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Custom-made electronics

Session 1:
Wireless Communication Technologies

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Embedded Software Engineer

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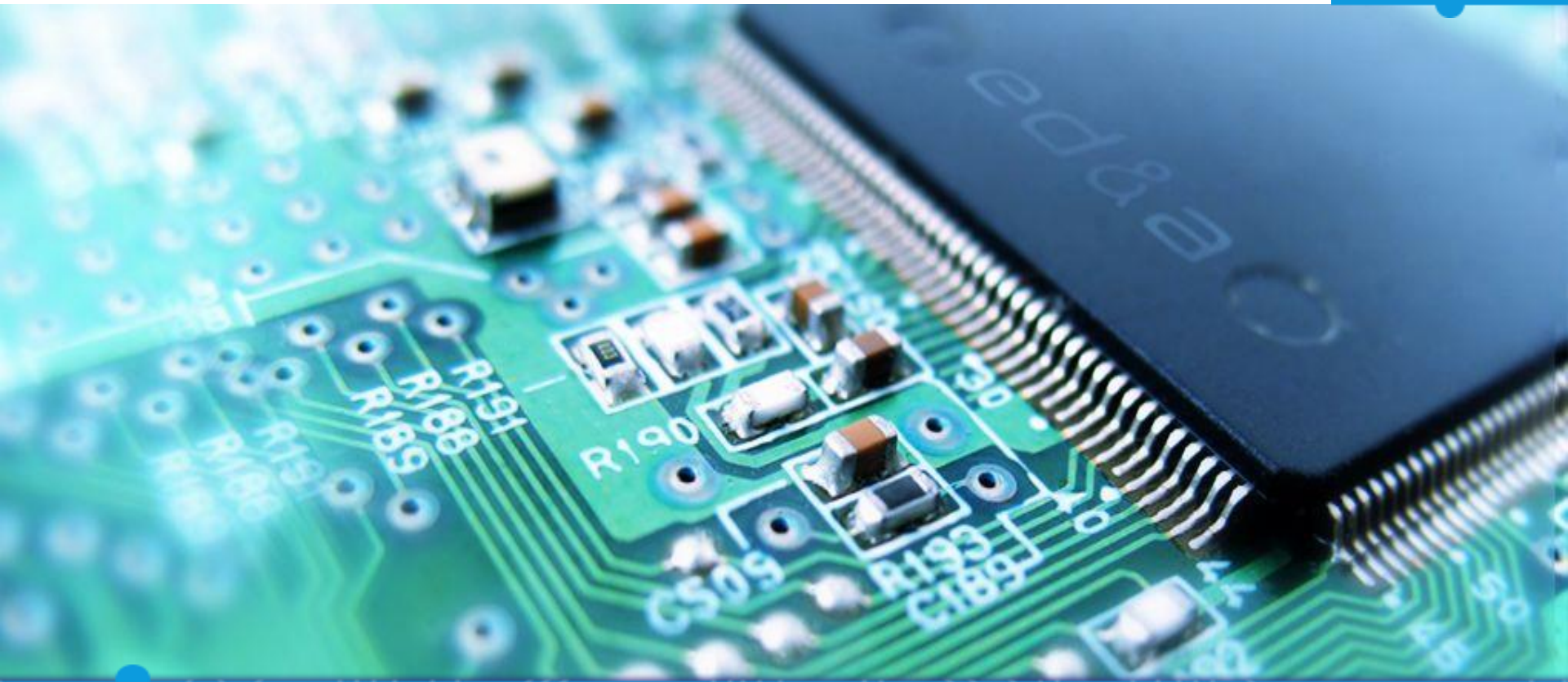
Agenda

- Technologies
- Protocols
- IoT
- Applications
- Future Trends

Technologies

The power to control



Technologies

Well known

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	Wi Fi	Bluetooth®
Speed	11…100Mbit/s	1…24Mbit/s
Range	20…100m	1…10m
Power Consumption	Medium	Low-Medium
Application	WLAN	WPAN
Frequency	2.4GHz/5GHz	2.4GHz

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Technologies

Low Power

	BLE	Zigbee	EnOcean	Dash7
Speed	0.1…1Mbit s/s	20…250kbit/s	125kbit/s	167kbit/s
Range	>100m	70…400m	30m	2km
Power Consumption	Low	Low	Extreme Low	Very Low
Application	PAN	LAN	Wireless sensors	Automatisation
Frequency	2.4GHz	868MHz (EU) 915MHz (US) 2.4GHz	868MHz (EU) 902MHz (US)	433MHz 868MHz (EU) 915MHz (US)

