# Introduction of Embedded Systems

## Embedded Systems

- Traditional Definition
  - Systems with hardware and software for special-purposes with customized designs
  - Systems whose sub-components are CPUs, memory, I/O, and other specialized components with customized software stacks are running
- Convergence of GP(General Purpose) and embedded systems
  - The line between embedded systems and GP systems blurred
  - Issues shared between two platforms
    - Performance
    - Power consumption
    - Use of operating systems

## Apllications of Embedded Systems

| | |
|---|---|
| Consumer electric devices | TVs, refrigerators, audio systems |
| Control systems | Factory automation, home automation, robot control |
| Portable devices | Phones, portable audio devices, cameras |
| Network systems | Routers, access points, switches |
| Game machines | Console game terminals, mobile game devices |
| Defense systems | Avionics, defense attack systems |
| Logistics | RFID, GPS-based tracking systems |
| Automotive systems | Car embedded systems, IVIs, telematics |
| Medical systems | Medical imaging devices (CTs, MRIs) |
| Wearable devices | Smartwatches, smartglasses |

### Portable Devices

- Portable information terminals
  - Simple voice communication devices ▶ **smart devices**
  - Architecture of **modern smart devices** resemble **GP computing systems**
  - Diverse smart devices are being converged into **one powerful smart phones**

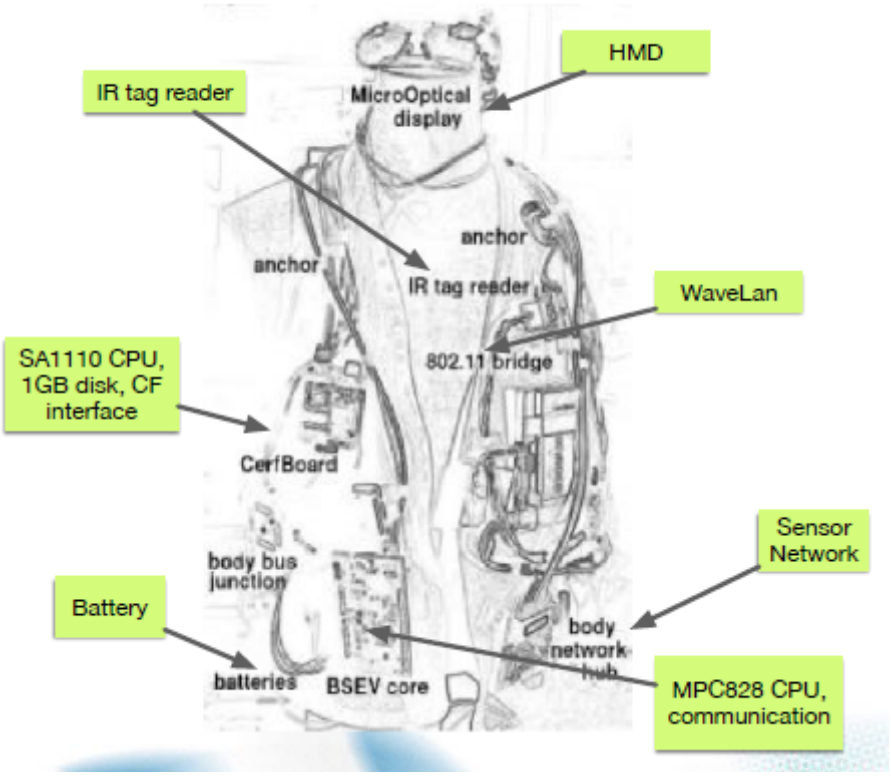
### Avionics(항공 전자 공학)

- Aircraft
  - Safety critical, hard real-time system with **hundreds of control CPUs**
- Space Aircrafts
  - RTOS-based **mission critical** systems
  - Hard **real-time** multimedia systems

## Automotives

- Automotive Systems
  - Car embedded systems, self-driving cars, electric cars
  - Intelligent transportation systems

