How Facility Data is Shared in Modern SCADA Computer Systems

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Session Objectives

Identify How Facility Data Travels And Is Used Within A Utility For:

- Control
- Monitoring
- Maintenance
- Planning
- Engineering
- Reporting
- Finance

Session Agenda

- Short History of SCADA Systems
- Typical Modern SCADA System Components
- Modern SCADA Data Users
- Why Share SCADA Data?
- Three Methods of Sharing SCADA Data

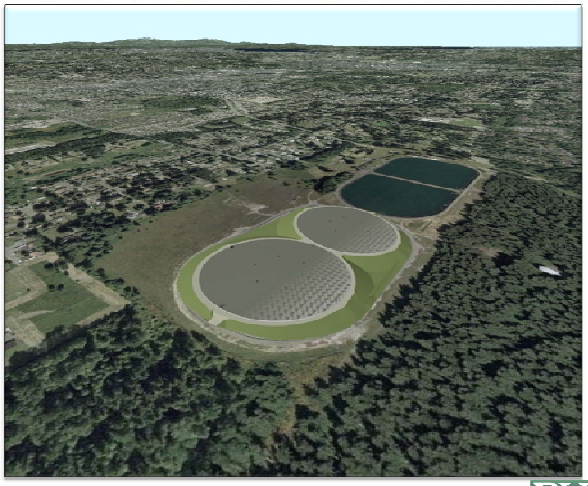
Component Layers of a Typical SCADA System

- **Control and Monitoring Instrumentation**
  - Switches, Sensors, Meters, Solenoids, Relays, Pumps
- **Communication**
  - Instrument Communications, PLC Communications, Computer System Communication
- **Controllers**
  - Sequential Relay Logic, Programmable Controllers
- **SCADA Computer Systems**
  - Viewing, Historical Database, Remote Access, Alarm Notification

Control and Monitoring Instrumentation

McMillin Reservoirs Data

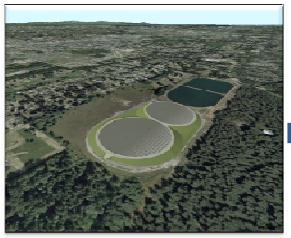
1. Levels
2. Flows
3. High Level
4. Intrusion



Short History of SCADA Data Use

Pre-SCADA/Telemetry control data typically traveled from facility to facility

Storage



Start/Stop Control Calls

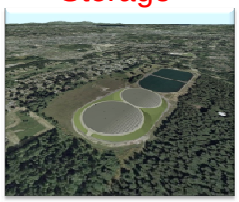
Production

Control data communications typically travels over dedicated connections between facilities. Remote monitoring was not usually implemented.

Short History of SCADA Data Use

Early telemetry systems (~1930's-1970's). Usually monitoring only. Control data still typically travels from facility to facility.

Storage



Start/Stop Control Calls

Production

Centralized Monitoring

Data collection consisted of pen charts and status lights. Pen charts represented the only method of storing historical data.

Centralized control was rarely implemented due to the simplicity of the systems.

Short History of SCADA Data Use

Monolithic SCADA systems (1970's-1990's)

Storage

1st Generation SCADA consisted of centralized **Monolithic Control and Monitoring** of remote facilities.

Production

SCADA Control Room

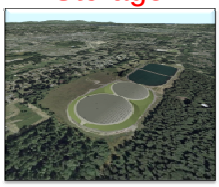
Monitoring and control using centralized dedicated programmable controllers (PLC's) with HMI computers starting to be introduced in the late 1980's.

Dedicated monitoring and control panels with chart recorders still heavily used during this time period. Difficult to obtain and use facility data was typically controlled by Operations.

Short History of SCADA Data Use

Distributed SCADA systems (1990's ~ 2005)

Storage



2nd Generation SCADA consisted of **Distributed Control/Monitoring**. Data typically travels through central facility but facilities had independent PLC controllers.

