Sensor Edge Processing for the IoT

Class 1: Architecture

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Louis W. Giokas

DesignNews

CEC CONTINUING EDUCATION CENTER

Presented by: Digi-Key ELECTRONICS

This Week's Agenda

Monday	Architecture
Tuesday	Data Considerations
Wednesday	Devices – Sensor Level
Thursday	Devices – Aggregation/ Communication Level
Friday	Algorithms

Course Description

- The cloud is the central gathering point for all data these days. The Internet of Things (IoT) generates a lot of data. Getting that data to the cloud introduces latency which is a problem for IoT analytics and real time decision making.
- The answer to this is processing data at the “edge”.
- New devices, and not a few older devices, make this possible.
- We will look at architectures and algorithms useful for edge processing of sensor data in the IoT.

Today's Agenda

- Course Overview
- Architectural Requirements
- Architectural Patterns
- Conclusion/Next Class

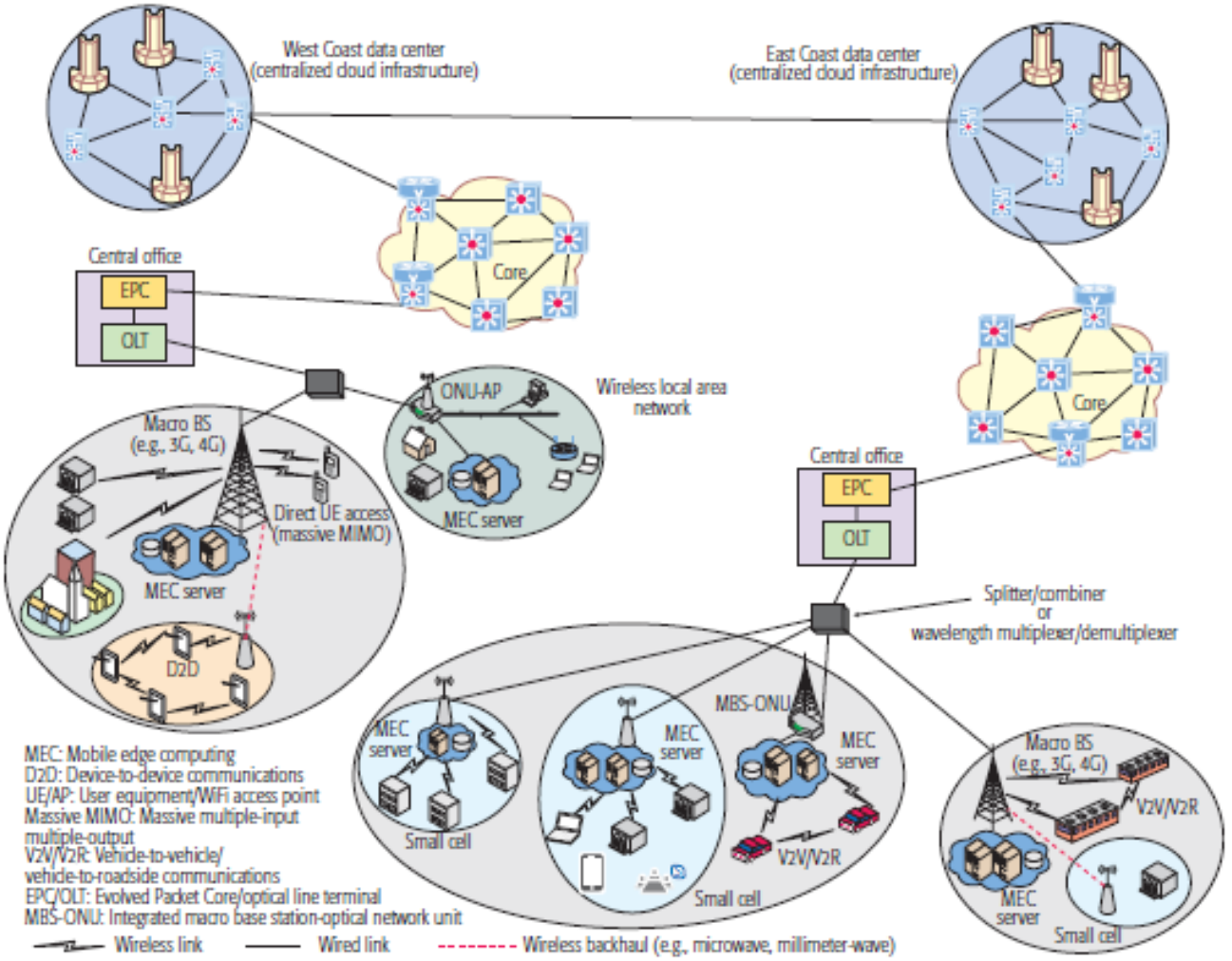
Course Overview

- In this course we will look at “edge” processing for the Internet of Things (IoT).
- The goal of edge processing is to move processing resources out closer to where they are used.
  - The motivation for this is to minimize latency in those cases where latency could be a problem
  - The IoT is one of those use cases

Course Overview

- The IoT is not the only situation where latency is a problem.
