

1

# IoT Platform



# 1) IoT Platform

## ITU-T Y.2060 IoT Reference Model

4 layers and management/security capabilities

### 서비스 지원 및 응용계층

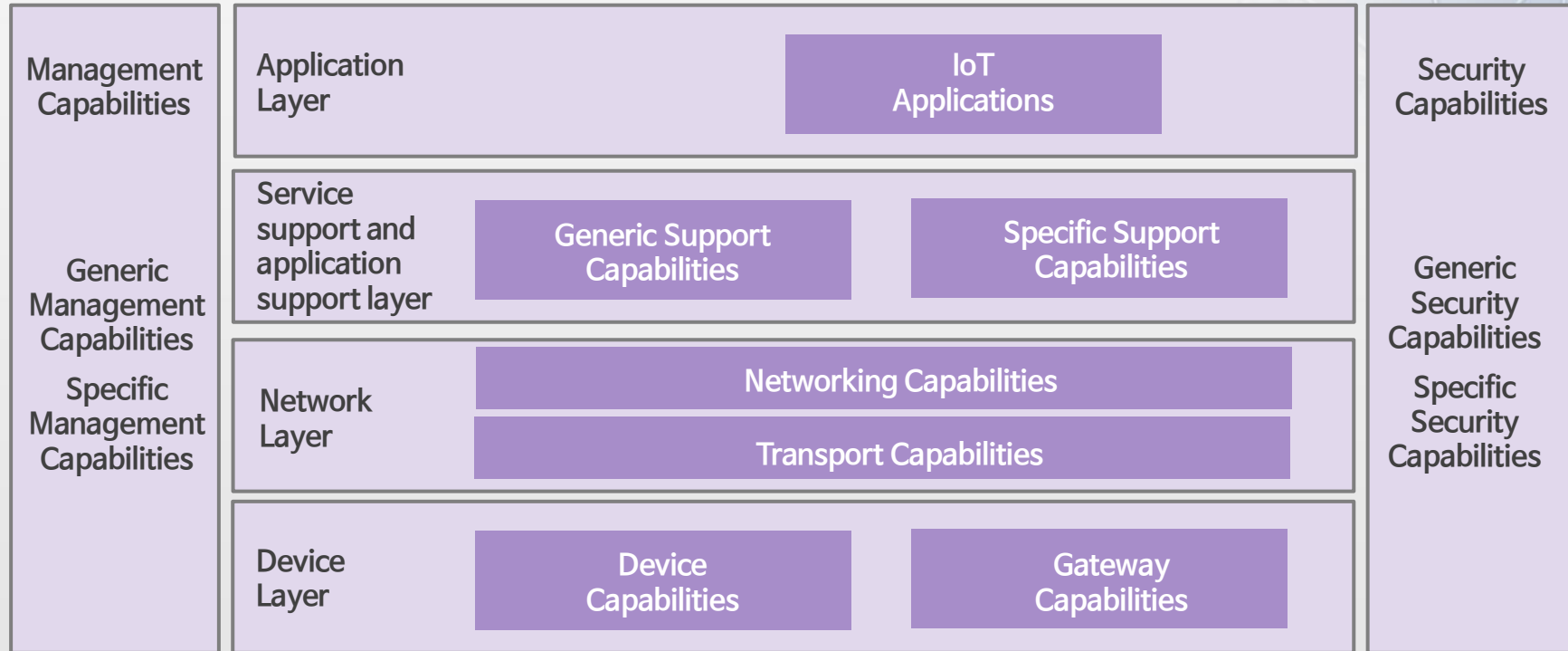
- 공통 지원 기능
- 특정응용 지원 기능

### 디바이스 계층

- Device 기능
- 게이트웨이 기능

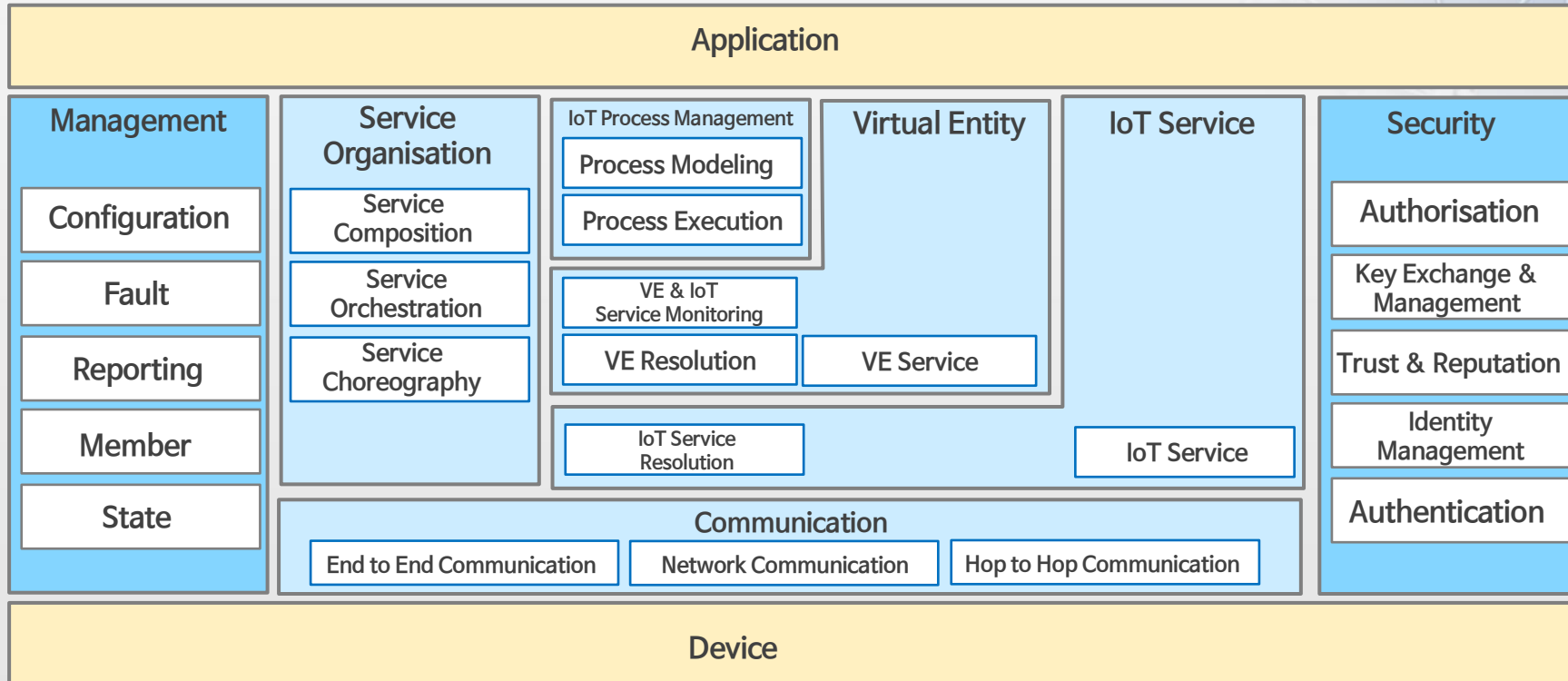
# 1) IoT Platform

## ITU-T Y.2060 IoT Reference Model



# 1) IoT Platform

## IoT Platform Architecture



2

## IoT 업계 동향

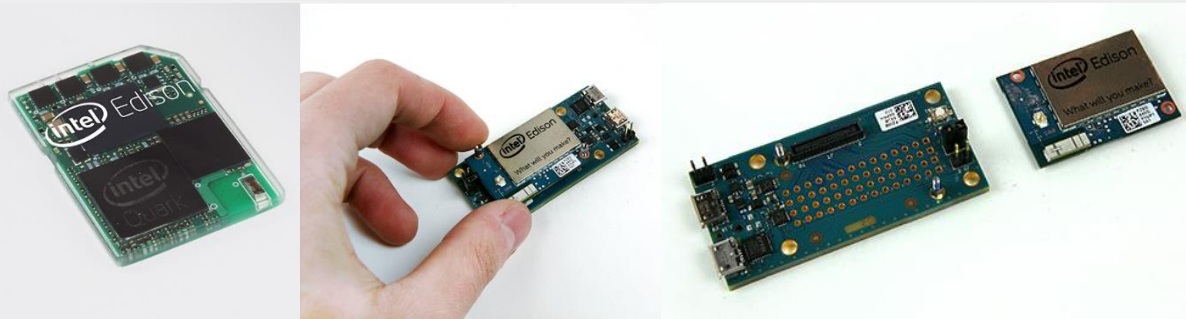


# 1) IoT 업계 동향



Edison Board

IoT 시장을 위한 초소형 보드



# 1) IoT 업계 동향



## Key Features

22nm 인텔 ® Atom™ SoC(기존 Silvermont 1)이 사용

Dual core dual thread 500 MHz CPU,  
100 MHz / 32bit Intel Quark™ MCU 탑재

40개 GPIO 지원

Dual band WiFi, Bluetooth Low Energy(BLE)  
우표 크기 모듈에 모두 탑재

# 1) IoT 업계 동향



## Key Features

인텔 ® Edison 모듈은 Arduino \*, C / C ++ 개발을 지원

곧 Node.JS, Python, RTOS, Visual Programming  
지원 예정

인텔 ® Edison 모듈은 장치 간 연결 및  
장치와 클라우드 사이의 연결 프레임 워크 포함

장치 간의 통신 및 클라우드 기반  
멀티 테넌트 분석 서비스 가능



# 1) IoT 업계 동향

## Freescale

### IoT Gateway

### Demonstration

#### LS1021A-IoT Gateway Demo

 **Sensor Data flow**  
Node 1 to Cloud via IoT Gateway

The Cloud



LS1021A IoT Gateway



MQTT  
Broker

MQTT

Wi-Fi

MQTT

Wi-Fi

Node 1 (Sensor Cluster)