Production

SCADA Control Room

Dedicated centralized control panels replaced with PC based HMI computer systems. Remote PLC's could provide much more facility data.

Data is collected in software based historical databases. Operations still mostly in control of data. HMI computer systems still evolving.

Short History of SCADA Data Use

Networked SCADA systems (~2005 - Future)

Storage

3rd Generation SCADA consists of **Networked Control/Monitoring**. Data is routed over a TCP/IP networked communications system.

Production

SCADA Control Room(s) with Remote Access

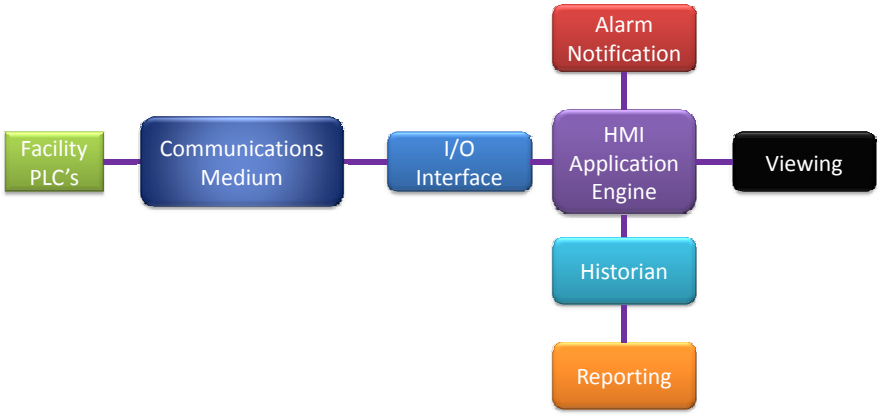
PC based HMI computer systems become more powerful with open standards, distributed viewing options and easier to use historical trending.

HMI computer systems allow interconnectivity to other utility software systems. Accessing historical data becomes easier with new tools.

HMI Computer System Components

- **I/O Interface**
  - Communications to Local and Remote PLC's.
- **HMI Application Engine**
  - Processes incoming/outgoing data.
- **Viewer**
  - Graphical interface for utility staff. Local and remote access.
- **Historian**
  - Data storage and retrieval system.
- **Alarms Notification**
  - Event and Alarm notification via phone, text message, email.
- **Reporting**
  - Historical data reporting system.

HMI Computer System Components



SCADA System Data Users

Operations
- Control and Monitoring Purposes

Maintenance
- Data used for Identifying Maintenance Issues

Engineering
- Data used for Design and System Modeling

Planning
- Data used for Infrastructure Planning.

Management/Finance
- Data used for Utility Management and Financial Purposes

Government Agencies (State, Federal)
- Production, Treatment, Wastewater Spills

SCADA System Data Users

Primary SCADA Data Users

Users that require real-time 24/7 access to SCADA system data to operate and maintain infrastructure.

Secondary SCADA Data Users

Users that require historical data for analysis purposes.

SCADA System Data Users

Operations
- Historically the Primary Users of HMI Data.

Maintenance
- Historically the Primary or Secondary Users of HMI Data.

Engineering
- Typically Secondary Users of HMI Data.

Planning
- Typically Secondary Users of HMI Data.

Management/Finance
- Typically Secondary Users of HMI Data.

Government Agencies (State, Federal)
- Typically Secondary Users of HMI Data.

