Connectivity Solutions for the Industrial Internet of Things (IIoT)

Class 4: Architectures for Individual Plants

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CEC CONTINUING EDUCATION CENTER

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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.

Today's Agenda

- Overview
- Islands of Automation
- Connecting the Islands
- Edge Processing
- Plantwide Control
- Conclusion/Next Class

Overview

- We will look at connectivity starting from a non-connected situation and build out from there
- This assumes existing plants that were not originally planned as fully automated
- For new plant design and construction a different approach might be taken

Overview

- Major connectivity decisions are driven by machine type and controller capabilities
- Choices include wired and wireless access
  - Generally we will see a mix of types
- Computing resources in the plant will also play a key role
  - Edge processing
  - Centralized computing

Islands of Automation

- Generally we start with “islands of automation”
- For example, a robotic system might be put in place to automate a particular, formerly manual, process
- Inspection systems may be added
- In many cases we will not assume an overall design process was undertaken
  - THIS IS NOT ALWAYS THE CASE

Islands of Automation

- The standard automation product is the PLC (Programmable Logic Controller)
- These can be used independently to control one device or set of devices
- Communications are typically with a set of sensors and actuators
  - Simple communications systems can be used such as Modbus or CAN bus

Islands of Automation

- Robot cells use a robot, with a sensor, which could be a vision system
- Vision systems typically require local computing resources
- An example would be a pick and place robot working on conveyor
  - The vision system identifies the part and controls the operation of the robot
- Programming can be done locally

Islands of Automation

Islands of Automation

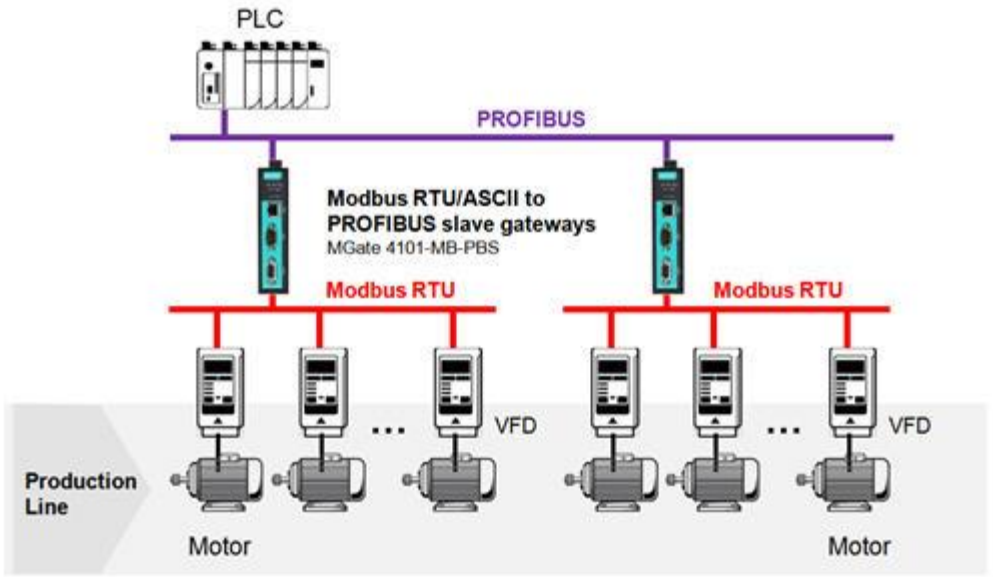
Portable HMI used to monitor and program the robot. No need for connection to a central system

