Peran Over-The-Air (OTA) Firmware Update Pasca Deployment Perangkat IOT

Nusantech Webinar

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January 12th, 2021

Agenda

01. IoT 101

Introduction to IoT Technology

02. IoT Networks & Protocols

Some protocols that utilized in IoT Solution

03. IoT Devices Deployment

Important points related to IoT Devices Deployment

04. OTA Firmware Updates

OTA Concept and its important key in IoT Solution

05. Hands-On Demo

OTA firmware update demo for Microcontroller-based IoT Devices

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Past careers:
Research Fellow at **SEEI ITB**
Embedded Engineer at **QIMTronics** and **Bukalapak**
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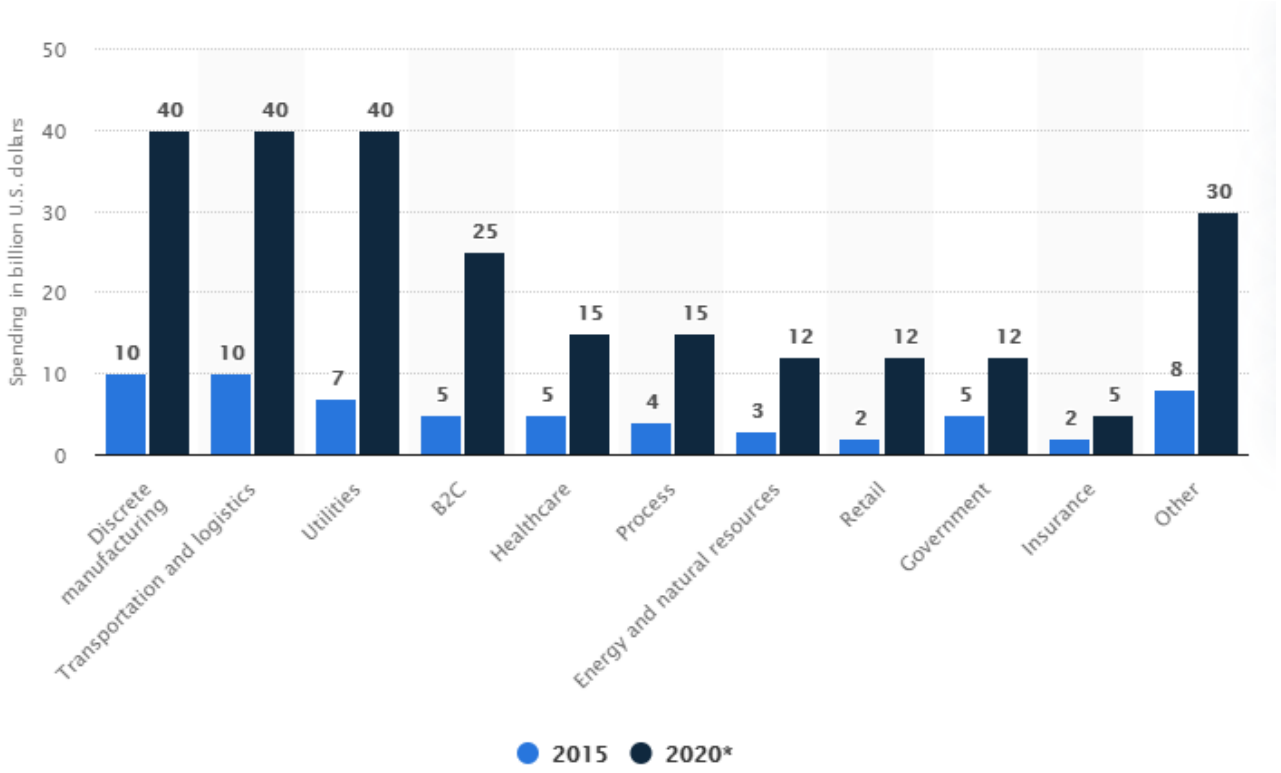
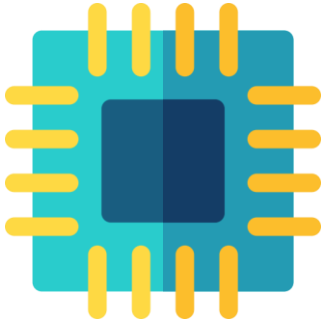
IoT 101

Growth of IoT Devices

- In 2009 for the first time, the number of “things” connected to the Internet surpassed the number of people
- More than 25 billion connected device in 2019, and 64 billion IoT devices by 2025