Freescale Freedom  
Board



MQTT  
Publisher

Light  
Movement  
Touch



Node 2 (Fan)

Freescale Freedom  
Board



MQTT  
Subscriber



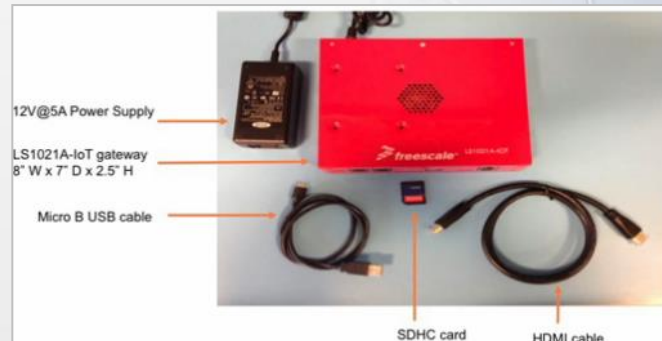
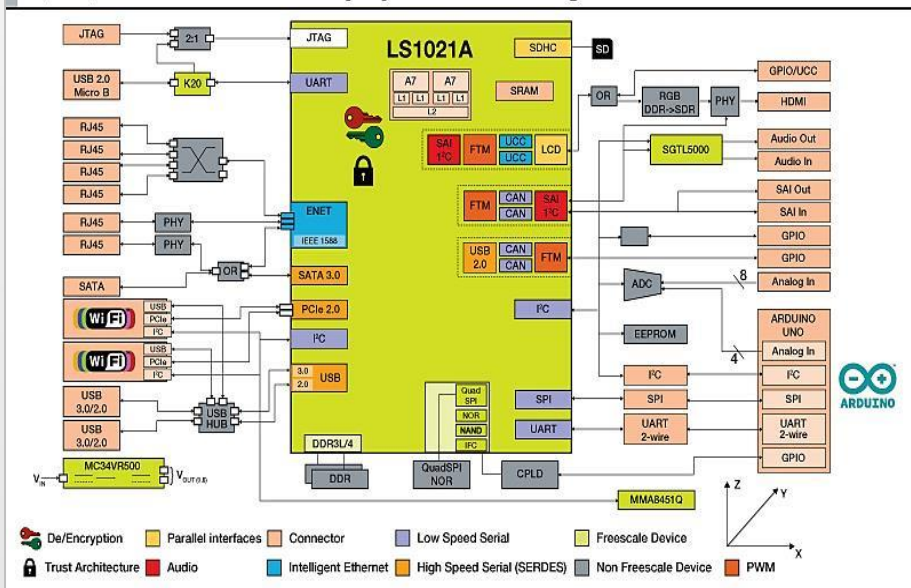
 **Control flow**

1. Node 1 Sensor Data to IoT Gateway
2. Process Data
3. Action : IoT Gateway to Node 2

# 1) IoT 업계 동향

## Freescale

QorIQ LS1021A-IoT Gateway System Block Diagram



# 1) IoT 업계 동향

## BeagleBone



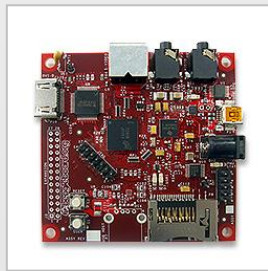
BeagleBone  
Green



BeagleBone



BeagleBoard  
-xM



BeagleBoard  
-Black

- BeagleBoard-xM  
AM37x 1GHz ARM Cortex-A8 compatible
- BeagleBoard  
OMAP3530 720MHz ARM Cortex-A8
- BeagleBone is an \$89 MSRP,  
AM335x 720MHz ARM Cortex-A8 credit-card-sized  
Linux computer that connects to the Internet and runs  
software such as Android 4.0 and Ubuntu
- BeagleBone Green  
AM335x 1GHz ARM® Cortex-A8 based on the open-  
source hardware design of BeagleBone(Black)

# 1) IoT 업계 동향



## ARM

Sensinode 인수를 통하여 All IP 기반의 개방형 솔루션 확보

ARM mbed IoT 디바이스 플랫폼 + mbed OS(무료)

# 1) IoT 업계 동향



## Sensinode

6LoWPAN (IPv6 over Low power Wireless Personal Area Network)

CoAP (Constrained Application Protocol) 기준 정립

IETF 표준화 활동, ZigBee IP 표준화

# 1) IoT 업계 동향

## CoAP

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CoRE 워킹그룹에서 제정하려는 CoAP의 표준화 영역은 TCP와 UDP 등의 트랜스포트 계층을 포함한 상위 애플리케이션 계층에서 M2M Node들 사이에서 어떻게 리소스 이벤트(예 온도, 습도)에 대한 요청을 하고 이벤트가 생겼을 경우 어떻게 비동기적으로 리소스 이벤트를 Node에게 전송할 지에 대한 방법을 REST(Representational State Transfer) 기반의 접근방식으로 프로토콜을 설계하는 부분임

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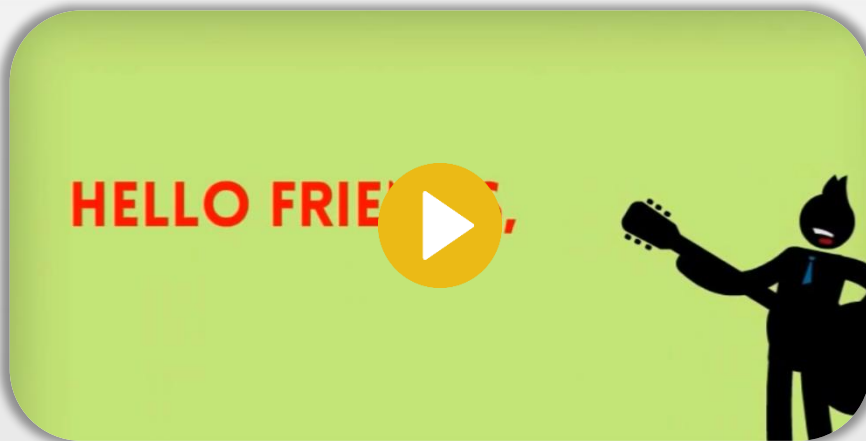
# 1) IoT 업계 동향

## Sensinode

분류	기능	현황	전망
Open HW Platform	<ul style="list-style-type: none"><li>Thing HW 플랫폼</li></ul>	<ul style="list-style-type: none"><li>Arduino, Raspberry Pi, Galileo 등</li></ul>	<ul style="list-style-type: none"><li>개발 편의성 중심, Open HW 중심</li><li>다양한 창의 IoT Product에 적용 예상</li></ul>
Device Platform	<ul style="list-style-type: none"><li>Device Operating System</li></ul>	<ul style="list-style-type: none"><li>Tiny OS, Rasbian, Embedded Linux, nanoQplus 등 경량 OS</li><li>Wearable Device 용 초경량/저전력 OS 등장</li></ul>	<ul style="list-style-type: none"><li>목적별 초경량/저전력 OS</li><li>네트워크 장비의 IoT 인프라화 예상</li></ul>
사물 데이터 플랫폼 (서비스)	<ul style="list-style-type: none"><li>사물 데이터</li><li>개방/연계/검색/분석</li></ul>	<ul style="list-style-type: none"><li>글로벌 기업 IoT 데이터분석 플랫폼</li><li>시맨틱 기술 IoT 접목을 통한 데이터 상호운용</li></ul>	<ul style="list-style-type: none"><li>공공 데이터 플랫폼 운용 확대</li><li>사물연동 및 지능형 서비스 요구 증대에 따른 관련 기술 중요도</li></ul>

# 1) IoT 업계 동향

[ Internet of Things – IoT (Explained Easily) ]