  - In the latest (February 2017) edition of IEEE Communications Magazine there is an article, “Mobile Edge Computing Fiber-Empowered Access Networks in the 5G Era” which lays out the motivation for edge processing in a general, including, but not limited to, the IoT

Course Overview



Architectural Requirements

- Cloud computing is the default answer to analytics problems and large scale data operations
- While the cloud has the capacity and the connectivity to be used in a highly distributed environment, it has one major flaw:
  - Communications latency
- The cloud was designed for large scale, variable volume and velocity environments

Architectural Requirements

- The cloud was not designed for real-time applications
- The cloud overlaps with Big Data
  - Large volumes
  - Variety of data and sources
  - Velocity of data
- These are important, but do not always meet the needs of the IoT

Architectural Requirements

- While hyper scale data centers are, well, hyper (big) the IoT still threatens to overwhelm them
  - Billions (perhaps trillions) of devices
  - Lots of data per device
- All of this data does not need to be analyzed together
  - This is a common fallacy
    - E.g., traffic data in Chicago does not have any connection with or bearing on construction equipment in China

Architectural Requirements

- Latency:
  - This is the main driver of edge processing
  - Typical scenarios include measurement, analysis and command (think SCADA)
  - This is a tied with QoS requirements more familiar in a communications context
  - Applications in this environment typically need latency of <10ms
    - E.g., telesurgery