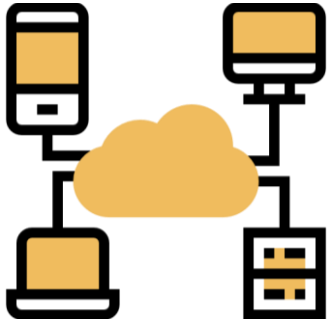


IoT Main Aspects



Sensors & Devices

The ‘THINGS’ in IoT



Networks & Protocols

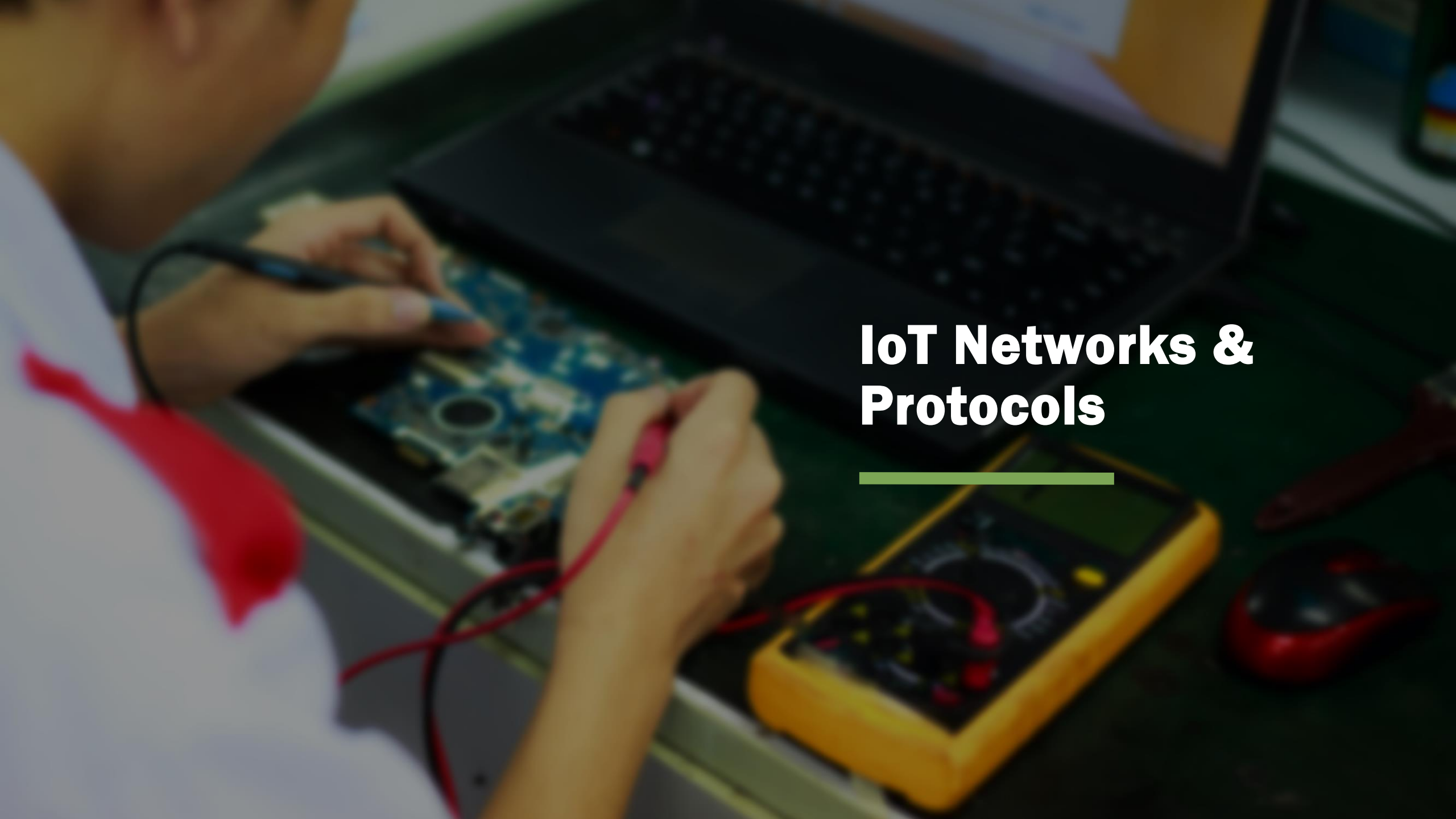
How every nodes interact between each other

