Basic Automation System

**Inputs**
- From field machine
- Sensors
- Push Button
- Selector Switch

**Outputs**
- Equipment in field/machine
- Motors/Drives
- Solenoid
- Indicating Lights
- Alarm annunciation System

**PLC (Central Processor)**

**MMI (Operator Interface)**
- To know status of M/C and to send command

**SCADA**
Programming Software
Becoming smarter is a long-term process & a step-by-step approach

Technology Evolution

- 2 Line HMI
- 4 Line Mono Chrome Display
- Touch Screen/Graphical Display
- SCADA
- MES, IOT, Analytics Softwares
A control system architecture comprising:

Computers, Networked data communications and Graphical user interfaces

Comprising other peripheral devices like PLC and PID controllers

Provides Management information, including the scheduled maintenance procedures, detailed schematics, logistic information, trending and diagnostic data for a specific sensor or Machine
SCADA provides an open system that supports multiple protocols for efficiently controlling & monitoring field devices. With SCADA we can:

- Capture data from Remote device
- Communicate data from RTUs to central location
- Present Data on HMI to visualize Process
- Monitor & Control Plant from a SCADA host
Advantage of SCADA

- Previously without SCADA an industrial process was entirely controlled by PLC, CNC, PID & micro controllers having programmed in certain languages or codes.

- These codes were either written in assembly language or relay logic without any true animation that would explain the process running.

- To make the understanding process easy with the help of true animations SCADA came into existence

- Obtain information leading to better process traceability -
  Frequency inverter configuration, Motor Speed, Pressure Settings, Fan Status, Cycles

- Storage of performance data in order to correct quality problems -
  Having a historical record of readings will allow for the timely correction of faults that adversely affect production quality – Fluctuation in instruments, Production issues, Shut downs, Operator efficiency

- Creating a smart maintenance regime and decreasing downtime

- Making operatives’ jobs easier by having graphical statistics presented in real time
Level 0 - Field devices such as flow and temperature sensors, and final control elements, such as control valves.

Level 1 contains the industrialized input/output (I/O) modules, PLCs, RTUs.

Level 2 contains the supervisory computers, which collate information from processor nodes on the system, and provide the operator control screens.

Level 3 is the production control level, which does not directly control the process, but is concerned with monitoring production and targets.

Level 4 is the production scheduling level.
SCADA System Architecture

Master Station Area –
Scada Server, Network & Operating System Software, Engineering Software
Application development platform
Performs calculations, logs and archives historical data
provides I/O server functionality and switching

Field Area
- Field Devices
- Communication Infrastructure
- RTUs
- Programmable Logic Controllers (PLC)
- Human Machine Interface (HMI)
Master Station

SCADA Servers

Systems include at least one, if not two, **data server computers**. The server computer is at the physical Centre of the Star topology.

Server computer performs **all of the communications with the PLCs and RTUs on the SCADA network**.

Each RTU/PLC maintains and collects data pertaining to its process areas. This data is then retrieved by the server computer to update the current process and the historical databases.

In small systems, a single workstation can perform the work of both the server and the operations user workstation.
Field Devices in a SCADA system include wireless sensors, multi-variables transmitters, and flow computers. These devices transmit data to the RTUs, regarding parameters that are monitored, such as flow, level or temperature. The RTUs in turn transmit the data to the SCAD server for monitoring and controlling purpose.
The communication infrastructure enables communication between the various components in a scada system. Such infrastructure includes cables and wireless networks, Data radios, Modems and satellites to connect all fundamental components via a Local Area Network (LAN) or Remote Connectivity, using Ethernet or other high-speed communication system.

There are three basic topologies used for SCADA system:
1. Bus topology
2. Star topology
3. Token ring topology
Communication Infrastructure

Bus Topology

All traffic or communications in the system is accomplished via this **single bus-type network**.

For increased traffic, the network can become overloaded, and the result is a slowing down of the transfer of data from one node to another.
Star Topology

This master node would typically consist of one or two master SCADA workstation functioning as masters of the system. All data collection from the various RTU/PLC nodes is done through individual connections in a star configuration.

The transfer of data between nodes on the Star network does require that the information be passed first from the source node, then through the host node, and then out to the destination node.