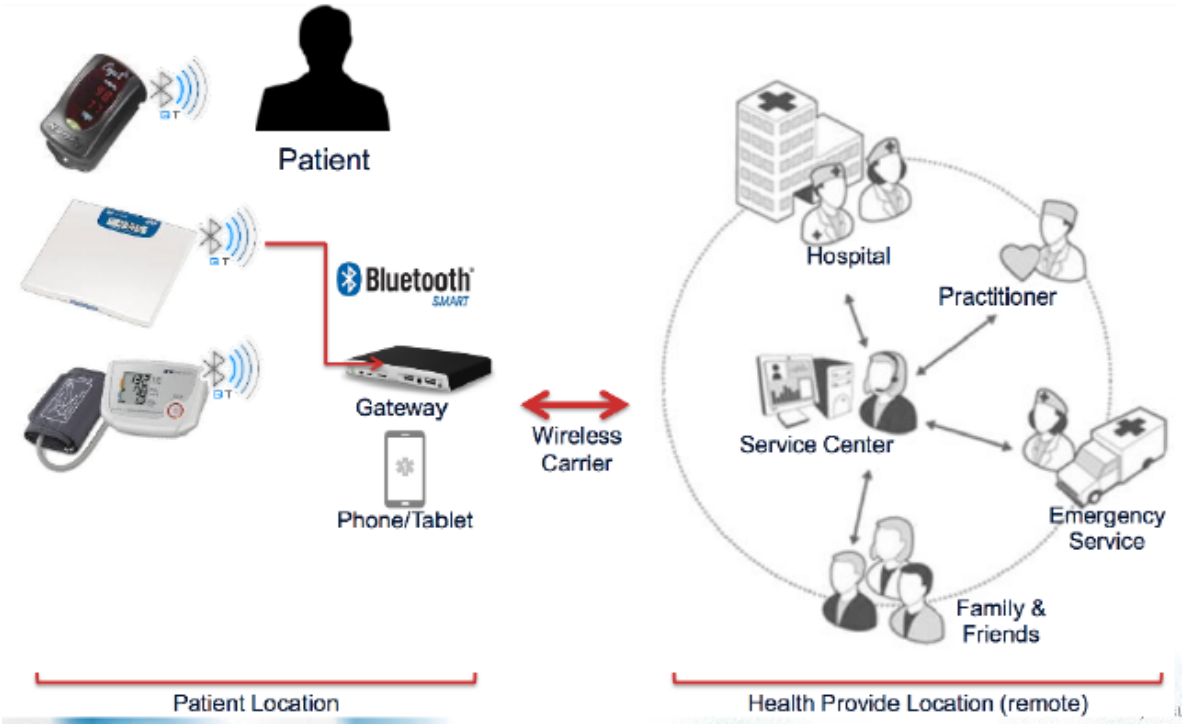
## Wearable Computer



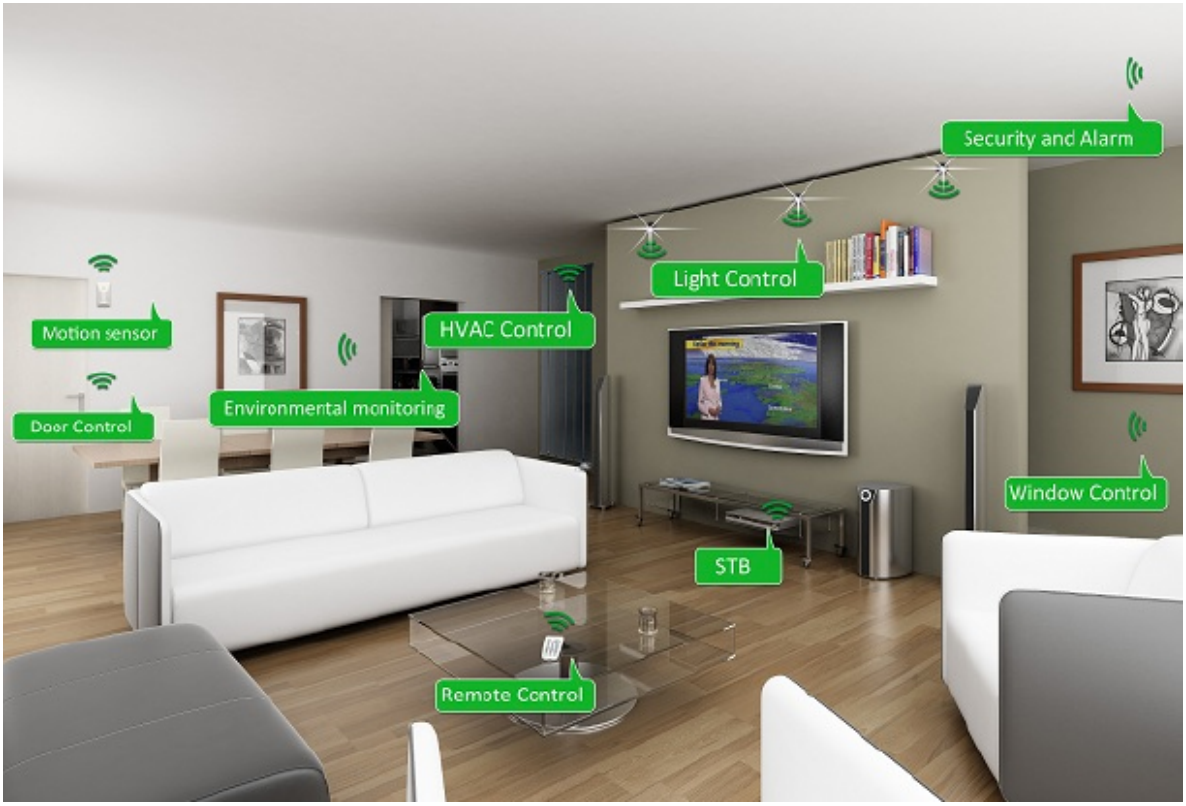

## IoT Systems

- Connected Home
- Automotive
- Retail
- Transportation
- Logistics
- Energy / Utilities
- Building automation
- Industrial automation
- Law Enforcement
- Fitness

