Intel Do-It-Yourself Challenge
Intel Galileo and Edison

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www.Intel-Software-Academic-Program.com
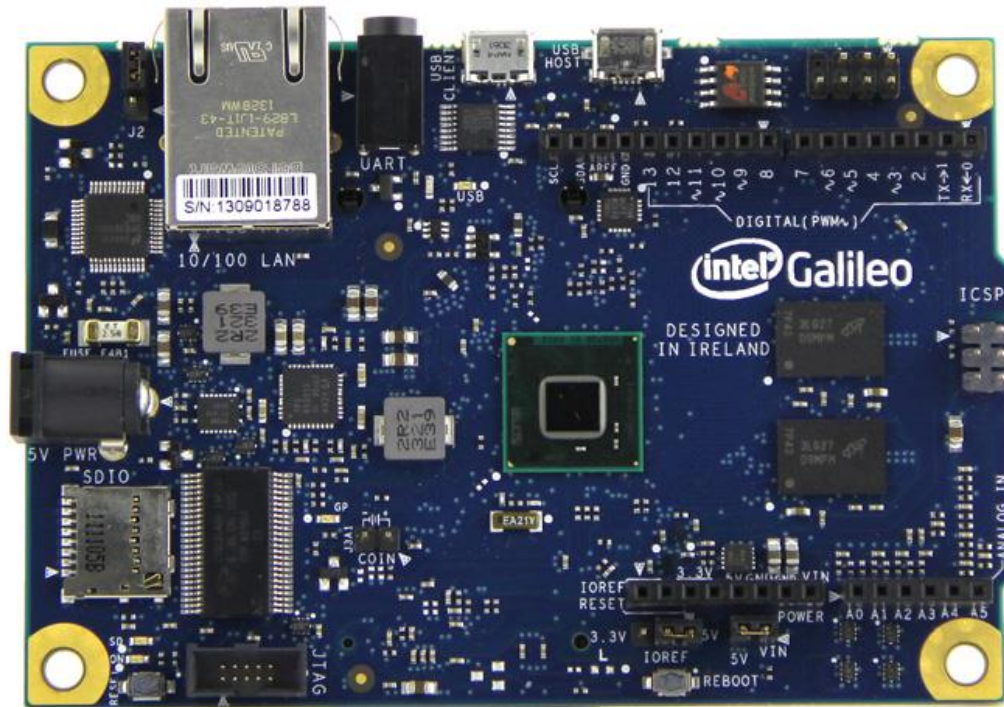paul.guermonprez@intel.com
Intel Software
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Software

Intel Galileo ? Arduino ?

You may know Arduino ... but do you know there's an Arduino board with an Intel processor on it ?

That's the Galileo board, with Intel Quark processor (SoC).

Intel Galileo / Arduino R3

Processors and IO

Arduino Uno R3

Based on the **ATmega328 8-bit microcontroller**.

USB port, power jack, 14 I/O pins, ICSP header.
http://arduino.cc/en/Main/arduinoBoardUno

Intel Galileo

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

Connections : mini-PCI Express, 100Mb Ethernet port, Micro-SD slot, RS-232 serial port, USB Host, USB Client.
http://www.intel.com/content/www/us/en/do-it-yourself/galileo-maker-quark-board.html

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Software

Compatiblity

Hardware and software with Arduino

Galileo is designed to be sw and hw compatible with Arduino Uno R3 boards.

If you can plug an extension shield on an Arduino Uno R3, you can plug it on an Intel Galileo.

You can reuse your scripts from the Arduino IDE.

X86 !

But it's also a full x86 processor (Pentium class).

So you can run tons of regular linux x86 binaries !

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Software

Linux Yocto

Full linux server

A microcontroller based Arduino can accept and run simple binaries compiled for it by the IDE. But Galileo is a lot more powerful and you have a **full linux system** running on it. There's an **Ethernet** port on the board, ssh to your Galileo ! No need for an additional ARM processor shield for your Arduino, you already have a powerful intel System-on-Chip.

Build your own, write SD card, boot with grub

The distrib is Yocto, it's open, you can rebuild your system yourself, write on a SD card and boot from it (grub).

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Software

IO

Storage and IO

Micro SD slot

Insert here an SD card with a embedded Linux image ! You can custom your own Linux configuration and run it on the board.

Mini PCI Express slot

Located on the bottom side of the board, this slot allow you to plug any compatible mini PCI express card to use it with your Linux system. Commonly, we like to plug here a WiFi or Bluetooth or GSM adaptor.

