Connectivity Solutions for the Industrial Internet of Things (IIoT)

Class 1: IIoT Landscape

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This Week's Agenda

Monday	IIoT Landscape
Tuesday	Wired Options
Wednesday	Wireless Options
Thursday	Architectures for Individual Plants
Friday	Distributed Operations and External Connections

Course Description

The Industrial Internet of Things (IIoT) consists of components and systems that interconnect industrial equipment together and, potentially with external systems. These are distributed systems that may span a great area inside a particular facility, and may interconnect facilities. In addition, external systems are typically added to the mix to facilitate control and analysis of the data. In this course we will look at the components, primarily communications, and how they are interconnected and architected.

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Today's Agenda

- Overview

- Industrial Considerations

- Facility Types

- Range of Applications

- Connectivity Requirements

- Conclusion/Next Class

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Overview

- We will look at the Industrial Internet of Things (IIoT) which is a subset of the Internet of Things (IoT)

- These are "things" or devices which are used in industrial settings and typically have different requirements and characteristics from other IoT devices.
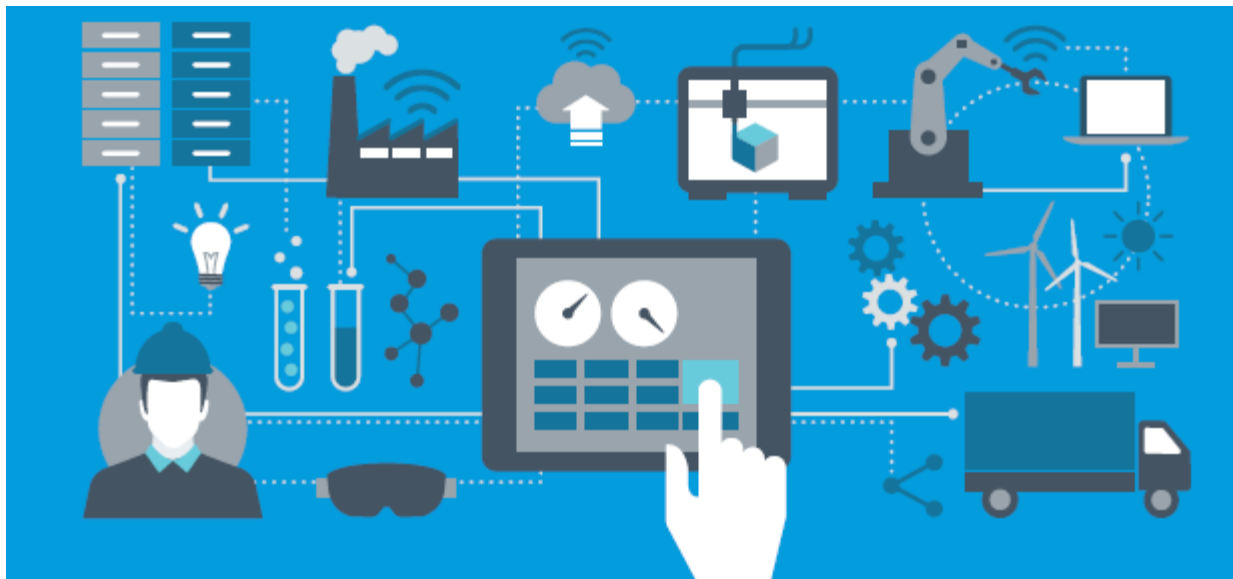
Overview

- By Industrial we mean not only devices in factories, but generally will include:
  - Factories (of course)
  - Warehouse and distribution centers
  - Industrial equipment in remote locations
  - Mines, roadbuilding and other "outdoor" locations
  - Utilities
    - Water and wastewater treatment plants
   - Power generation plants

Overview

- Many industrial facilities have varying levels of automation
  - Few, unless designed from scratch to be "highly" automated, will be fully connected
  - Over time there will typically be "islands" of automation
    - As systems evolve, these will be connected together to achieve higher levels of automation and precision
    - In many cases, plants change as new products are introduced
  - Thus, connectivity needs to be flexible and expandable

