

Industry 4.0 & IoT Revolution

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Agenda

- ❖ *Industry 4.0*
- ❖ *IoT Platforms*
- ❖ *Sensors & Actuators*
- ❖ *Prototyping*
- ❖ *Connectivity*
- ❖ *Production*

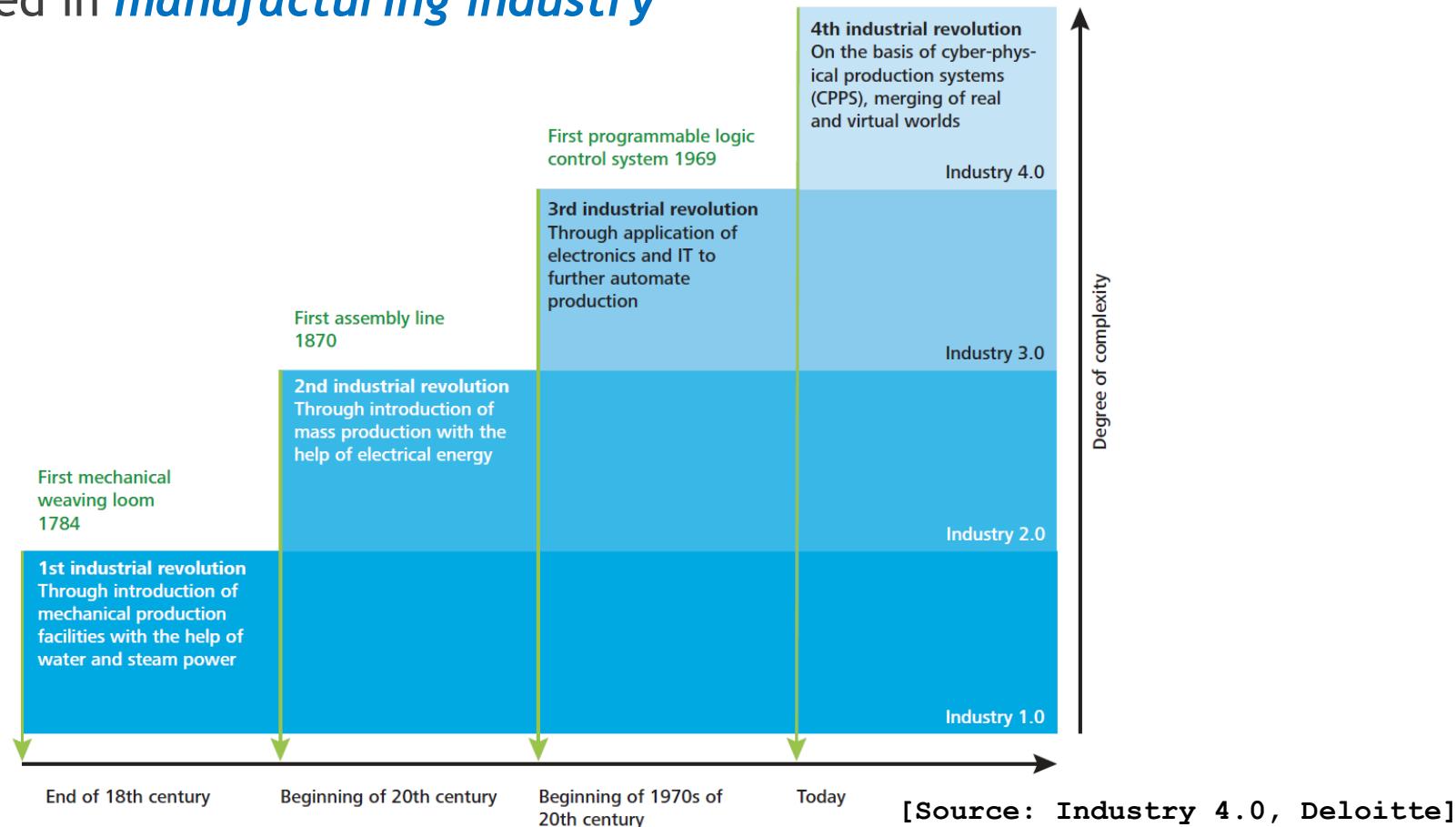
Industry 4.0



Industry 4.0

❖ Definition

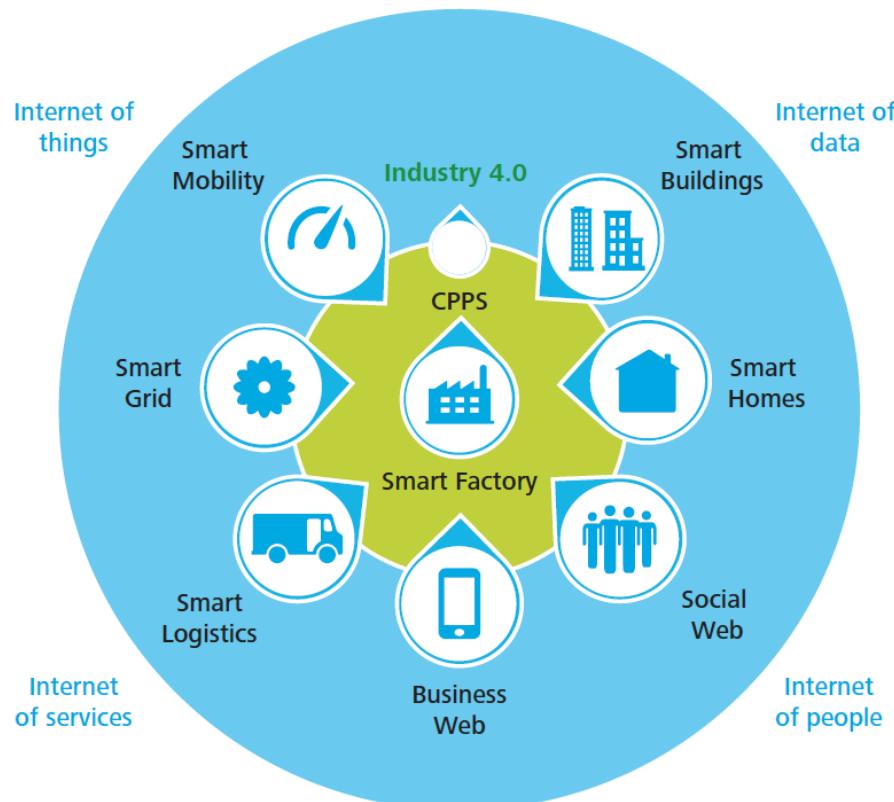
- ▶ Industry 4.0 refers to a further developmental stage in the organisation and management of the entire value chain process involved in *manufacturing industry*



Industry 4.0

❖ Environment

- ▶ Of central importance for industry 4.0 is its interface with other smart infrastructures
- ▶ Links to both business and social networks

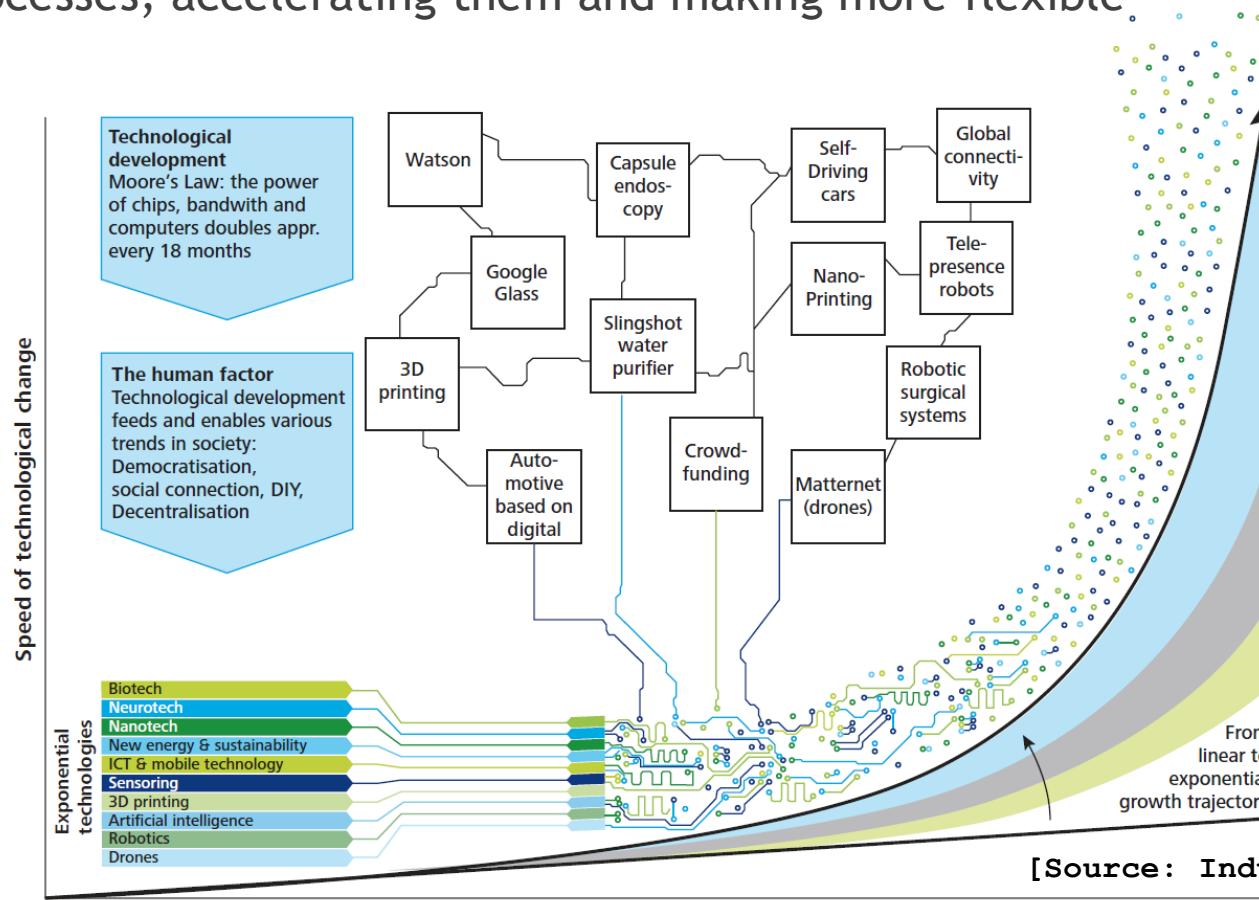


[Source: Industry 4.0, Deloitte]