Update times to the host node are very fast but does require multiple paths out from the host master node.
Token Ring Topology

Works like a **ring in which all nodes are interconnected by two network connections**. All nodes in the topology are of equal value, and data is passed via this ring from one node to the next.

This topology is predictive in that the speed is constant and the time to transfer data is always at a fixed rate. As the number of nodes in the network increases, the overall data transfer rate drops since there are more nodes through which data must pass to travel from the source node to the destination node.
Remote Terminal Units - RTU

To Connect to field devices like sensors, flow meter

Microprocessor based controlled device, extreme temp environment, rugged, remote location

Converts field level signal into data and transfer data to Supervisory system
Added advantages is in environment tolerances, backup power options, and autonomy.

Basic, Visual Basic, C++, Ladder logic, Structure Text

IEC and DNP3 protocol compatible
Programmable Logic Controller-PLC

A solid state device that controls output devices based on input status and a user developed program.

To Connect to field devices like sensors, flow meter

Microprocessor based controlled device, receives information from input devices, processes the data, and triggers outputs based on pre-programmed parameters.

Brick type and modular PLC

Unlike an RTU, a PLC is configurable, economical and flexible

Human Body Is the biggest Example of PLC
Also known as Operator Station/Work Station /Control Client

Present the **process graphic displays with operator interaction**

Process Values ,Monitor & Analyze ,Control Process ,Optimize performance

A "**historian"**, is a software service within the HMI which accumulates time-stamped data, events, and alarms in a database which can be queried or used to populate graphic trends in the HMI. The historian is a client that requests data from a data acquisition server.
What is server?
The server performs the core SCADA functions of IO data gathering, alarming, historizing and reporting. The server license also includes one client which is able to run on the server machine.

What is Development & Run Time?
**Development Runtime** – For application configuration. Allows access to administration activities (e.g. security management). Can simultaneously function as a client as well as a primary or backup server. Also supports all Runtime capabilities above.

**Runtime** – An operator interface where users can view process data, make operational changes, and perform administrative activities (e.g. security management). Can simultaneously function as a client as well as a primary or backup server. Does not allow application configuration.

What is Control Client and view-only client?
A control client has the complete functionality of the application to view any screen and access any variable controlled through the SCADA system. This makes the control client an extremely valuable tool for operators. The view-only client has the ability to view information within the SCADA system, but cannot write to any variable or execute code to communicate with another server. This makes the view-only client a great tool for senior management and process optimization, or casual users of the control system.

What is web client?
Web clients allow users outside the control room to access control system data in real time. The web client is a completely functional client with an identical interface to the dedicated control clients (displayed within a web page), which requires zero maintenance. The client controls and project are downloaded from the website, with project updates automatically synchronized with web clients.
Hard key and soft key License?

There are two types of license keys for the SCADA software, hard key and softkey. The type of key you’re given will depend on how you intend to use your SCADA software, and whether you want to develop applications, or merely run them in industrial machines.

Hard key vs softkey

Hard key Pros: Hard key advantages are the portability, as well as the access to easy licensing for integrators and support technicians who may need to move from location to location to offer support on the go. Another benefit of the hardkey is that if your machine goes down, and you have a redundant machine, you can easily remove the hardkey and put it into the other machine.

Hardkey Cons: Hardkeys can be damaged or lost (though they are under warranty for two years). In addition, a hardkey can be kicked out or removed from a machine while using the software, which may cause issues for users. A hardkey in a production may mistakenly be seen as a USB memory stick and “accidently” taken home.

Softkey Pros: A softkey cannot become broken or damaged, because it is not a physical item. The softkey can also be delivered more quickly to the user. Softkeys can be deployed remotely to embedded targets using the built-in Remote Management tool.

Softkey Cons: A softkey is embedded into the Windows registry, and is therefore not portable.