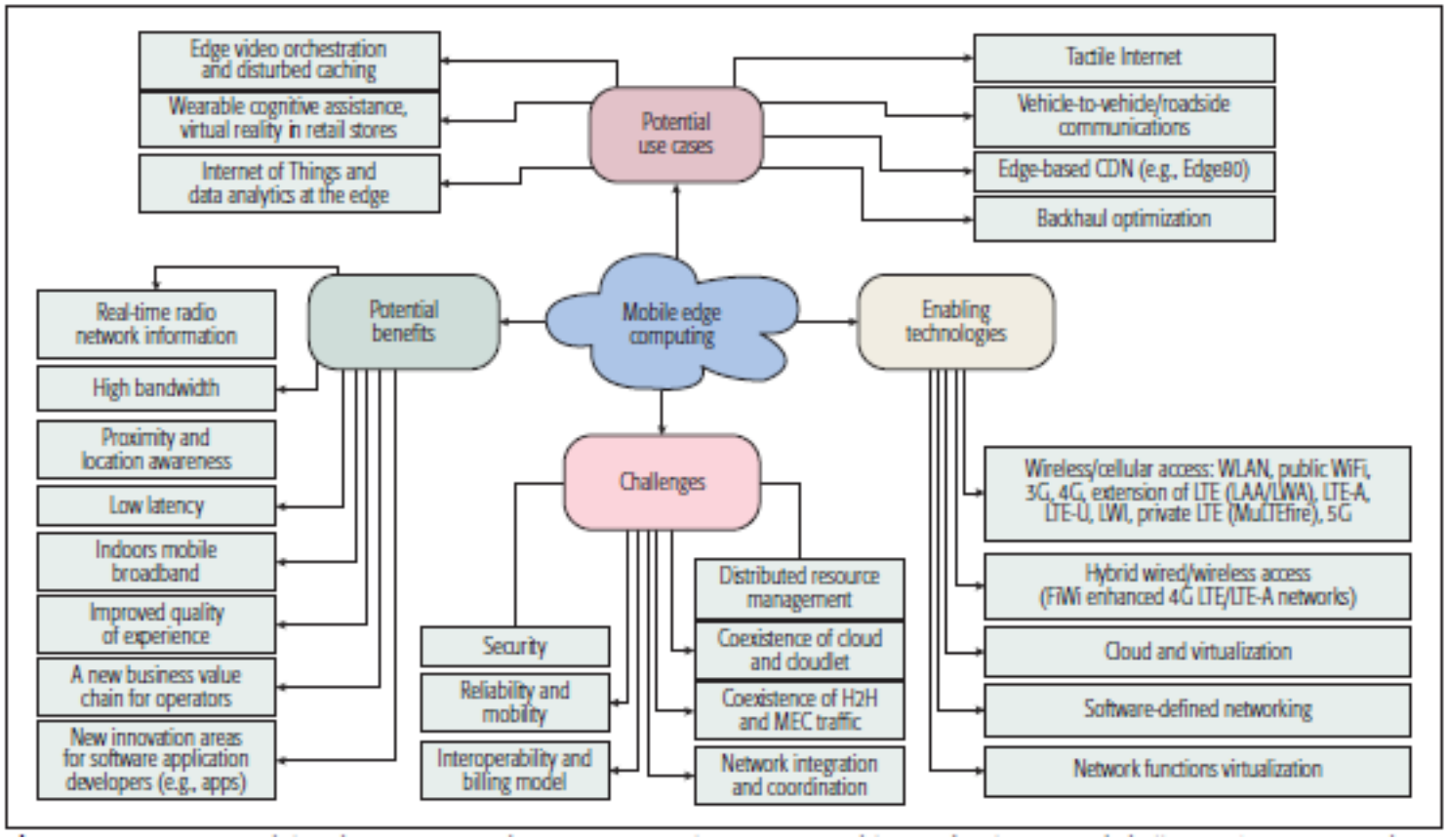
Architectural Requirements

- Reliability
  - Carrier grade reliability of 99.999% (five 9s) is required for the communications network and control applications in many cases
  - Mission critical applications include traffic control, telesurgery, industrial control applications
- Mobility
  - Many of the devices are mobile and require constant connectivity

Architectural Requirements

- New types of IoT communication and applications
  - Vehicle to Vehicle (V2V)
  - Vehicle to Roadside (V2R)
  - Location services for healthcare
- Connection with the cloud for large scale analytic processing
  - Determining and evolving the parameters used at the edge

