Building a Robust Industrial Ethernet Network In Water & Wastewater Treatment Plants

Reliable Benefits & Features for WWTP Management

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May 1, 2013
The control and management of a Water and Wastewater Treatment Plant (WWTP) is a complex task that requires the supervision of human experts. The geography of a typical WWTP is covering hundreds of acres are not uncommon; plus many older plants and remote stations which previously had no network are implementing SCADA systems linked with Ethernet.

A reliable Ethernet Network within Water and Wastewater Treatment Facilities is required, in order to
- Obtain precise control – any data error may result in the release of pollutants into the environment.
- Flexibility on the connectivity for typical SCADA (Supervisory Control and Data Acquisition) system linked with Master Terminal Unit (MTU), Remote Terminal Units (RTU); in order to perform remote data collection, control devices, such as control pumps, gates, aerators, flow meters/sensors for the process.
- Increase remote monitoring performance with Human Machine Interface (HMI) from remote stations.

There are several considerations of what major features of the Industrial Ethernet Switches would benefit the WWTP Management:
- Redundancy Ethernet Network
- Flexible Fiber connectivity
- Increase Determinism
- Network Management
- Advanced Event Handling
- High Reliabilities
- Cost Effective
Redundancy Ethernet Network

Having Redundancy Ethernet Network is important to WWTP management. Many WWTP are still legacy, either built with stand-alone station or having traditional Star Topology Ethernet Network. A lot of valuable data from field devices will be dropped if any point of stations encounter cable cut or disconnected by accident.

Building a Ring Topology

Redundancy Ethernet Network could perform “Self-Healing” function in order to re-build the network and route data immediately with backup path. Most typical Ethernet Switches built-in the Traditional STP/RSTP network recovery protocol will still have limitation about maximum allow downtime around 2~3 seconds; which means there’s risk about some data will be dropped within this period.

For Instance, in the popular Antaira LNX-802 series of Industrial Managed Switches, a firmware method called “Redundancy Network” configuration is used.

The built-in User-Friendly web console allows user easy to configure the Redundancy Network by just click on the “Drop-down” menu by choosing the standard STP/RSTP or Antaira Ring network recovery protocol setup. User also can assign any uplink ports from switch to switch to form a Ring Topology Network.

Benefits: By configure the redundancy network with Antaira’s proprietary fast network recovery protocol will allow WWTP to build a Robust Network to achieve the Self-Healing Network <20ms (up to 250 Switches) to prevent any network downtime or accident shutdown.
Flexible Fiber connectivity

Due to over miles and miles of Wastewater Treatment Plant Network coverage, Fiber Optic is the choice to extend long distance connection from station to station. The standard Ethernet cable has limited distance for the cable uplink <100Meters (326ft), but Fiber Optics cable can have the distance implemented up to 2Km with Multi-Mode Fiber, and from 15Km up to 120Km options with Single-Mode Fiber.

Bandwidth with Fiber Optics
- In the past, mostly the Wastewater Treatment Plant network design for field sites or pump stations was choosing 100Fx fiber uplink network for those low data rate transmission measurement equipment, such as Flow Meters, Sensors, Valves, etc.
- Today, the consideration of wider bandwidth network is a trend, due to more and more field sites or stations devices are required to be networked, in order to allow the SCADA system from Administration Control center could execute remote status monitoring and control for devices such as, Radio Modem, HMIs, PLCs, VoIP, Surveillance Cameras, etc.

Benefits with Fiber Optics
- Expand distance among Administration Center and Stations
- Prevent Electrical Noise Interference
- Saving Fiber cable budget by building a Fiber Ethernet Ring Topology

Antaira Industrial Managed Switches series provides wide range options of 10/100/1000Tx Ethernet in RJ45, and 100Fx or 1000SX/LX Fiber Connection models in SC, ST, and LC connector interface options. All models are rugged design for operating in wide Ambient Weather and Temperature range:
- Standard version: 0 to 60 Degree C
- Extend Temperature version: -40 to 75 Degree C
Below figures shows how a Network Topology with Star VS Ring
Increase Determinism

To building a reliable Ethernet Network within the WWTP, Redundancy Network Feature is not the only consideration, but more about Increase Determinism within the Network, in order to perform real-time data transmission within the Network.