Big Data & Analytics

Data processing and visualization to get helpful insight

Cybersecurity & Privacy

How to protect devices, software and data in IoT



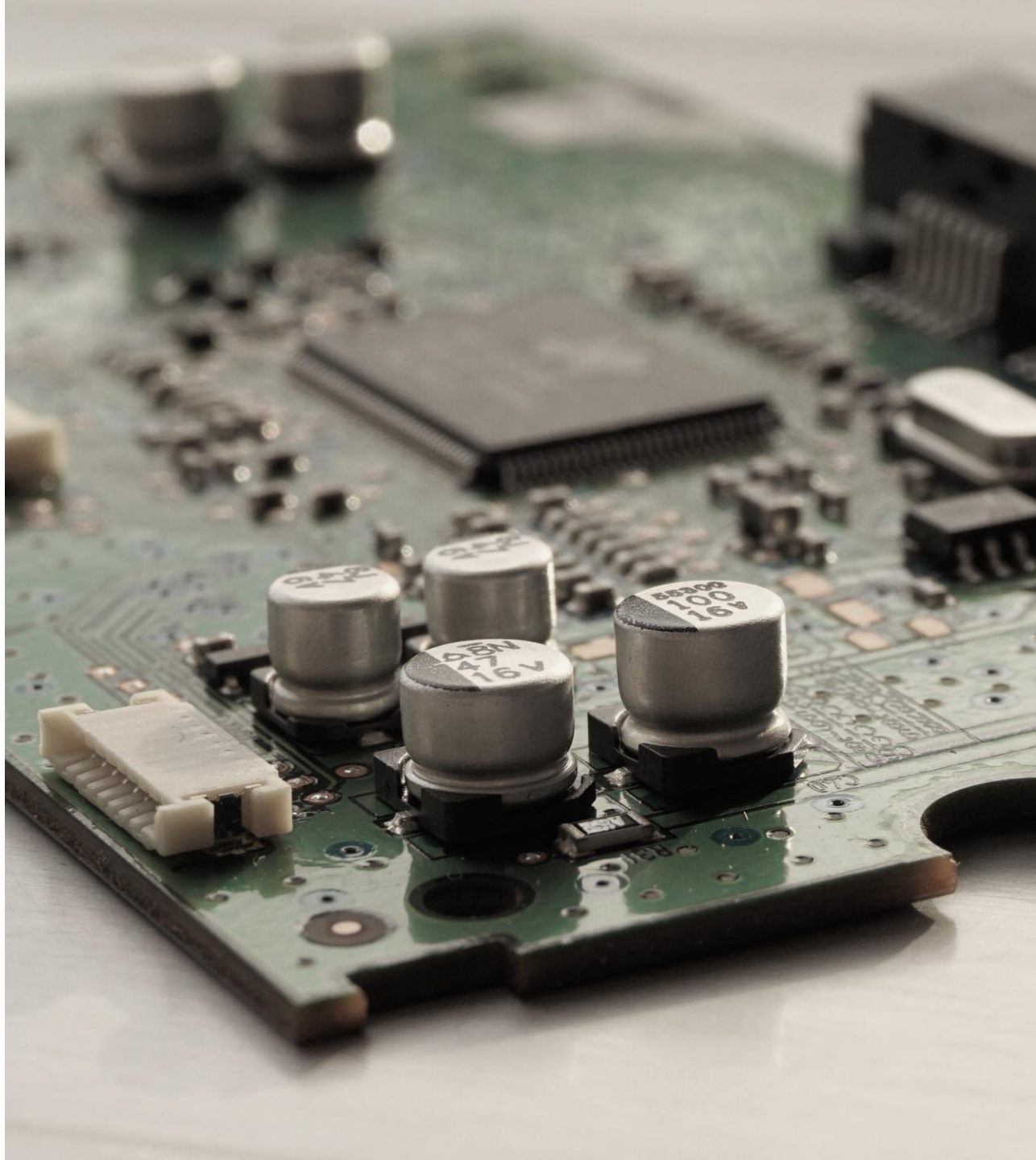
IoT Networks & Protocols

Sensors & Devices

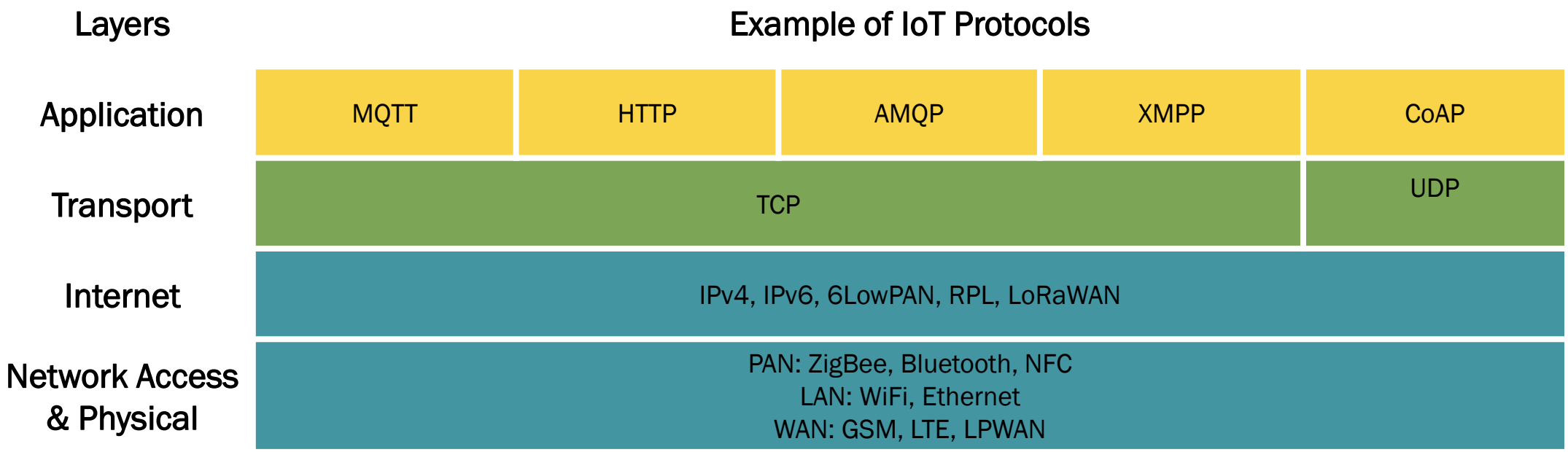
Popular embedded devices

- 8-bit: ATMega328 (Arduino Nano and Uno)
- 16-bit: MSP430
- 32-Bit: STM32, ESP8266, ESP32, NRF, Renesas
- 64-bit: Raspberry Pi 4