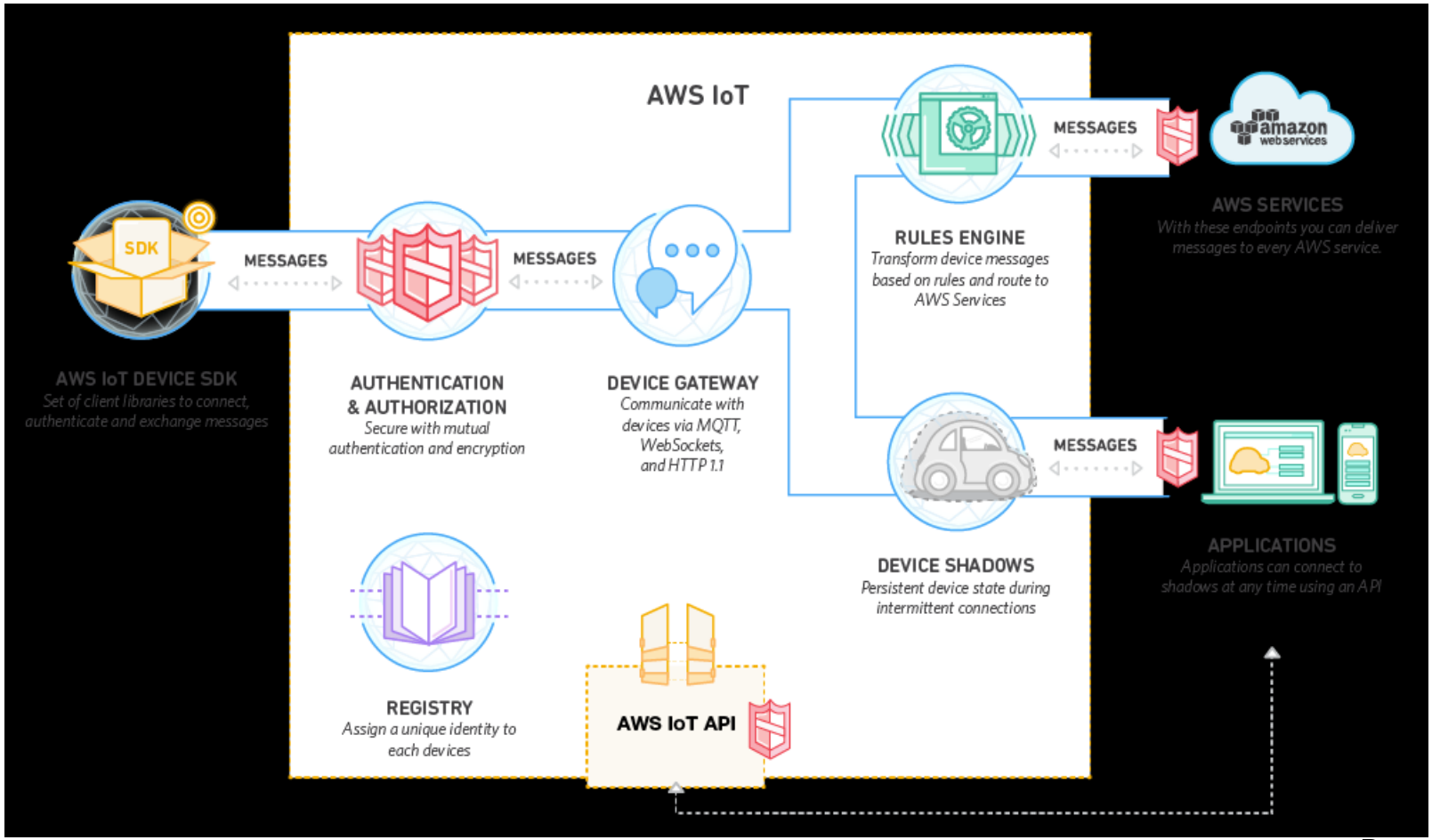
Architectural Requirements



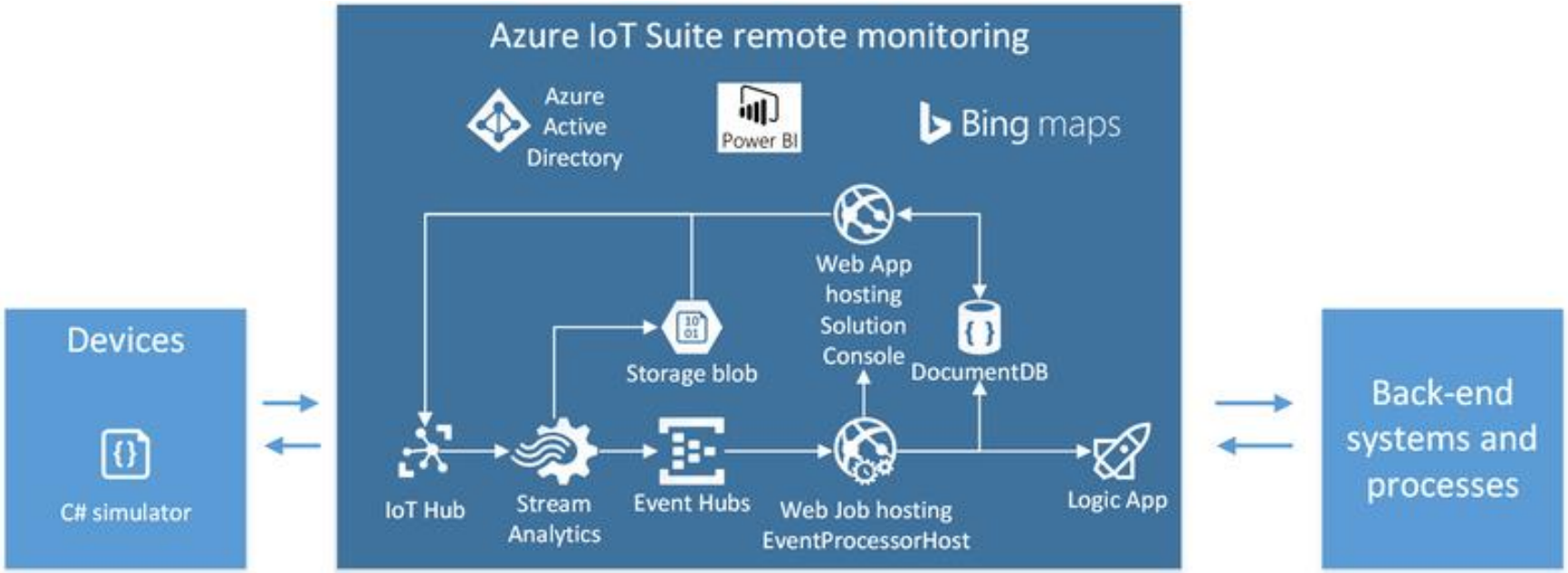
Architectural Patterns

- There are many ways to organize Edge Processing