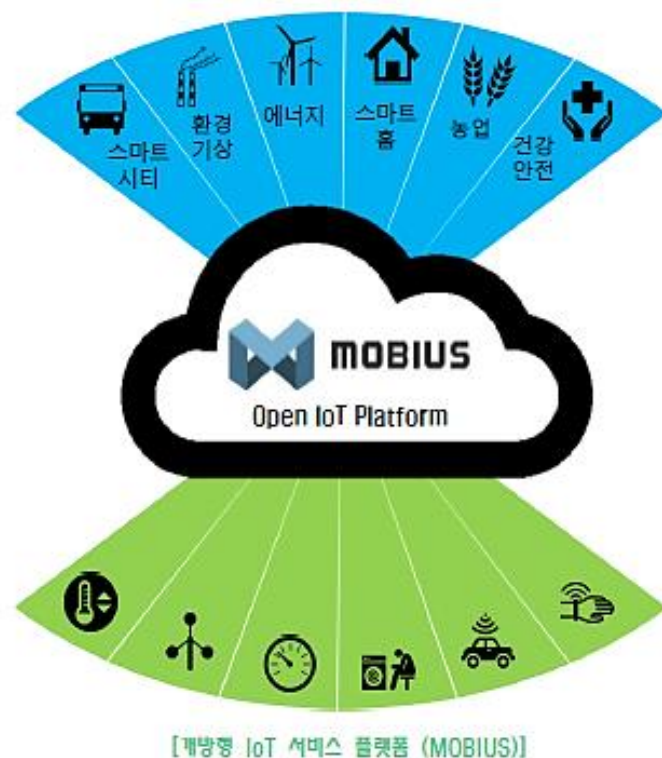
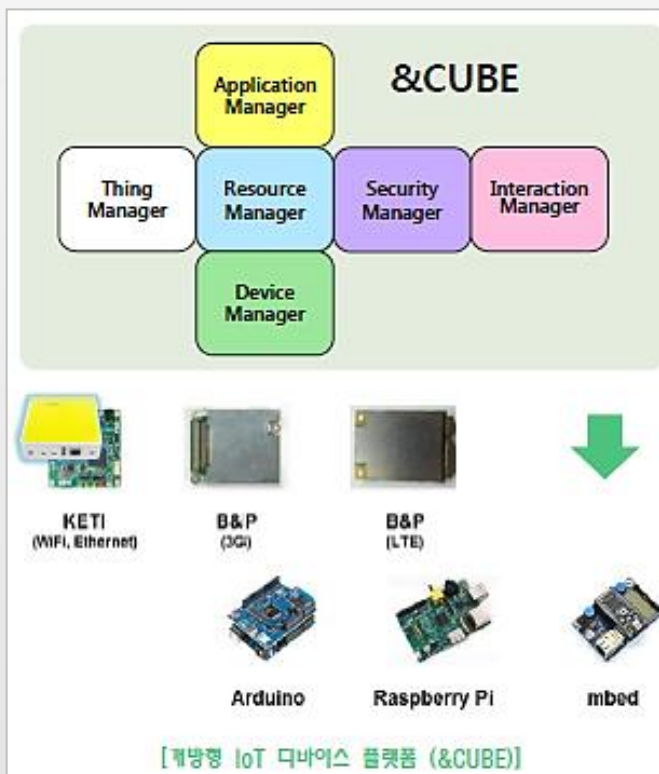
〈출처 : <https://www.youtube.com/watch?v=o7VXyolenvU>〉



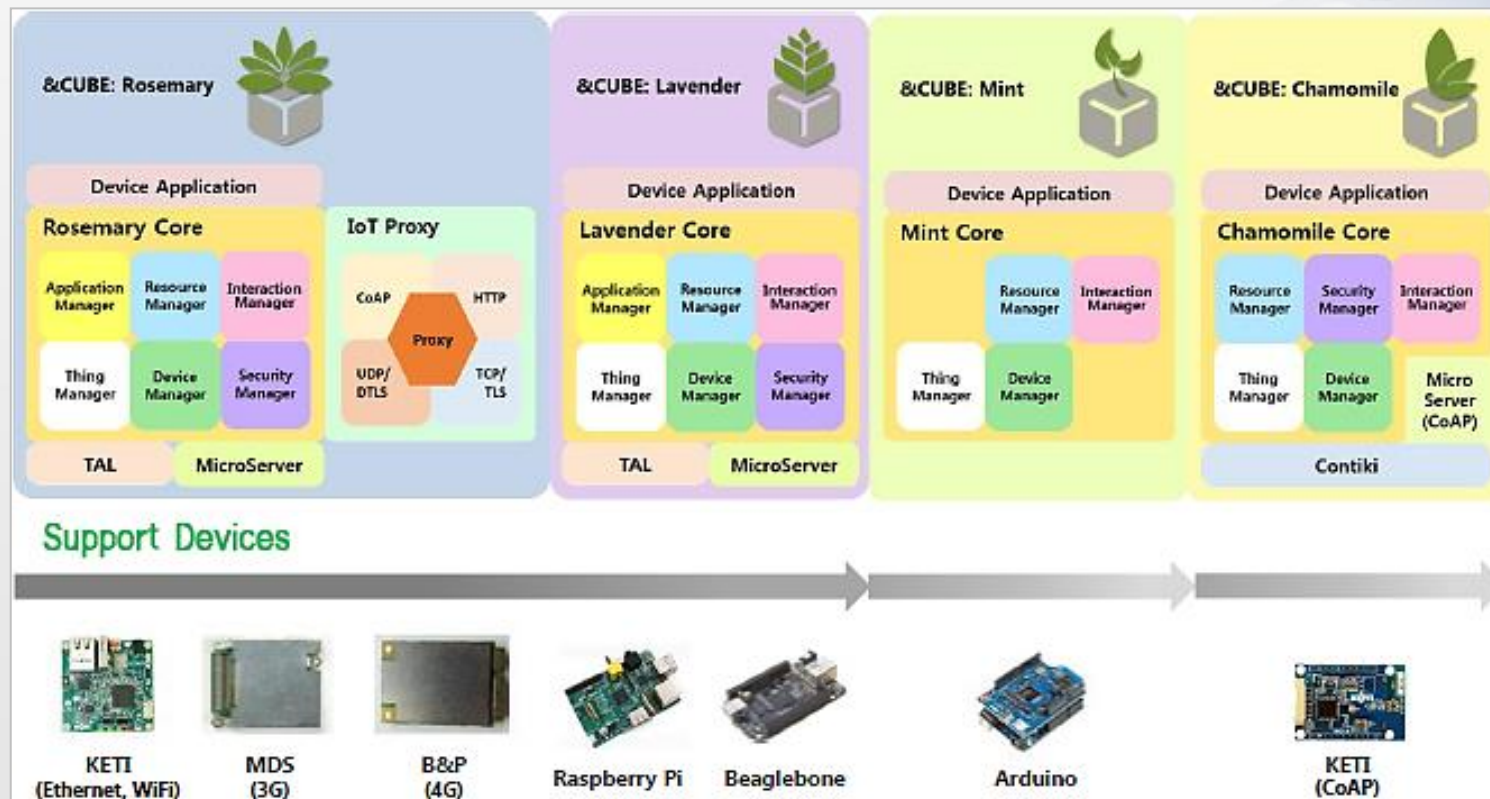
# 1) IoT 업계 동향



# 1) IoT 업계 동향



# 1) IoT 업계 동향



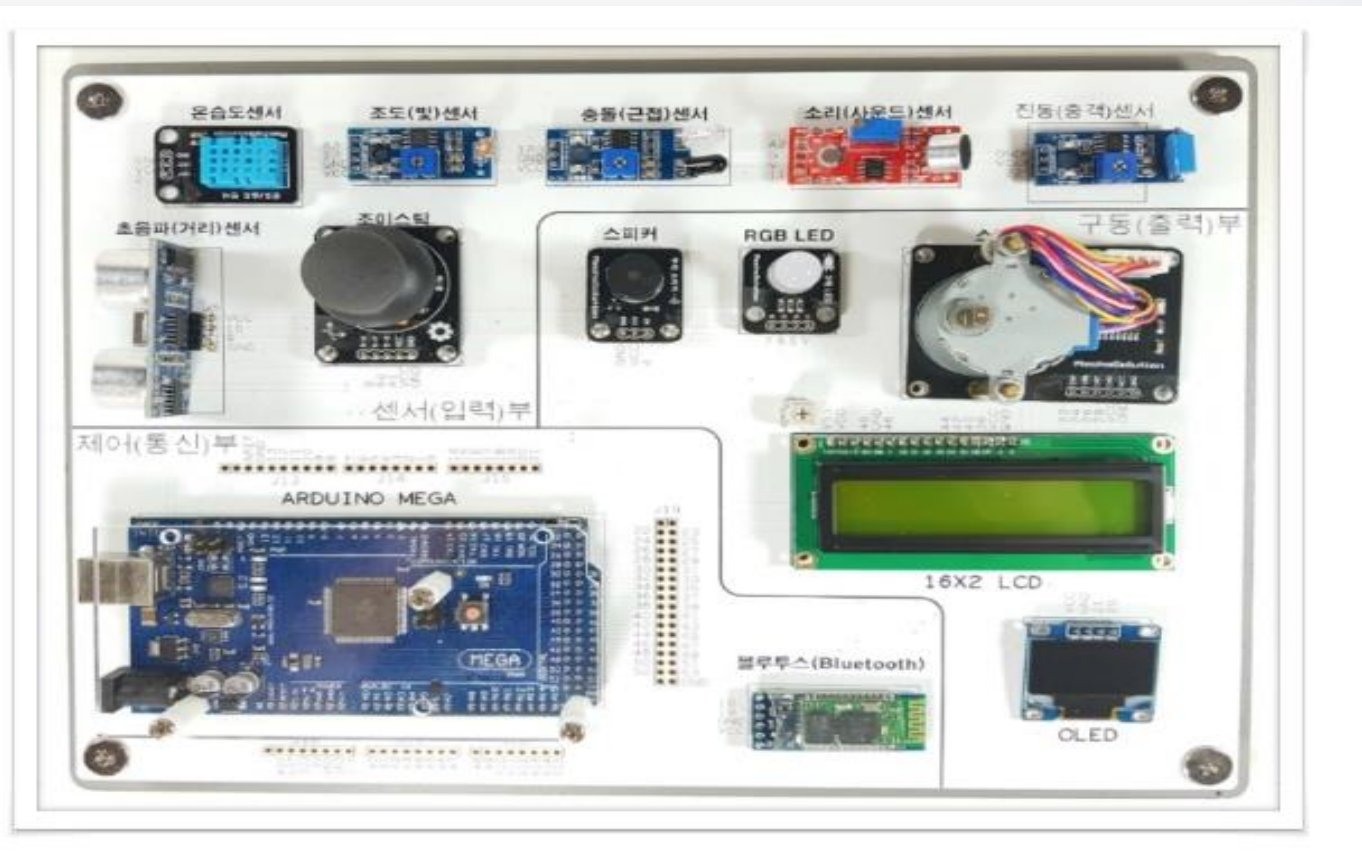
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# IoT Kit Example





# 1) IoT Kit Example



# 1) IoT Kit Example

DC 모터 2개	16×2 캐릭터 LCD	40핀 헤더 (male)	가변저항 10K옴
			
220옴 저항 (5개)	빨간색 LED (5개)	조도센서 (CdS) 2개	1K옴 저항 (5개)
			

To. 설계자  
슬라이드 삭제하겠습니다.