Version Upgrade
Tag Upgradation
Customer First
SCADA - Applications

- Manufacturing & Processing
- Water & Waste Water
- Power Generation
- Building
- Control & Command Center
- Transportation
SCADA – Load Management, AMF, DG Sync

Pump House

Lighting

DG Room

AHU/Chillers

Switch

PLC

Energy Meter
SCADA – Water Distribution

Master Control Room

Site Control Room

GSM/GPRS

Radio interface

RTU

Control valve

Process transmitters
Clients at each site are only interested in the local cluster, whereas Global Clients at the central control room are able to view every cluster.
TYPICAL SYSTEM ARCHITECTURE ELEVATED STATION

( KARUNAMOYEE, CITY CENTER, SALT LAKE SECTOR-V, CENTRAL PARK, BENGAL CHEMICAL & SALT LAKE STADIUM )

LEGEND:
- SMS SERVER
- WORKSTATION
- PROGRAMMING LOGIC CONTROLLER (PLC)
- ET SW
- ETHERNET SWITCH
- IBP
- INTEGRATED BACKUP PANEL
- CAT 4 CABLE
- HARDWARE SIGNALS
- PARK OPTIC CABLE

STATION CONTROL ROOM

TO OCC & BCC
COMMUNICATION NETWORK
BACKBONE FROM OTHERS

CFC NETWORK

ASS \ TSS ROOM
PLC PANEL-1

PUMP ROOM (GROUND FLOOR)
PLC PANEL-2

Equipment Detail As Per TB

Confidential Property of Schneider Electric | Page 26
SCADA – Metro Elevated Station

- **Main Distribution Board (MDB)**
- **Emergency Power Panel (EPP)**
- **A/C Power Panel**
- **Main Lighting Panel (MLP)**
- **Escalator Panel**
- **Emergency Lighting Panel (EMLP)**
- **UPS Output Panel**
- **APFC Panels**
- **E&M UPS Systems**
- **Lifts**
- **Escalators**
- **Main Fire Alarm Panel**

**Additional Elements**

- **Combined DB**
- **Panel Gas Flooding Systems**
- **BMS WORKSTATION**
- **PRINTER**

**Communication Networks**

- **ETHERNET NETWORK**
- **MODBUS IP**
- **PLC PANEL - 1**
  - **ENERGY METERS @ VARIOUS LOCATIONS**
  - **VRF Outdoor Units**
  - **Waste Water Sump**
  - **Overhead Waste Water Tank**
  - **Overhead Domestic Water Tank**
  - **Overhead Fire Water Tanks**
  - **Temp. & Humidity Sensors for SCR, TER, SER, UPS & T**
  - **Temp. Sensors for TOM, OCC, UPS-ELE**
  - **Wind Velocity Meter**
  - **Combined DB**
  - **Main Distribution Board (MDB)**
  - **Panel Gas Flooding Systems**

- **PLC PANEL - 2**
  - **ENERGY METERS @ VARIOUS LOCATIONS**
  - **RS 485 MODBUS HARDWIRED SIGNALS**
  - **Central Lighting Control Panel**
  - **Overhead Waste Water Tank**
  - **Overhead Domestic Water Tank**
  - **Overhead Fire Water Tanks**
  - **Temp. & Humidity Sensors for SCR, TER, SER, UPS & T**
  - **Temp. Sensors for TOM, OCC, UPS-ELE**
  - **Wind Velocity Meter**
  - **Combined DB**
  - **Main Distribution Board (MDB)**
  - **Panel Gas Flooding Systems**

**Other Elements**

- **DOMESTIC WATER PUMP PANEL**
- **AMF PANEL**
- **DG SET**
- **ENERGY METERS @ VARIOUS LOCATIONS**
- **VRF OUTDOOR UNITS**
- **WASTE WATER SUMP**

**Networks**

- **ETHERNET NETWORK**
- **PLC PANEL - 1**
- **PLC PANEL - 2**
- **MODBUS IP**

**Rooms**

- **ASS ROOM**
- **MEZZANINE LEVEL**
- **PUMP ROOM**
- **SCADA – Metro Elevated Station**

**Systems**

- **RS 485 MODBUS**
- **HARDWIRED SIGNALS**
- **ETHERNET NETWORK**
- **TRANS MITTERS**
- **WATER METER**
- **PLC PANEL - 1**
- **PLC PANEL - 2**
What is a Railway tunnel?