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Technologies

Long Range

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	2G/3G/4G	LoRa/LoRaWAN	Sigfox
Speed	2…300Mbit/s	0.3…50kbit/s	100…800bits/s
Range	1…8km	>15km	>10km
Power Consumption	Medium-High	Very Low	Very Low
Application	WWAN	LPWAN	LPWAN
Frequency	Multiple	868MHz (EU) 915MHz (US)	868MHz (EU) 902MHz (US)

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Technologies

RFID & NFC

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	NFC	RFID
Communication Direction	Uni- and bi-directional	Uni-directional
Range	10cm	10…100cm
Application	Exchange data	Readout tags
Frequency	13.56MHz	13.56MHz and others

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Technologies

Security

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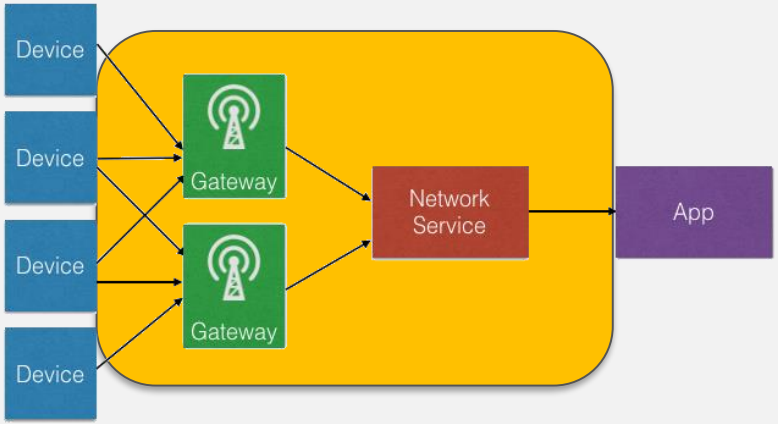
Device to Device Connection