Industry 4.0

❖ Exponential Technologies

- ▶ 3D printing, sensor technology, AI, robotics, drones, nanotechnology
 - ↘ Exponentially growing technologies that are radically changing industrial processes, accelerating them and making more flexible

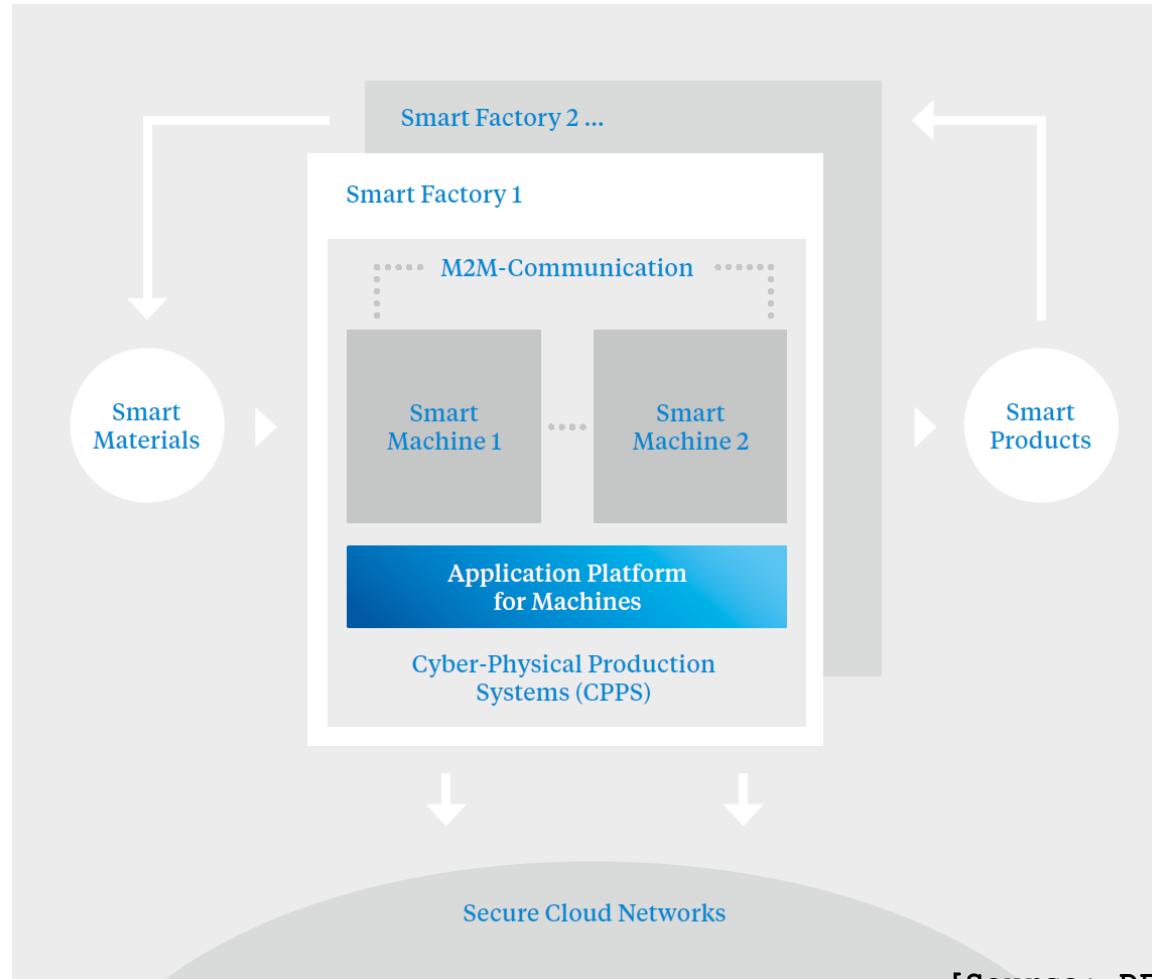


[Source: Industry 4.0, Deloitte]

Industry 4.0

❖ Smart Factory

▶ Smart Factory Pipeline



IoT Platforms



OSHW Platforms

❖ Open Source H/W Platforms

▶ 저가, 초소형의 고성능 컴퓨팅 플랫폼



Intel Edison



NXP mbed LPC1768



TI BeagleBoneBlack



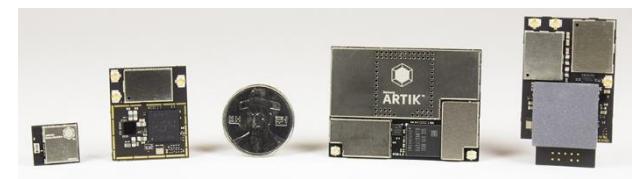
Particle Photon



Banana Pi



Odroid-C1



ARTIK



Raspberry Pi



Arduino

OSHW Platforms

❖ Open Source H/W Platforms

▶ 저가, 초소형의 고성능 컴퓨팅 플랫폼

2005

2009

2012

2013

2014

2015

2016



Arduino

mbed

Raspberry Pi 1

Cubieboard

BeagleBoneBlack

Galileo

Raspberry Pi 2

Raspberry Pi 3

WICED Feather

Photon

⋮

Controller

High-end

Small, Connectivity (IoT)

Discontinued



Linux



Android



Windows 10

RTOS or Firmware

Banana Pi

Odroid-C1

Edison

Orange Pi

Orange Pi Plus

LattePanda

ARTIK 0

ARTIK 5/7/10

OSHW Platforms

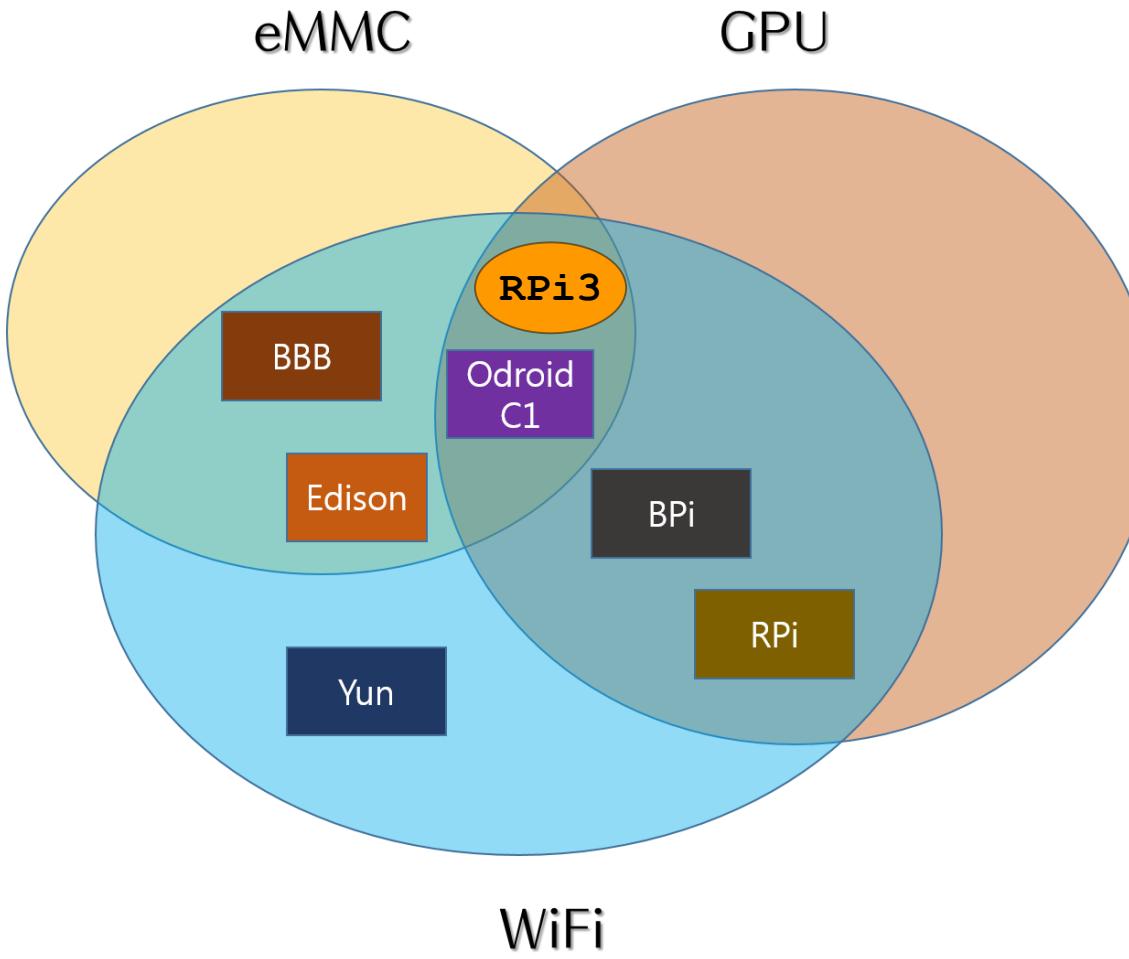
❖ Comparison

▶ 어떤 플랫폼을 선택할 것인가?

Product	Performance	Price
Arduino Uno R3	ATmega328, 16MHz, Flash memory : 32KB, SDRAM : 2KB, EEPROM : 1KB	\$25
Arduino Mega ADK	ATmega2560, 16MHz, Flash memory : 256KB, SDRAM : 8KB, EEPROM : 4KB	\$76
Arduino Yun	ATmega32u4, 16MHz, Flash memory : 32KB, SDRAM : 2.5KB, EEPROM : 1KB *Atheros AR9331, MIPS@400MHz, 64MB DDR2 SDRAM, Flash memory : 16MB	\$75
Edison	“Tangier” Intel Atom 500MHz, 100MHz 32-bit Intel Quark 1GB LPDDR3 POP RAM, 4GB eMMC	\$75
Raspberry Pi B	Broadcom BCM2835 (ARM11) 700MHz Combined CPU & GPU, 256MB SDRAM	\$35
Raspberry B+	Broadcom BCM2835 (ARM11) 700MHz Combined CPU & GPU, 512MB SDRAM	\$25
Raspberry A+	Broadcom BCM2835 (ARM11) 700MHz Combined CPU & GPU, 256MB SDRAM	\$25
Raspberry Pi 0	Broadcom BCM2835 (ARM11), 1Ghz, Single-core CPU	\$5
Raspberry Pi 2	Broadcom BCM2836 32Bit Quad Core 900 MHz, 1GB SDRAM	\$35
Raspberry Pi 3	Broadcom BCM2837 64Bit Quad Core 1.2 GHz (ARM Cortex A-53), 1GB SDRAM	\$35
BeagleBoneBlack	AM335x 1GHz (ARM Cortex-A8), 2x PRU 32-bit microcontrollers 512MB DDR3 RAM, 4GB 8-bit eMMC	\$55
Mbed	ARM® Cortex™-M3 Core 96MHz, 32KB RAM, 512KB FLASH	\$65
Banana Pi	ARM Cortex-A7 1GHz dual-core, Mali™-400MP2 GPU, 1GB DDR3 SDRAM	\$40
Ordroid-C1	ARM Cortex-A5 1.5GHz quad-core, Mali™-450 MP2 GPU, 1GB DDR3 SDRAM	\$35

Your Choice?