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# IoT Communication



# 1) IoT Communication



## 사물인터넷 통신 기술

### 1 WiFi, Cellular

- 사물인터넷 통신으로 사용하기에는 too much power consumption

### 2 ZigBee, Bluetooth LE(BLE) 등의 저전력 무선 네트워킹 기술 등장

### 3 센서 정보 저장에 최적화 기반 데이터의 관리 기술 필요

- Query 및 데이터 관리를 위해 객체 간 통신/데이터 전송이 빈번하게 발생
- 지능화된 DB 관리 방법 필요



# 1) IoT Communication

## 사물인터넷 통신 기술

### 4 LoRa(Long-Range)

- 저전력 저비용 고신뢰 요구
- LPWA(Low Power Wide Area, 저전력 장거리 통신)
- 최소한의 전력으로 먼 거리까지(통상 10km 이상) 통신
- ➔ 기존 3G, 4G, LTE 등과 달리  
몇 백kb 수준에 불과한 데이터를 송수신할 수 있으며,  
충전 없이 수년간 사용할 수 있음

# 1) IoT Communication

## 사물인터넷 통신 기술

### 5 LTE-M

- LTE-MTC(Machine Type Communication)  
3GPP에서 표준화한 기술
  - ➔ 전국망이 구축된 LTE망을 이용하므로  
기존 통신망으로 전국 서비스가 가능하고,  
로밍 등 글로벌 확장성 측면에서 장점이 있음

# 1) IoT Communication



## IEEE 802.15.4 : LR-WPAN (Low Rate Wireless Personal Area Network)

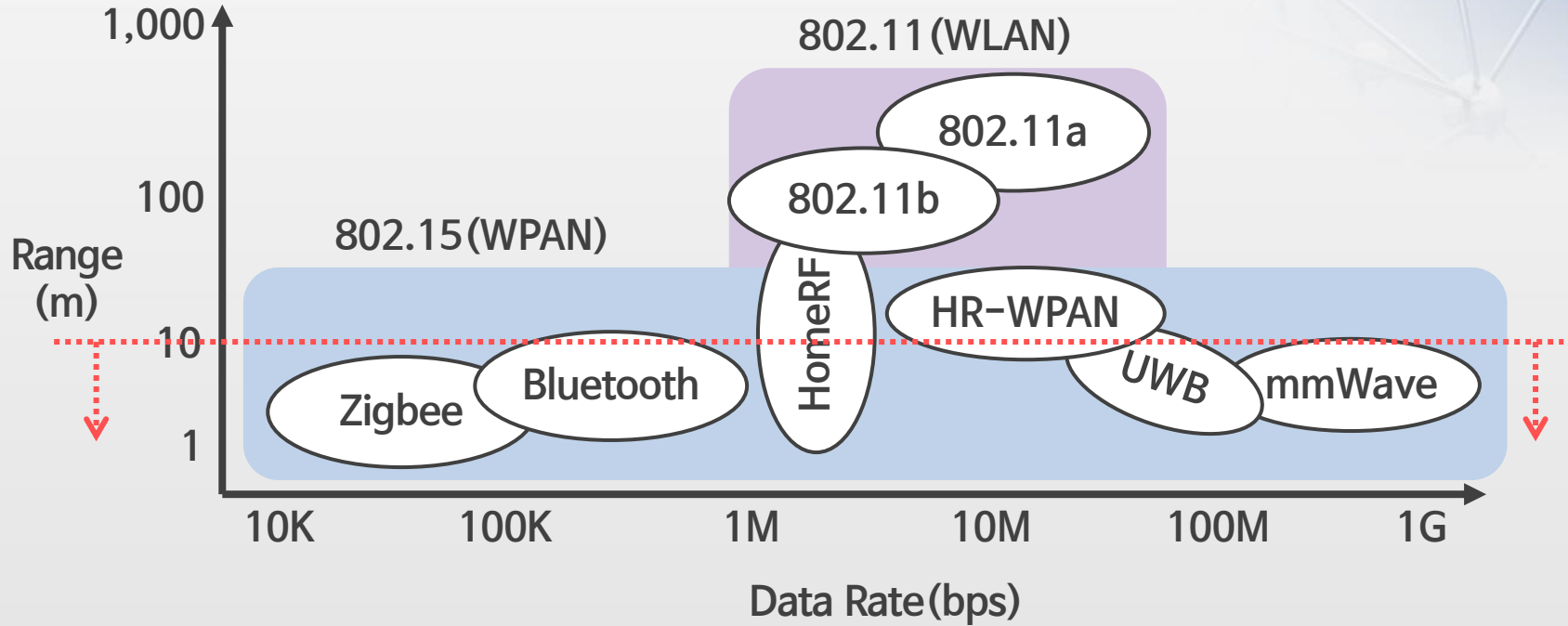
10m 이내의 좁은 영역에서 사용하는  
저전력/소형/저가 개인 무선 네트워크 기술

2.4GHz(World), 868MHz(EU), 915MHz(US) 대역 사용

CSMA/CA(Collision Avoidance)

# 1) IoT Communication

## IEEE 802.15.4: LR-WPAN (Low Rate Wireless Personal Area Network)



# 1) IoT Communication

## IEEE 802.15.4 : LR-WPAN (Low Rate Wireless Personal Area Network)

- ▶ 6LoWPAN  
(IPv6 over Low-Power Wireless Personal Area Networks), Adaptation

### 6LoWPAN

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L2 Layer에 IEEE 802.15.4를 기반으로 하는 센서 네트워크 상에 IPv6를 지원하기 위한 이슈를 다루는 그룹

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### ZigBee

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Open Standard가 아니고 ZigBee Alliance에 가입한 멤버에 한하여 사용할 수 있음

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# 1) IoT Communication

## IEEE 802.15.4 : LR-WPAN (Low Rate Wireless Personal Area Network)

### ▶ 6LoWPAN 고려사항

① Small Packet Size : 헤더를 제외하고 최대 127byte

② 16비트 단축형

③ IEEE 802.15.4 주파수 대역, 데이터 전송률

④ Topology : Star, Mesh

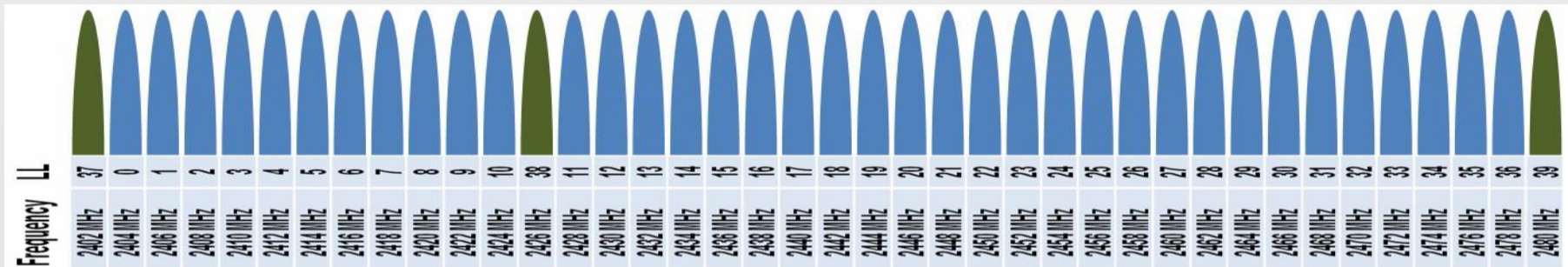
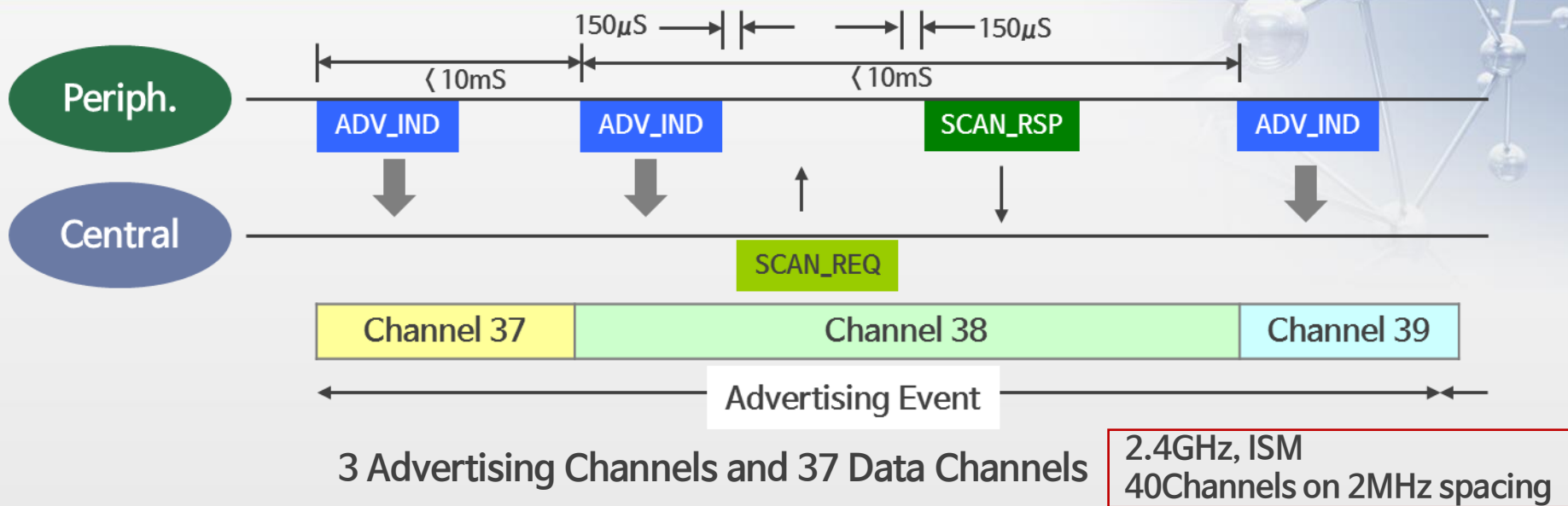
⑤ 저전력, 저가, 저신뢰성, Sleep Mode 등