Overview

- A typical manufacturing environment

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Course Overview

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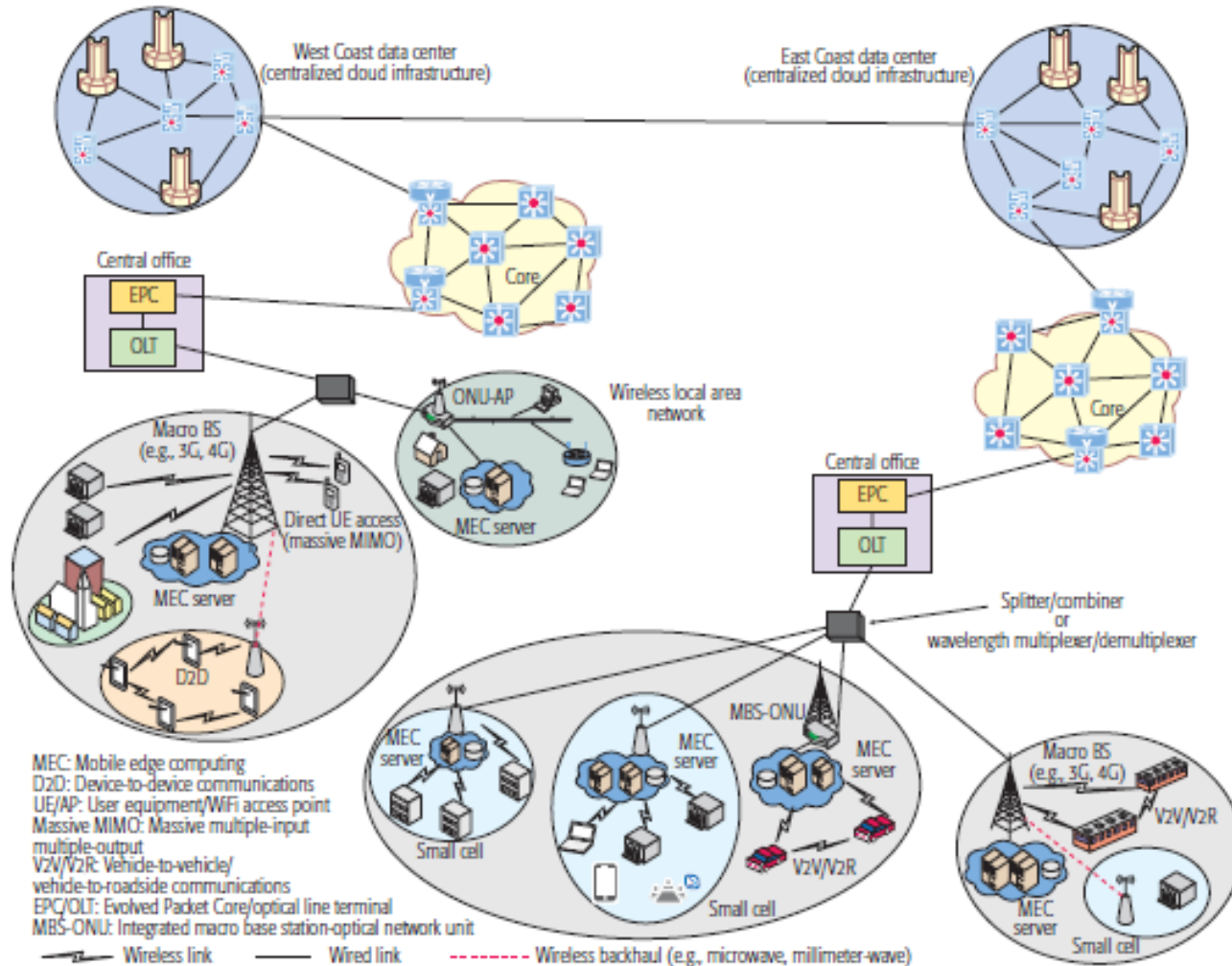
Industrial Considerations

- Availability

- Reliability

- Predictability

- Safety

- Security

- All of these attributes of industrial systems are important and go beyond what is required in the non-industrial IoT

Industrial Considerations

- From a communications point of view, many connections in an industrial setting require high bandwidth
  - Vision based systems
  - Computational robotic systems
- Cost of installation
  - Evolution of automation (i.e.., connecting existing islands of automation)
  - Reconfiguration (i.e., new processes, machines and products)

Facility Types

- We will consider a number of types of facilities
  - Factories, or industrial plants
  - Warehouses
    - Both for incoming materials and distribution of finished goods
  - Transportation systems
  - Mines and raw material facilities
  - Utilities
    - e.g., electrical and water

Facility Types

- We will concentrate on factories and related facilities (e.g., warehouses and distribution)

- Each facility type contains different types of devices and environments

- Factories typically have the widest range of devices and communication needs

Facility Types

- Utilities are another type of industrial facility that must be considered
  - In some cases, factories and mines may have their own utilities
  - The same type of monitoring and control functions are often present
  - Similar types of equipment may be present

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Facility Types

- While not an industrial facility per se, data centers are also important to the industrial landscape
  - Many types of data are originated here or stored
  - Connectivity requirements for data centers are key to modern industrial operations
  - Data centers may be dedicated, or now very often, in the cloud
  - Issues with security of sensitive information is also a consideration

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Range of Applications

- Devices with an industrial facility vary widely
  - Simple sensors and actuators
  - Machine control
  - Robots
  - Vision systems
  - Material handling systems
  - Inventory control

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Range of Applications

- Applications also have a wide range
  - MRP (Manufacturing Resource Planning)
    - Systems that help plan and keep track of the flow of materials and processes in a plant
    - Dynamic allocation of resources
    - Constant feedback and adjustment of operations
    - Typically run across a whole enterprise
  - Plant or individual facility control
    - Direct operation of a single facility
    - Interface with the MRP system and plant devices
    - Sometime considered part of the MRP system