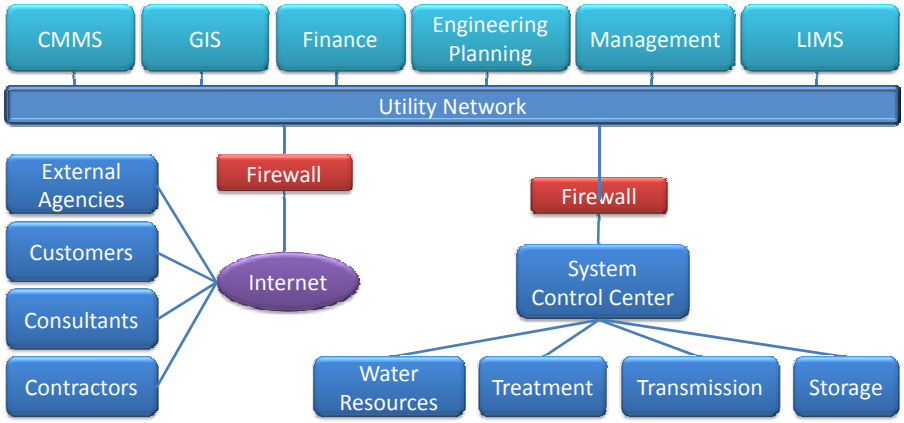
SCADA System Data Users

Historical Issues with Secondary Access to Data

1. Tight SCADA security access easy access to data.
2. Proprietary historical databases make exporting data difficult.
3. Lack of good reporting software tools.
4. SCADA system lacking data points required by some secondary users.
5. Secondary users unaware of SCADA system capabilities.

Why Share SCADA Data?

Because Utility Computer Systems are Becoming "Integrated"



Why Share SCADA Data?

- Sharing SCADA data with secondary users can help improve entire utility business model.
- Secondary users realize the significance of improving and maintaining SCADA system.
- It is becoming more straightforward to implement.

How to Share SCADA Data – Step 1

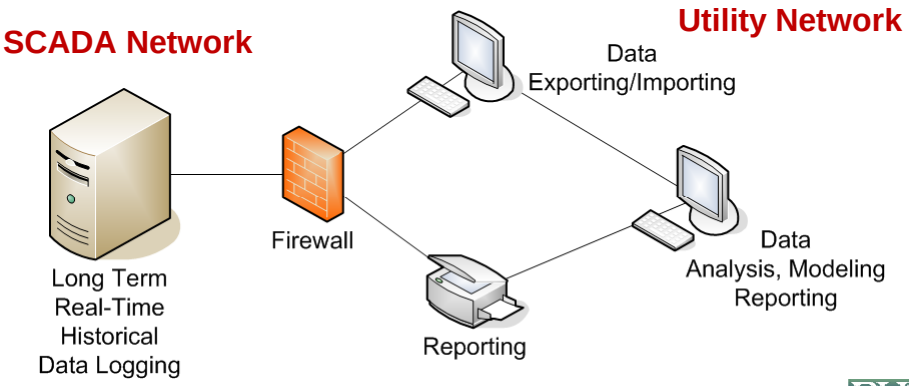
Upgrade Historian and Reporting Tools

Examples:

- **Wonderware** Historian, HMI Reports, ActiveFactory Tools
- **Allen Bradley** FactoryTalk Historian, Metrics, VantagePoint
- **Siemens** Simatic IT Historian