Embedded Peripheral: USART, SPI, I2C, USB, Ethernet, WiFi, BLE, etc

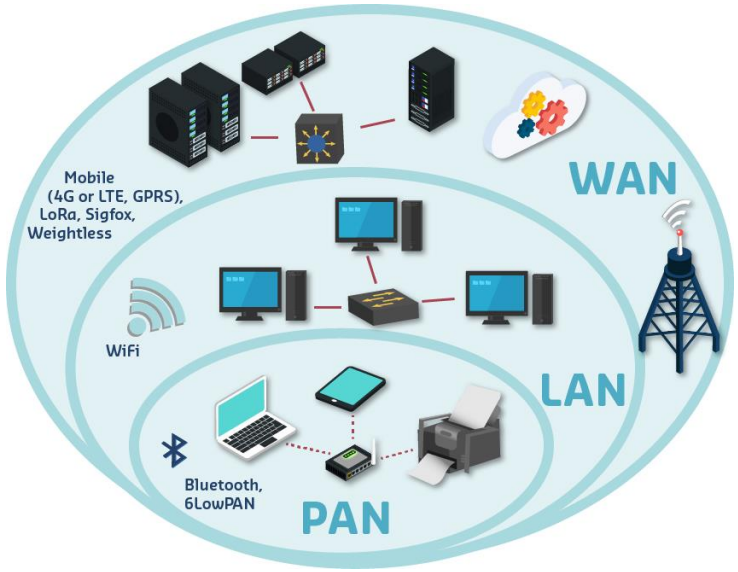


IoT Protocols

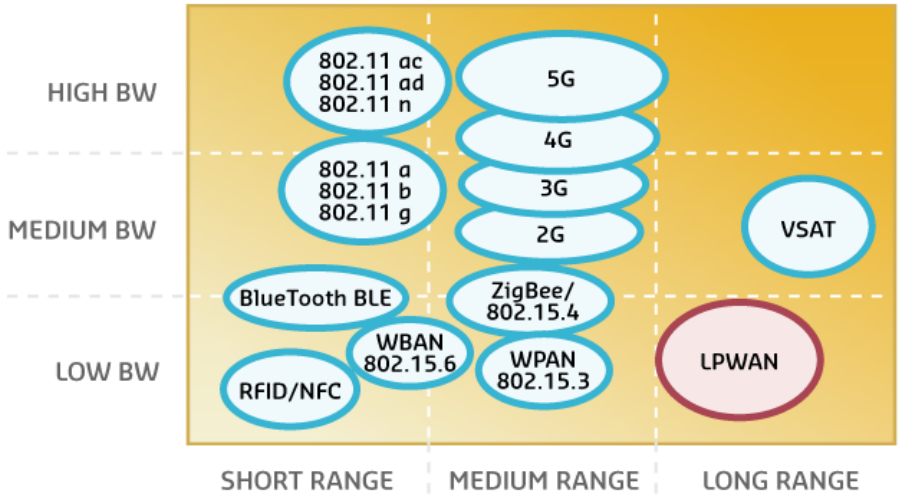


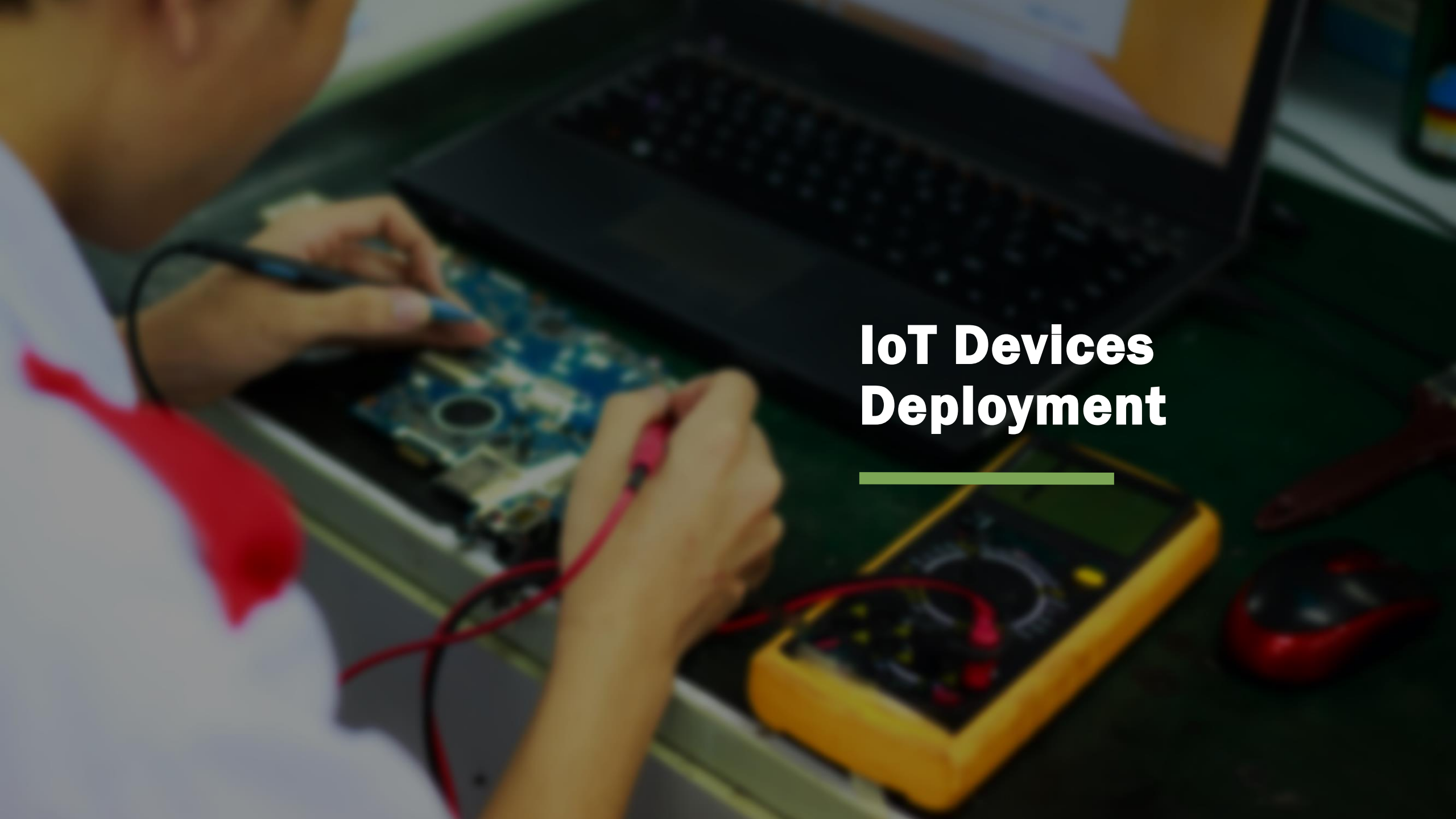
IoT Protocol: Physical Layers

Coverage Area



Range vs Bandwidth





IoT Devices Deployment

IoT Use Cases

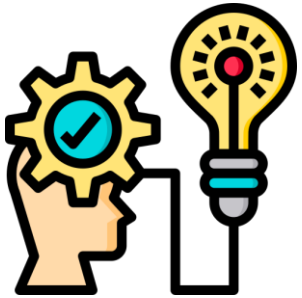
Stationary

- Deploy in static locations
- Signal quality can be measured easily
- e.g.: Building Management System, Smart Farming, Smart Factory, etc

Mobile

- Deploy in mobile locations
- Have to constantly adapt to variabilities in signal quality
- e.g.: Vehicle Tracking, Smart Watch, Fitness Wearable Devices, etc

Deployment Vital Keys



Strategic Planning

- Build KPI to measure manhour and load
- Create checklist and schedule document
- List of devices and materials
- Legal documents