A railway tunnel is an excavation or a construction surrounding the track that allows the railway to passthrough obstacles, such as mountainous areas, buildings or water. The length of a tunnel is defined as the length of the fully enclosed section, measured at railway level. There are three types of tunnel construction: Cut-and-cover tunnels are constructed in a shallow trench and then covered over. Bored tunnels are bored in situ. Immersed tunnels are tube elements assembled and sunk into water.
SCADA – Sub Station Automation
SCADA – MMM Cement

Energy Management

Quarrying & Crushing
Mills
Klin & Clinker Burning
Cooler/Clinker Conveyor
Packing

Various Automation Supplier
SCADA Launch Pad ISRO

ISRO Satellite Launch Pad 1
138000 Tags, 108 Operator Stn

ISRO Satellite Launch Pad 2
138000 Tags, 108 Operator Station
SCADA-AND ON System

Large Display

Work Station

Local HMI
Metal Forming Welding Shop

Local HMI
Paint Shop

Local HMI
Assembly Shop
Tags Calculation

Each tag is a “variable” capable of holding an independent value, such as “Pressure Tank A”, “TemperatureOver1”, “State Motor C”, and so forth. The following rules apply for tag count:

– The tags created by the user. Application or Project tags in the SCADA software are counted against the license limit. However, the System Tags, created automatically for any project, are not counted against the license tag limit (e.g.: Time, Date, User Name, and so forth).

– The tag count does not depend on the data type supported by each tag (Boolean, Integer, Real, or String).

– The same tag can be configured in many interfaces, and it still counts as only one tag. For example, the same tag can be configured on Screens, Trend worksheets, Alarm worksheets, Driver worksheets, OPC worksheets, and this will not affect your tag count.

– Any tags created for the project are counted against the license limit, even if they are not linked to an external device (e.g.: PLC) via communication drivers, OPC, or any other task.

– Each array position counts as one tag because it holds an independent value. For example, a tag configured with 3 array elements counts as three tags (Tag[0], Tag[1], and Tag[2]).
Monitor & Control the Plant process

Customer has shared the following requirement.

- 1 Scada Development Server and 1 client PC to be included in the offer.
- Redundant SCADA Server capabilities
- Dashboard should be seen in our office LAN also which is separate from our Automation LAN.
- Trend history minimum 1 years storage.

Hardware available at customer location

PLC- Schneider Electric (Quantum PLC)
Communication Protocol- (OPC or Modbus)
No. of PLC- 1 Nos.
No. of RIO - 2 Nos.
Total Calculated tags- 3000 approximately
## SCADA – Case Study

### SCADA Architecture

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCADA Full Server 5000 Tags or above 3000Tags</td>
<td>2</td>
</tr>
<tr>
<td>SCADA Control Client 5000 Tags or above 3000Tags</td>
<td>1</td>
</tr>
<tr>
<td>Web Client for view only</td>
<td>1</td>
</tr>
<tr>
<td>1 Historian Client</td>
<td>1</td>
</tr>
</tbody>
</table>
THE POWER OF TWO
coming together as ONE

AVEVA GROUP
The leading global provider of Engineering, Design and Information Management software

Offerings in:
▲ Integrated engineering and design
▲ Asset Life Cycle Information Management
▲ Enterprise Resource Management
▲ Construction Management
▲ Marine, Fabrication and BIM solutions
▲ Procurement Management

SCHNEIDER ELECTRIC’S INDUSTRIAL SOFTWARE BUSINESS
The leading global provider of industrial software and services for operational efficiency and asset reliability

Offerings in:
▲ Engineering
▲ Planning & Scheduling
▲ Operations and Optimisation
▲ Asset Performance Management
▲ Monitoring and Control
Schneider Electric & Aveva Alliance

Partnerships and ecosystems are the foundation upon which we have built our business

**Asset Life Cycle**

- Improved Return On Capital
  - Asset Performance
  - Monitor and Control
  - Engineer Procure Construct
  - Operate and Optimize
  - Plan and Schedule