Connecting the Islands

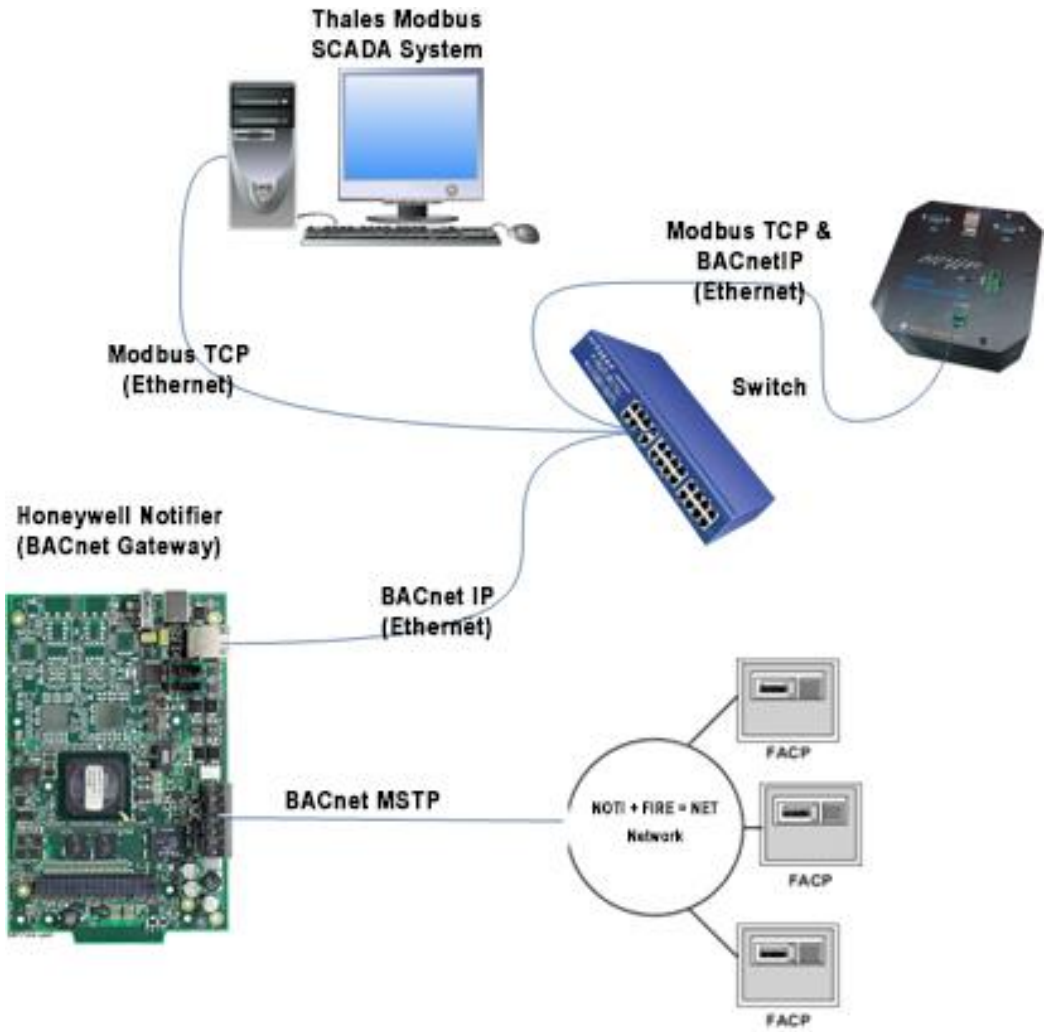
- As an evolutionary step, it may be desirable to connect several separate systems together for a higher level of automation and/or coordination
- Compatibility among systems then becomes an issue
  - Are the systems compatible?
  - Will some form of protocol conversion be necessary?