▶ 플랫폼 선택의 기준은?



Multi-core

- Edison
- Odroid-C1, C1+
- RPi2/3
- BPi

USB 3.0

- ARTIK 10

SATA

- BPi

BlueTooth LE

- RPi3
- Edison

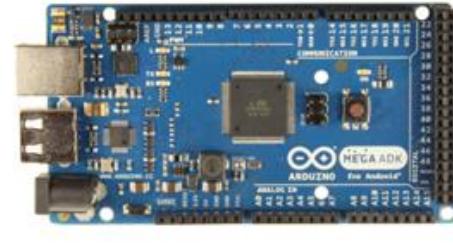
WiFi

- RPi3, RPi Zero W

Arduino

❖ Arduino 특징

- ▶ Arduino IDE를 통해 펌웨어의 개발, 빌드, 다운로드 기능을 지원
- ▶ C/C++ 기반의 다양한 라이브러리 제공
- ▶ Digital I/O, Analog I/O를 모두 지원
- ▶ 추가적인 장치의 사용을 위해 다양한 쉴드(shield) 제공
- ▶ Android Accessory Device를 위한 Arduino Mega ADK
- ▶ Atheros AR9331과 ATmega32u4를 통합하여 네트워크 기능(WiFi, Ethernet)을 강화하고 리눅스를 기반으로 하는 Arduino Yun



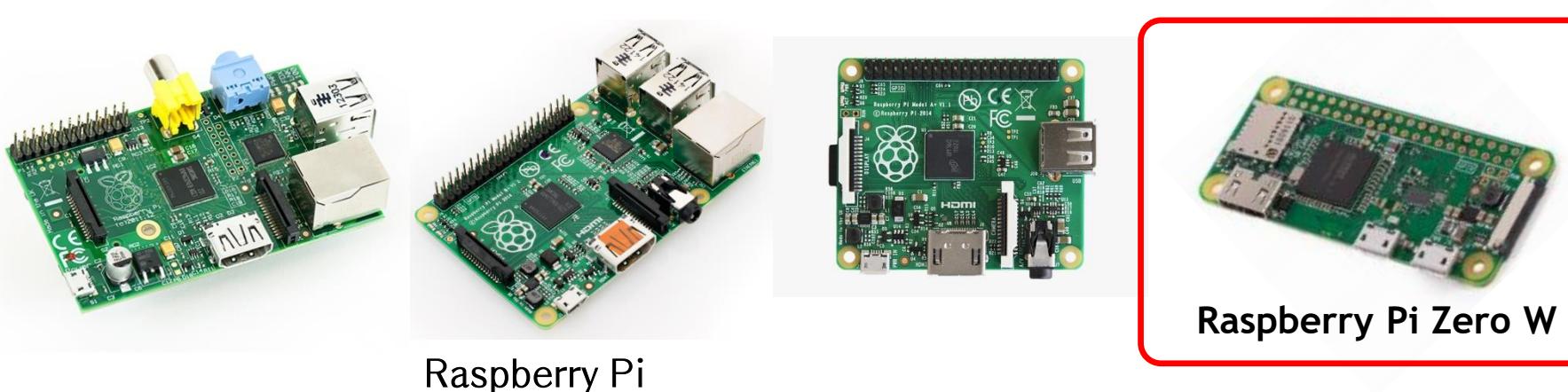
Arduino

Arduino Uno WiFi

Raspberry Pi

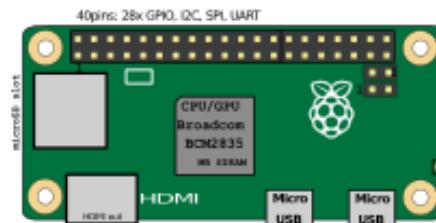
❖ Raspberry Pi 특징

- ▶ Python, C/C++, Java, C#, Ruby 등 다양한 언어에 대한 라이브러리 제공
- ▶ Broadcom의 BCM2835는 CPU와 GPU가 통합된 SoC이며, 메모리 공유
- ▶ Digital I/O 만 지원
- ▶ 추가적인 장치의 사용을 위해 다양한 쉴드(shield) 제공

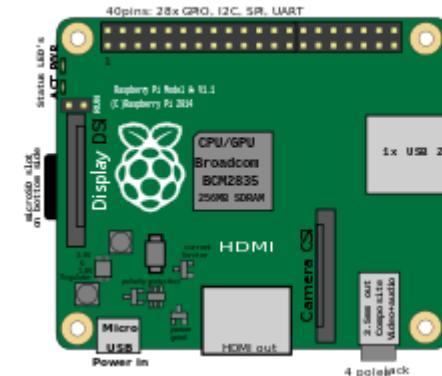


Raspberry Pi

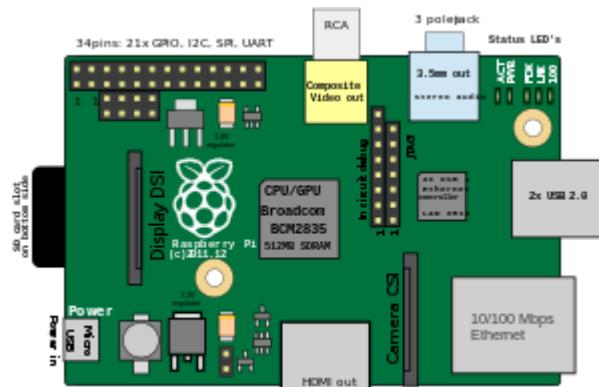
❖ Raspberry Pi Interface



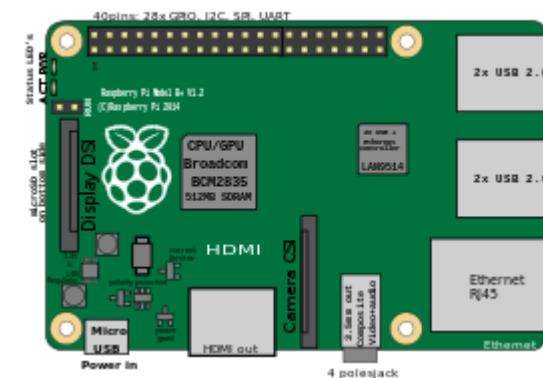
Raspberry Pi Zero



Raspberry Pi A+



Raspberry Pi 1



Raspberry Pi 2/3

Edison

❖ Edison 특징

- ▶ Intel Atom 500MHz, 100MHz 32-bit Intel Quark
- ▶ 아두이노 호환
- ▶ 다양한 개발 환경 지원 (이클립스 기반의 C/C++, 인텔 XDK 기반의 WebApp, 아두이노 IDE를 이용한 펌웨어)
- ▶ WiFi, BlueTooth LE 내장

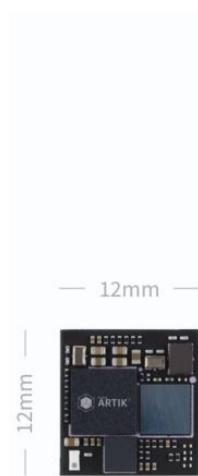


Intel Edison

ARTIK

❖ ARTIK 특징

- ▶ RTOS(FreeRTOS, ThreadX, TizenRT), Linux(Fedora) 지원
- ▶ SDK(C), Node.js, Arduino 기반의 디바이스 제어
- ▶ ARTIK IDE, Eclipse Che 등의 통합 개발 환경 (윈도우, 리눅스, 맥 지원)



ARTIK 1

Smallest module in its class

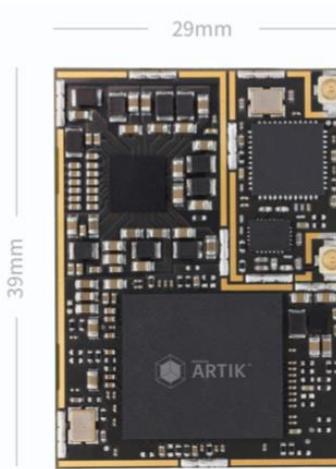
- Small size (12mm x 12mm)
- Low power consumption
- Built in BLE



ARTIK 5

Balances size and power

- Dual-core ARM chip
- Hardware video decoding (720p)
- Built-in WiFi, BLE, ZigBee, Thread



ARTIK 10

Industry-leading performance

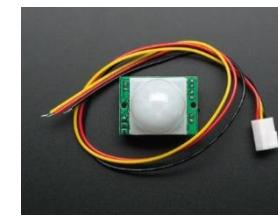
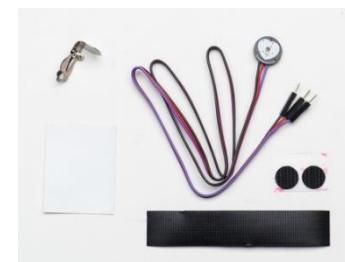
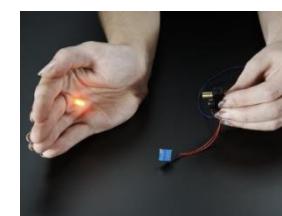
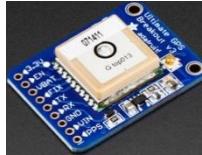
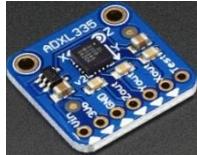
- Octa-core ARM chip
- Hardware video decoding (1080p)
- Built-in WiFi, BLE, ZigBee, Thread

