 | 1.75–3.5 | – | 10 | | ✓ | 5/9 | 50 | ✓ | | ✓ | | ✓ | | | ✓ | | | | | | ✓ | | | | | | | ✓ | | | | | | | | | ✓ | | | | |

# Suite logiciel

Microchip :

# Suite logiciel
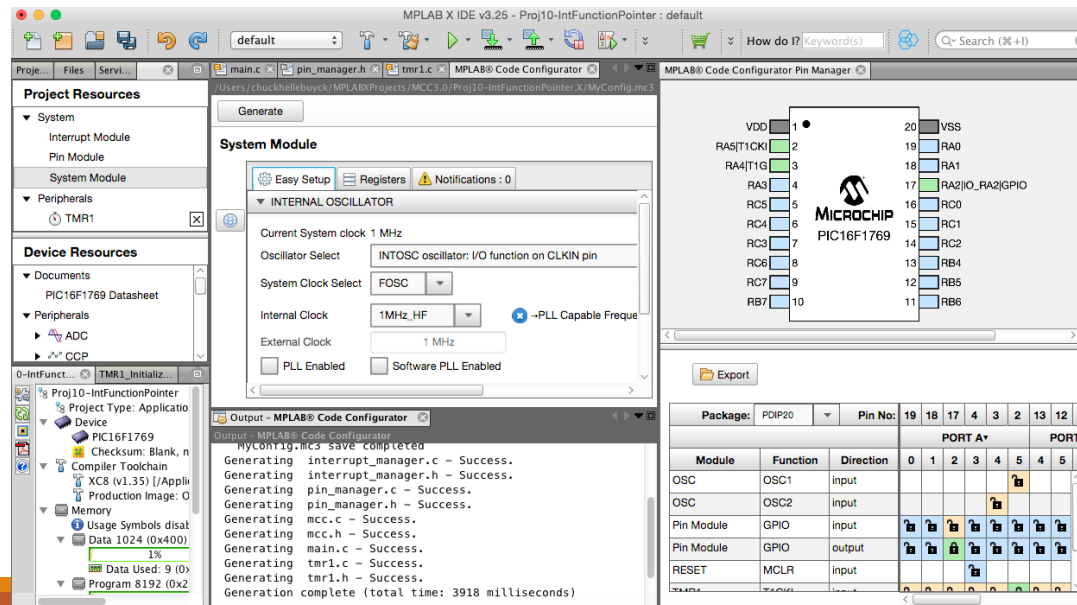
## ST MICROELECTRONIC : CUBE MX
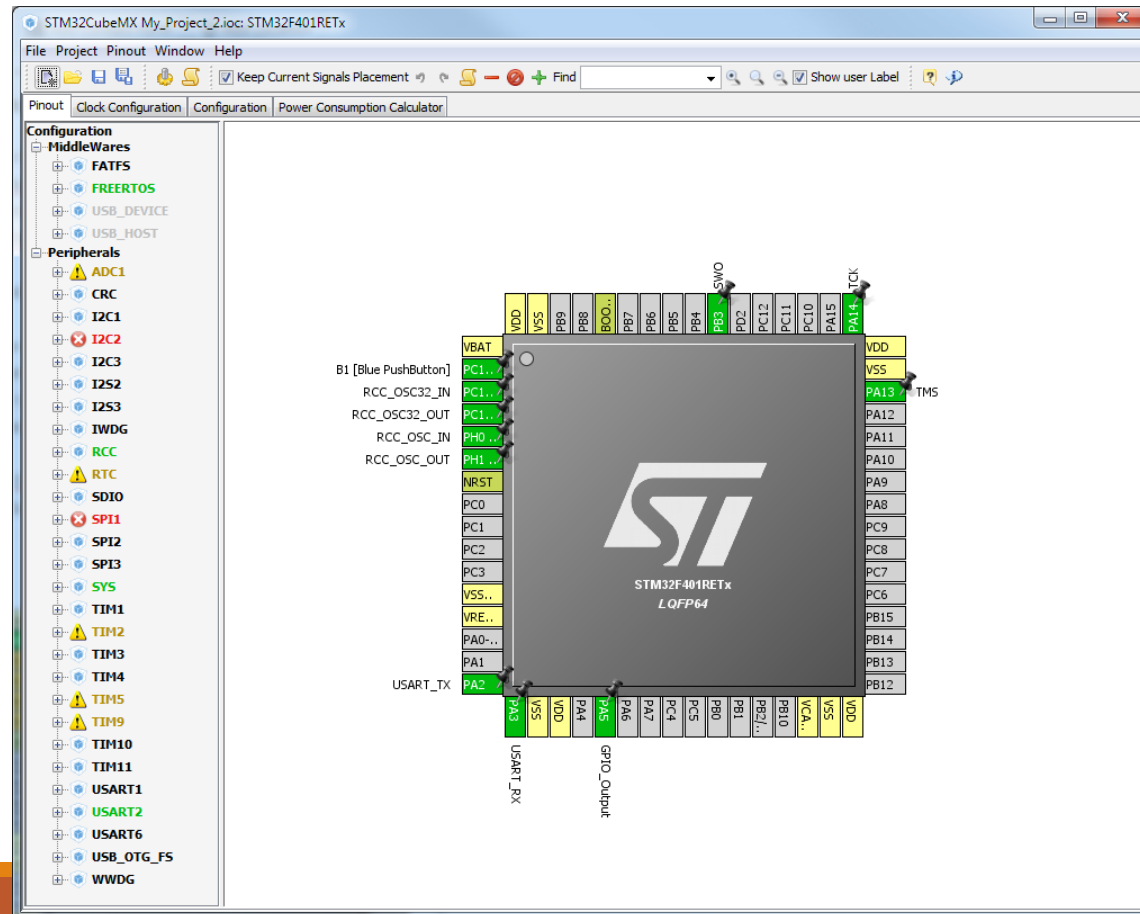
# Question de réflexion

Comment échanger des informations entre deux éléments électroniques intelligents?