On Site Survey

- Signal Quality
- Network Management

Test Cases Covered

- Pass certification procedure
- Testing small number of devices

After Deployment of IoT Devices

Continuous Development

- Device improvements
- Implement new technology
- Implement change request

Monitoring Platform

- Monitor syslog
- Device Performance
- Network Performance

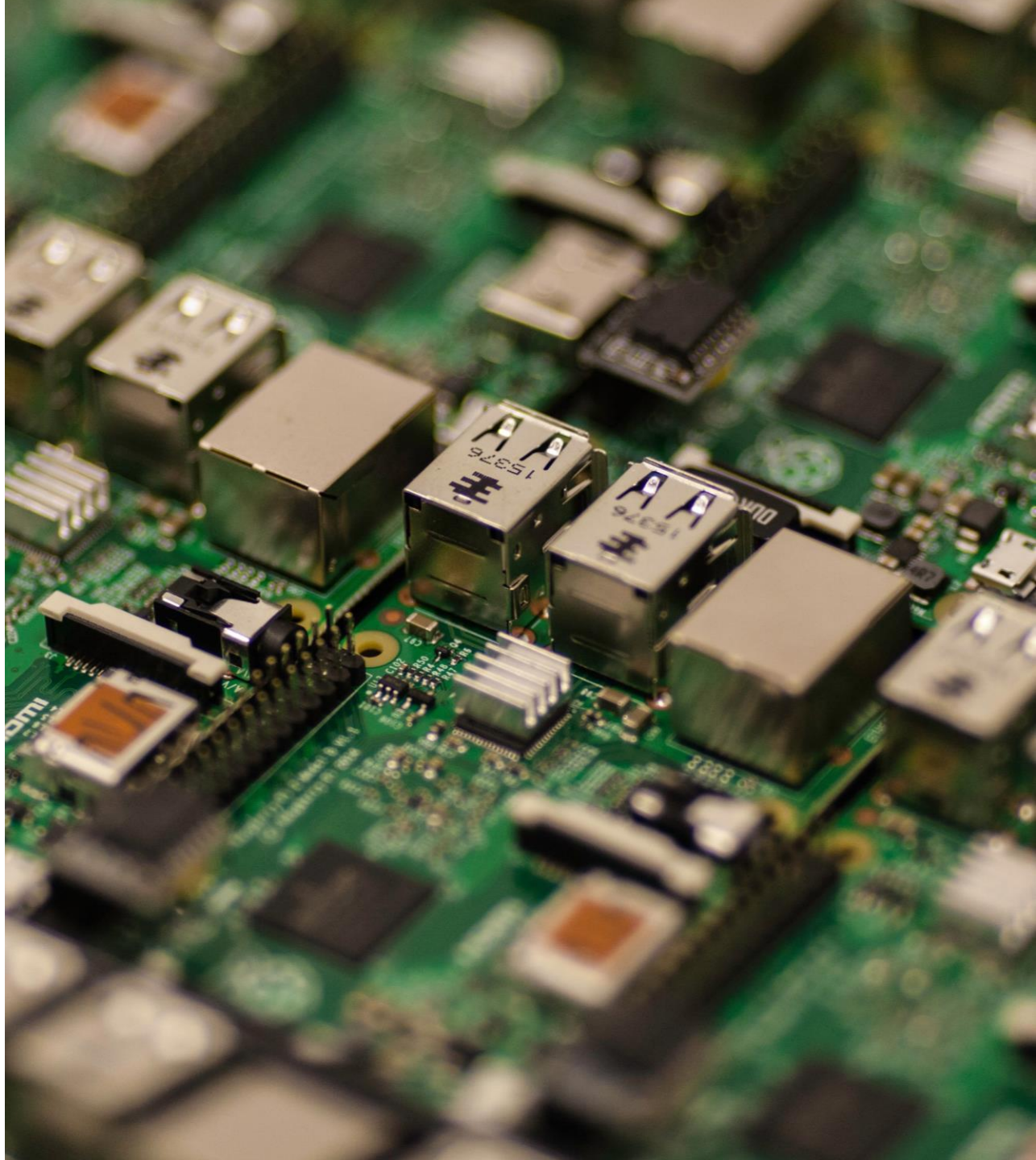
Software Update

- Pass certification procedure
- Testing small number of devices

OTA Firmware Update

What is OTA Update?

“A mechanism for remotely updating internet-connected hardware with new settings, software, and / or firmware”



OTA Update Background

Security Issue and Bugs

Some security vulnerabilities and bugs could be found after devices are deployed.

Require to Implement CR Quickly

Change request should be implemented quickly for all devices deployed.

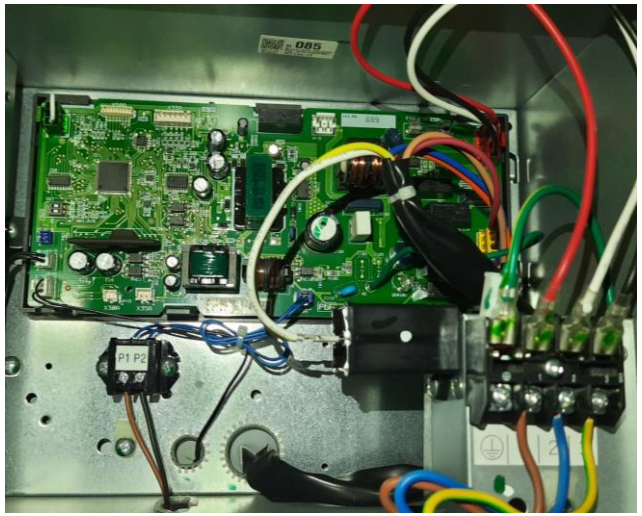
Big Effort to Update Devices in Multiple Locations

Onsite update mechanism to multiple locations needs large number of technician and increase maintenance cost.

Takes Time to Update Device by Wiring

Plug and disassemble devices need more effort and will takes time.

OTA Update Background



IoT Devices

Bare Metal Device

- Program will be flashed directly to FLASH Memory (EEPROM)
- Pretty low concurrency
- Usually perform as edge devices
- e.g.: Microcontroller programming, FPGA,

OS-based Device

- Application run under the operating system
- Several applications can run concurrently at the same time
- Usually perform as Gateway devices
- e.g.: Linux-based SBC: Raspberry Pi, NVIDIA Jetson,

OTA Update Important Keys

Version Verification Mechanism

Capability to perform firmware comparison with latest firmware in cloud server

Frequently Update System Time

Device should have capability to update system time with ntp server

Unique Variables in EEPROM

Do not overwrite unique variables for devices when perform OTA, e.g: Device ID, Serial Number, Hardware Version, etc