Sensor & Actuators



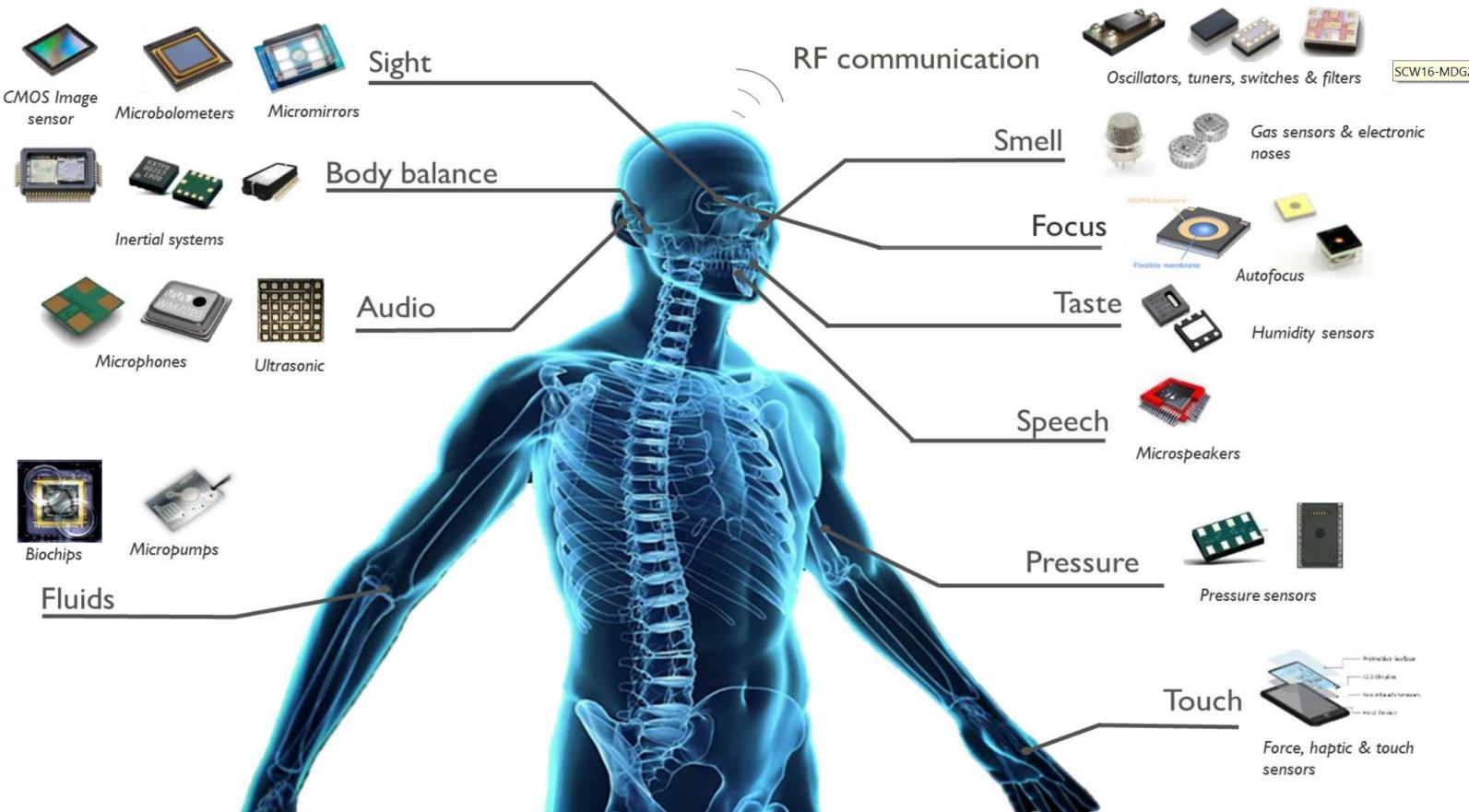
Sensors & Actuators

❖ 다양한 센서와 액추에이터



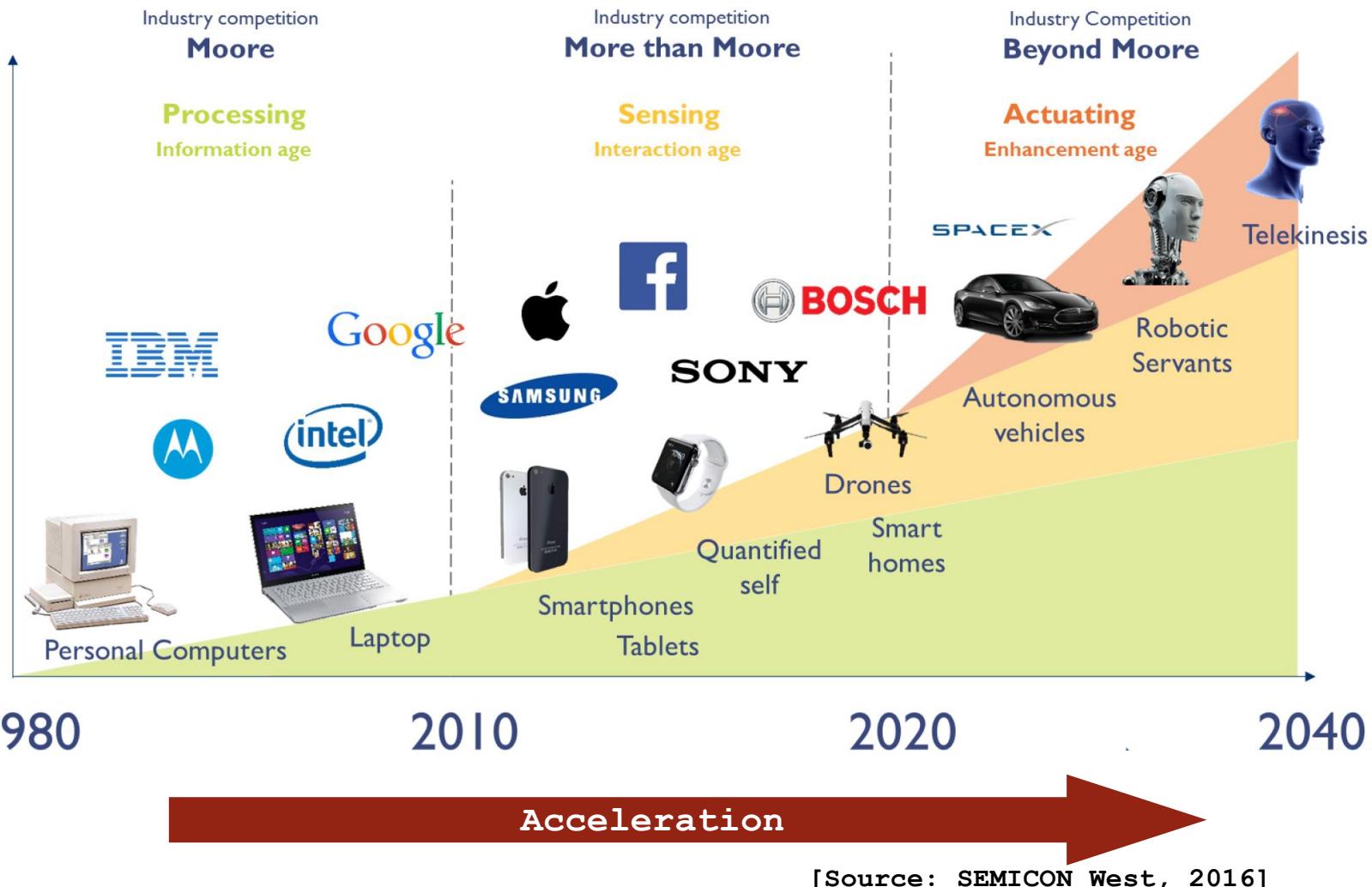
Sensors & Actuators

❖ MEMS Sensors



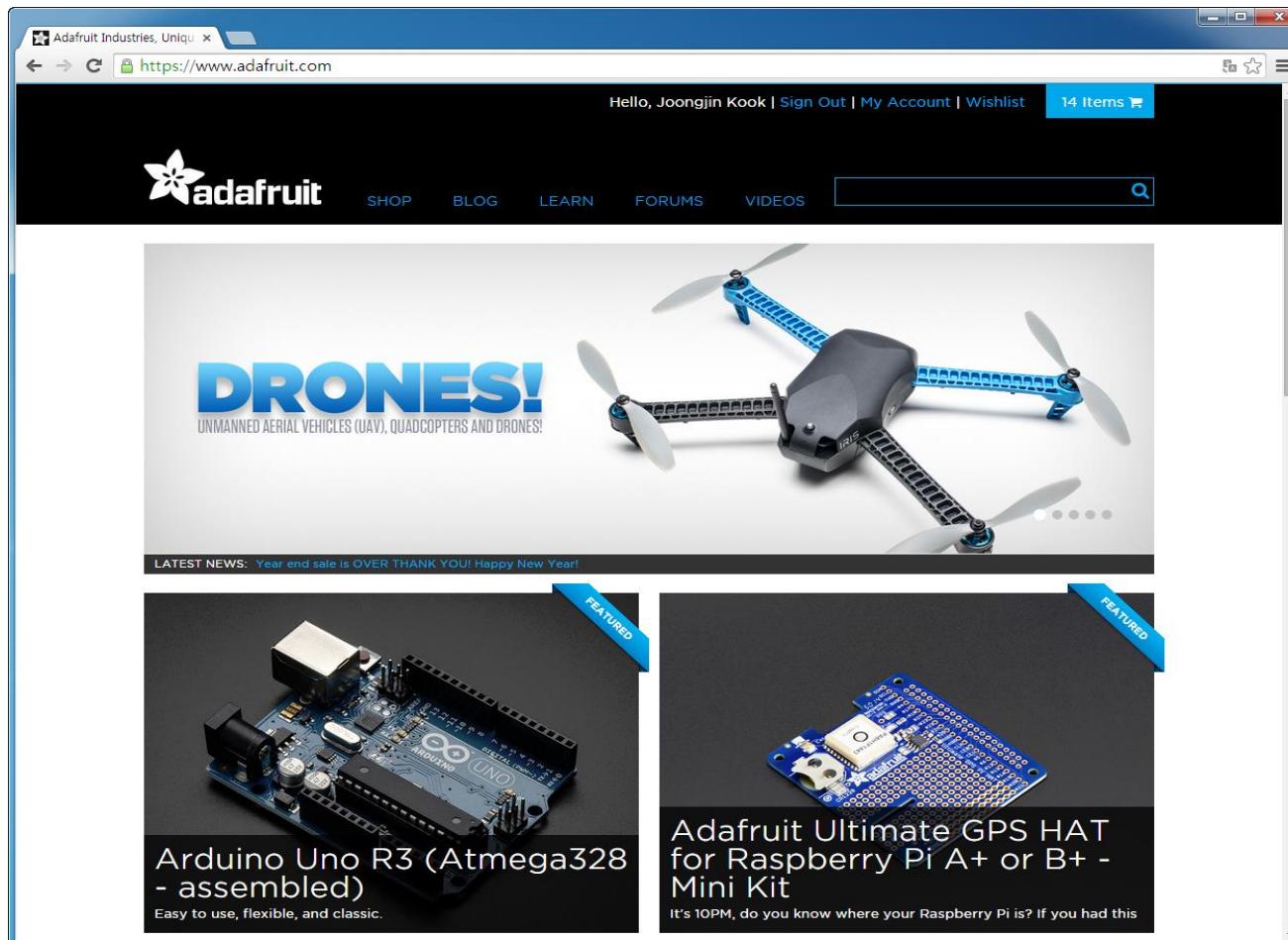
Sensors & Actuators

❖ MEMS & Sensors Roadmap



Distributors

- ❖ Adafruit (<https://www.adafruit.com>)