  - Many will coexist
- There are several names for this
  - Mobile Edge Computing (MEC)
  - Edge Computing
  - Fog
    - Typically two layers
      - Fog Layer and Hyper Fog
  - Extreme Edge Network

Architectural Patterns



Architectural Patterns



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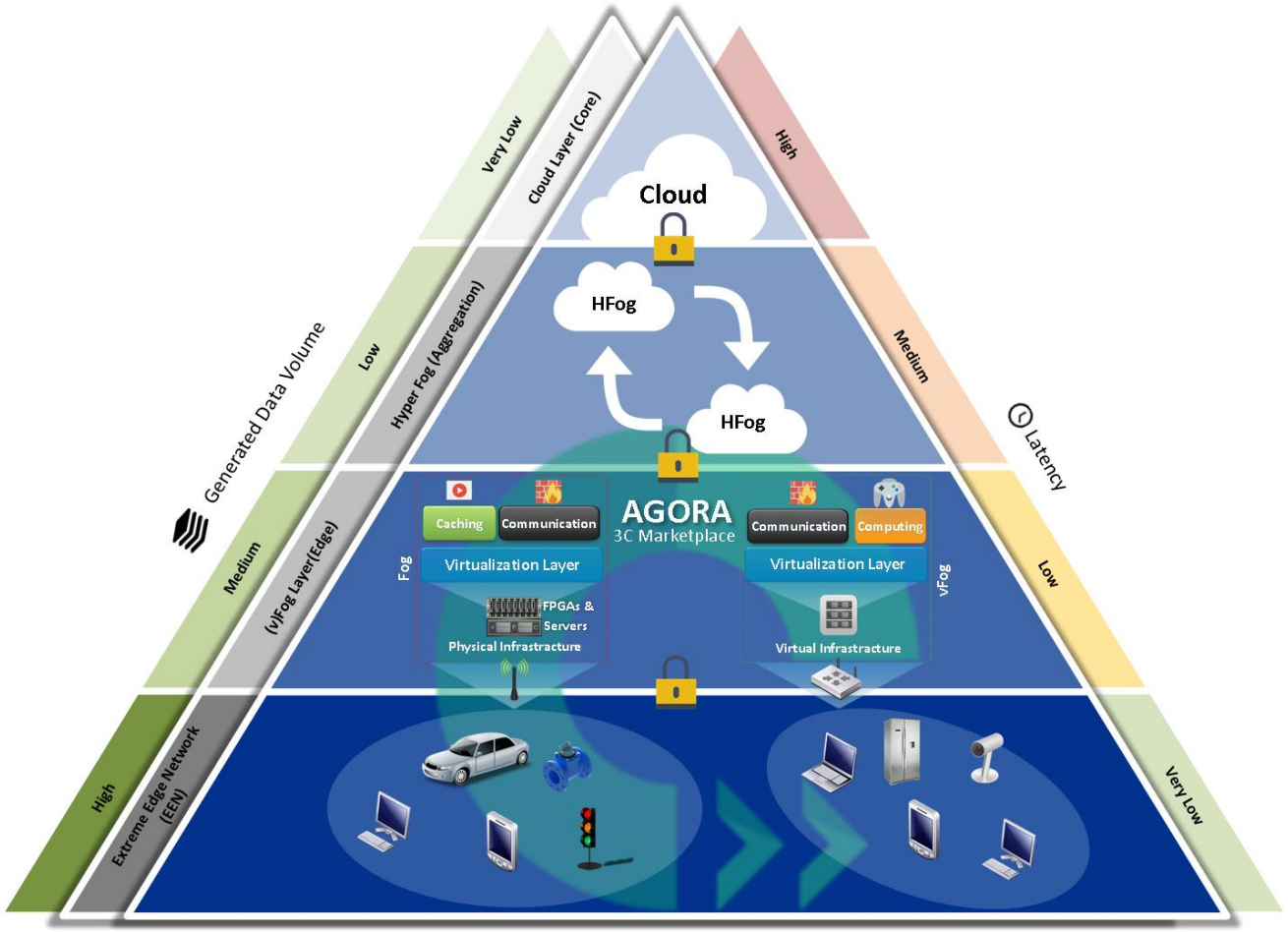
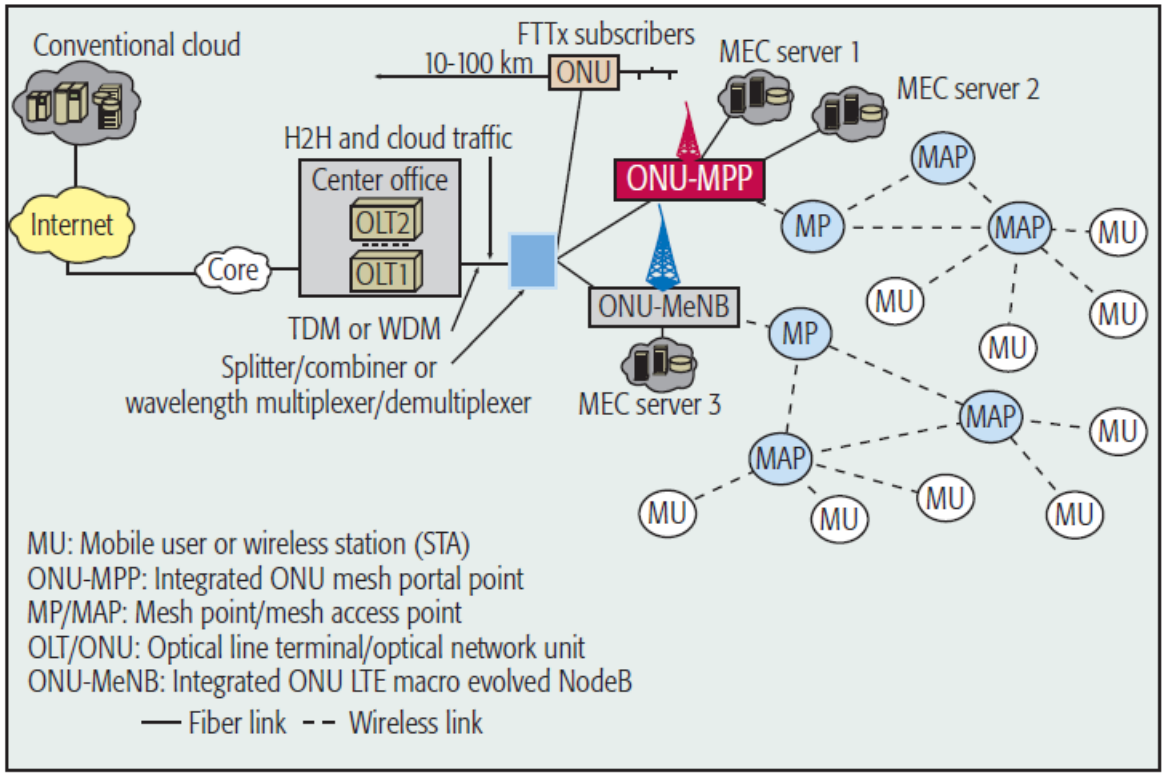


