# Internet of Things with Intel A2 – IoT boards

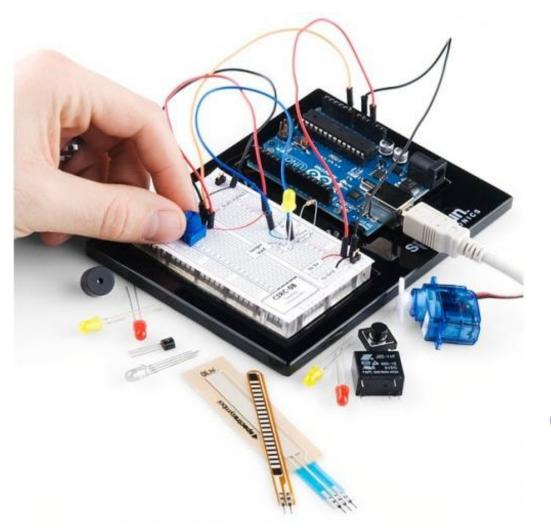
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### History



### Arduino



```
🔞 🖨 📵 Blink | Arduino 1.0
Blink
  Turns on an LED on for one second, then off for one second, repe
 This example code is in the public domain.
void setup() {
  // initialize the digital pin as an output.
  // Pin 13 has an LED connected on most Arduino boards:
  pinMode(13, OUTPUT);
void loop() {
  digitalWrite(13, HIGH); // set the LED on
  delay(1000);
                                  // wait for a second
 digitalWrite(13, LOW); // set the LED off delay(1000); // wait for a second
 delay(1000);
                                                       Arduino Uno on /dev/ttyACM1
```





# Raspberry Pi





### Evaluation of IoT boards



### Microcontroller vs Processor

Arduino is using a 8-bit microcontroller. It's simple and predictable for people new to software development.

But it's impossible to install a full system like linux, so it's limited by nature.

To have a full OS with network, the programming language of your choice and a lot of potential, a processor is required.

## Digital / Analog IO

If you develop on your laptop, you can only plug devices with high level IO like USB. But most IoT sensors are a lot simpler than that, using low level analog and digital IO.

To be really useful as an IoT platform, you must have digital and/or analog IO.

Note: Some IoT platforms only have digital IO, others like Intel Galileo and Intel Edison have both digital and analog IO.



## Graphics

Many wearable projects like watches have a touch screen, or a projector for glasses. They look like a lot like small mobile devices, and require graphics.

We have such platforms at Intel.

But for all the other IoT projects, you don't need and don't want graphics.

Remember: display = interaction = brain attention share = not scalable.



## Networking

Network connectivity is important in IoT.

You may take a platform without wireless internet and add a dongle for prototyping, but :

- It's harder to switch to production
- Power optimizations are limited
- Dongle often propose limited features : Bluetooth instead of Bluetooth Low Energy.
- Integration with software-OS is not always trivial.

Advice: take platforms with great networking inside for prototyping then production.



### Form factor

It's convenient to have large boards with lots of IO for prototyping. But you'll need to design a new board for production. It takes a lot of money, time and skills.

Or you take a board with a modular design: your compute module has all the complex parts you won't redesign, and the simper connectivity board can be replaced or designed easily.



### Power features

A big difference between IoT prototypes and production is total power consumption.

You would not plug a 3G dongle on a desktop and call it a mobile phone, right? Same for IoT.

### You need:

- a very efficient processor,
   with advanced sleep/hibernation features
- power optimized wireless
- great integration of all parts
- lots of software, driver and OS optimization



### OS

We all like to prototype with our desktop OS.

It can be a big linux distro like Ubuntu, Windows 10, OSX ... it's easy, all the packages are readily available.

But a professional grade embedded project requires to start from scratch, perhaps use a substitute of glic, control each piece of code added to the system and integrate with a large team of software developers.