Distributors

- ❖ Sparkfun (<https://www.sparkfun.com>)

The screenshot shows the SparkFun Electronics website (https://www.sparkfun.com) in a web browser. The page features a navigation bar with links for SHOP, LEARN, FORUM, DATA, PRODUCTS, BLOG, TUTORIALS, VIDEOS, WISH LISTS, DISTRIBUTORS, SUPPORT, LOG IN, REGISTER, and a search bar. A sidebar on the left lists various product categories such as New Products, Top Sellers, Open Hardware, SparkFun Originals, Actobotics, Sale, Gift Certificates, Arduino, Audio, Books, Breakout Boards, Cables, Cellular, Components, Development Tools, Dings and Dents, Educators, GPS, Intel® Edison, Kits, LCDs, Programmers, Prototyping, Raspberry Pi, Retail, Robotics, Sensors, Swag, and Tools. The main content area includes a banner for "Music Technology for the Electronically Inclined" featuring a person with a DJ setup. Below this are sections for "New Products" (Intel® Edison, Polymer Lithium Ion Battery - 18650 Cell (2600mAh, Solder Tab), Circuit Scribe Conductive Ink Pen, USB Micro-B Cable - 6") and a "LATEST BLOG POST" about "Paper Circuits - Valentine Edition". A red banner at the bottom right offers "FREE SHIPPING All U.S. Orders OVER \$75".

Distributors

- ❖ Seeed (<http://www.seeedstudio.com>)

The screenshot shows the Seeed Studio Bazaar website at www.seeedstudio.com/depot/. The main navigation bar includes 'Wish', 'Bazaar' (which is highlighted), 'Recipe', 'Fusion', and 'Propagate'. A search bar says 'Find something great...'. On the right, there's a sign-in account dropdown, a shopping cart icon with '0', and social media links for Facebook (1.5K), Twitter (366), and Google+.

GrovePi+
The bridge Between
Raspberry Pi & Grove family

WEB ENABLE YOUR WORLD!

The central image features a blue GrovePi+ expansion board connected to a Raspberry Pi. Various sensor modules are shown connected to the board, including a rotary angle sensor, a humidity sensor, a relay module, an ultrasonic sensor, a temperature sensor, an LED, and a light sensor. Below the main image, there are icons for other products:

- &Seeeduino
- Raspberry Pi
- LinkIt ONE
- Beaglebone Black
- Grove
- Shield
- Wearables
- Starter Kit
- RF Explorer
- DSO
- Mbed
- Shenzhen2U

At the bottom right is a 'Feedback & Support' button.

Prototyping

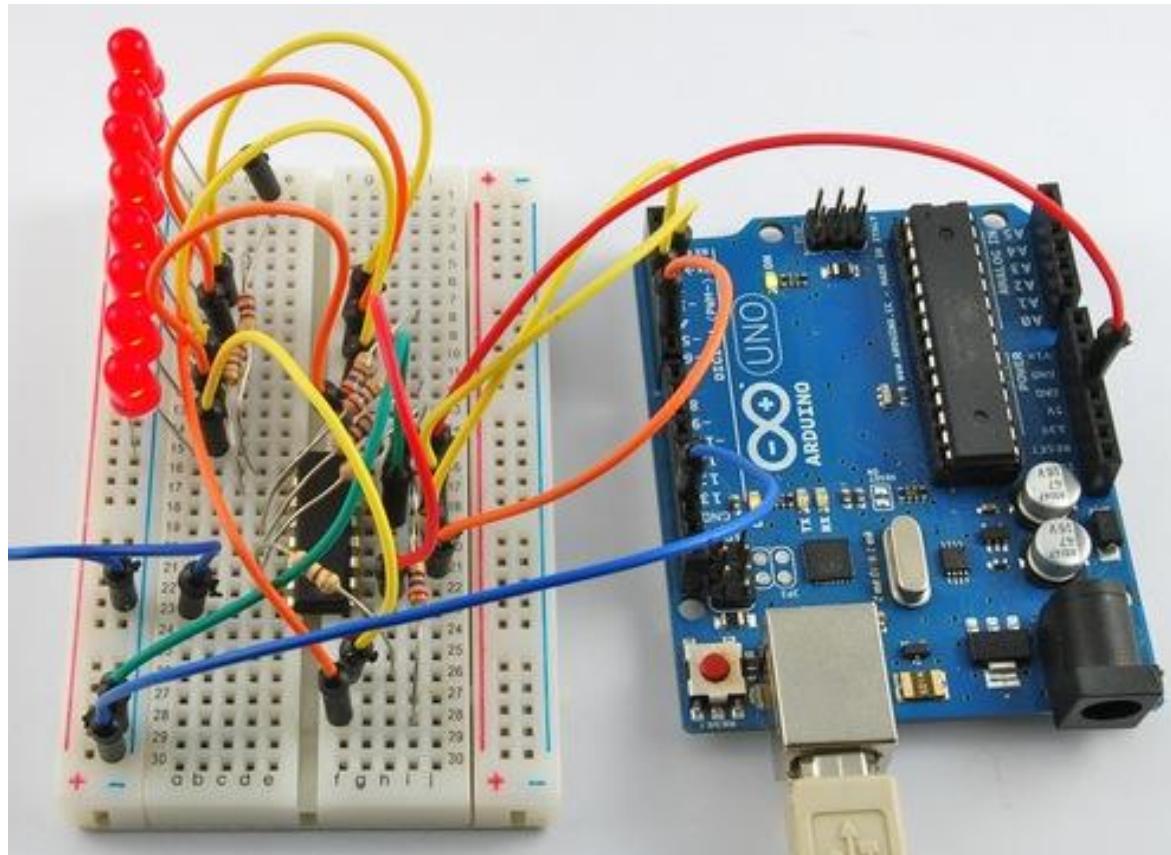


System Design

- ❖ Prototyping

- ▶ Breadboard

- ↳ 전기, 전자, 회로 등

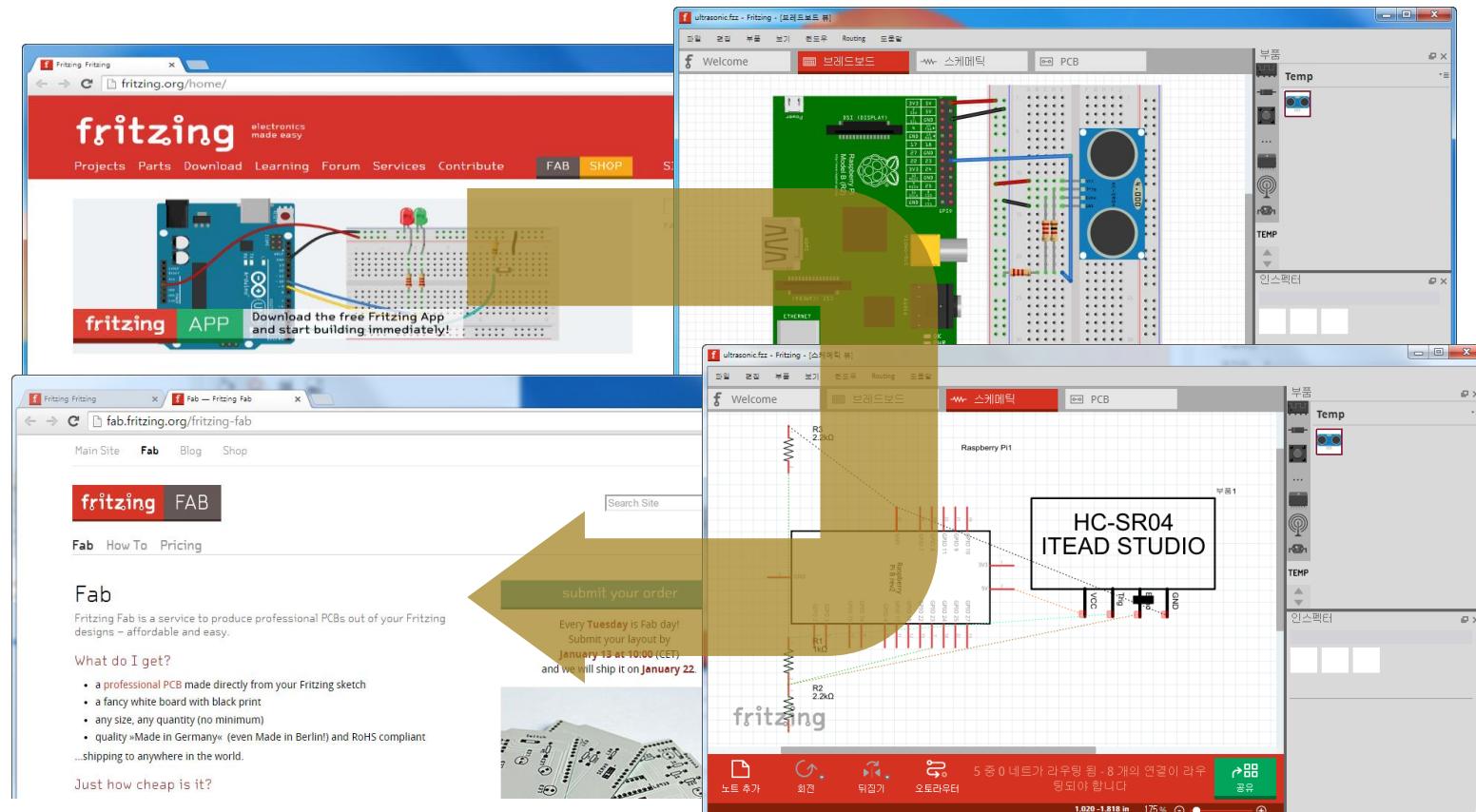


System Design

❖ Fritzing (<http://www.fritzing.org>)