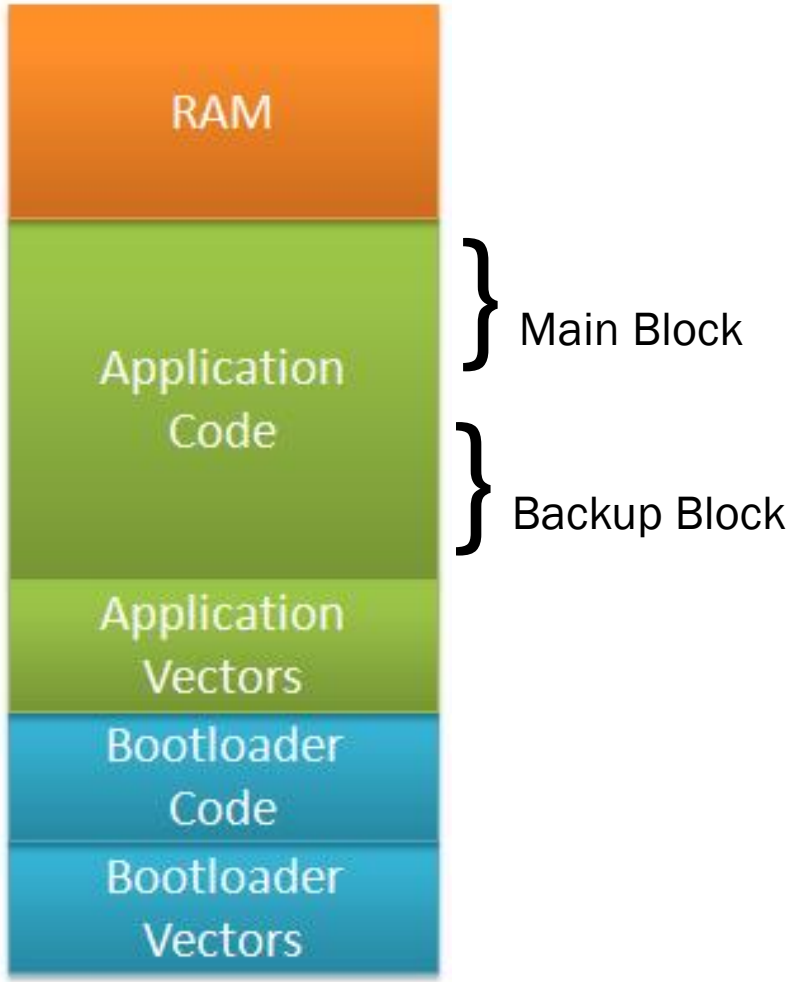
Rollback Mechanism

Automatic recovery from corrupted or interrupted updates is a must.

Secure Communication

Cryptographic code signing must be used to confirm that connected devices only accept code from verified authors.

