Smart Connected Pipelines

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Pipeline Operations: Reality of Today

- Lack of expertise in modern designs and cyber security by EPCs
- Increasing Cyber Security Threats
- Legacy Infrastructures / Asset Management
- Product Theft / Third Party Interference
- Minimize downtime in control center software upgrades
Agenda

- Converged architectures for today and tomorrow
- Smart Connected Pipelines
  - Introduction
  - Validated Architectures
  - Benefits
  - Summary / Resources
Converged Architectures

Addressing the pipeline requirements of today and tomorrow
Schneider Electric - Cisco: Industry Partnership

Pipeline SCADA, Process & Energy Automation
Pipeline Simulation, LDS & Operational Applications
Domain Expertise

IP Networking, Wireless and Optical Communications
Industrial Cyber Security, ISA SP99
High Availability Designs
Virtualization and Convergence Architectures

Smart Upstream
Smart Pipelines
Smart Distribution
Cisco Schneider Electric - Pipeline Functional Reference Model

Forward-looking functional architecture for end-to-end pipeline infrastructure.

- A flexible, modular approach that supports a phased Oil and Gas Pipeline operational excellence
- End to End Integrated Solution for Process, Safety, Power & Security
- Control Room Virtualization
- Converged Wide Area Operational Telecoms
- Pipeline Station Wired and Wireless Networks
- Integrated Multi-Service use cases
- IEC 62443 / ISA99 Security model

Converged OT & IT Operational Field Telecoms

Internet

3rd Party Support

Centralized Operations ORC / Business Domain Internet Edge

SCADA & Operational Business Systems Physical Security Voice IDMZ

Backup Control Center

MADA Control Center

WAN Networks

Converged Wide Area Networks

IDMZ

SIEM

AAA

TIming

Server

SIEM

AAA

WAN

Networks

IDMZ
Smart Connected Pipelines
Solution Overview

Pipeline StruxureLab Main functional blocks (Application View)

Pipeline Management Systems

Pipeline management systems consist of multiple services and systems applications to facilitate safe and efficient operations. This combines operational SCADA with real-time applications specific to the oil and gas industry, leak detection and historical flow measurement.
Applications can be categorized as Operational (those directly involved with supporting pipeline operations such as the SCADA or leak detection systems), and Multiservice (those which either support pipeline operations such as video surveillance, or those more concerned with business applications such as voice and corporate data).

Note: To explore Invensys offers for Pipeline Designer Tool and to support Scheduling/Planning Advisor.
## Enterprise Pipeline Management System Requirements

<table>
<thead>
<tr>
<th>Component</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervision &amp; control</td>
<td>Real-time control and supervision of operations along the pipeline through a SCADA system based in one or more control centers</td>
</tr>
<tr>
<td>Measurement</td>
<td>Accurate measurement of flow, volume and levels to ensure correct product accounting</td>
</tr>
<tr>
<td>Leak detection</td>
<td>Detect and locate pipeline leakage including time, volumes and location distances</td>
</tr>
<tr>
<td>Physical safety &amp; security</td>
<td>Integrated security systems for personnel, the environment, and infrastructure using video surveillance, access control, and intrusion detection systems</td>
</tr>
<tr>
<td>Process safety systems</td>
<td>Ensure safe operations through instrumentation and safety systems</td>
</tr>
<tr>
<td>Energy management</td>
<td>visualize, manage and optimize energy consumption</td>
</tr>
<tr>
<td>Block valve station</td>
<td>Isolate a segment of the line for leaks or maintenance</td>
</tr>
</tbody>
</table>