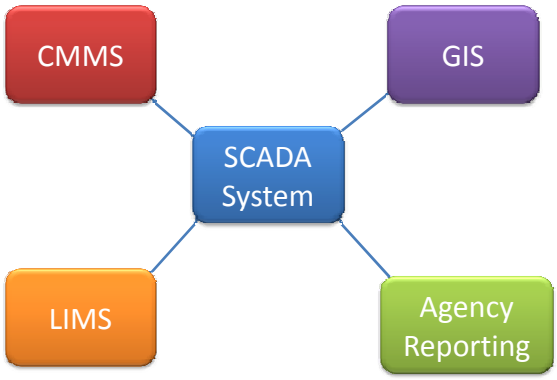
How to Share SCADA Data

Manual Data Sharing



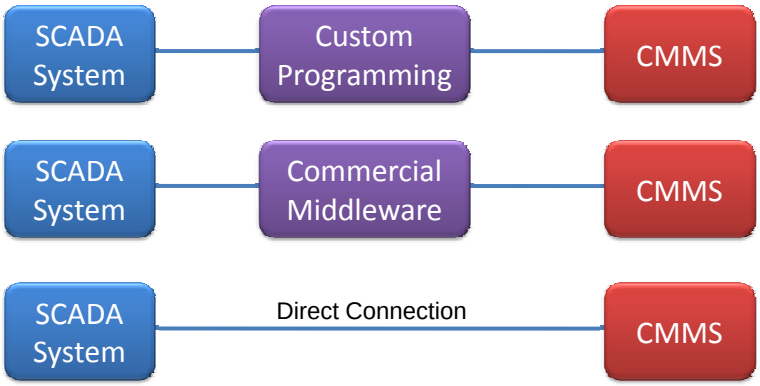
How to Share SCADA Data – Step 2

Integration of Utility Computer Software System



Utility Software Integration

How To Integrate Utility Software - Examples



Utility Software Integration

What Software Should Be Integrated?

Depends on:

1. Existing SCADA and Utility Software
2. Hardware/Software Upgrade Capabilities
3. Internal Resources (Technical Staff)
4. External Resources (Consultants)
5. Return on Investment – Will this help the Utility?

Utility Software Integration

What Data is Transmitted Between Software?

SCADA System ← **SCADA to CMMS Example** → CMMS

To CMMS:
Alarms/Events
Pump Runtimes
Pump Start Counts

To SCADA:
Maintenance work orders based on equipment data received from SCADA.

Utility Software Integration

What Data is Transmitted Between Software?

SCADA System ← **SCADA to GIS Example** → GIS

To GIS:
Any System Facility Data

To SCADA:
GIS Map & Data May be Accessible in SCADA Viewer.

Utility Software Integration

What Data is Transmitted Between Software?

SCADA System ← **SCADA to LIMS Example** → LIMS

To LIMS:
Real Time Water Quality Data

To SCADA:
Sampled Water Quality Data

Utility Software Integration

What Data is Transmitted Between Software?

SCADA System → **SCADA to LIMS Example** → Agency Reporting

To Reporting:
Data points necessary for reporting purposes:
1. Influent/Effluent Totals
2. Production Totals

To SCADA:
None

How to Share SCADA Data – Step 3

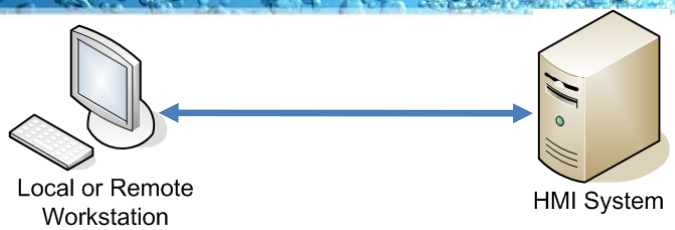
Remote SCADA Data Interfaces

1. Virtual Clients – VNC, Terminal Servers
2. Web Site Remote Data
3. Audio Access
4. Email/SMS Text Messaging

Remote SCADA Data Access Devices

1. Remote Field Laptops
2. Cell/Smart Phone
3. Facility Operator Interface

Remote Access – Virtual Clients

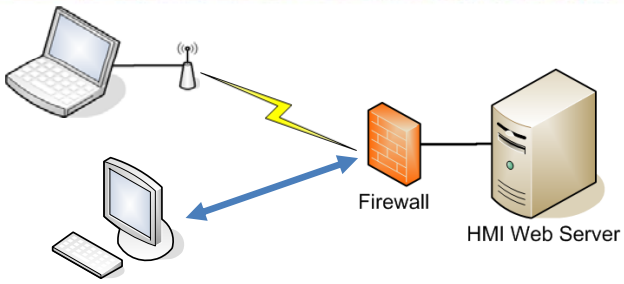


Virtual Access of HMI Screens

VNC Type Software
- Remote control of HMI Computer keyboard and mouse.
- Uses client software or web browser.