Connecting the Islands

- If protocol conversion is required, some form of gateway may be necessary

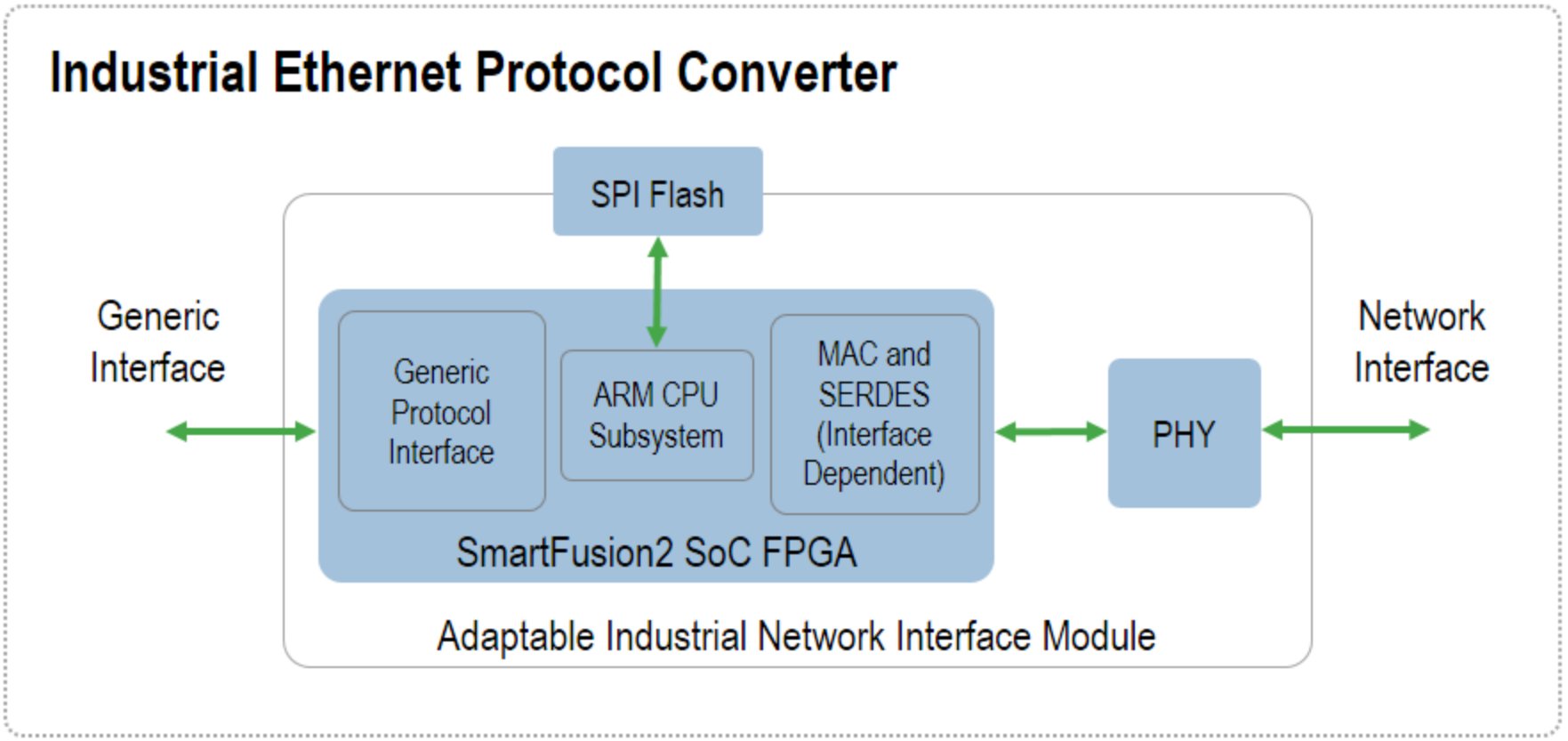


Connecting the Islands



Many different types of protocols in one network

Connecting the Islands

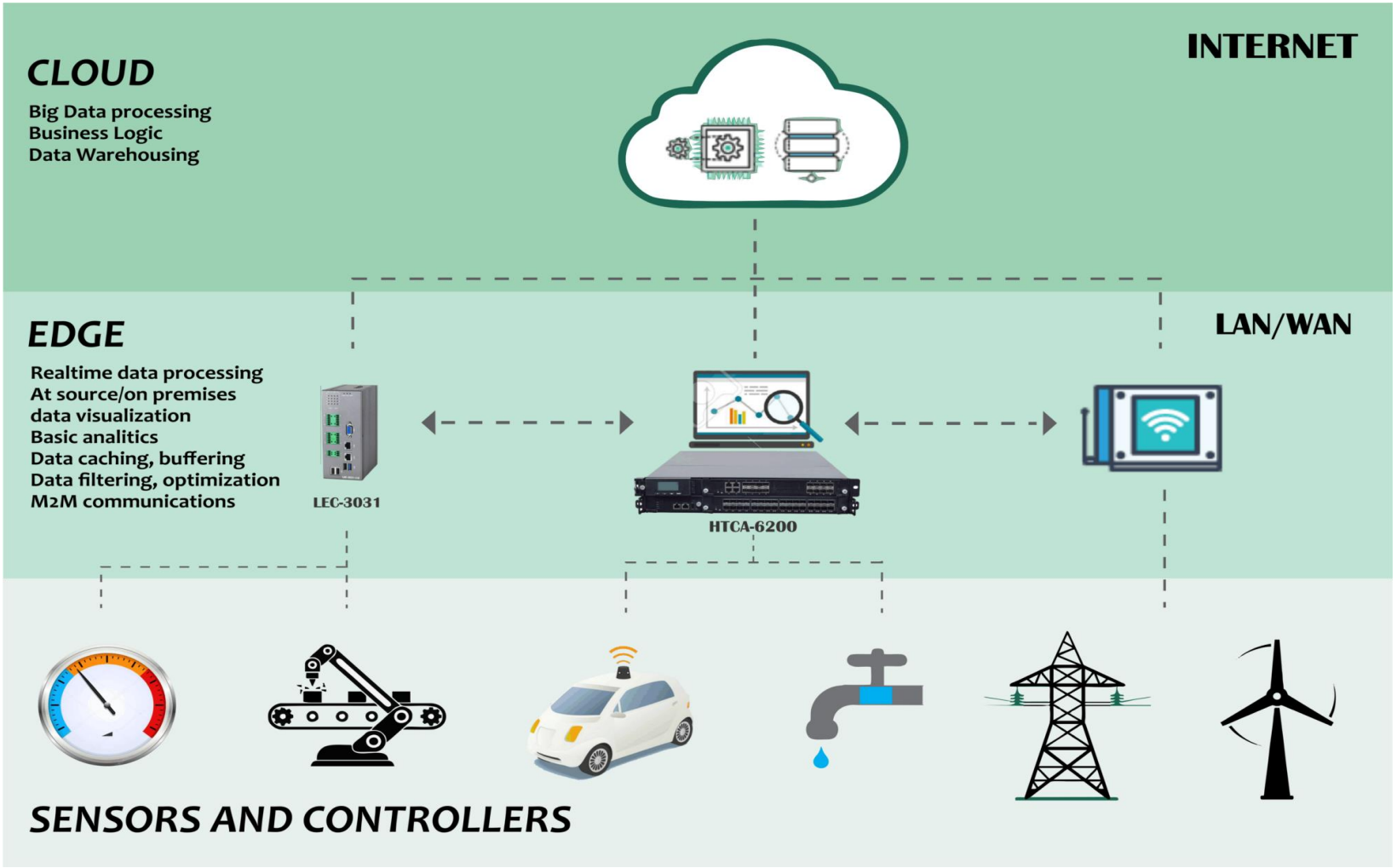


Programmable devices used for protocol conversion

Edge Processing

- In many cases, especially where many cells or machines are interconnected, it is useful to have local, or “edge” processing resources
- These can be PC type devices, or powerful embedded devices
- Communications infrastructure will be key in connecting the local devices and centralized systems