### System Components

- **Energy Management**
- **Asset Management**
- **Supply Chain Mngt (scheduling, nominations, & revenue accounting)**
- **Data Management**
  - Simulation (Leak Detection)
  - Historian
  - Measurement
- **Operations**
  - Supervisory Control
  - Real Time Applications (Gas ; Liquids)
- **Control**
  - Network / Communications
    - Local Control,Safety System ; RTU, Security
    - Instrum & Meters
    - IED’s / Power
  - Equipment (MV, LV, MCC, MV Drives, Valves) & Process
## Operational Telecoms & Communications Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High availability &amp; reliability</strong></td>
<td>• Backup WAN services to ensure operational services continuation</td>
</tr>
<tr>
<td></td>
<td>• Provide several primary and failover infrastructure connectivity options (Ethernet, MPLS, DWDM, OTN, Cellular, Wireless etc) depending on project requirements</td>
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<tr>
<td><strong>Transport multiple traffic types across common infrastructure</strong></td>
<td>• Differentiated quality of service (QoS) between traffic types, ensuring performance requirements of all operational traffic, and multiservice traffic</td>
</tr>
<tr>
<td></td>
<td>• Segregation capabilities (physical or logical) between services, ensuring one traffic type does not impact another where designed</td>
</tr>
<tr>
<td><strong>Open standards</strong></td>
<td>• Multi-level security to protect against cyber attacks and non-intentional security threats</td>
</tr>
<tr>
<td></td>
<td>• Centralized configurable policy-based services</td>
</tr>
<tr>
<td><strong>Multiservice applications</strong></td>
<td>Optional services to support pipeline operations including VoIP, local WiFi access, mobility, collaboration tools, and internet access</td>
</tr>
<tr>
<td><strong>Management</strong></td>
<td>End to end communications network management, security management, and administration management - from the instrumentation/sensor to the control centre application</td>
</tr>
<tr>
<td><strong>Ruggedization</strong></td>
<td>Locations may require ruggedized equipment due to harsh conditions, local legislation or industry certifications</td>
</tr>
</tbody>
</table>

### Network Requirements:
- High availability and reliability mechanisms to ensure operations
- QoS for differentiated services and bandwidth reservation,
- Monitorable SLAs must be delivered to ensure the right applications operate in the right way at the right time.
- Higher bandwidth requirements from newer applications and multiservice applications
- Sub 50ms network re-convergence redundancy and reliability mechanisms
- Traffic engineering for path selection and path redundancy,
- Device redundancy.

<table>
<thead>
<tr>
<th>Ethernet/IP Based Protocols</th>
<th>Serial Based Protocols</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modbus/TCP</td>
<td>Modbus</td>
</tr>
<tr>
<td>IEC 61850 GOOSE (Station), SV (Station), MMS</td>
<td>IEC 60870-101</td>
</tr>
<tr>
<td>IEC 60870-104</td>
<td>DNP3/IP</td>
</tr>
<tr>
<td>DNP3/IP</td>
<td>DNP3</td>
</tr>
<tr>
<td>EtherNet/IP (Industrial Protocol)</td>
<td>OPC</td>
</tr>
<tr>
<td>TCP/IP</td>
<td>FTP</td>
</tr>
<tr>
<td>Proprietary protocols</td>
<td>Proprietary protocols</td>
</tr>
</tbody>
</table>
• Architectural approach required (for example: Purdue Model of Control Hierarchy and ISA95/ISA99 security levels.
• Security services should include common security policies, management and context, transport security, network policy enforcement, research intelligence and threat defense, and physical security leading to the key network architecture principles to deliver:
  - **Access Control**: Authentication and authorization of all personnel and devices
  - **Data Confidentiality and Privacy**: Data privacy and data integrity for all operational and control data must be ensured
  - **Threat Detection and Mitigation**: Protection of all critical assets
  - **Integrity of Platforms and Devices**: Secure devices over the entire life-cycle
Pipeline Safety System Architecture

- Ethernet Modbus / TCP
- HMI
- Safe Ethernet
- XPMF Distributed Safety (CAT4 equivalent to SIL3)
- Unity XLS
- Hot Standby SIL3
- Machine Safety
- Process Safety
Smart Connected Pipelines - Validated Architectures
Cisco - Schneider Electric
Lab Documentation Project
Joint Validated Architecture
Schneider Electric Validated SCADA System Architecture

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Full in-site and inter-site redundant Pipeline Management System Architecture

- Production, Test, Development and Training Domains
- Real-time SCADA
- Long Term Historian
- Full suite of pipeline applications
- Casual user access
- Secure Domain base security
Converged Pipeline Control Centre Architecture

Space, power, and performance optimized control center infrastructure for Pipeline Management Systems and Multiservice applications

- Main & Back-up site ensure reliability & update
- Unified Compute System
- Nexus Data Centre switching fabric
- Fibre channel storage
- Operational WAN aggregation
- Enterprise WAN access
- Secure remote access
- IEC 62443 / ISA99 Security model
Cisco Pipeline Station Architecture Overview