Lora/Sigfox



Is secure

Protocols

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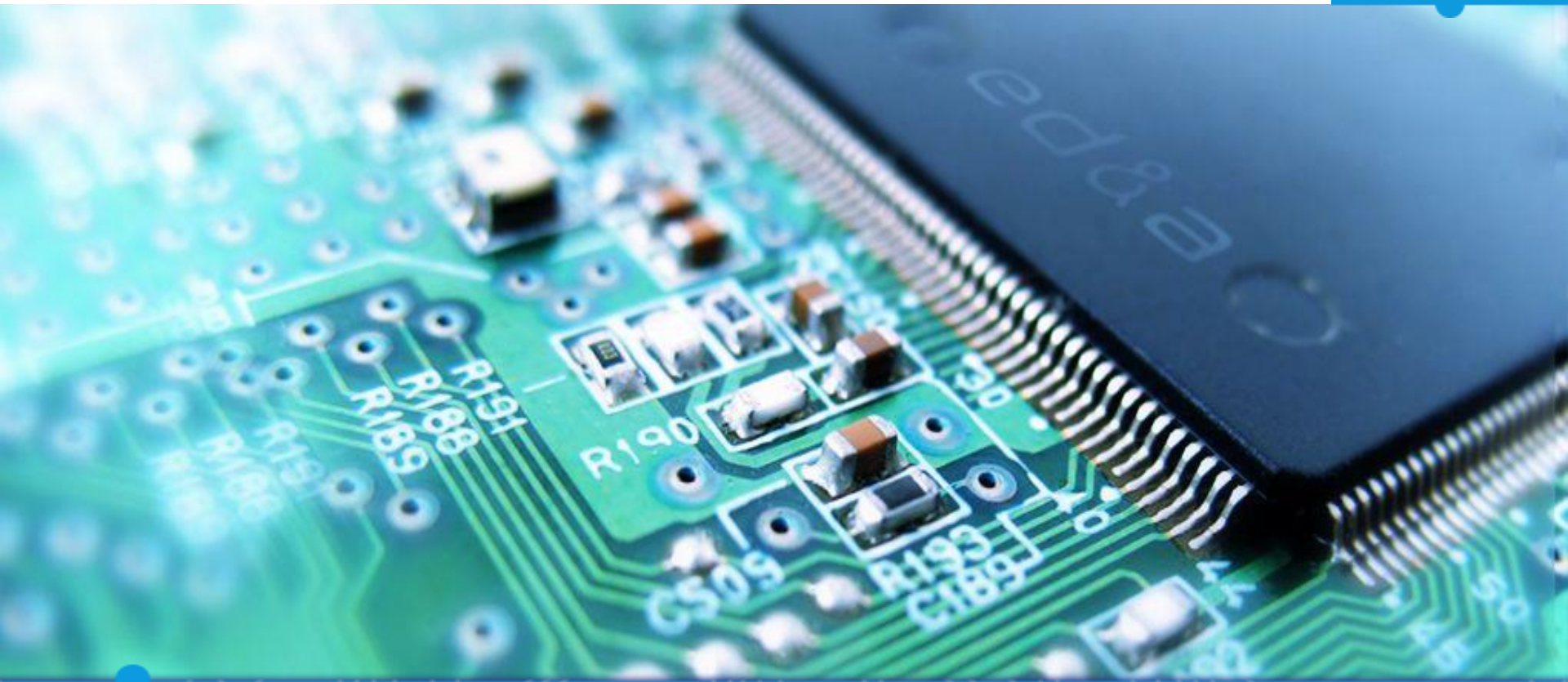
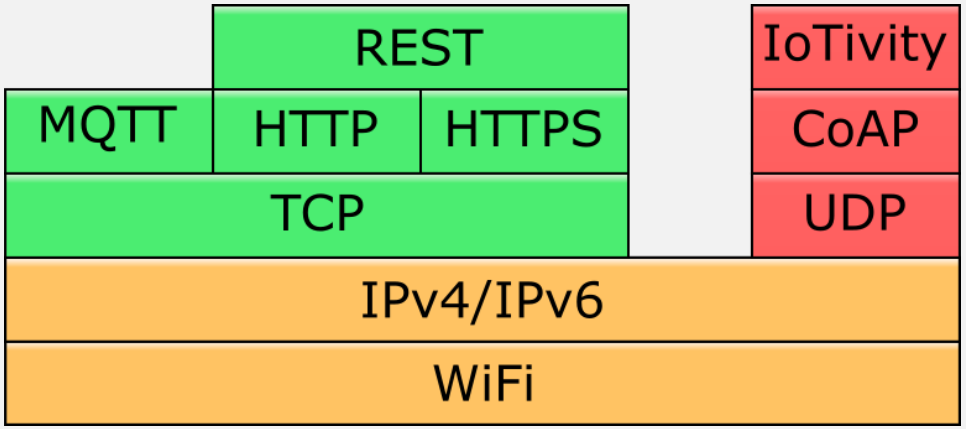


Protocols

Overview

- Addressing
  - IPv4
  - IPv6
- Communication
  - TCP/UDP
  - HTTP, HTTPS, REST
  - MQTT
  - CoAP
  - IoTivity



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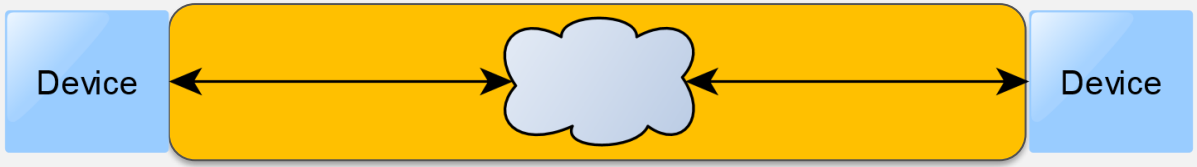
Protocols

Security

- Most IoT communication protocols have end-to-end encryption
- REST must use HTTPS to be secure