Microcontroller Memory



Hands-On Demo

Devices

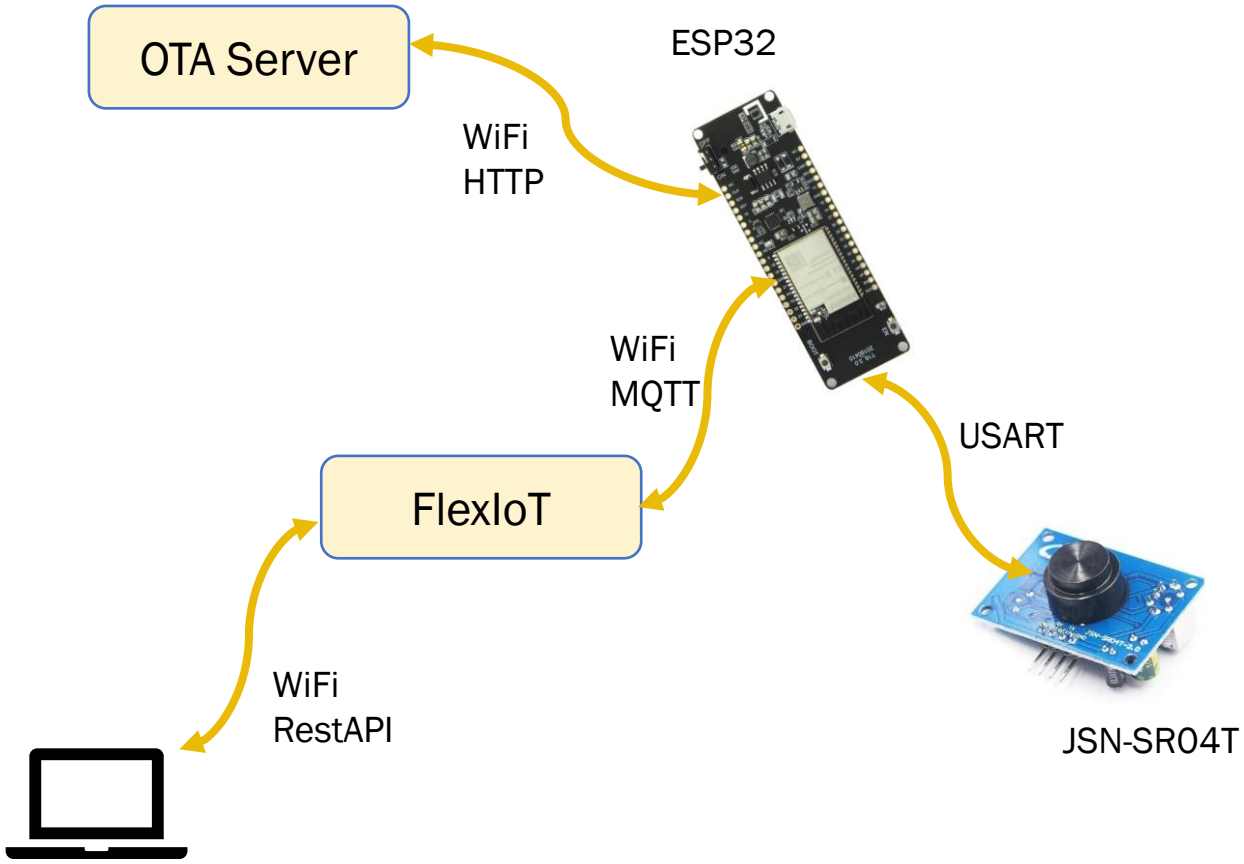
ESP32

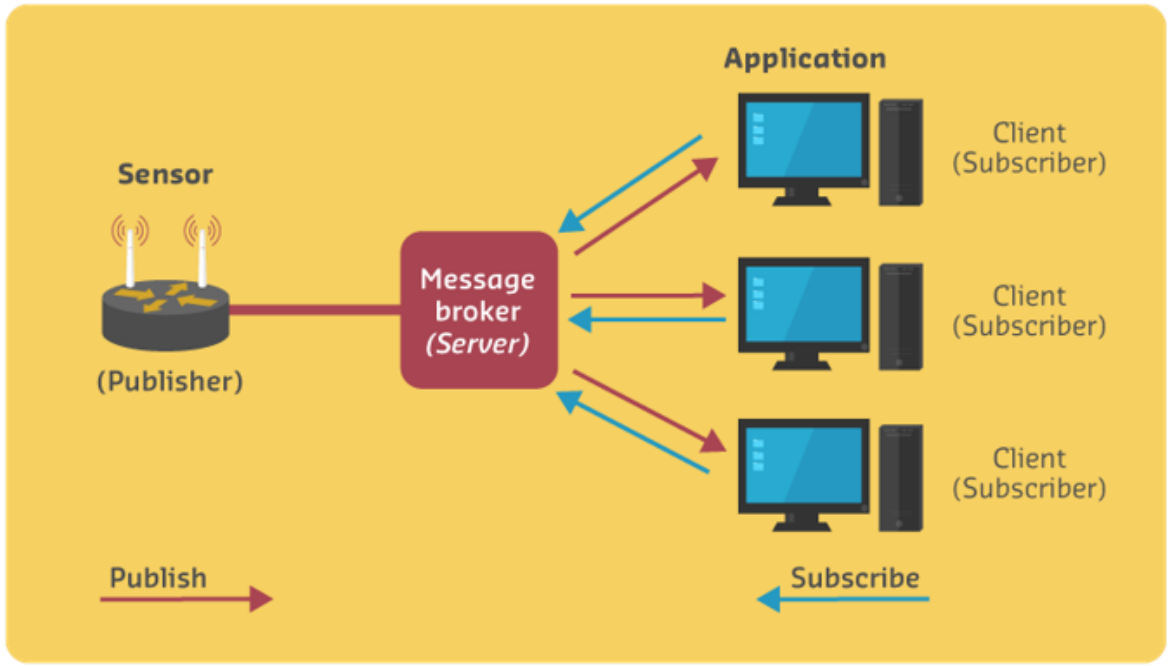
- Processor: Tensilica Xtensa 32-bit LX6 microprocessor
- Clock frequency: up to 240 MHz
- Wi-Fi: 802.11 b/g/n/e/i (802.11n @ 2.4 GHz up to 150 Mbit/s)
- Bluetooth: v4.2 BR/EDR and Bluetooth Low Energy (BLE)
- ROM: 448 KB, SRAM: 520 KB, Embedded Flash: Up to 4MB

JSN-SR04T-3.0

- Operating Voltage DC 3.0-5.5V
- Measurement range 20 - 600cm
- Distance accuracy +- 1cm
- Resolution 1mm
- Output the echo signal Output pulse width level signal, or TTL
- Operating temperature -20 ° C to + 70 ° C

Architecture





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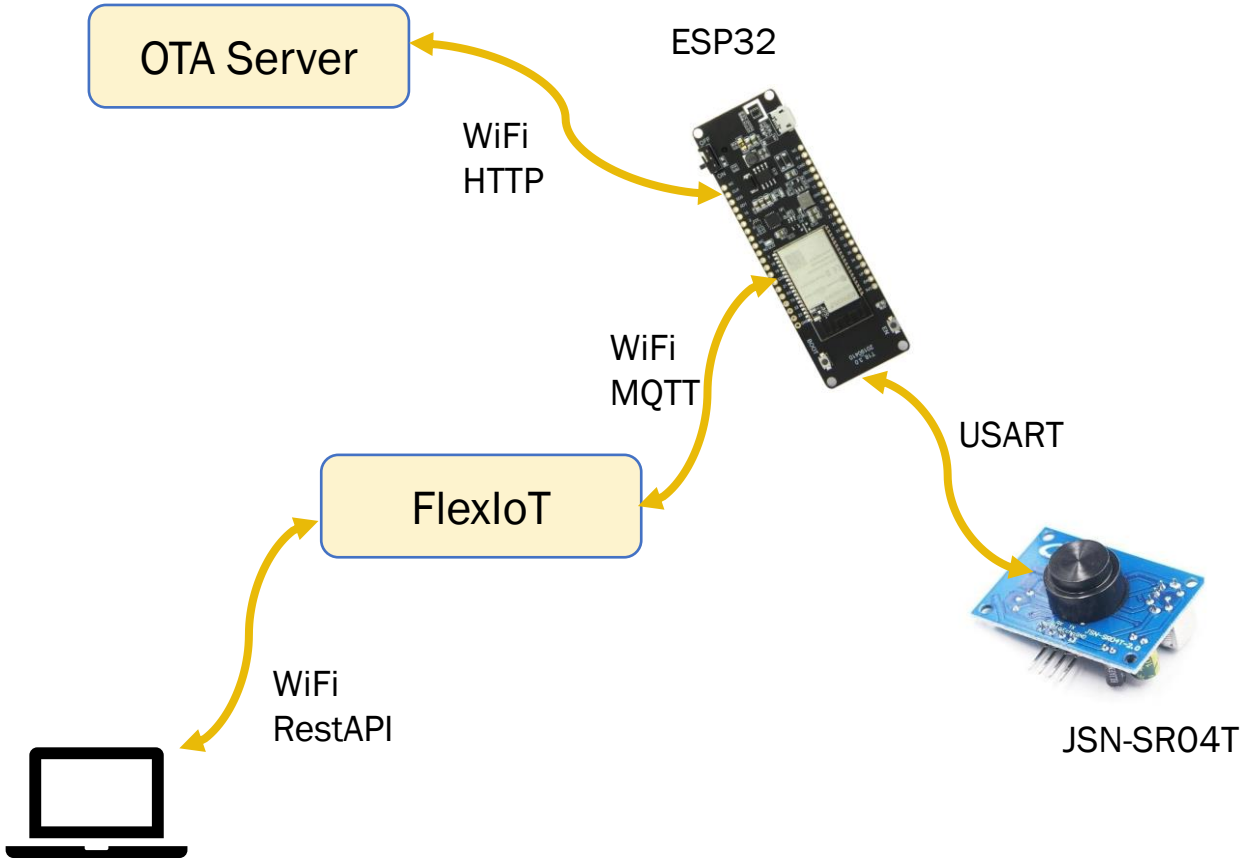
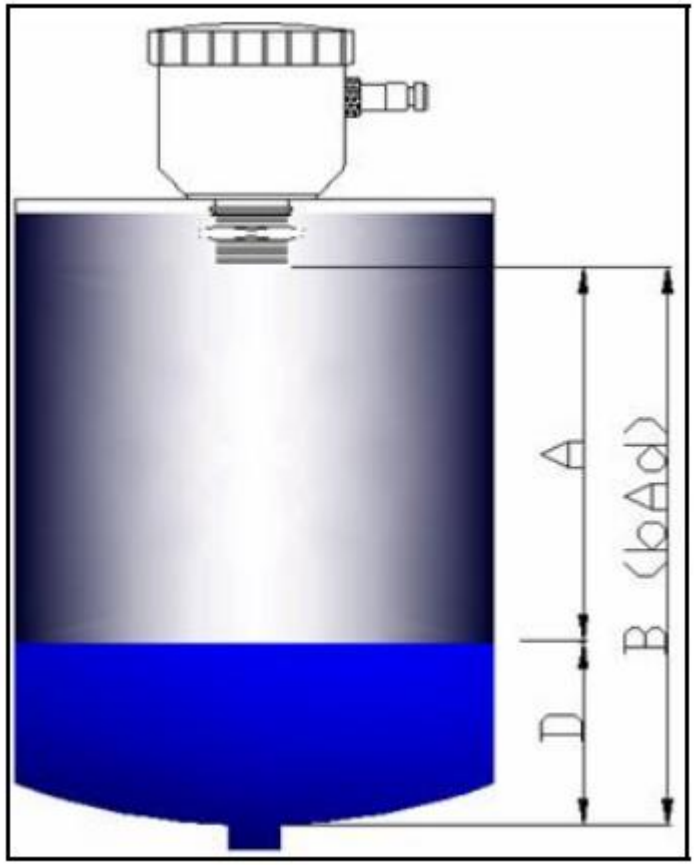
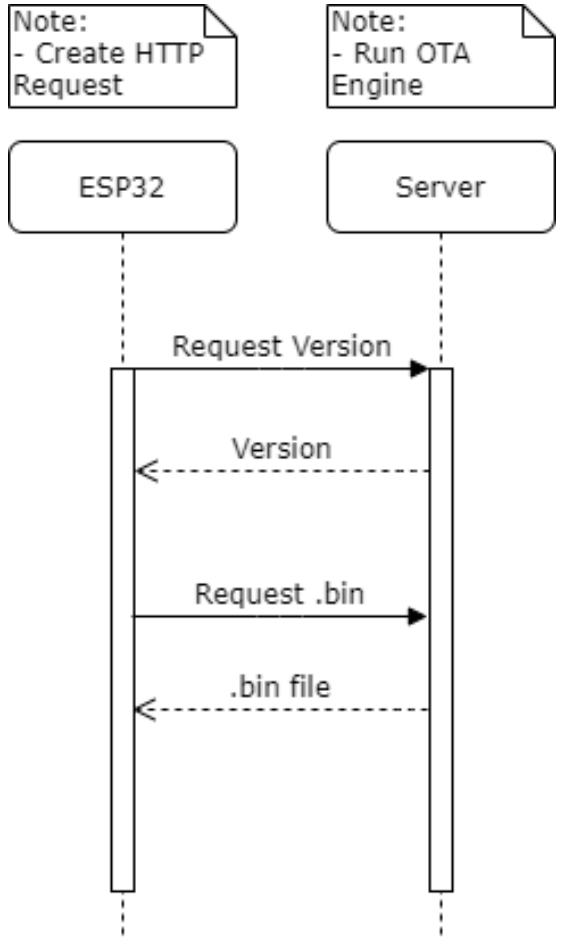