**Station wired architecture – greenfield considerations**

- DWDM, L2 ethernet, Wireless failover
- Station edge operational field telecoms
- Level 2.5 protection zone
- Process, safety & energy domains
- Multiservice domain
- Industrial and wireless mobility
- Legacy serial transport
- Distributed acoustic optical sensing (DAS)
- IEC 62443 / ISA99 Security model
Cisco Pipeline Block Valve Station Architecture

Block Valve station wired architecture – greenfield considerations

- L2 Ethernet, Wireless failover
- Station edge access
- Process, safety & energy domains
- Multiservice domain
- Industrial and wireless mobility
- IEC 62443 / ISA99 Security model
Smart Connected Pipeline
Tangible benefits
Customer pain points
• Safe, Reliable and Efficient Operations
• Secure Communications
• Mitigate Risks (leaks, accidents, hazards)

Customer benefits
• Enhanced performance and safety
• Reduce Operational Risk & rapid response to events
• Increased Availability & Uptime
• Predictable performance, Standardization, Network Mngt & Diagnostics
Creating Greater Value for our Customers

Interconnecting Gas Pipeline into Gas Storage

Customer Challenge:
- Tight Project Schedule
- Strict environmental conditions
- Harsh climate environment (weather)

Solution Value Proposition:
- Complete End to End Pipeline Management Solution delivered through MAC-MEC approach

Scope:
- Electrical: UPS, Electrical Systems, Shelters
- Control: SCADA, Bop Control Center, Simulation, PLC’s (redundant), ESD
- Security: Video System, Intrusion Detection
- Telco: Fiber Optic Ring & Switches, VOIP
- Instrumentation: P.T.L, Gas Quality, Motorized Valves (w/ profibus)

Benefits:
- Single Source Solution Provider
- Reduce Project Risk via integrated offer
Creating Greater Value for our Customers

Smart Connected Pipeline

Export Pipelines & Gathering System

Customer Challenge:
- Safe Operation (including Leak Detection)
- Major Upgrade of Trunk Line w/out Interrupting Operation

Solution Value Proposition:
- Complete Solution comprised of Modern Pipeline SCADA, Leak Detection & Telecommunication System

Scope:
- Network & Telcom: Fiber Optic Ring & Switches, VOIP
- Control Center: SCADA, Leak Detection
- Leak Detection

Benefits:
- Complete Modern Solution from Control Room, Operational Software & Communications Infrastructure
- Upgrade w/out disruption to operation

CPC (Caspian Pipeline Consortium) operates a 1,600 km crude oil pipeline originating from the Tengiz Fields in Kazakhstan transporting oil to a marine terminal in Novorossiysk on the Black Sea. The original project was delivered between 1999-2001 and subsequently maintained, extended and expanded several times over the next ten years.

In 2011, a contract was awarded to completely upgrade and expand the SCADA and Pipeline Simulation System, as part of a major expansion CPC capacity expansion project.

In parallel, Schneider Electric is executing a project to completely upgrade the entire telecommunication network for the CPC pipeline.
Summary

- Predictable Performance
- Differentiated Services
- Standardization
- Network Management and Diagnostics
- Network Cyber Security
- Reliability
- Real-Time Traffic Performance
- Power Availability and Equipment Footprint
Schneider Electric Approach to Realize an enterprise Pipeline Management Solution

Enterprise Applications
- Measurement & Volumetric Accounting
- Scheduling, Planning & Optimization
- Sustainability Reporting & KPI

Pipeline Operations Management
- Control Room Management
- Decision support Applications
- Simulation, Leak Detection

Pipeline Digitization & Measurement
- Instrumentation & Measurement
- Process & Energy Automation
- Remote Surveillance & Control

Enabling Infrastructure
- Electrical – Utility
- Telecom / Networking
- Information Technology / Cyber Security
Schneider & Cisco: Smart Connected Pipelines

Available Today:

- White Paper - Recommended Practices for O&G Pipeline Designs
- White Paper - Recommended Practices for Pipeline Control Centre Virtualization and Designs

Joint Innovations:

- Distributed Leak Detection enabled by Cisco Fog Computing Platform
THANK YOU