5

# IoT Communication : BLE

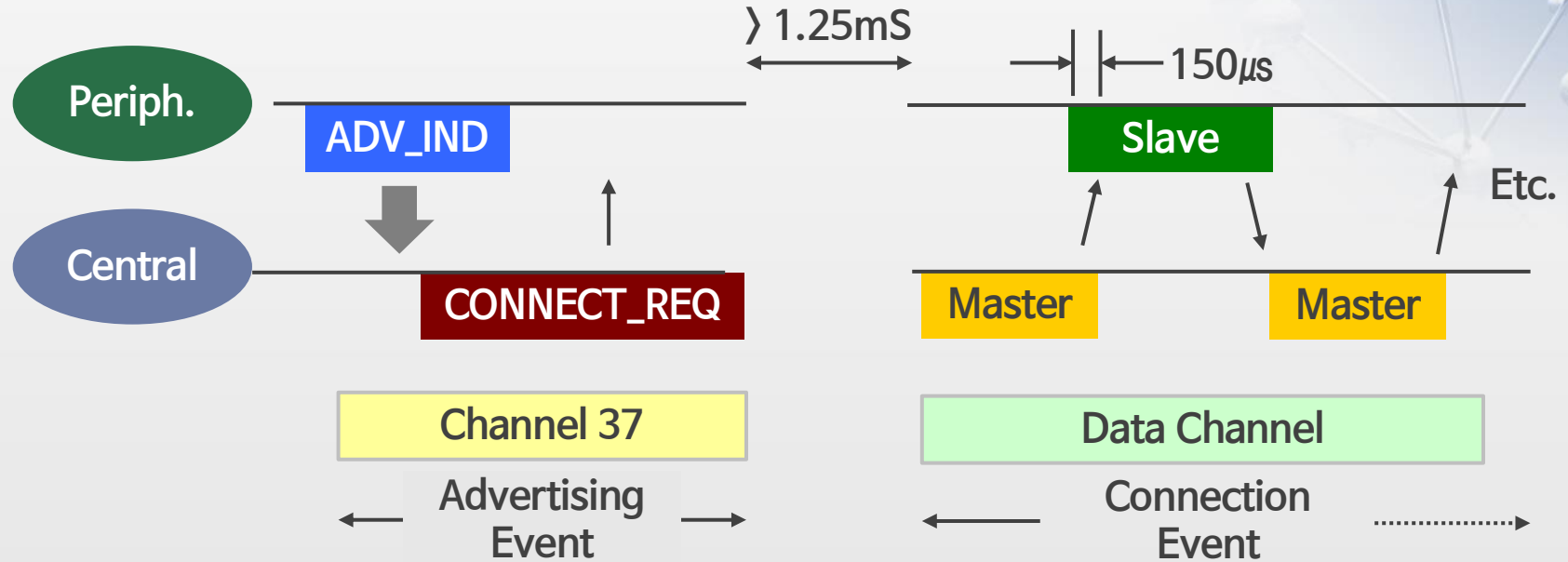


# 1) IoT Communication : BLE





# 1) IoT Communication : BLE



# 1) IoT Communication : BLE



Once a connection is made

All subsequent transactions are performed in the 37 data channels

Transactions can be encrypted

Both devices can go into deep sleep between transactions



# 1) IoT Communication : BLE

 Assume an upper bound of 3ms per minimal transaction

21.6 M transactions using 180 mAh battery

41.1 years with 1 transaction/minute

# 1) IoT Communication : BLE

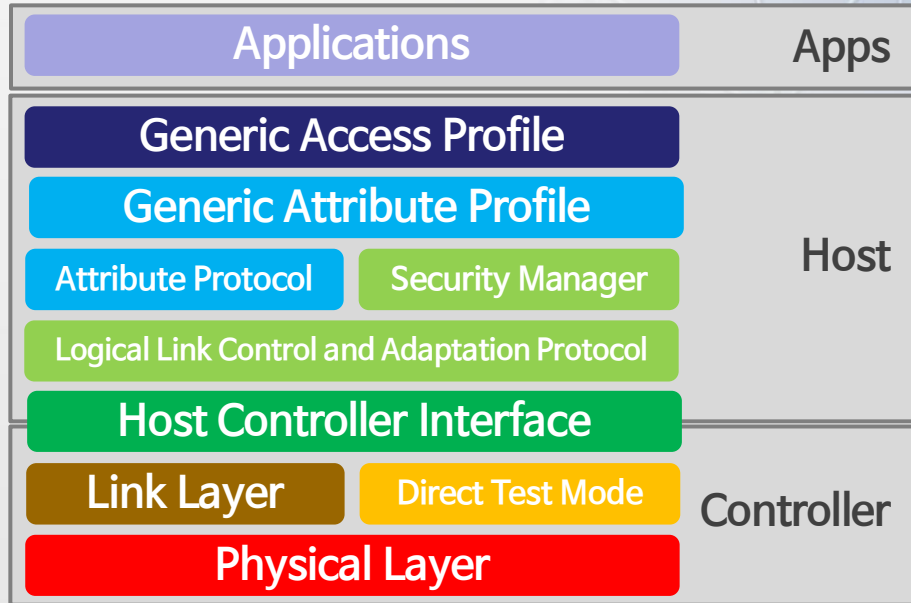
## GAP

장치가 다른 장치들에게 어떻게  
보여지도록 할 것인가를 결정함

어떻게 두 장치를 연결할 것인가를  
결정함

장치가 맡을 수 있는  
다양한 역할에 대해 정의함

- E.g., Central vs. Peripheral



# 1) IoT Communication : BLE



## GATT

두 BLE 장치 간에 Service, Characteristic을 이용하여 데이터를 주고 받는 방법을 정의함

- Each attribute has a 16-bit UUID standardized by Bluetooth SIG
- 128-bit UUID if assigned by a manufacturer

# 1) IoT Communication : BLE



## BLE GATT

프로파일 (Profile), 서비스 (Service),  
특성 (Characteristic)에 기초

- Profile
  - Bluetooth SIG 또는 Peripheral 설계자에 의해서 만들어진, 미리 정의된 서비스의 묶음
- Service
  - 데이터를 논리적인 단위로 나누는 역할
  - 각 서비스는 UUID라 불리는 16bit(for officially adopted BLE Services) 혹은 128bit(for custom services) 구분자를 가짐
- Characteristic
  - 데이터 단위를 하나 이상 포함

### Profile

#### Service

Characteristic

Characteristic

Characteristic

#### Service

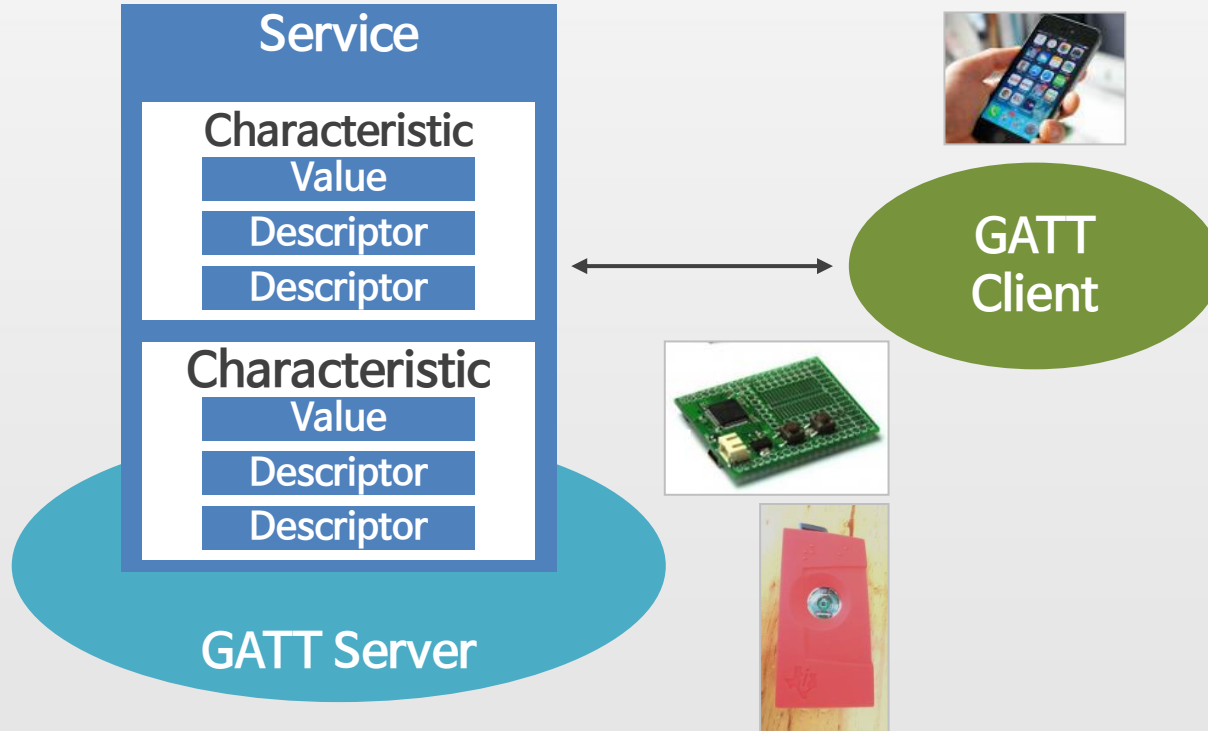
Characteristic

Characteristic

To. 설계자  
네 좋습니다. 감사합니다.