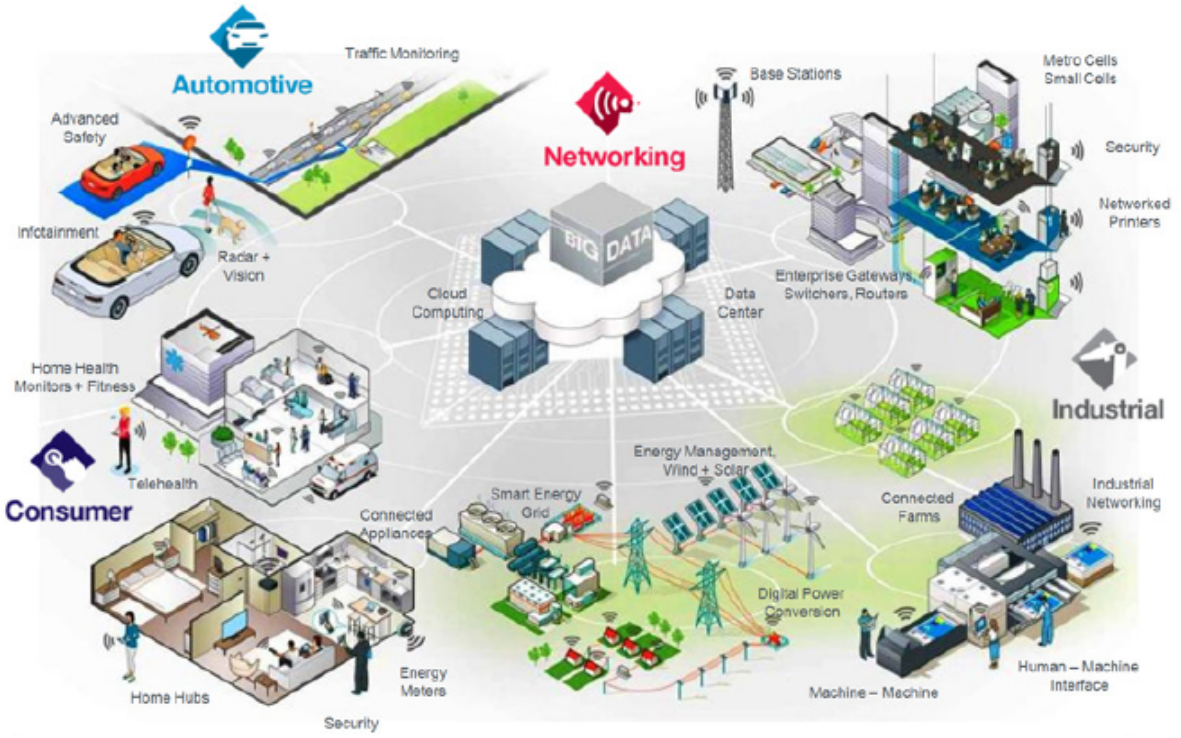
## Healthcare Example



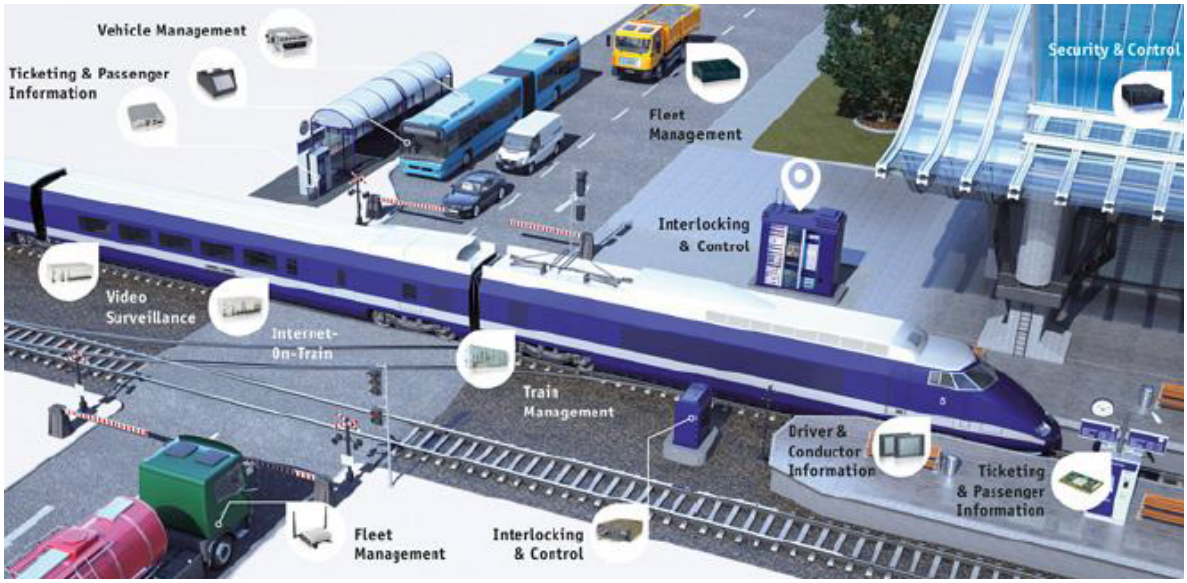

## Home Networking with IoT




## IoT Practical Uses




## Other Practical Uses




## IoT Software Platforms

- IFTTT
    - Gives you creative control over the products and apps you love

## IoT Hardware Platforms

## ARM-based Devices


## Characteristics

- Usually **lower performance** CPUs are used
- **Pre-determined** functionalities
- **Light**-weight and **low** power
- **Low cost**
- **Mission** critical
- Mostly **hard real-time**