RS232 – Serial port

We usually use USB or ethernet to access the board, but there's a serial port too (you may need an UART-USB adaptor)

USB

USB Client

Connector you have to use to plug the board to your computer. The board will act as a client for your computer (your board is a device for your computer).

USB Host

The board will act as a host with this connector. You can connect here a keyboard, a mouse or even a smartphone...

Network

Ethernet

An Ethernet port included in your Arduino board !
No shield needed. Galileo is a full little linux x86 server.

WiFi

The mini PCI-express port is usually used to plug a laptop-style WiFi card. It's very cheap and very small.
There's lot of drivers for most intel WiFi cards.

IO

JTAG connection : test access port to determine if your card has been well manufactured. It's also useful to check logical signal on all I/O of the board.

Real time clock (2-pin coin cell battery connector) : connect a 3.0V cell battery here to keep Real Time clock updated, even when the board Is off.

6-pin ICSP connector (stands for In-Circuit Serial Programming) : program the board using an ICSP programmer, connected to your computer via USB.
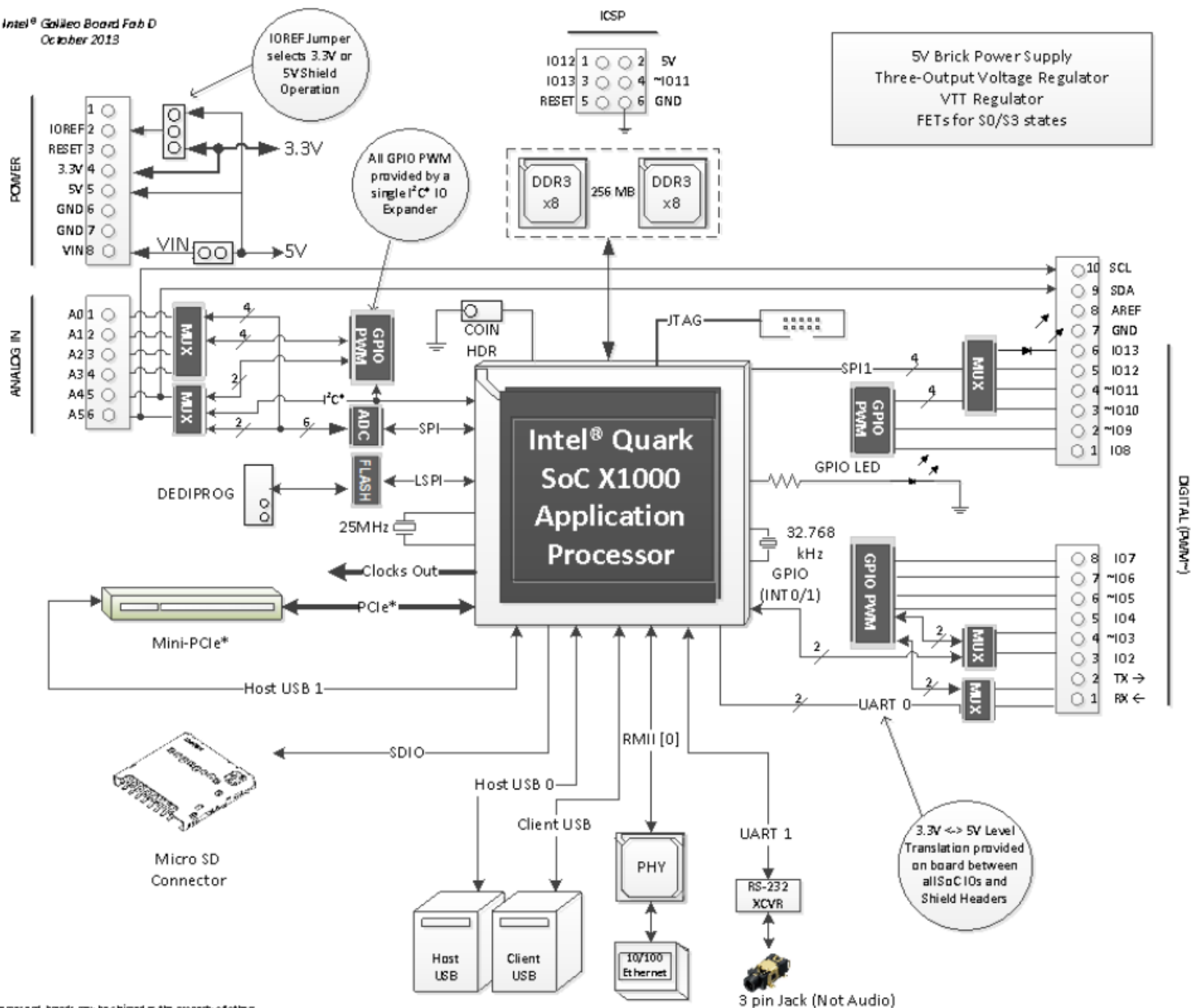
TWI/I2C (stands for Two Wire Interface / Inter Integrated Circuit) : Developed by Philips in 1982, it is a data bus commonly used by multimedia devices (such like TVs and hifi). In theory, you can control your devices using this connector.