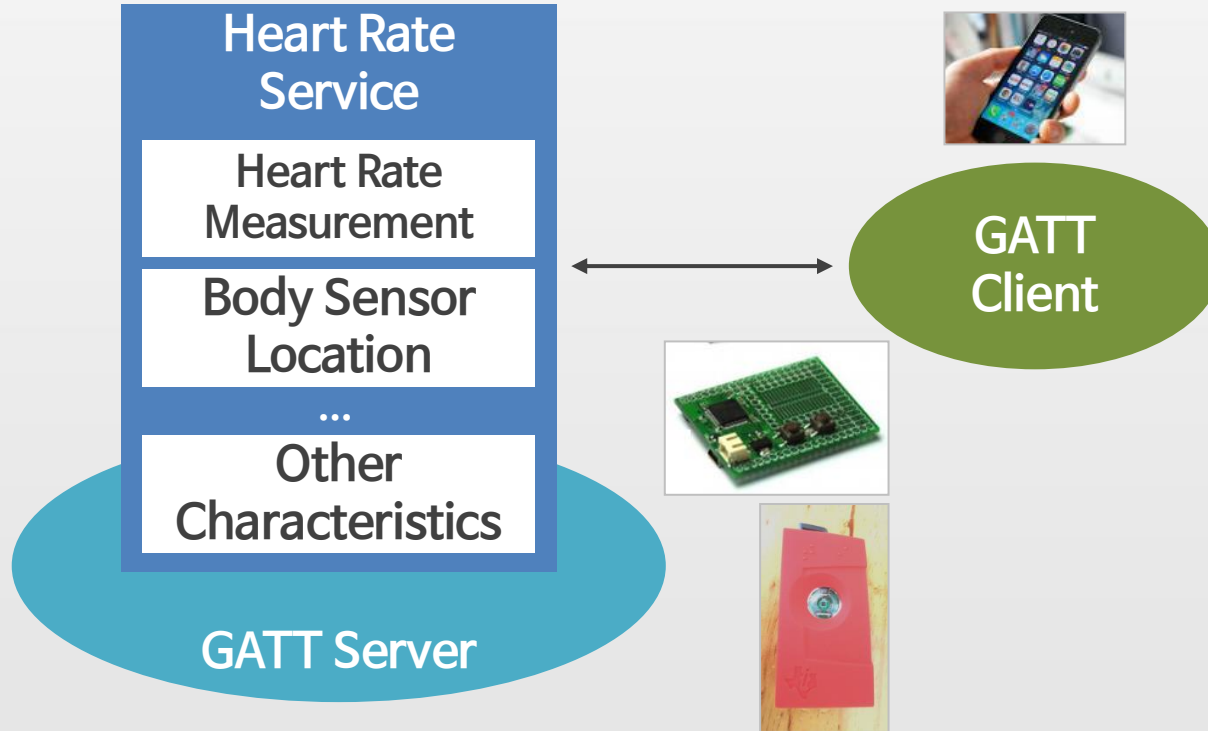
# 1) IoT Communication : BLE

## GATT



# 1) IoT Communication : BLE

## GATT : Heart Rate Measurement





# 1) IoT Communication : BLE



## GATT : Heart Rate Measurement

Services

+	s1: 0 00001800-0000-1000-8000-0...
+	s2: 0 00001801-0000-1000-8000-0...
+	s3: 0 0000180a-0000-1000-8000-0...
+	s4: 0 f000aa00-0451-4000-b000-0...
+	s5: 0 f000aa10-0451-4000-b000-0...
+	s6: 0 f000aa20-0451-4000-b000-0...
+	s7: 0 f000aa30-0451-4000-b000-0...
+	s8: 0 f000aa40-0451-4000-b000-0...
+	s9: 0 f000aa50-0451-4000-b000-0...
+	s10: 0 0000ffe0-0000-1000-8000-0...
+	s11: 0 f000aa60-0451-4000-b000-0...
+	s12: 0 f000ccc0-0451-4000-b000-0...
+	s13: 0 f000ffc0-0451-4000-b000-0...

Services

-	s1: 0 00001800-0000-1000-8000-0...
+	c14: 00002a00-0000-1000-80...
+	c15: 00002a01-0000-1000-80...
+	c16: 00002a02-0000-1000-80...
+	c17: 00002a03-0000-1000-80...
+	c18: 00002a04-0000-1000-80...
+	s2: 0 00001801-0000-1000-8000-0...
+	s3: 0 0000180a-0000-1000-8000-0...
+	s4: 0 f000aa00-0451-4000-b000-0...
+	s5: 0 f000aa10-0451-4000-b000-0...
+	s6: 0 클림보드에 복사되었습니다. 0000-0...
+	s7: 0 f000aa30-0451-4000-b000-0...

Bond Management	org.bluetooth.service.bond_management	0x181E	Adopted
Continuous Glucose Monitoring	org.bluetooth.service.continuous_glucose_monitoring	0x181F	Adopted
Current Time Service	org.bluetooth.service.current_time	0x1805	Adopted
Cycling Power	org.bluetooth.service.cycling_power	0x1818	Adopted
Cycling Speed and Cadence	org.bluetooth.service.cycling_speed_and_cadence	0x1816	Adopted
Device Information	org.bluetooth.service.device_information	0x180A	Adopted
Environmental Sensing	org.bluetooth.service.environmental_sensing	0x181A	Adopted
Generic Access	org.bluetooth.service.generic_access	0x1800	Adopted
Generic Attribute	org.bluetooth.service.generic_attribute	0x1801	Adopted
Glucose	org.bluetooth.service.glucose	0x1808	Adopted
Health Thermometer	org.bluetooth.service.health_thermometer	0x1809	Adopted
Heart Rate	org.bluetooth.service.heart_rate	0x180D	Adopted
Human Interface Device	org.bluetooth.service.human_interface_device	0x1812	Adopted
Immediate Alert	org.bluetooth.service.immediate_alert	0x1802	Adopted
Internet Protocol Support	org.bluetooth.service.internet_protocol_support	0x1820	Adopted
Link Loss	org.bluetooth.service.link_loss	0x1803	Adopted
Location and Navigation	org.bluetooth.service.location_and_navigation	0x1819	Adopted
Next DST Change Service	org.bluetooth.service.next_dst_change	0x1807	Adopted
Phone Alert Status Service	org.bluetooth.service.phone_alert_status	0x180E	Adopted
Reference Time Update Service	org.bluetooth.service.reference_time_update	0x1806	Adopted

# 1) IoT Communication : BLE



## Bluetooth(Classic) Profiles

Headset Profile

Global Navigation Satellite System Profile

Hands-Free Profile

Phone Book Access Profile

SIM Access Profile

Synchronization Profile

Video Distribution Profile

# 1) IoT Communication : BLE



## Bluetooth(Classic) Profiles

Blood Pressure Profile

Cycling Power Profile

Find Me Profile

Heart Rate Profile

Basic Printing Profile

Dial-Up Networking Profile

File Transfer Profile

# 1) IoT Communication : BLE



## BLE (IEEE 802.15.6) Profile 예시

Blood Pressure Monitor(혈압 모니터)

Health Thermometer(체온계)

Health Weight Scale(체중계)

Pulse Oximeter(맥박 산소포화도)

Manufacture Information(제조사 정보)

Alert(알림)

Emergency(비상경보)

# 1) IoT Communication : BLE



## BLE (IEEE 802.15.6) Profile 예시

Find Me(위치 검색)

Net Availability(네트워크 사용가능성)

PUID(개인 사용자 인터페이스 디바이스)

Proximity(근접)

Soft Button(소프트 버튼)

Time(시간)

Simple Remote Control(단순 리모트 컨트롤)

# 1) IoT Communication : BLE



## BLE (IEEE 802.15.6) Profile 예시

Battery Status(배터리 상태)

Device Power(디바이스 전력)

Generic Input/Output(일반 입 · 출력)

Humidity(습도)

HVAC(공조시스템)

Location(위치)

Temperature(온도)

# 1) IoT Communication : BLE



## BLE (IEEE 802.15.6) Profile 예시

Watchdog(감시)

HID(휴먼 인터페이스 디바이스)

Heart Rate Monitor(심박모니터)

Physical Activity Monitor(신체 활동 모니터)

Glucose Meter(혈당 측정기)