Edge Processing



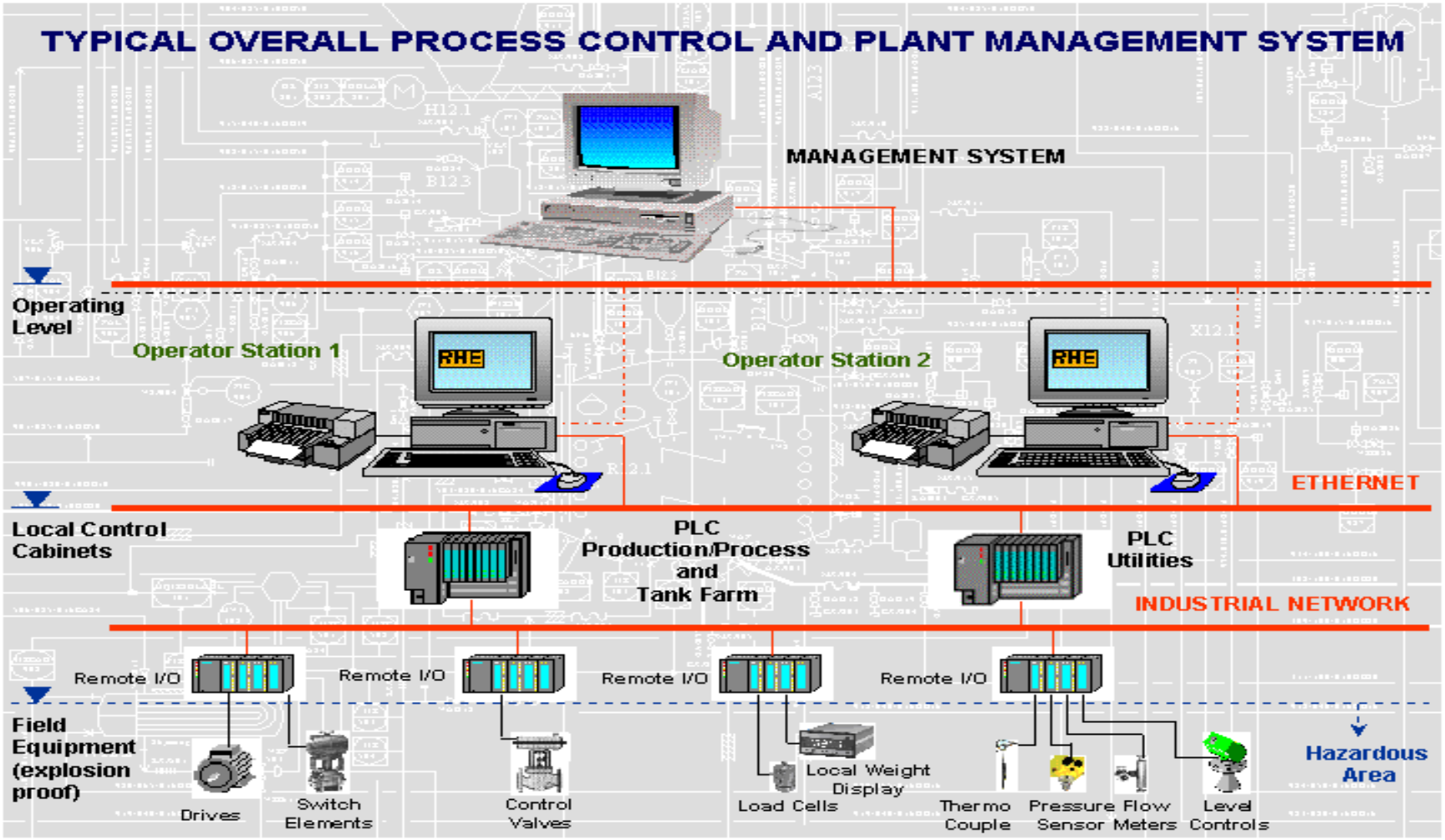
Edge Processing

- Communications between edge systems will typically be via Ethernet, either wired or wireless
- If connected to centralized resources, communications will some form of Ethernet or a Internet connections
- Communications to controlled devices will be various and may require some for of gateway

Plantwide Control

- As the plant becomes fully connected, centralized computing resources will be added to provide overall control and status
- Within a plant that has been fully connected it is often useful to have an overall view of the operation in some sort of human readable form
  - Control, or operations center

Plantwide Control



Plantwide Control

Plantwide Control

- The industrial system configured in this way is truly a distributed system with diverse components
- The plantwide system can also serve as the gateway to the larger enterprise
  - Between plants
  - From the plant to the MRP systems or analytics systems
    - Cloud?

Plantwide Control

- One of the biggest decisions to be made is wired vs wireless
  - Wired
    - Higher cost to install
    - Less of an issue with EMI
    - More robust/higher capacity
  - Wireless
    - Easier to install
    - Flexibility
    - EMI issues/testing

Conclusion/Next Class

- We have looked at communications with an existing plant
- We have discussed some of the evolutionary issues
  - New plants, designed for automation do not have most of these
- Next time we will look at communications between dispersed parts of the enterprise and external systems