Is secure

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IoT

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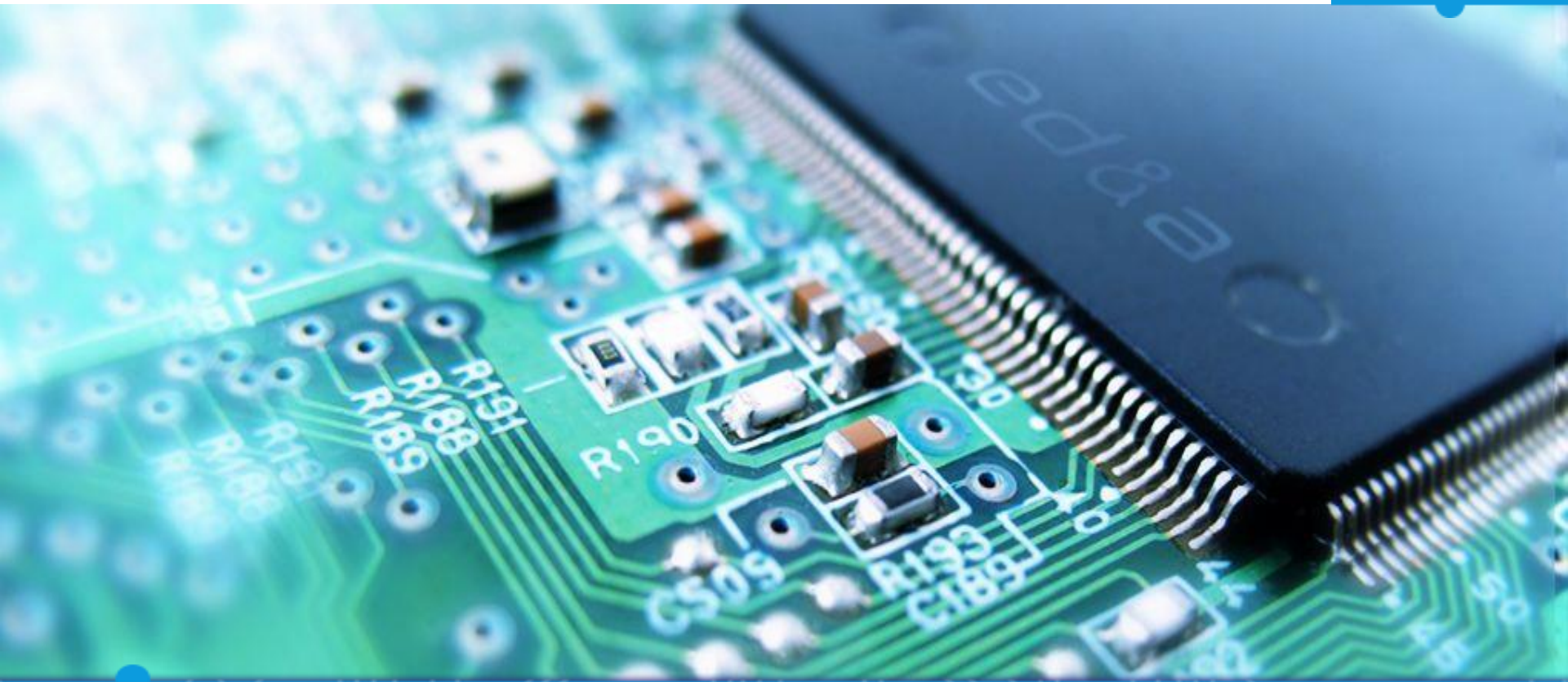

IoT

Introduction

- What is the Internet of Things?

A network of (embedded) devices, connected to the internet enabling advanced services.

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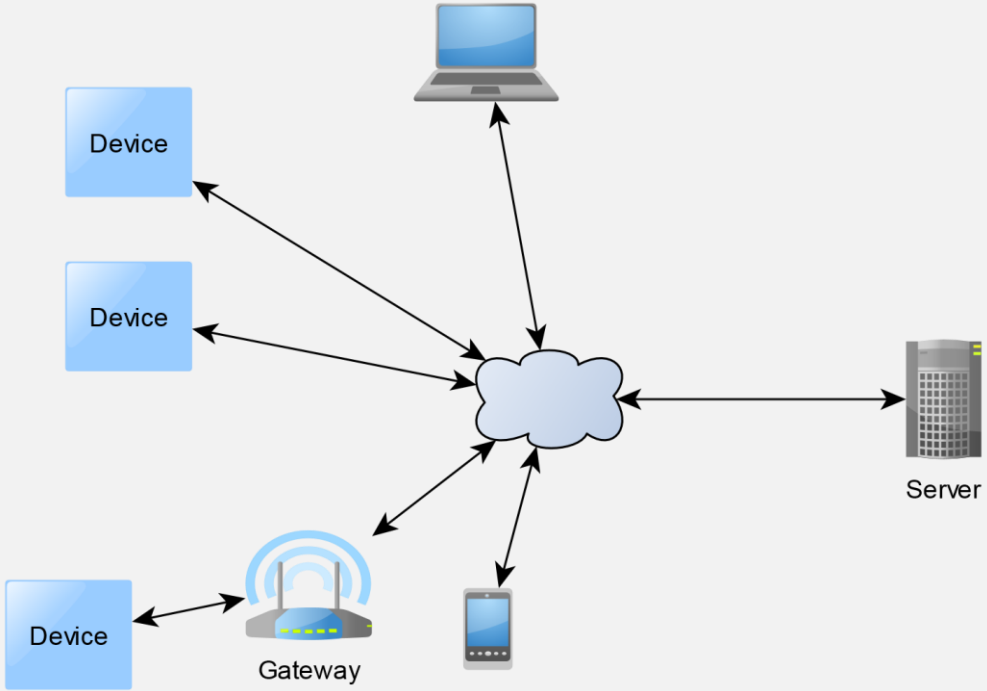
IoT