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TI BLE : CC2541





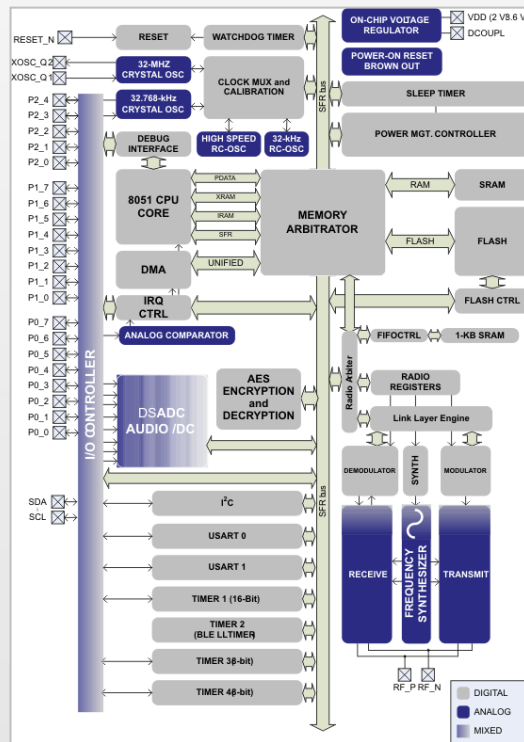
# 1) TI CC2541

## SimpleLink Bluetooth Smart and Proprietary Wireless MCU



To. 설계자

<http://www.ti.com/product/CC2541>



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# IoT 응용사례



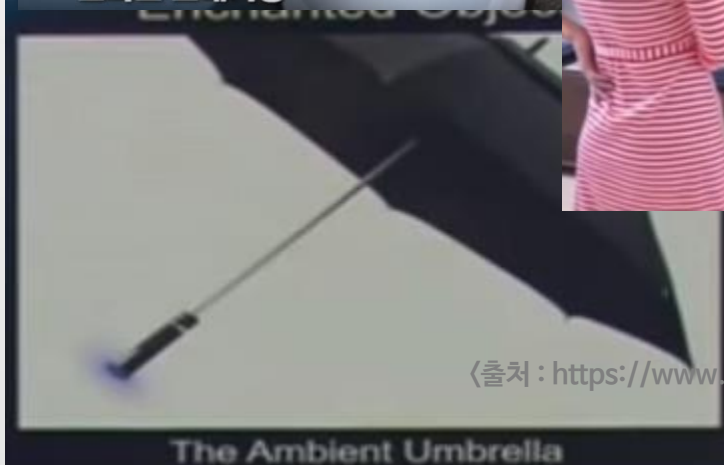
# 1) IoT 응용사례

다음 동영상을 시청하고 사물인터넷 기술이  
4차산업혁명 시대에 미칠 영향에 대하여 생각해 보세요.



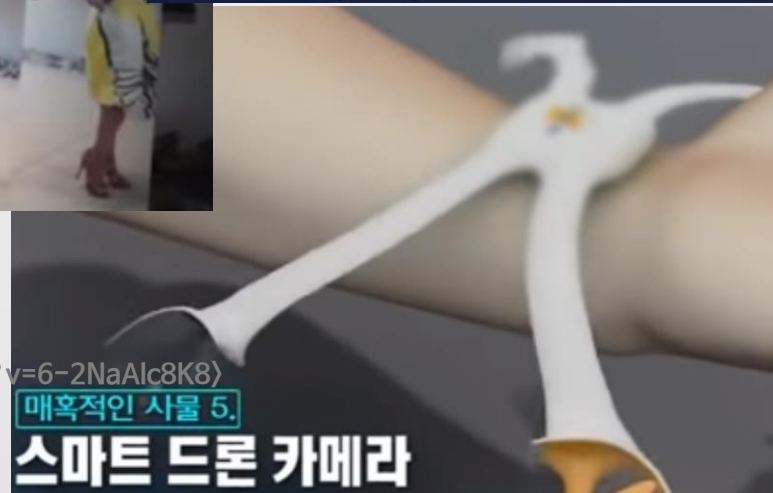
〈출처 : <https://www.youtube.com/watch?v=6-2NaAlc8K8>〉

# 1) IoT 응용사례



〈출처 : <https://www.youtube.com/watch?v=6-2NaAlc8K8>〉

매혹적인 사물 5.  
스마트 드론 카메라



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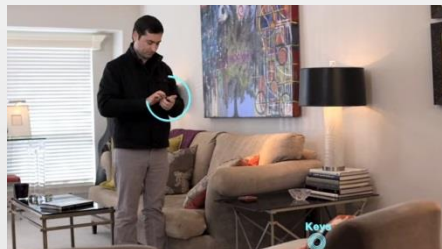
[ Bluetooth Smart SensorTag with iBeacon technology ]



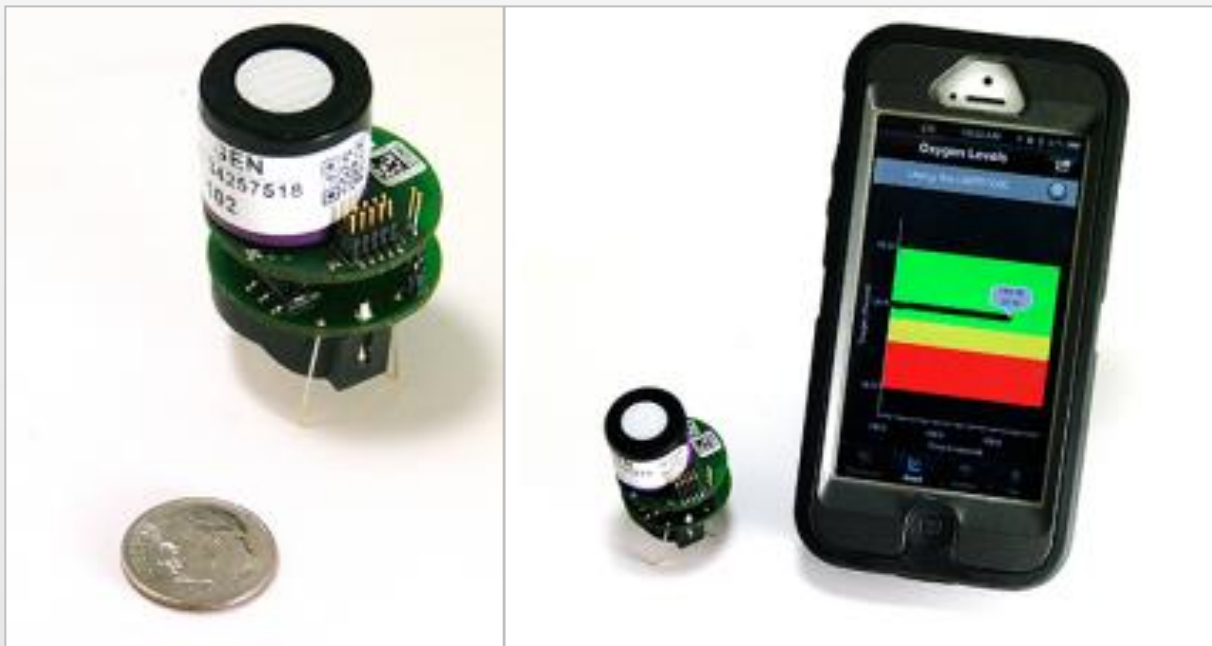
〈출처 : <https://www.youtube.com/watch?v=TvtrU9lCKmQ>〉



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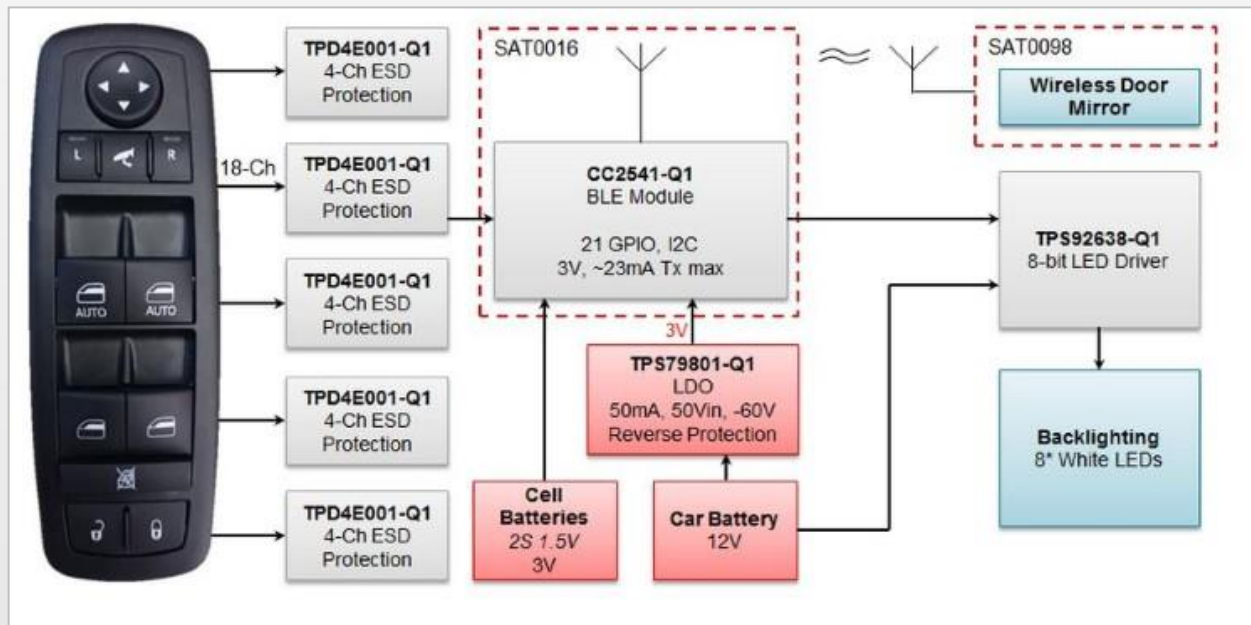


# 1) IoT 응용사례



[ Gas Sensor Platform with BLE ]