Architectural Patterns



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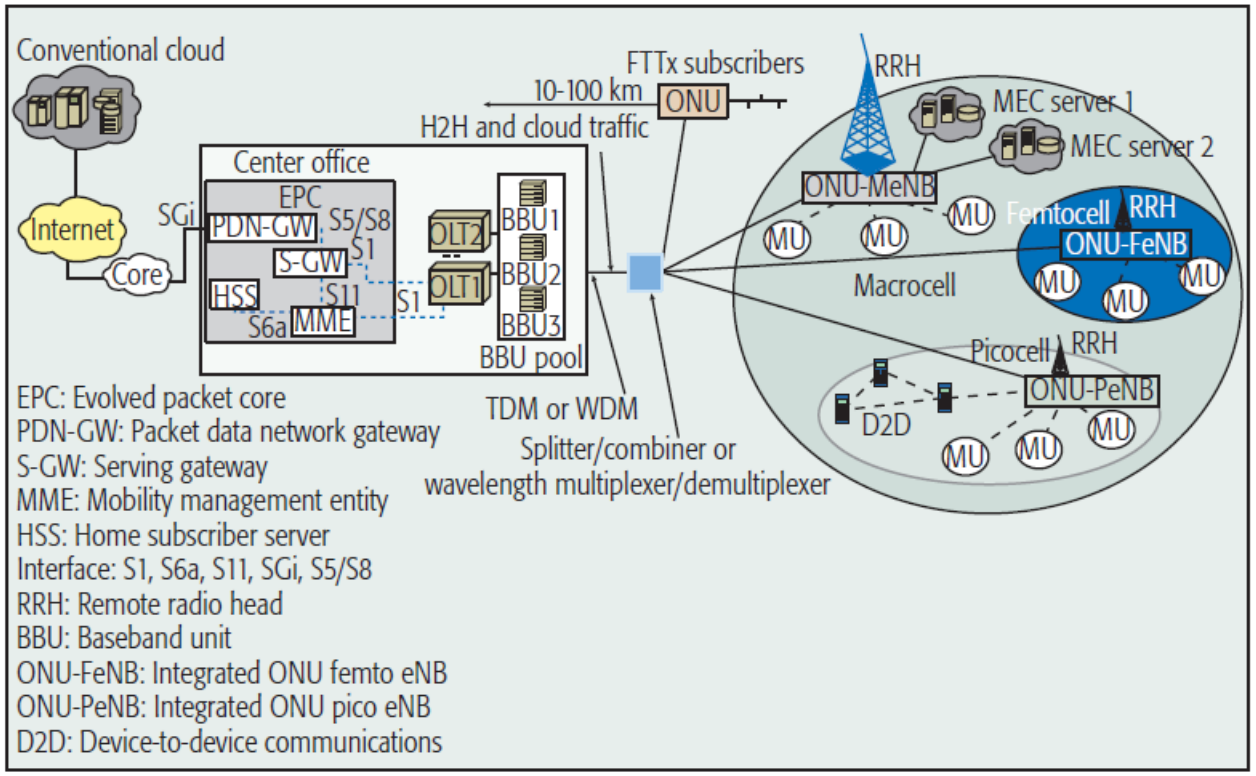

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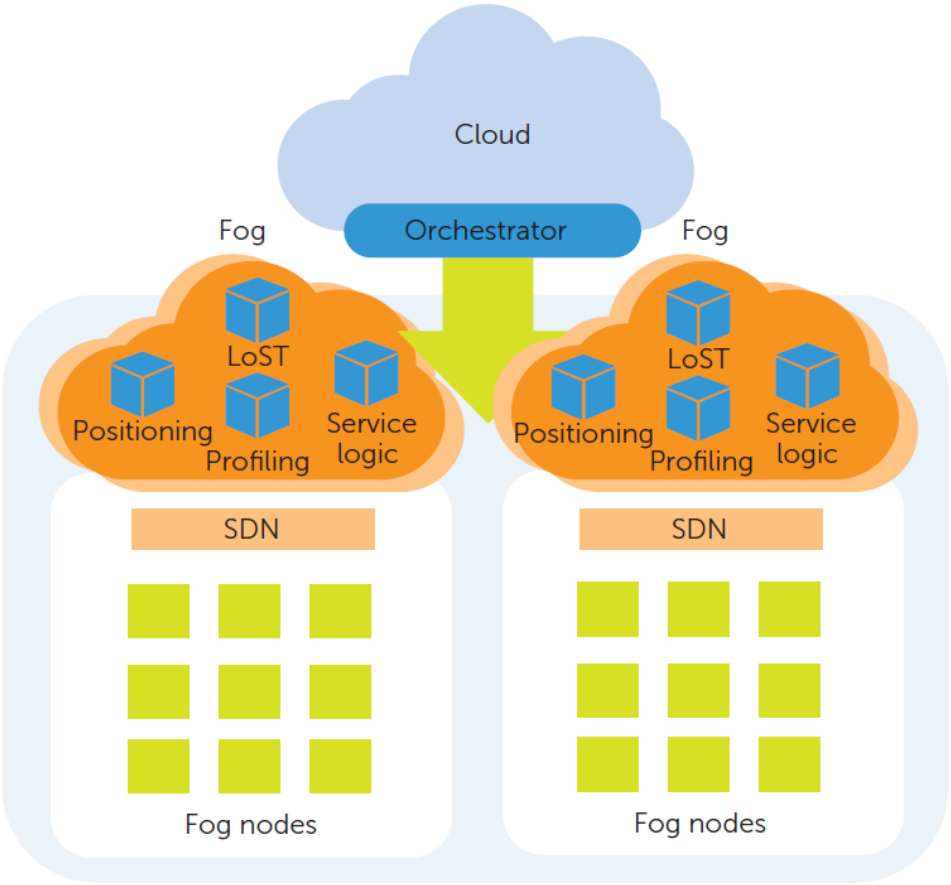