Today's Demo

Time-based OTA Update

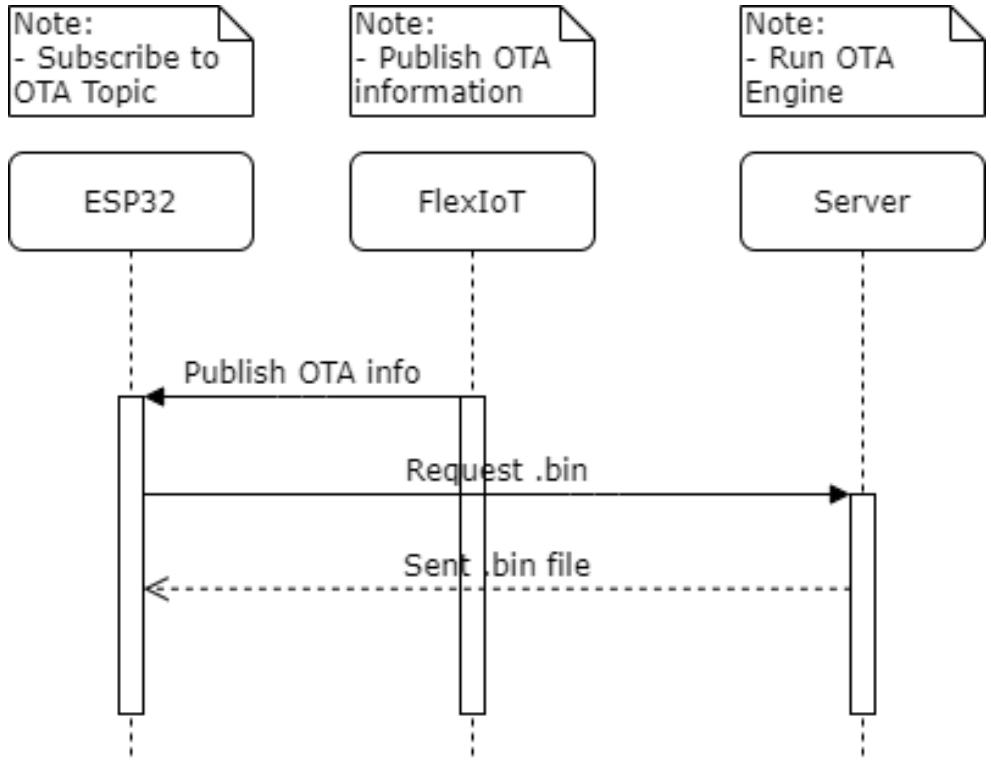
- Should be synchronized to ntp server and has RTC module
- Newest version of firmware in cloud server should be checked periodically or at fixed time (usually at midnight)



Today's Demo

Forced OTA Update

- Device must be connected to server all the time (Subscribed to broker)
- Server will sent update command to every node by sending required information to perform OTA updates



Thank you

Thanks to your time for joining this webinar. Do not hesitate to reach me if you need to discuss everything related to IoT Projects.

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