# 1) IoT 응용사례



[ Automotive Door Control Switch ]



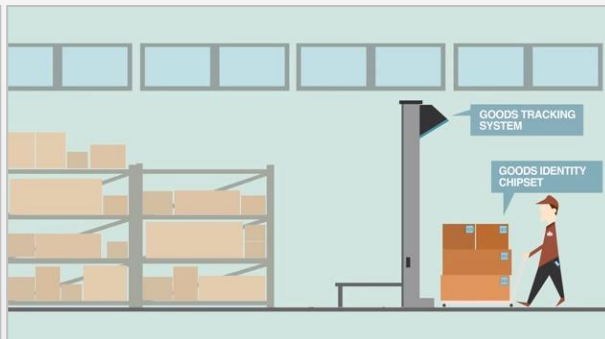
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[ What is IoT? ]

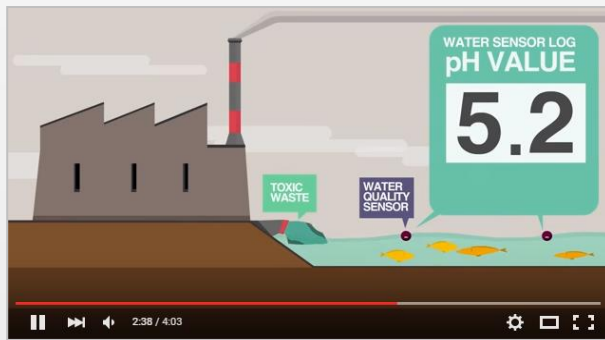


〈출처 : <https://www.youtube.com/watch?v=TvtrU9lCKmQ>〉

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## 센서 데이터 취득 및 표시, 구현 사례

[ Bluetooth Smart SensorTag, How can You design? ]

### Sensor Tag Introduction



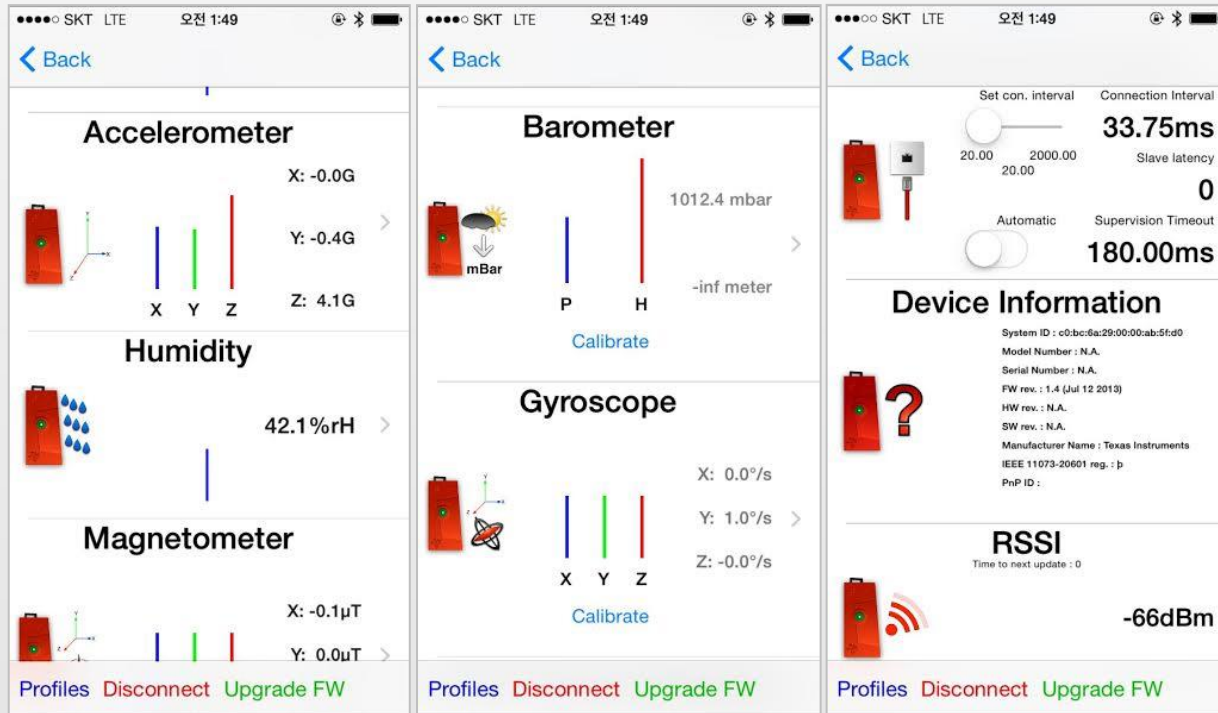
Connect with Bluetooth Low Energy



〈출처 : <https://www.youtube.com/watch?v=zPhjnN0HD2E>〉

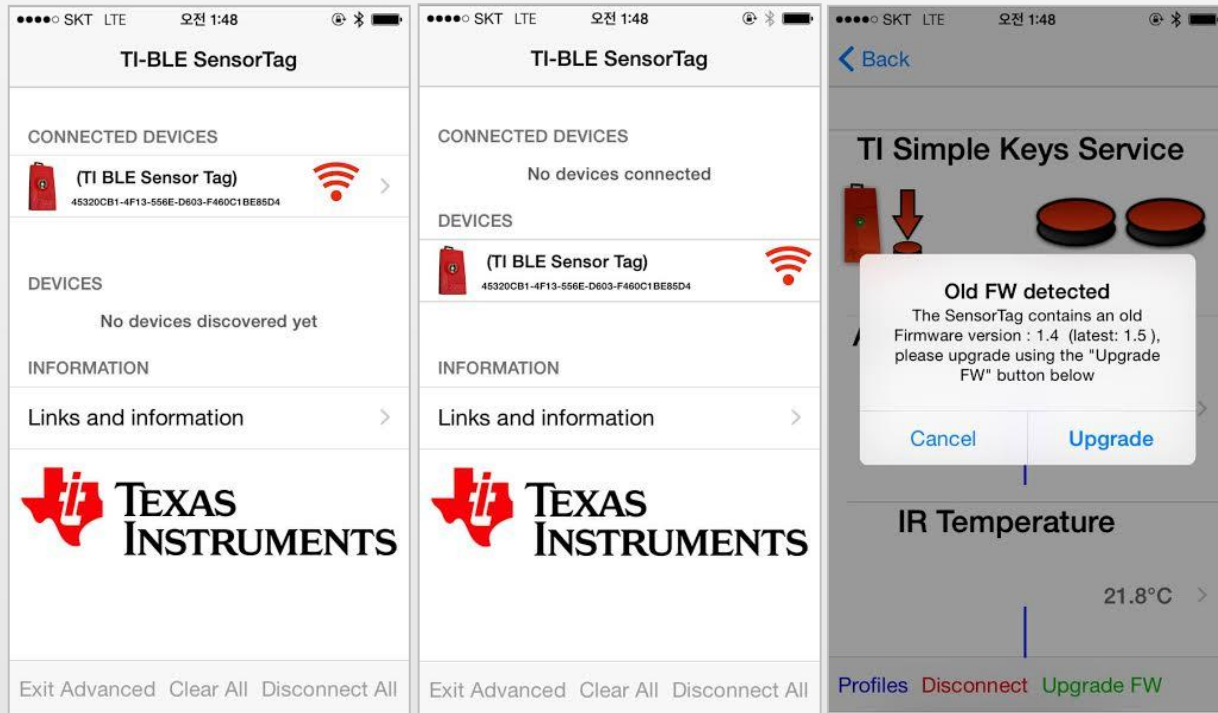
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## 📖 센서 데이터 취득 및 표시, 구현 사례



# 1) IoT 응용사례

## 센서 데이터 취득 및 표시, 구현 사례



The image displays three screenshots of the TI-BLE SensorTag mobile application interface, illustrating the process of connecting a device and checking for firmware updates.

**Left Screenshot:** The app is titled "TI-BLE SensorTag". Under "CONNECTED DEVICES", a device named "(TI BLE Sensor Tag)" with ID "45320CB1-4F13-556E-D603-F460C1BE85D4" is listed. The "DEVICES" section shows "No devices discovered yet". The "INFORMATION" section has a link "Links and information". The Texas Instruments logo is at the bottom.

**Middle Screenshot:** The app is titled "TI-BLE SensorTag". Under "CONNECTED DEVICES", it says "No devices connected". The "DEVICES" section lists the same device as the first screenshot. The "INFORMATION" section has a link "Links and information". The Texas Instruments logo is at the bottom.

**Right Screenshot:** The app is titled "TI Simple Keys Service". A dialog box titled "Old FW detected" is displayed, stating: "The SensorTag contains an old Firmware version : 1.4 (latest: 1.5 ), please upgrade using the 'Upgrade FW' button below". The dialog has "Cancel" and "Upgrade" buttons. Below the dialog, the "IR Temperature" is shown as "21.8°C". At the bottom, there are links for "Profiles", "Disconnect", and "Upgrade FW".

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## 센서 데이터 취득 및 표시, 구현 사례

Get SensorTag - Microsoft

https://www.microsoft.com/en-us/p/sensortag/9nblggh0mq6h?activetab=pivot:overviewtab

Microsoft | Store Devices Software More

All Microsoft

**SensorTag**  
Chris Lovett • Utilities & tools  
Wish list  
★★★★★ 4  
This app works with the Texas Inst Accelerometer, Gyroscope, Magn the Buttons. It also supports the r  
More

Free

Get

See System Requirements

Overview System Requirements

**Screenshots**  
PC

SensorTag

Accelerometer

Available on