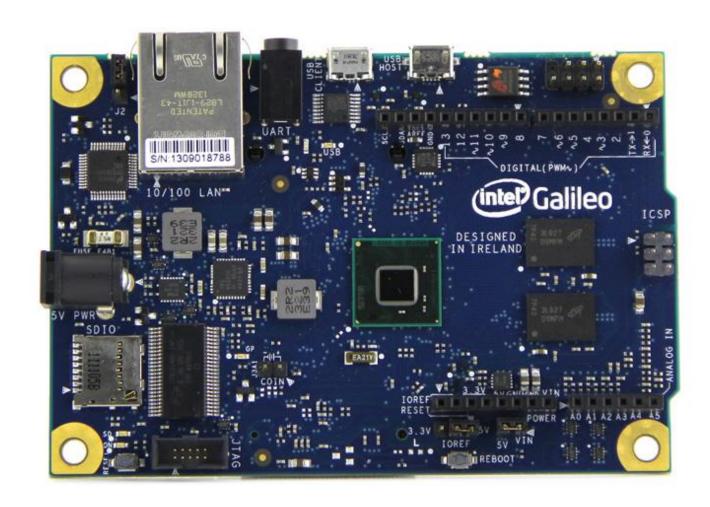
A typical open source OS for professional projects is Yocto.



### Intel IoT boards

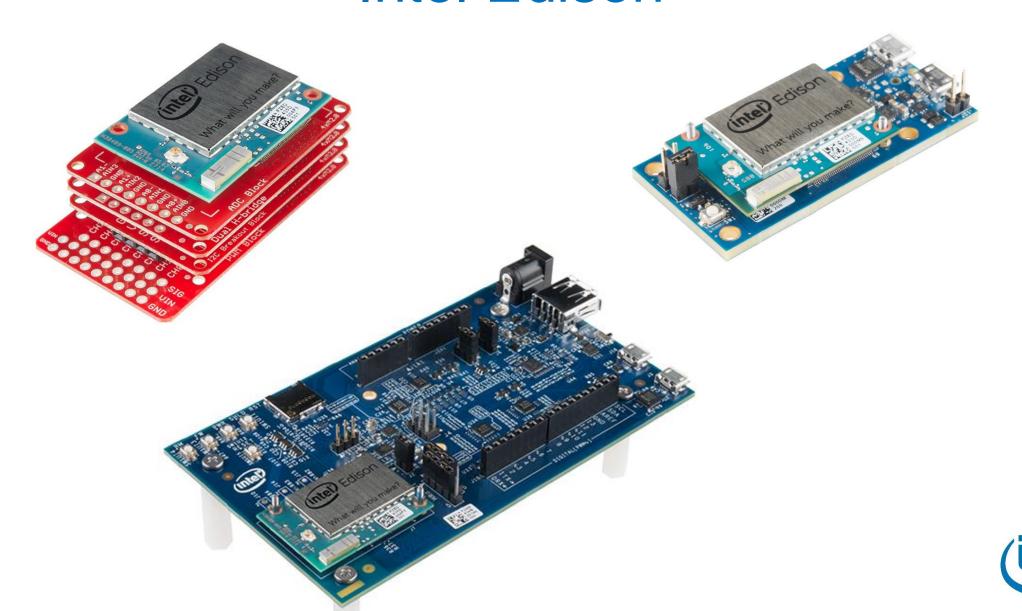


## Intel Galileo





### Intel Edison



# Intel Curie





# But also: HDMI Stick, NUC



# Intel IoT boards Intel Galileo Specifications



## Intel Galileo Specs



Intel Quark System-on-Chip (SoC) x1000 with a 32bit core running at 400MHz.

Connections: mini-PCI Express (for Wifi-Bluetooth module), 100Mb Ethernet port, Micro-SD slot, RS-232 serial port, USB Host, USB Client.

Form factor: Arduino compatible pins.



## Intel Galileo Specs



### The board can run:

- Linux Yocto by default from Intel.
   (Yocto is an open source linux used by embedded professionals)
- Debian variant by the community.
- Arduino style code by an emulator.
- Windows by Microsoft.
- In some cases, WindRiver solutions.



# Intel IoT boards Intel Edison Specifications



## Intel Edison Specs



### 22 nm Intel SoC that includes:

- a dual-core, dual-threaded
   Intel Atom CPU at 500 MHz, running linux
- a 32-bit Intel Quark microcontroller at 100 MHz, running RTOS

Memory: 1 GB LPDDR3

Storage: 4 GB eMMC

Wifi: a/b/g/n

Bluetooth: 4.0 Low Energy



## Intel Edison Specs



### 40 GPIO:

- SD card: 1 interface
- UART: 2 controllers (1 full flow, 1 Rx/Tx)
- I2C: 2 controllers
- SPI: 1 controller with 2 chip selects
- I2S: 1 controller
- GPIO: Additional 12 (with 4 capable of PWM)
- USB 2.0: 1 OTG controller

Form factor: modular. The connectivity boards are available from Intel, Sparkfun, ...

## Intel Edison Specs



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