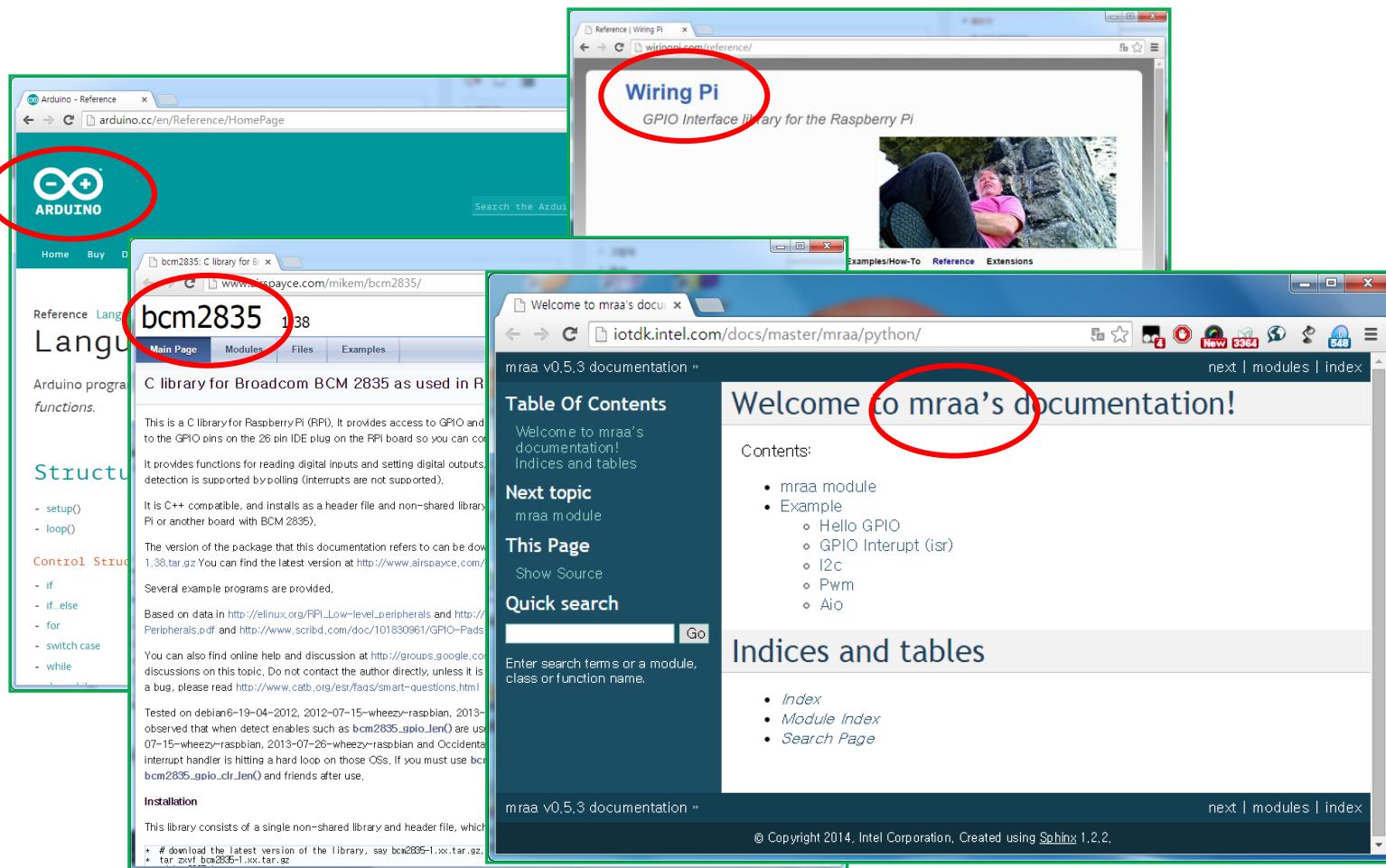
▶ CAD Tool

↳ 오픈 소스 기반의 CAD 툴이며, 브레드보드를 통한 물리적인 구현에 대해 PCB 디자인 기능 제공



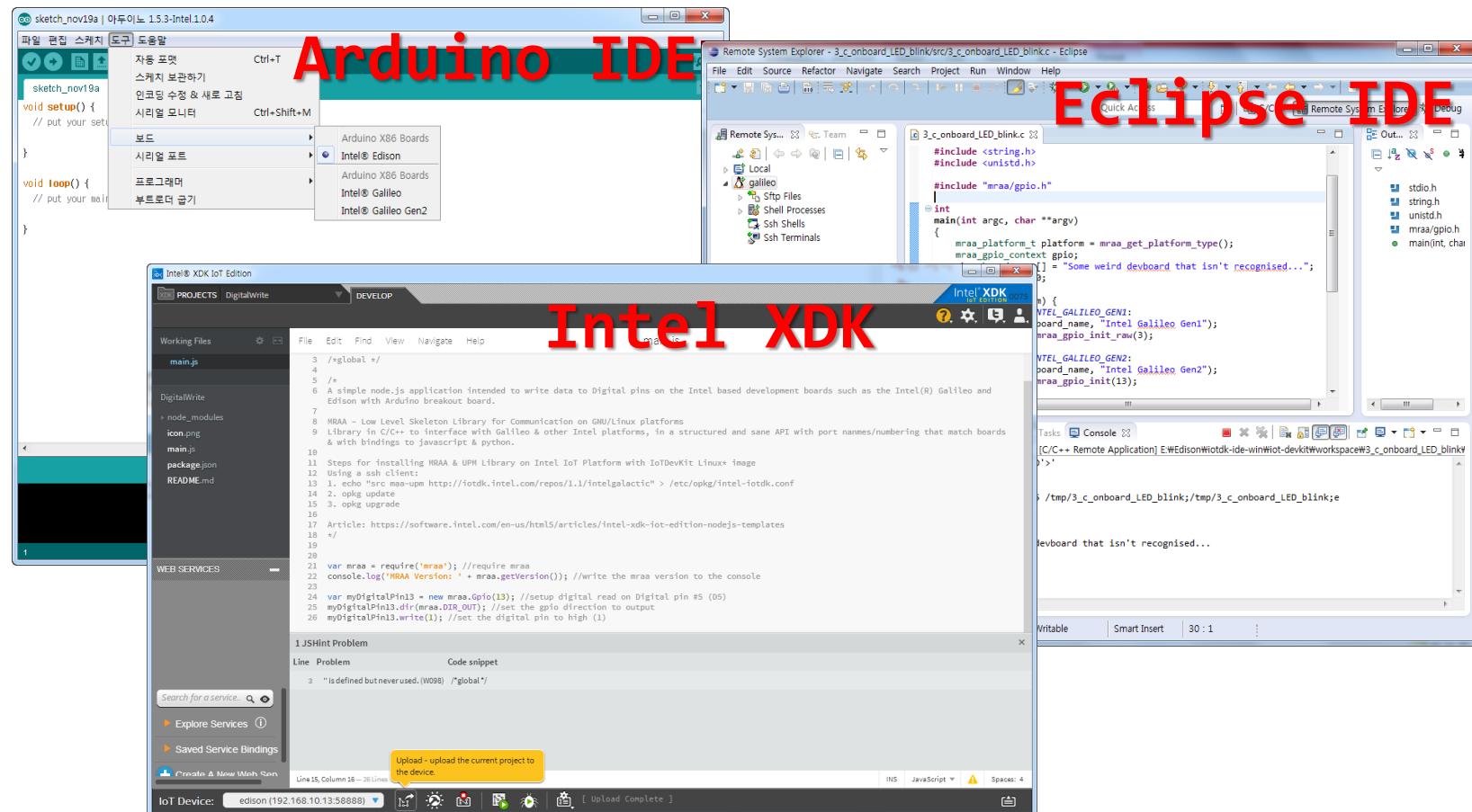
Software Development

- ❖ 소프트웨어 개발을 위한 라이브러리들
 - ▶ 아두이노, 라즈베리 파이, 에디슨 등



Software Development

- ❖ 소프트웨어 개발을 통합 개발 환경
- ▶ 아두이노, 라즈베리 파이, 에디슨 등

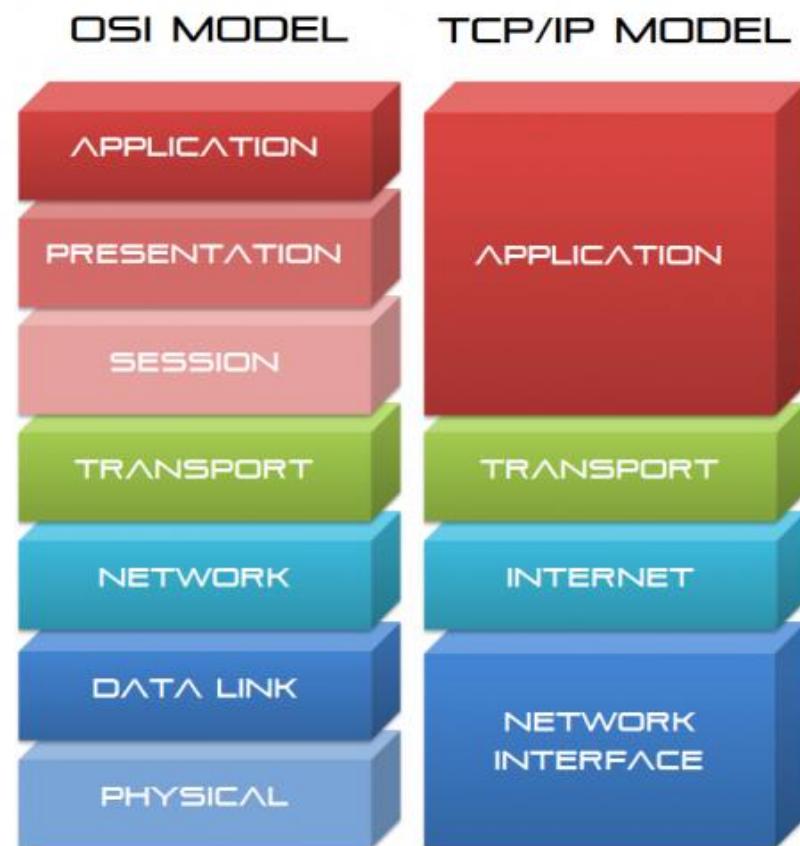


Connectivity



Connectivity

- ❖ Networking & Protocols
 - ▶ Ethernet, WiFi, Bluetooth, IrDA, RF, NFC, ...
 - ▶ IEEE 802.3, 802.11, 802.15, ...
 - ▶ Network Layer Protocols
 - ▶ Transport Layer Protocols
 - ▶ Application Layer Protocols
 - ▶ ...