14 I/O pins (digital connectors) 6 I/O pins (analog connectors) : Originally from Arduino board, allow you to connect Arduino shield, but can also be used directly with wires to connect everything you want to your Galileo board.

6 I/O digital pins can be used with Pulde-Width Modulation (PWM, ~ on the board).
IOREF allow a shield to adapt voltage provided by the board (switch between 3.3 and 5V).

AREF is not supported by Intel Galileo

Intel® Galileo Board Fab D
October 2013

IOREF Jumper selects 3.3V or 5V Shield Operation

ICSP

IO12	1	○ ○	2	5V
IO13	3	○ ○	4	~IO11
RESET	5	○ ○	6	GND

5V Brick Power Supply
Three-Output Voltage Regulator
VTT Regulator
FETs for S0/S3 states

POWER

1	○
IOREF	2	○
RESET	3	○
3.3V	4	○
5V	5	○
GND	6	○
GND	7	○
VIN	8	○

3.3V

VIN 5V

All GPIO PWM provided by a single I²C* IO Expander

DDR3 x8   256 MB   DDR3 x8

DIGITAL (PWM~)

○	10	SCL
○	9	SDA
○	8	AREF
○	7	GND
○	6	IO13
○	5	IO12
○	4	~IO11
○	3	~IO10
○	2	~IO9
○	1	IO8

ANALOG IN

A0	1	○
A1	2	○
A2	3	○
A3	4	○
A4	5	○
A5	6	○

MUX

MUX

GPIO PWM

COIN HDR

JTAG

SPI1   MUX

GPIO PWM

I²C*

ADC   SPI

FLASH   LSPI

DEDIPROG

Intel® Quark SoC X1000 Application Processor

GPIO LED

25MHz

Clocks Out

32.768 kHz

GPIO (INT 0/1)

GPIO PWM

○	8	IO7
○	7	~IO6
○	6	~IO5
○	5	IO4
○	4	~IO3
○	3	IO2
○	2	TX →
○	1	RX ←

Mini-PCIe*

PCIe*

Host USB 1

MUX

MUX

UART 0

Micro SD Connector

SDIO

Host USB 0

Client USB

RMII [0]

UART 1

3.3V <-> 5V Level Translation provided on board between all SoC IOs and Shield Headers

Host USB

Client USB

PHY

10/100 Ethernet

RS-232 XCVR

3 pin Jack (Not Audio)

*Other names and brands may be claimed as the property of others.

Potential

Arduino + x86 server !

Software

It's good to be Arduino compatible for scripts, but having full x86 capability to run existing linux binaries allows you to do a lot more and reuse code from PCs and servers.

Processing power

A Pentium class 32bit core running at 400MHz will allow you do analyse the sound, images, run a web server, …

Hardware

Ethernet is already on the board, but WiFi mini PCIe laptop-style cards are small and cheap.

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Software

Focus on linux

Arduino scripts or direct linux ?

We'll focus in the following courses on linux projects,
connecting directly to the embedded linux on the board.
We'll use the Arduino IDE to show you
how to run Hello World.

Yocto

Yocto is free (as in speech) and it's a regular linux,
no surprises ;-)