Within the WWTP facilities, a lot of Measurement Devices, Control or Communication Equipment, are required to report real-time data to SCADA system; but other equipment will not require doing so, such as VoIP, or Surveillance Cameras.

An Industrial Managed Switch with Network Management Software built-in is required, in order to increase determinism for all field equipment data transmission.

VLAN 802.1Q
A Virtual LAN (VLAN) is a logical network grouping that limits the broadcast domain, which would allow user to isolate network traffic, so only the members of the same VLAN will receive traffic from the ones of the same VLAN.

Benefits:
Allows user to segment entire control network in different substations equipment transmit data to the same VLAN ID group.
- Effective Traffic Control
- Enhanced Network Security
- Simple Network Management
IGMP Snooping

The Internet Group Management Protocol (IGMP) is an internal protocol of the Internet Protocol (IP) suite. IP manages multicast traffic by using switches, routers, and hosts that support IGMP. Enabling IGMP allows the ports to detect IGMP queries, report packets, and manage IP multicast traffic through the switch.

Benefits:

- Allows user able to prune multicast traffic equipment data (e.g. PLCs, Video) travels only to those end destinations that require this kind of traffic.
- To prevent hosts on a local network from receiving traffic for a multicast group they have not explicitly joined.
- Improve Performance and Real Time responsive
- Saving Bandwidth of the network

QoS (Quality of Service)

Using the 8,4,2,1 weight fair queue scheme to process priority queue from High to lowest queue, while the system processing, 1 frame of the lowest queue, 2 frames of the low queue, 4 frames of the middle queue, and 8 frames of the high queue will be processed at the same time in accordance with the 8,4,2,1 policy rule.

Allow user to prioritize Traffic from control devices, such as I/O, drives or PLCs in high priorities, in order to perform real-time control. Devices that are not time-critical such as operator displays, HMIs and supervisory PCs are assigned low priorities. If communication traffic is high, the switch processes the high priority messages before the low priority messages.

Benefits:

- Capable to ensure Important Data is delivered consistently and predictably.
Network Management

Web based management console User Friendly setup/configuration Network Online Monitoring
- Allow Field Engineers to remote access the Switches monitoring the connectivity status.

Advanced Event Handling

System Event Log
Users can set up the mail server IP, mail account, password, and forwarded email account for receiving the event alert:
- Enable Syslog/SMTP within Switches’ web console, the event log will be sent to system log server/SMTP server.
- Also, per port log (link up, link down, and both) events can be sent to the system log server/SMTP server with the respective checkbox ticked.

■ System event type selection:
  ▪ Device cold start,
  ▪ Device warm start,
  ▪ Authentication Failure
  ▪ Network topology change

■ Port event type selection:
  ▪ Link UP,
  ▪ Link Down, and
  ▪ Link UP & Link Down.
  ▪ Power 1 or 2 Fail

Benefits:
- Able to allow Field Engineers receive events alert through email at anytime
- Able to log-in the switches to check the status remotely
- Able to arrange schedule for immediate or future maintenance/repair
High Reliabilities

Within WWTP facilities, most of the applications and equipment are in outdoor environment. The Ambient Weather will affect the life cycle of any equipment in field sites. Although many points will obtain a NEMA Enclosure to protect any measurement devices or control/communication equipment, a high industrial grade Ethernet Switch with Wide Temperature Operating support is important.

Antaira Industrial Managed Switches families are designed not only contain open IEEE standard technologies, IEC Industrial Grade Test Level, and with High MTBF, Wide Operating Temperature support – 40 to 75 Degree C to support any Harsh Environment within WWTP.

Cost Effective

Antaira Industrial Managed Switches families are designed focus in Industrial Environment Networking purpose, and with User-Friendly Web Console design is easily understood and applied, even by personnel with limited experience in networking and communications. This makes it a very important method of networking for overall WWTP applications with Cost Effect solutions.

“Make Connectivity Simple” is the motto of Antaira Industrial Networking communications families of Industrial Ethernet Switches, Ethernet Media Converters, Wireless, and Serial Connectivity. A proud product

Far from being antiquated, because of its ubiquity, RS-485 has been updated and easily interfaces to common application development environments like .NET. “Works fine, lasts a long time!” could be the motto of the serial data communications family of RS-232, RS-422 and, of course RS-485. A proud solution indeed.