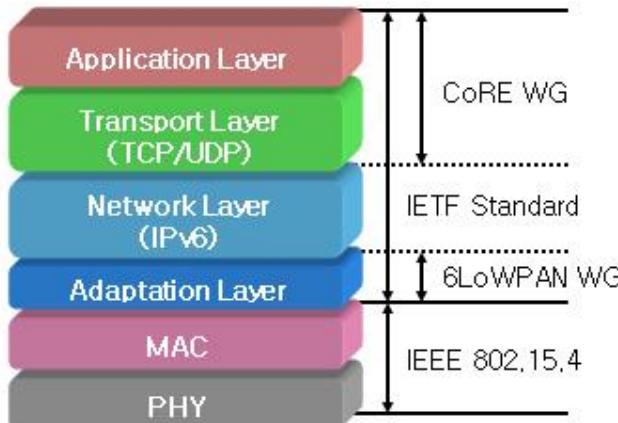


Connectivity

- ❖ 사물인터넷을 위한 네트워킹
 - ▶ 웹(web) 또는 사물인터넷 프로토콜 지원

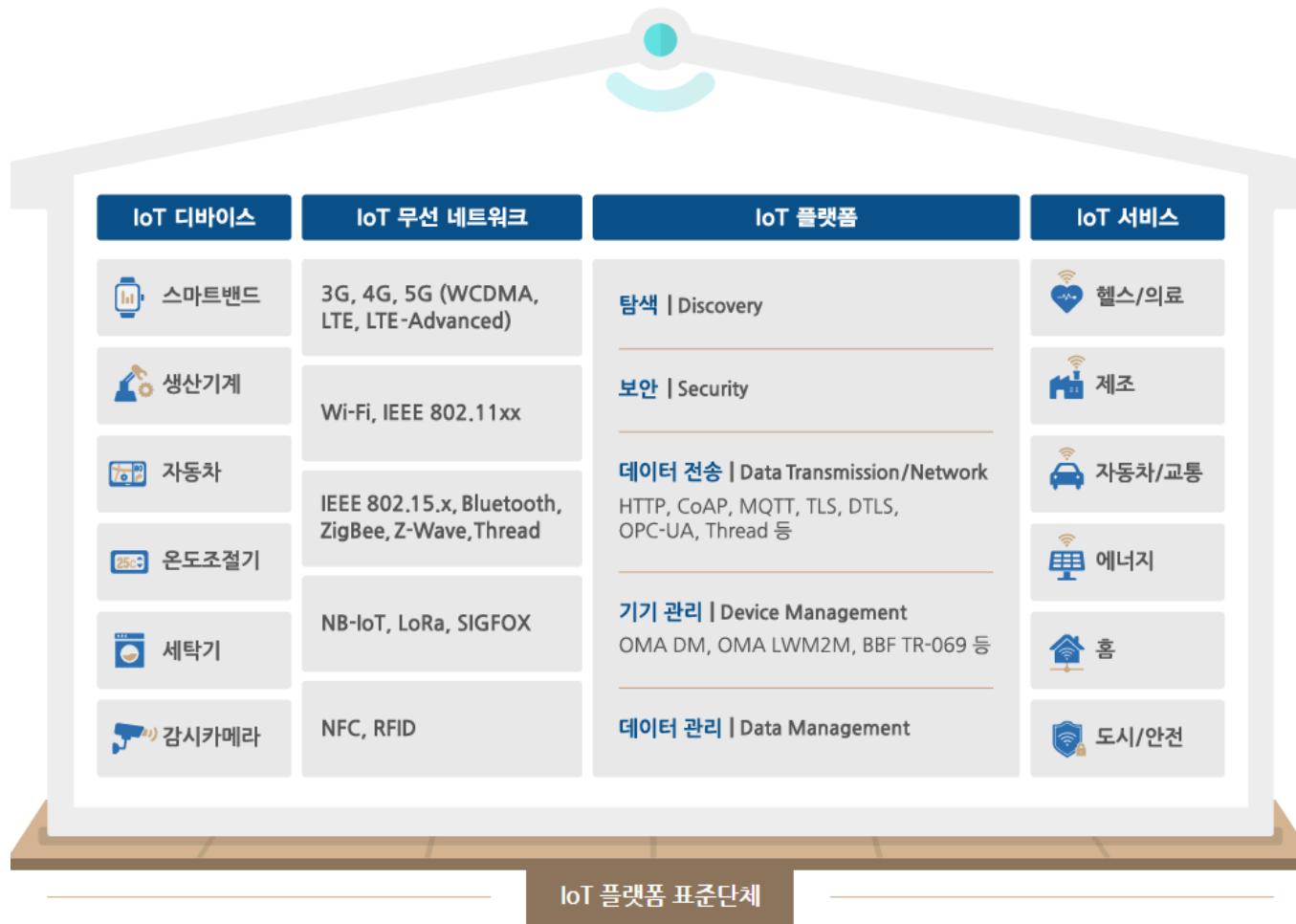


CoAP



Connectivity

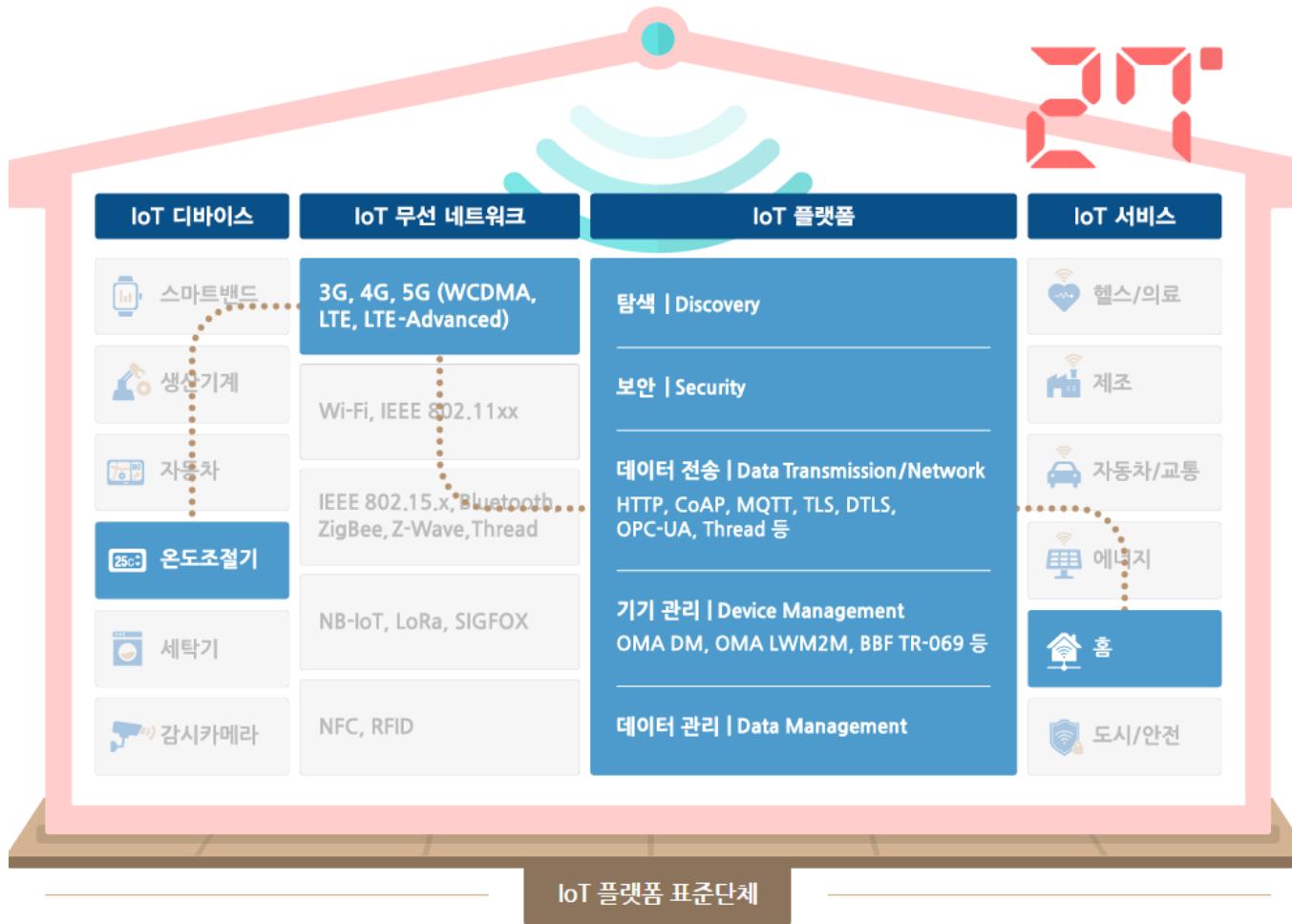
❖ IoT Service Layer Protocol Standard



[Source: TTA]

Connectivity

❖ IoT Service Layer Protocol Standard



[Source: TTA]

Connectivity

- ❖ 사물인터넷을 위한 네트워킹
- ▶ 사물인터넷, 홈 오토메이션을 위한 제품들

Welcome to the RaZberry Project

The diagram illustrates the RaZberry architecture:

- 1. Generic Hardware and Operating System
- 2. Z-Wave Hardware
- 3. Z-Wave Firmware
- 4. Z-Wave Stack
- 5. User Interface 1
- 6. User Interface 2 and 3

Compatible Model B+ includes RaZberry, Raspberry PI board, and Your own Code.

Zwave Products

Product Finder: Select Category, Select Type, Keyword (optional)

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Web Frameworks

- ❖ 웹 연결을 위한 프레임워크, 서버



Warning: This is the documentation for the development version of Jinja2



Welcome to Jinja2



SERVICES ABOUT COMMUNITY BLOG ☎ 1-855-663-8727

About Jinja2

Jinja2 is a templating engine for Python.