Client-Server

- HTTP
- HTTPS
- REST



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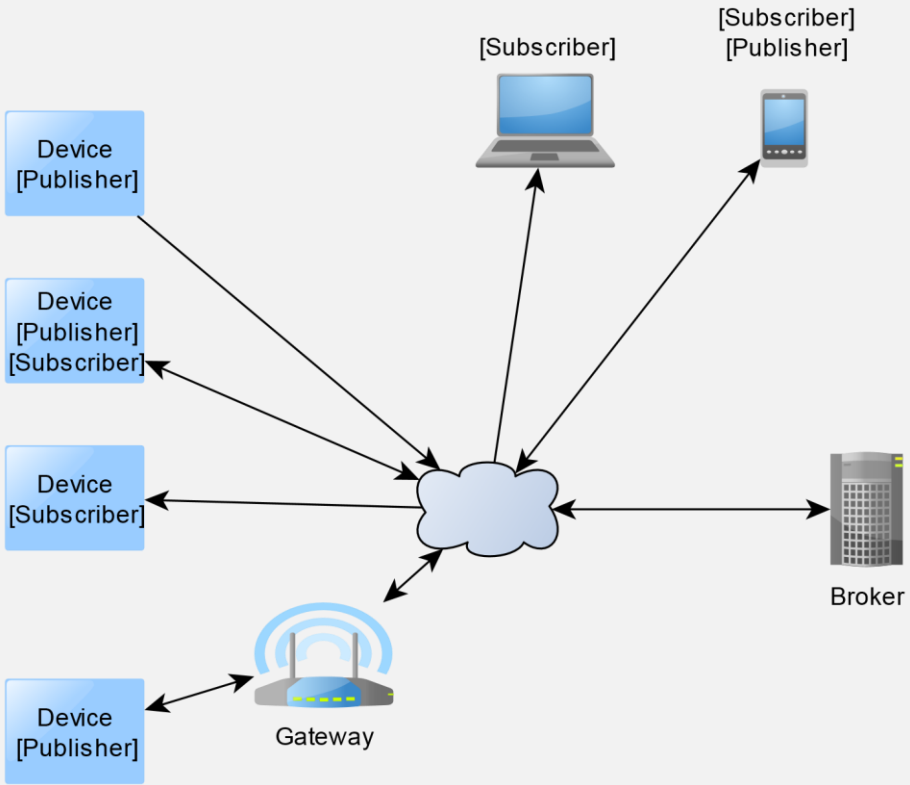
IoT