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Range of Applications

- Work cell control
  - Many plants are organized in cells that combine a number of machines into one process group
  - Computational elements may be local or remote
- Individual machine control
  - Typical industrial application
- Smart systems
- Simple reactive systems

Connectivity Requirements

- Runs the full range from high bandwidth data center connections to a simple duplex connection

- Includes fixed machines as well as mobile devices (e.g., mobile robots)

- New trend toward wireless
  - Fixed devices
  - Mobile devices for inspection and operation
   - Portable HMI

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Connectivity Requirements

- Wired
  - Within plant
  - Plant to plant
  - External agents (i.e., suppliers)
  - Plant to warehouse
  - High speed and robust
  - Safety considerations
    - Need for uninterrupted operations
  - Ease of configuration and reconfiguration

Connectivity Requirements

- Wireless
  - Similar requirements as for wired
  - Standards based
  - EMI considerations
  - Ease of reconfiguration
  - Typically not used for the highest bandwidth applications
  - Enables portable HMI

Connectivity Requirements

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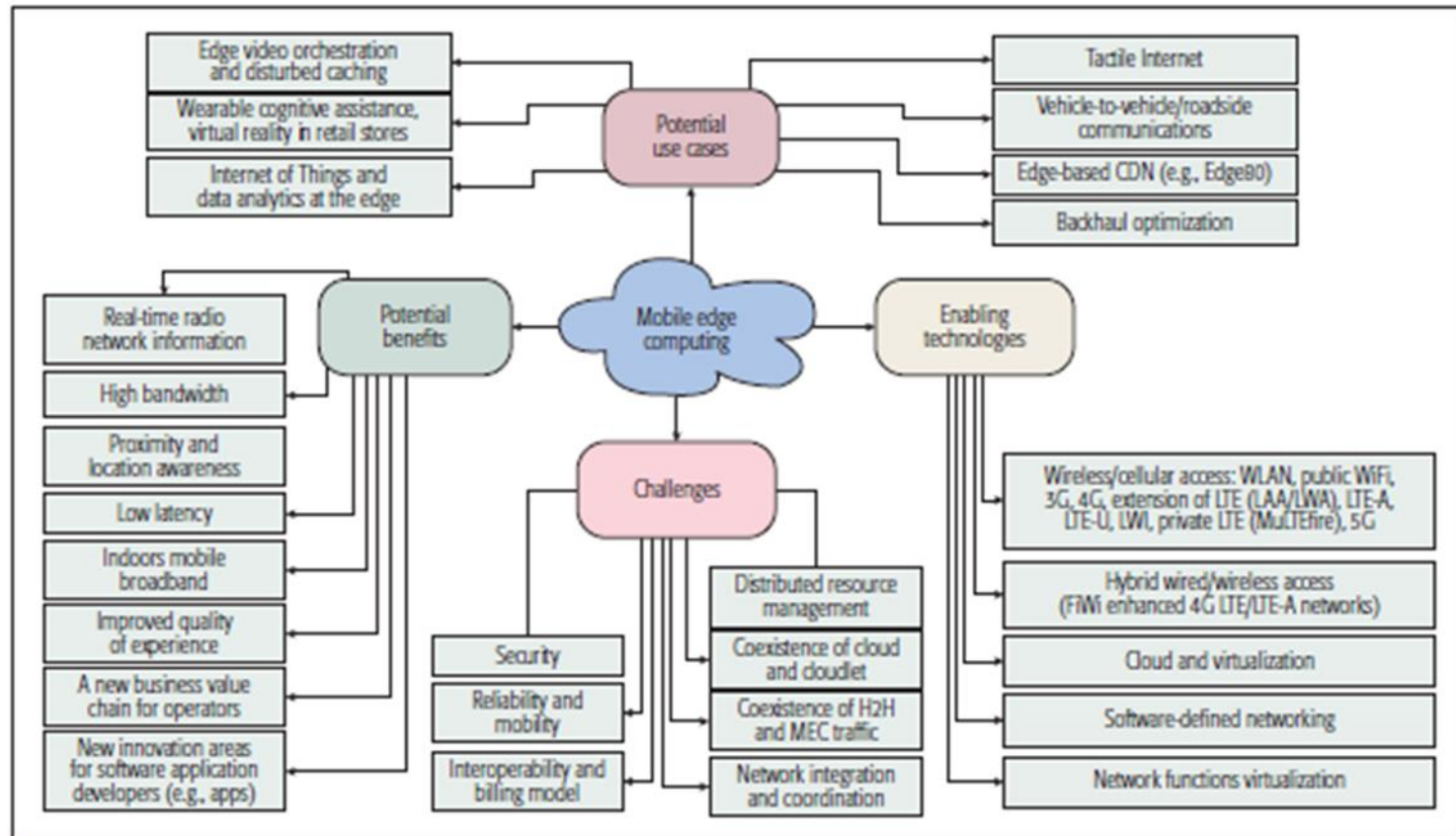
Conclusion/Next Class

- Today we laid out environment that is present in the IIoT

- We discussed some of the requirements and applications that might be encountered

- We looked briefly at some architectures

- In the next class we will concentrate on the wired enviroment

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