Useful Links

Jinja2 is a modern and designer-friendly template engine, after Django's templates. It is fast, widely used and has a flexible template execution environment:

```
<title>{% block title %}{% endblock %}</title>
<ul>
  {% for user in users %}
    <li><a href="{{ user.url }}">{{ user.username }}</a>
  {% endfor %}
</ul>
```

Features:

Five Best Mobile Web App Frameworks

- [Sencha Touch review](#)
- [jQuery Mobile + Backbone review](#)
- [Kendo UI review](#)
- [Angular JS + Ionic review](#)
- [React review](#)

Production



Utensil Design

❖ Modeling, Design Tools

► CAD, Pro Engineer, PTC Creo, SketchUp ≡

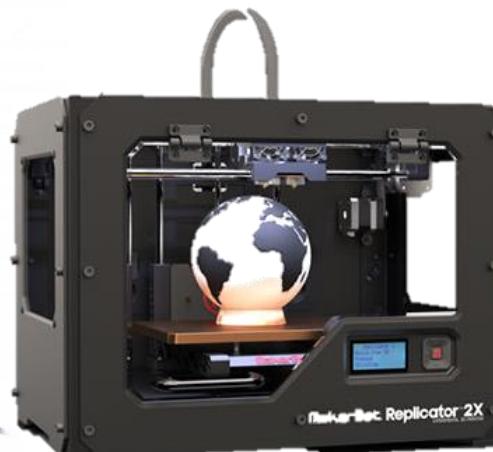
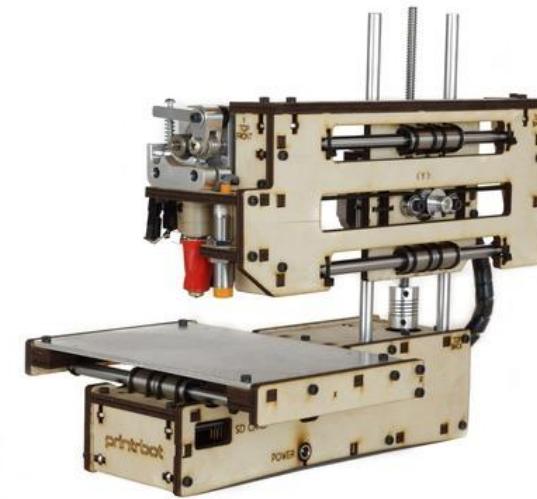
The image displays three screenshots of 3D modeling software:

- PTC Creo Options Modeler Tutorial:** A screenshot of the PTC University Learning Exchange website showing a list of tutorials for PTC Creo, including "Creo Options Modeler Overview" and "Exploring a Configurable Assembly".
- SketchUp Tutorial:** A screenshot of the SketchUp website showing a 3D model of a house and a pipe system, with a callout text: "The easiest way to draw in 3D".
- Water Control Cabinet Concept Model:** A detailed 3D model of a water control cabinet assembly, showing various pipes, valves, and components. Below the model is a table listing the parts and their sizes.

NO.	QTY	SIZE	DESCRIPTION
S-1	4	2"	UNION SOCKET 1/2" NPT FEMALE X 1/2" NPT FEMALE BALL VALVE
S-2	2	2"	UNION SOCKET 1/2" NPT FEMALE X 1/2" NPT FEMALE MOTORIZED THREEWAY BALL VALVE (STAINLESS)
S-3	1	2"	UNION SOCKET 1/2" NPT FEMALE X 1/2" NPT FEMALE MOTORIZED THREEWAY BALL VALVE (STAINLESS)
S-4	1	2"	CPC STRAINER 1/2" NPT FEMALE X 1/2" NPT FEMALE
S-5	2	2" X 1"	CPC 2" X 1" TEE
S-6	2	1"	UNION SOCKET 1/2" NPT FEMALE X 1/2" NPT FEMALE
S-7	1	2"	OPTIONAL VENT VALVE
S-8	1	2"	CPC DUAL NOZZLE REGULATOR
S-9	2	2"	CPC DUAL NOZZLE VALVE
S-10	1	2"	CPC STRAINER

Finale

- ❖ Finished Product
 - ▶ 3D 프린터



Finale

❖ Finished Product

▶ 3D 프린터

Product	Formlabs Form 2	LulzBot Mini 3D Printer	MakerBot Replicator+ Desktop 3D Printer	MakerBot Replicator Desktop 3D Printer	XYZprinting da Vinci Mini	Flashforge Finder 3D Printer	MakerBot Replicator Mini Compact 3D Printer	New Matter MOD-t 3D Printer	Robo 3D R1 +Plus	Ultimaker 2+
										
Lowest Price	\$3499.00 MSRP	\$1,250.00 Amazon	\$2,499.00 Amazon	\$1,284.56 Amazon	\$189.95 Amazon	\$399.00 Amazon	\$849.99 Amazon	\$399.00 MSRP	\$799.99 Amazon	\$2,499.00 Amazon
	SEE IT	SEE IT	SEE IT		SEE IT	SEE IT				
Editors' Rating	 EDITORS' CHOICE	 EDITORS' CHOICE	 EDITORS' CHOICE	 EDITORS' CHOICE	 EDITORS' CHOICE					
Dimensions	20.5 by 13.5 by 13 inches	15.2 by 17.1 by 13.4 inches	16.2 by 20.8 by 17.4 inches	16.2 by 17.4 by 20.8 inches	14.2 by 15.4 by 13.2 inches	16.5 by 16.5 by 16.5 inches	15 by 11.6 by 12.2 inches	11.6 by 13.1 by 15.4 inches	18.2 by 17 by 15 inches	23.1 by 19.9 by 13.4 inches
Weight	28 lbs	18.8 lbs	40.4 lbs	35 lbs	24.3 lbs	28 lbs	18 lbs	11 lbs	28 lbs	24 lbs
Maximum Build Area	6.9 by 5.7 by 5.7 inches (HWD)	6 by 6 by 6.2 inches (HWD)	6.5 by 11.6 by 7.6 inches (HWD)	5.9 by 7.8 by 9.9 inches (HWD)	5.9 by 5.9 by 5.9 inches (HWD)	5.5 by 5.5 by 5.5 inches (HWD)	3.9 by 3.9 by 4.9 inches (HWD)	5 by 6 by 4 inches (HWD)	8 by 10 by 9 inches (HWD)	8.1 by 8.8 by 8.8 inches (HWD)
Frame	Closed	Open	Open	Open	Open	Open	Open	Closed	Open	Open
LED/LCD Screen	Yes	No	Yes	Yes	No	Yes	No	No	No	Yes
Technology	Stereolithography	Fused Filament Fabrication (FFF)	Fused Filament Fabrication (FFF)	Fused Filament Fabrication (FFF)	Fused Filament Fabrication (FFF)	Fused Filament Fabrication (FFF)	Fused Filament Fabrication (FFF)			

[Source: The Best 3D Printers of 2017, PC Reviews]

Finale

❖ Finished Product

▶ Metal 3D Printer

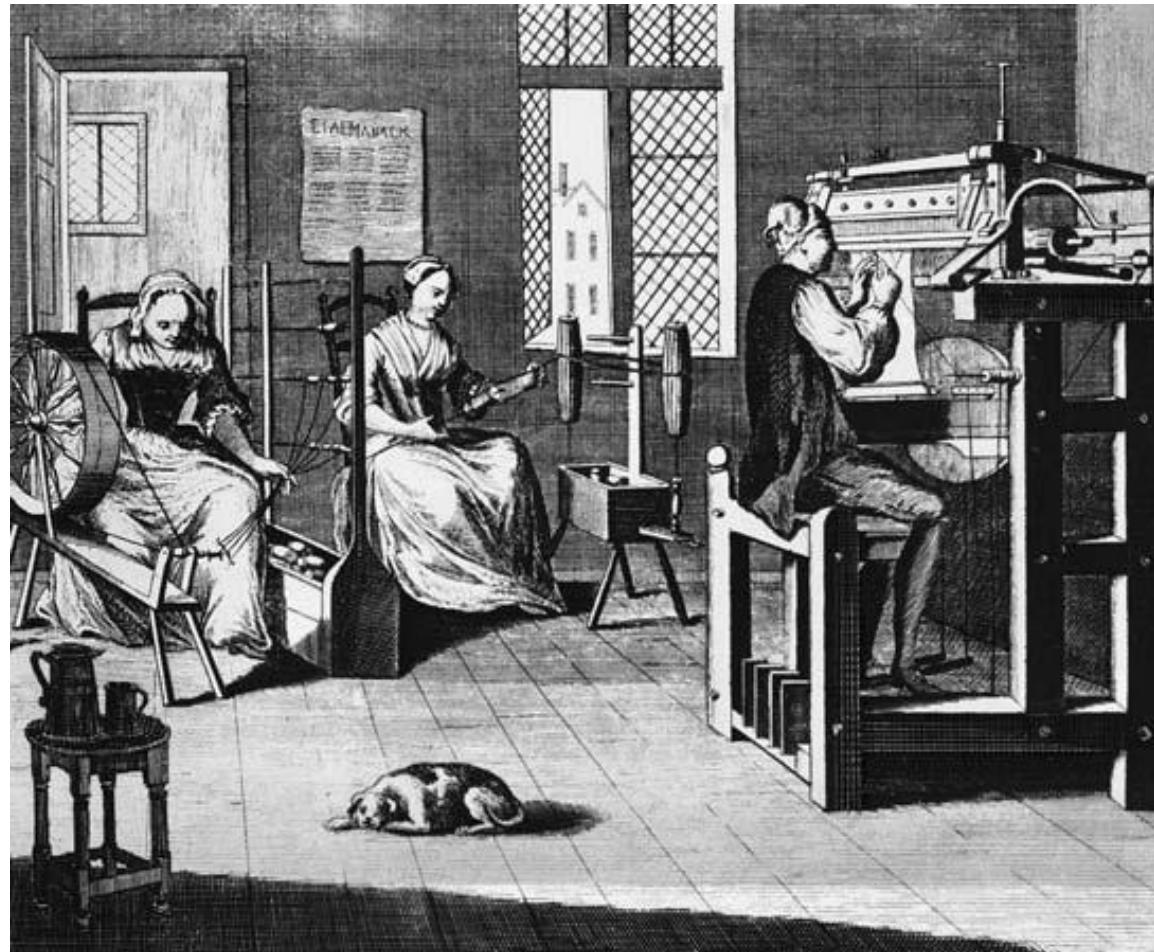
- ↳ <https://all3dp.com/1/3d-metal-3d-printer-metal-3d-printing/>
- ↳ <https://youtu.be/20R9nItDmPY>

▶ Full Color 3D Printer

- ↳ <https://3dprint.com/189088/mcor-ark-e-reseller-xperia-xz1/>

IoT Revolution

❖ Rapid Cottage Industry



Profile

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<저서 및 역서>

- 라즈베리 파이로 구현하는 사물인터넷 프로젝트 (위키북스)
- 임베디드의 모든 것 (위키북스)
- 리눅스 커널 in a Nutshell (프리렉)
- 언로킹 안드로이드 (프리렉)
- 안드로이드 ADK와 아두이노 (한국전자정보통신산업진흥회)
- 안드로이드 내부구조의 이해 (한국전자정보통신산업진흥회)

<교육>

- 삼성전자, LG전자, SK텔레콤, KT Tech, 팬택, 모토로라, Foxconn (리눅스 커널, 디바이스 드라이버, 안드로이드, 컴파일러 등)