Broker

- MQTT



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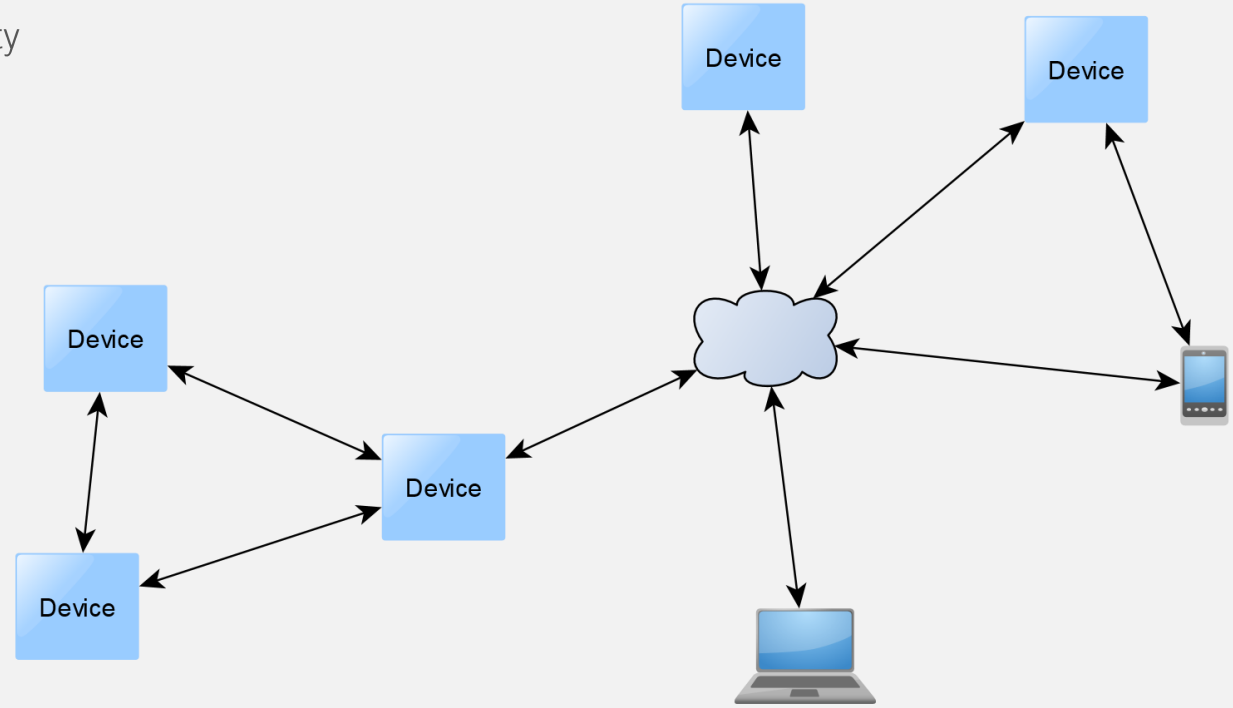
IoT

Peer to Peer

- IoTivity
- CoAP



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Applications

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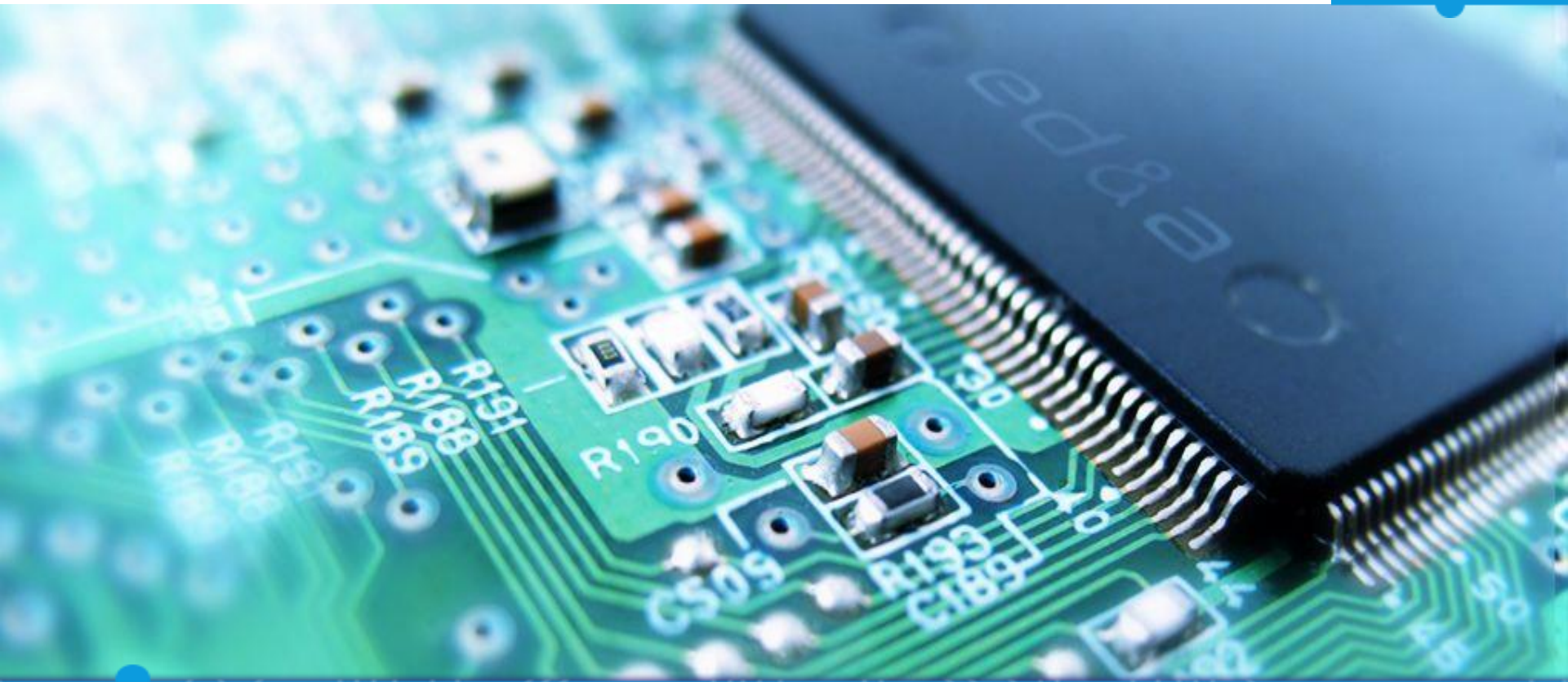

