SCADA Systems for Water and Wastewater Applications

• What are we going to talk about?
  – What a SCADA is
  – System architecture
  – Process
  – Field devices
  – Control of or interfacing to field devices (PLC)
  – Connectivity (communication media)
  – Visualization or display of the process or data

• Questions?
SCADA

• Supervisory
• Control (of a process)
• And
• Data
• Acquisition (of a process)
SCADA System Architecture

- **Process**
- **Field Devices**
- **Control and Interfacing**
  - **PLC**
- **Connectivity**
  - **Network**
- **Visualization and Display**
  - **OIT**
  - **PC Software**
Process

- Anything going on in a water or wastewater plant
- Pumping
- EQ Basin, elevated storage, flocculation, primary settling,
- dewatering
- Metering chemicals
- Mixing
- Anything going on in a water or wastewater plant
Field Devices

Monitoring
• Door switches (intrusion)
• High level or low level switches/floats
• Gas monitoring
• Flow meters
• Level transmitters
• Pressure transmitters
• Temperature transmitters

Controlling
• Valves Open/Close
• Valves Modulating, (position control)
• Pumps, fractional HP to 1000s HP
• HVAC
Methods of Interfacing to Field Devices

- **Discrete**: On/Off

- **Analog**: Continuously Varying

- **Network**: Digital data (Intelligent Devices)

  - Valves
  - pH, ORP, Turbidity
  - Flow Meters
  - MCCs
Examples of Interfacing to a Typical Field Device

- **FLOAT**
  - TO PLC
  - LEVEL
  - L.S.
  - LS
  - LS.

- **PRESSURE**
  - TO PLC
  - PRESSURE
  - P.T.
  - PT
  - PT.

- **VALVE ACTUATOR**
  - TO PLC
  - IN REMOTE
  - CLOSED
  - OPENED
  - FAULT
  - OPEN/CLOSE
  - M.E.

- **MOTOR STARTER**
  - TO PLC
  - IN REMOTE
  - RUNNING
  - FAULT
  - START/STOP
  - M.E.
  - M.E.
Considerations When Specifying or Purchasing Field Devices

• Make sure it does what you want it to do!

  – Obvious considerations
    • Process functionality, Flow range, Pump capacity, Gate size, etc.

  – Not so obvious considerations
    • Environment, Enclosure rating
    • Interfacing options, local/remote, digital (24 or 120 volt) or analog signals
    • Feedback, confirmation or status signals
Interfacing to or Controlling a Field Device

- Important item in a SCADA system.
- Typically a Programmable Logic Controller (PLC) panel or Remote Input Output (RIO) panel is used.
Typical PLC Panel
Location of PLC or Remote I/O Panels

- Grouped by process
  - Influent pumping
  - Chemical treatment
- Grouped by building
  - Sludge dewatering
  - High service
- Located close to field devices
  - Keep conduit/wire runs short
  - Keep trouble shooting close to devices
Connectivity History

• Plant networks and PLC communications were not always Ethernet Based...
  – Serial RS485, RS232, DH+, Modbus Serial
  – Proprietary, sometimes manufacturer specific
  – Did not interface easily to other equipment
  – Not easily routable, peer to peer, multi drop network with only a few dozen nodes (addresses)

• Plant control networks are now predominantly Ethernet IP based
• Very cost effective, leveraged hardware from the business and corporate network industry
• Internet is Ethernet based
Connectivity (communication media)

- Network connects the PLC panels to the visualization layer
- **Inside plant (Within the same building)**
  - Copper
    - Common
  - Fiber
    - Becoming standard practice
  - Radio

- Considerations
  - Twisted Pair Copper, Fiber Optic Cable, Radio
  - Temporary or permanent, Fixed location vs mobile
  - Distance, Bandwidth, Speed
  - Electrical noise immunity, reliability
  - Cost materials, cost installation, cost to maintain
Connectivity (communication media)

• **Between Buildings**
  – Media Type
    • Twisted Pair Copper, Fiber optic cable, Radio
    • Fixed Location vs Mobile
    • Distance, bandwidth, speed
    • Noise immunity, reliability
    • Cost materials, cost installation, cost to maintain
  – Copper
    • Not generally used any more
  – Fiber
    • Preferred, immune to lightning
  – Radio
    • Microwave link, large distances
Visualization and Display

• Graphical User Interface (GUI)
• Human Machine Interface (HMI)
• Man Machine interface (MMI)
• Graphical representation of the process populated with real data.

• Operator interface terminal (OIT)

• PC based, software package
Typical HMI Screen
Visualization and Display

• Trending
  – Process monitoring
  – Process trouble shooting
  – Record keeping

• Event Logging
  – Know what happened and when
  – Time stamping events

• Alarm logging
  – Time stamping alarms
  – Who acknowledged what alarm

• Alarm Notification
  – Voice call to cell phone
  – Text message or Email.
Scalability

Operations

Maintenance

Management

Information Network

Server

Plant Network
Telemetry
What it **is** and what it **isn’t**

- Isn’t
  - Turnkey
  - Off the shelf
  - One size fits all

- Is
  - Many parts/components, many products, many manufacturers, many vendors
  - Highly scalable, flexible, and customizable
  - Requires a controls/instrumentation staff, or systems integrator to develop, implement, configure and maintain
Questions?