AVEVA
360° Digital Twin

**Operations Life Cycle**

- Improve Profitability

SALES Enablement of existing sales

DELIVERY Delivers turn key solutions and ongoing support to end users

TECHNOLOGY Co-development of hardware and/or software with AVEVA technology

CONSULTANCY Advise customers on industrial solutions that include AVEVA offering

Operations Life Cycle

Improved Profitability

AVEVA 360° Digital Twin

SALES Enablement of existing sales

DELIVERY Delivers turn key solutions and ongoing support to end users

TECHNOLOGY Co-development of hardware and/or software with AVEVA technology

CONSULTANCY Advise customers on industrial solutions that include AVEVA offering
EcoStruxure Plant IIOT with AVEVA SW in the Apps Layer

EcoStruxure Plant: Our IIoT architecture that maximizes the value of data

EcoStruxure Plant is our IoT-enabled open and interoperable system architecture that optimizes the entire performance of an industrial enterprise. Across three levels (connected products, edge control, and apps, analytics, & services) and with access to the cloud and end-to-end cybersecurity, it is a complete solution that covers the breadth and depth of industrial markets.

**TAKE ACTION**
Drive action through real-time information and business logic

**ANALYZE**
Convert data into meaningful insights through analytics

**COLLECT**
Capture critical data at every level, from sensor to cloud

**CONNECT**
everything from shop floor to top floor
An Alliance based on technological superiority
AVEVA plays an integral part in Schneider Electric EcoStruxure
The AVEVA Edge-to-Enterprise Strategy

Make Timely, Actionable Decisions

Scope & Complexity

Equipment | Asset | Line | Plant | Multisite

+ I/O Points
+ Users
+ Integrated Systems
+ Interconnections
+ Technologies
+ Cyber Threat Landscape
SE HMI SCADA Portfolio Positioning

- **System Platform & OASyS DNA**
- **Citect & ClearSCADA**
- **InTouch HMI**
- **InTouch ME & InduSoft WS**

- **Automation Maturity**
  - MANUAL Level 0
  - REACTIVE Level 1
  - PREPARED Level 2
  - CONSISTENT Level 3
  - REINFORCED Level 4
  - ADAPTIVE Level 5

- **No Automation**
- **Single Node**
- **Multi-node**
- **Client / Server**
- **Client / Server with Redundancy**
- **Distributed system**
- **Tiered Enterprise OMI**
The AVEVA Edge-to-Enterprise Strategy

Make Timely, Actionable Decisions

Monitor and Control Edge-to-Enterprise Solutions
The AVEVA Edge-to-Enterprise Strategy

Make Timely, Actionable Decisions

<table>
<thead>
<tr>
<th>Product</th>
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</tr>
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<tbody>
<tr>
<td>InTouch Edge HMI</td>
<td>Edge management, and a full HMI/SCADA software. InTouch Edge HMI runs on small-footprint devices like a Raspberry Pi, all the way up to server level operating systems, and has web thin client options to monitor or control your HMI from the web, tablets, and smartphones.</td>
</tr>
<tr>
<td>InTouch HMI</td>
<td>The classic InTouch offers powerful HMI. Used in 1/3 of industrial facilities worldwide, InTouch HMI offers advanced graphics and remote web viewing capabilities.</td>
</tr>
<tr>
<td>Citect SCADA</td>
<td>Citect SCADA offers a serious SCADA software solution for data-heavy processes that require thousands or hundreds of thousands of tags. A dedicated out-of-the-box Situational Awareness Workspace that provides flexible, consistent, rich context for operators, as well as a new way to build context-aware SCADA visualization.</td>
</tr>
</tbody>
</table>
## The AVEVA Edge-to-Enterprise Strategy

### Make Timely, Actionable Decisions

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<tr>
<td><strong>System Platform</strong></td>
<td>System Platform is a responsive, scalable solution for supervisory, SCADA, HMI, and IIoT applications that integrates the process with the enterprise. System Platform provides a collaborative, standards-based foundation that unifies people, processes, and assets across all facilities for continuous operational improvement and real-time decision support.</td>
</tr>
<tr>
<td><strong>Historian</strong></td>
<td>Enhance decision-making and accelerate collaboration across the enterprise. AVEVA Historian captures and store high-fidelity industrial data, bridging the IT-OT gap to improve operational performance.</td>
</tr>
<tr>
<td><strong>AVEVA Insight</strong></td>
<td>Empower end-users and solution builders with a secure, managed cloud solution for collecting, storing, and visualizing process and performance data.</td>
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</table>