Applications

Control devices

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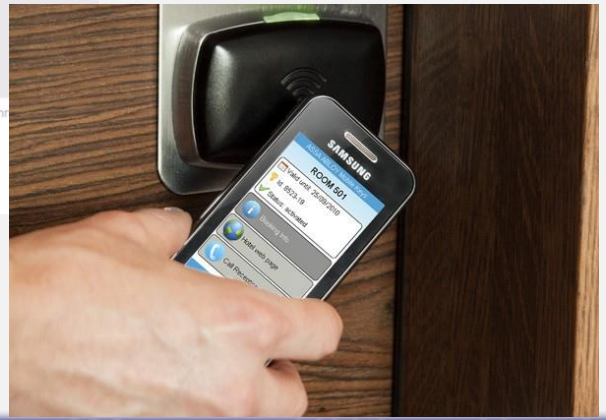

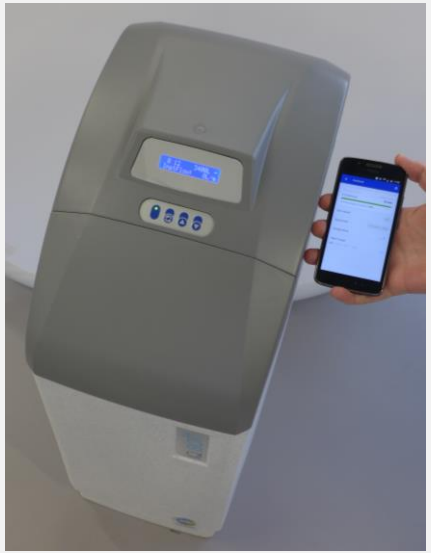

Applications

Managing devices

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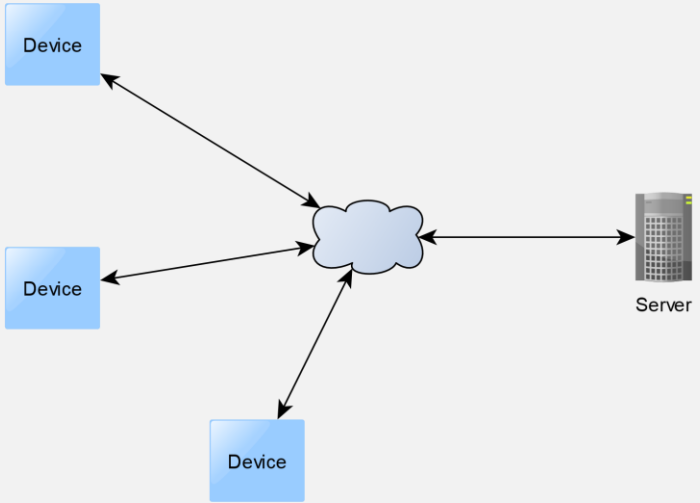
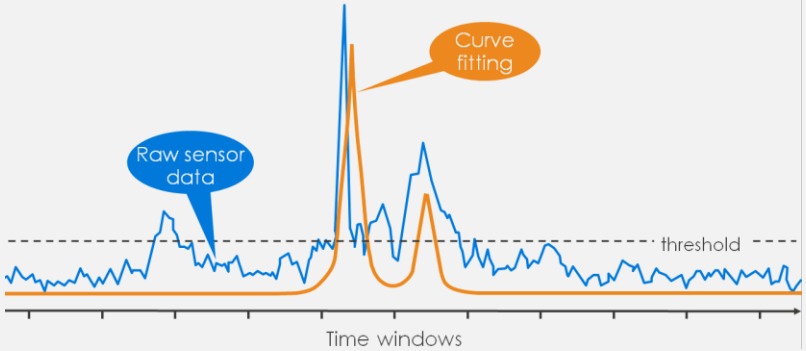
Applications