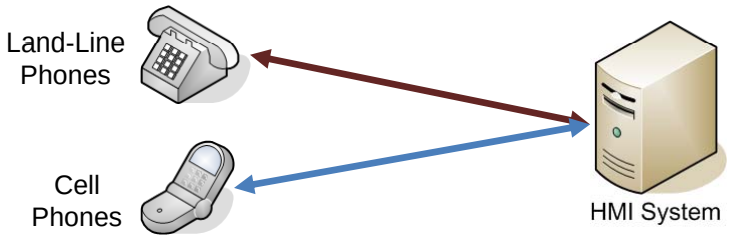
Terminal Servers
- Multiple Remote Simultaneous Connections.
- Uses standard Microsoft Remote Access software.

Remote Access – Web Servers



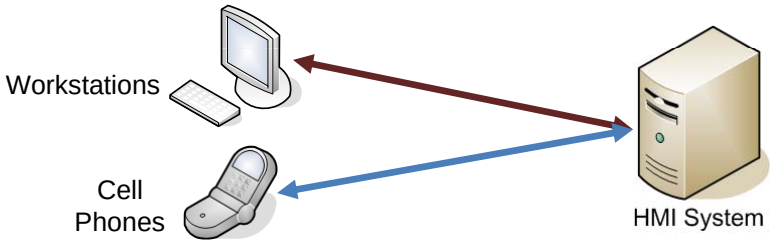
- Web Server transmits real-time SCADA data to secondary users over web browsers.
- Usually does not include control access.
- Number of connections limited by licensing.

Remote Access – Audio Access



- Audio Alarm Notification
- Event/Data Access
- Remote Control

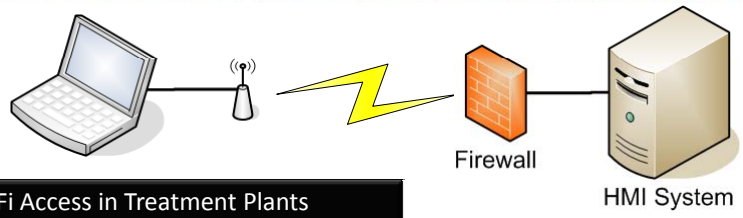
Remote Access – Email/Text Message



Email
- Alarm/Event Notification
- Alarm and Event Reports
- System Totalizer Reports

Text Message
- Alarm/Event Notification

Remote Access – Remote Field Laptops



1. Wi-Fi Access in Treatment Plants
2. Cellular Access in Vehicles or Home
3. Internet Access using Direct Connection

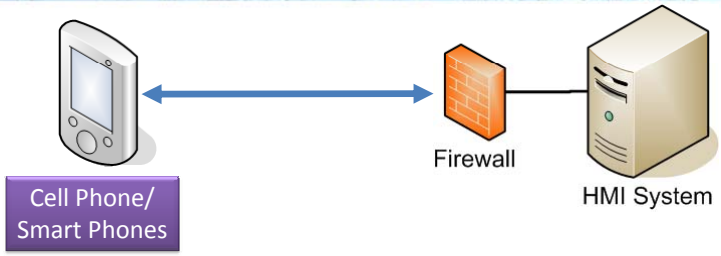
Connections over local Wi-Fi use heavy encryption of data.

Connections over Public Internet use Virtual Private Networks – (VPN)

Remote Terminals of Full SCADA Client – Control

Web Access of Specific System Data – No Control

Remote Access – Cell/Smart Phones



Cell Phone:
- Audio Alarm/Events Data
- Audio Analog Data
- Control via Touchtone

Smart Phone:
- Same Features of Cell Phone
- Email/SMS Text Messaging
- Web Access
- Remote Terminal Access

Remote Access – Operator Interfaces

Operator Interface:
- Typically used to display only local status/data or limited remote data from one PLC.

New Features:
- Remote access to HMI screens.
- Able to display data from multiple facility PLC's.

Q&A

Questions?