Intel Edison

Galileo great for PoCs but …

It's great to have all the IO and ports of Galileo to test and prototype, but it may be difficult to build a very compact product with it.
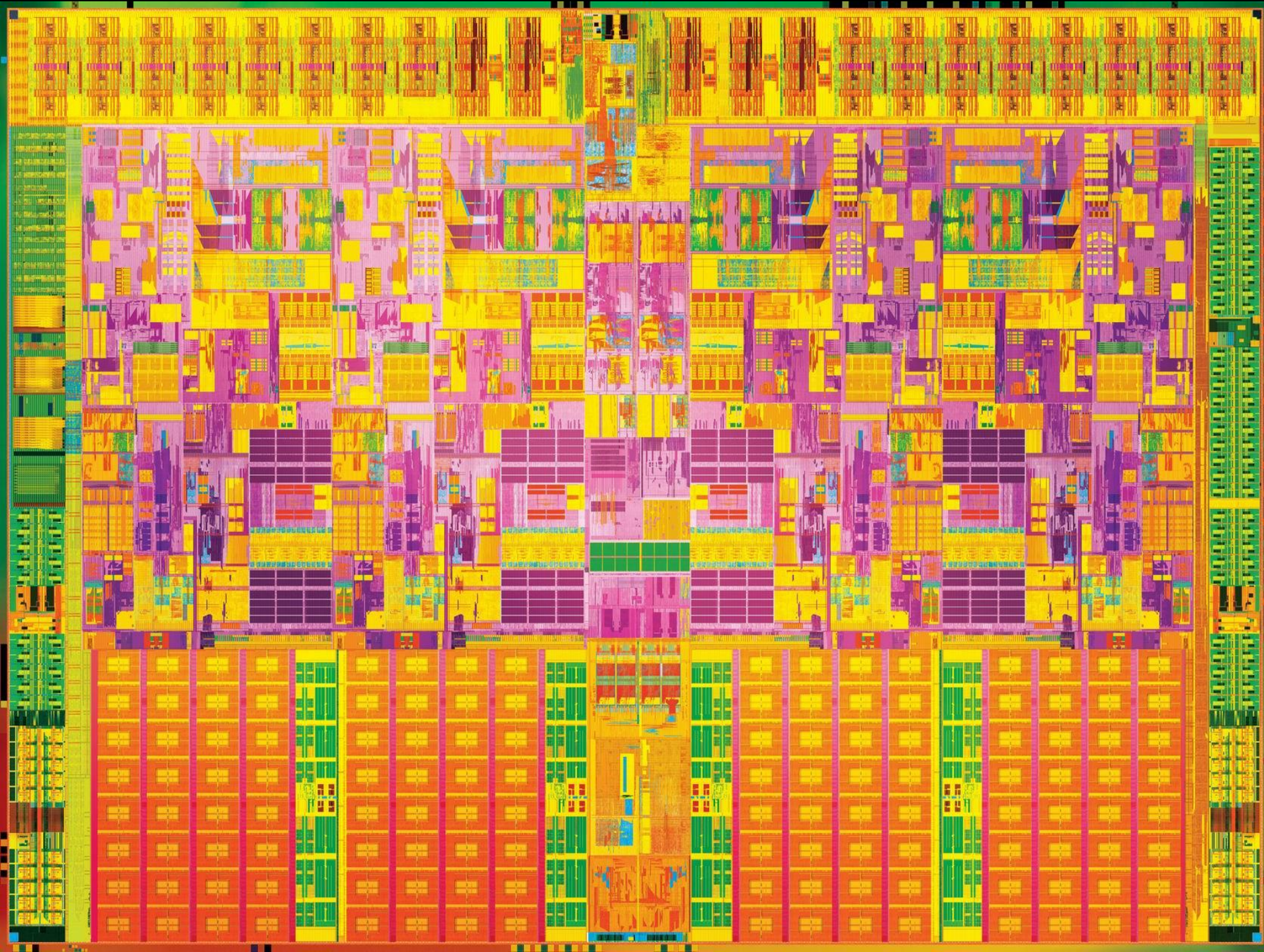
Edison !

So Intel will release soon Edison, a SD-card sized computer with Intel Quark inside.

Develop your proof of concept with Galileo, and use Edison if you need something smaller !
http://www.intel.com/content/www/us/en/do-it-yourself/edison.html
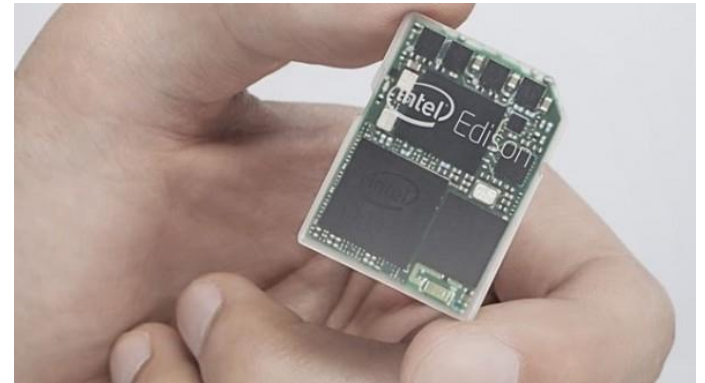
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