Predictive maintenance





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Applications

Advertising

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Future Trends

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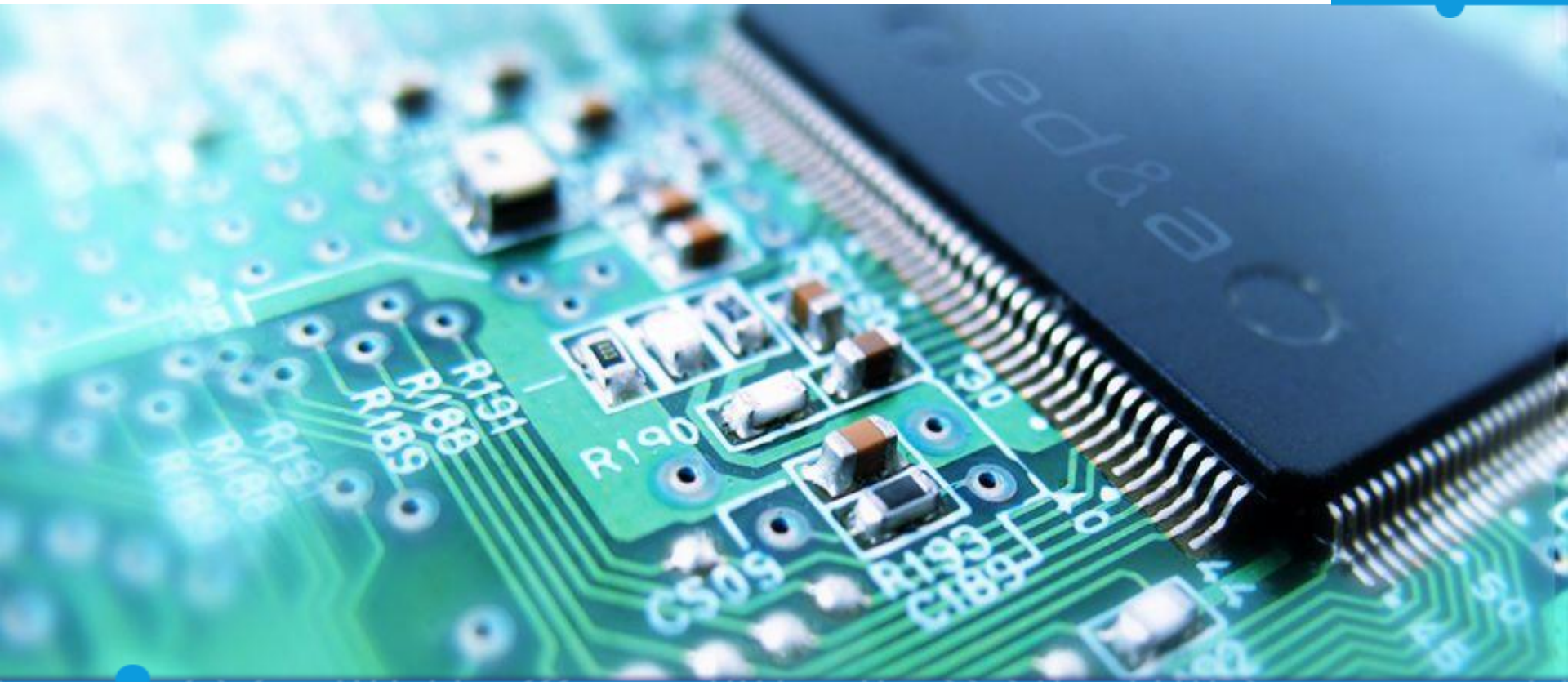

Future Trends

User Interfaces

- Consumer market
  - Simple interfaces on device
  - Complex interface on smartphone
- Industrial applications
  - Interface on device
  - Service through mobile devices

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Future Trends

Technologies

- Mobile network
  - New IoT Technologies:
    - LTE Cat NB1, M1
    - EC-GSM-IoT
  - End of old technologies
    - 2G, 3G
- Other new Technologies
  - Bluetooth 5
  - 802.11ah (WiFi)

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Future Trends

IPv6

- Addressing problem
  - 30.7 billion IoT devices in 2020, 75.4 billion in 2025
  - IPv4 can address 4 billion devices
- IPv6 can address 3.4×10^{38} devices (+1000 addresses/m²)
- All devices directly addressable

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Future Trends

Security

- Security will become more important
- Security updates necessary
- Secure update mechanism
- Encryption needed

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Questions?