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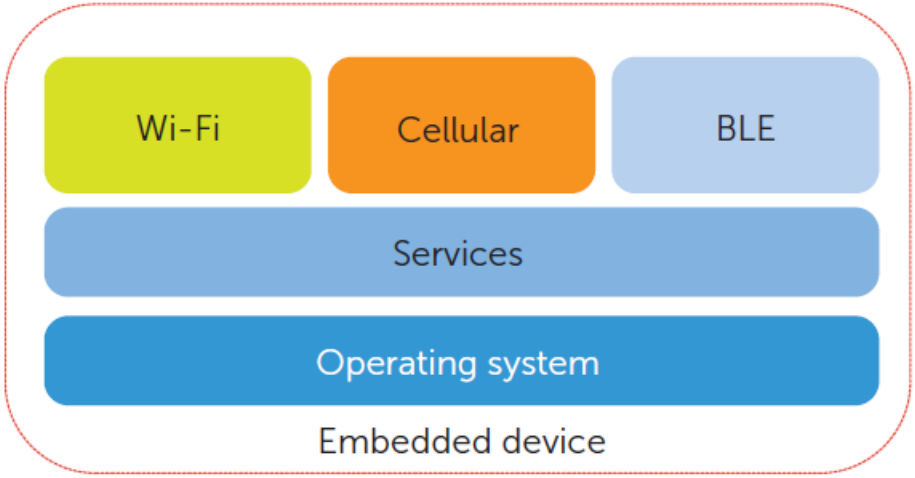

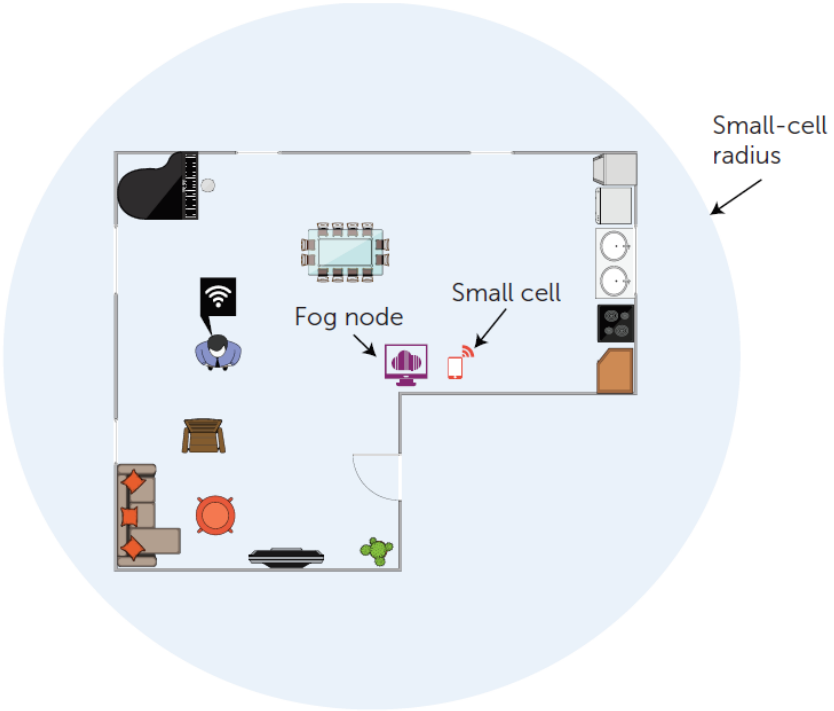

Conclusion/Next Class

- Today we discussed the requirements and architectural patterns for IoT Edge Processing
- Several different architectures have been developed/proposed
- One common thread is a mixed environment of edge processing and cloud analytics
- Tomorrow we will look at the data and how it is transmitted/stored