Sunsetting traditional ITS SCADA with AVEVA

Futureproofing Intelligent Transportation System (ITS) SCADA

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1. PROJECTS: (Buildings, Roads, Highways & Drainage Network)
2. AA: DNO&M Department
3. AA: RO&M Department

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# Roads Network Operations & Maintenance Department (RO&M)

<table>
<thead>
<tr>
<th>Highways &amp; Roads</th>
<th>Intersections</th>
<th>Tunnels &amp; Underpasses</th>
<th>Bridges</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 12,000+km linear and 33,000+km lanes</td>
<td>• 400+ intelligent intersections</td>
<td>• 50 tunnels and underpasses equipped with ITS devices</td>
<td>• 50 bridges, foot bridges &amp; cable bridges</td>
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ITS (Intelligent Transportation System) Devices in ROMD

- 8+ Over Height Detection System (OVDS)
- 1210+ CCTV
- Pan-Tilt-Zoom Camera (PTZ)
- 2220+ Lane Control Signs (LCS)
- 1070+ License Plate Recognition (LPR)
- 200+ Automatic Incident Detection Camera (AID)
- 370+ Dynamic Message Signs (DMS)
Our Global Presence

+30 Years of commitment
+12 Key partners worldwide
+1,500 Medium & large-scale projects
+200 Government & blue-chip customers
+200 Employees
+9 Offices, 3 Operating Centers
+15 Industrial Segments Served
+70% Control System Engineers
+300K Man Hours

Worldwide Headquarters
North America
Regional Operations Center
Exton, PA, USA

Southeast Asia
Regional Operations Center
Lahore & Karachi

Middle East Operations
Saudi Arabia, UAE & Qatar

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Digital Transformation

Octopus Digital

OmniConnect
Collects data from any source

MultiCloud
Ingests and pushes to any cloud

Data-lake
Stores data into any data-lake

Analytics
Publishes data on any visualization or analytics software

Machine Learning
Artificial Intelligence & Machine Learning

KPIs
Computes and configures KPIs as required

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While industry specific SCADA systems are quick and easy options, these lack some of the key features that we considered essential for critical operations for our road tunnels.
Cyber Security

• Cyber Security: Qatar introduced stringent cyber security framework compliance requirements
  • 2014: National ICS Security Standard (latest revision at 3.1)
  • Security Framework Qatar 2022 v1.0
• These security standards drive asset owners to adopt COTS (Commercial Off The Shelf) software that have Cyber Security Certifications for these software.
We were looking for a platform that has broad support base in terms of integrators and market skillset availability. High serviceability is a desired factor as it helps avoid vendor lock-in scenarios. As our assets are spread across the country, it was important to have a SCADA system with built in GI capabilities.
Flexibility & Developer Ecosystem

• We wanted the ability to have flexible architectures when it comes to deployment as we have local and central control rooms.

• We wanted to enjoy the add-on products developed by a larger developer ecosystem presently and in future. (e.g. version management, GIS.)
Challenges

From obscure protocols to secure handshaking – it required extensive collaboration with AVEVA development team and third parties.
NTCIP Protocol

Extracts from NTCIP001 V4 Guide 2009

- National Transportation Communications for ITS Protocol (NTCIP)
- Used for remote control of roadside devices
- Center to Center (C2C) & Center to Field (C2F) schemes
- “NTCIP is a family of open standards, defining common communications protocols and data definitions.”
NTCIP Framework

Figure 4 NTCIP Framework

Figure 5 OSI Layer to NTCIP Level Mapping
NTCIP Published Standards

NTCIP 1102-2004, Octet Encoding Rules (OER)Base Protocol Published October 2005
NTCIP 1103-v03, Transportation Management Protocols Published December 2016
NTCIP 1104-v01, Center-to-Center Naming Convention Specification Published May 2008
NTCIP 1201-v03, Global Object (GO) Definitions Published March 2011
NTCP 1202-v05A, Object Definitions for Actuated Signal Controllers (ASC) Interface Published May 2019
NTCP 1202-v04A-5001, Object Definitions for Actuated Signal Controllers (ASC) Interface (TCP-Enabled) Published May 2019
NTCP 1202-v04, Object Definitions for Actuated Traffic Signal Controller (ATSC) Units – version 02 Published November 2009
NTCP 1203-v01, Object Definitions for Dynamic Message Signs (DMS) Published September 2014
NTCP 1203-v03A-5001D TPG, Object Definitions for Dynamic Message Signs (DMS) Published August 2017
NTCP 1204-v04, National Transportation Communications for ITS Protocol (ENX) Interface Protocol Published April 2022
NTCP 1204-v03, Environmental Sensor Station (ESS) Interface Protocol Published October 2009
NTCP 1205-v01And1, Object Definitions for Closed Circuit Television (CCTV) Camera Control Published September 2014
NTCP 1206-2009, Object Definitions for Data Collection and Monitoring (DCM) Devices Published November 2009
NTCP 1207-v02L, Object Definitions for Ramp Meter Control (AMC) Units Published September 2014
NTCP 1208-2006, Object Definitions for Closed Circuit Television (CCTV) Switching Published October 2005
NTCP 1208-v01, Object Definitions for Transportation Sensor Systems (TPSS) Published May 2014
NTCP 1209-v04A-5001D TPG, Object Definitions for Signal Control and Prioritization (SCP) Published August 2017
NTCP 1210-v01, Field Master Stations (FMs)–Part 1: Object Definitions for Signal System Masters (SSMs) Published September 2013
NTCP 1211-v02L, Object Definitions for Signal Control and Prioritization (SCP) Published September 2014
NTCP 1211-v02A-500, Object Definitions for Transportation Sensor Systems (TPSS) (TCP-Enabled) Published August 2017
NTCP 1213-v03, Object Definitions for Electrical and Lighting Management Systems (ELMS) Published January 2023
NTCP 1213-v02, Object Definitions for Electrical and Lighting Management Systems (ELMS) Published March 2011
NTCP 1218-v01, Object Definitions for Roadside Units (RSUs) Published September 2020
NTCP 1218-v01A-5001, Object Definitions for Roadside Units (RSUs) (TCP-Enabled) Published September 2020
NTCP 2102-2003, Point to Multi-Point Protocol Using FSK/FSK Modem Subnetwork Profile Published September 2005
NTCP 2103-v02, Point to Point Protocol over RS-232 Subnetwork Profile Published December 2008
NTCP 2104-2003, Ethernet Subnetwork Profile Published September 2005

NTCP 2201-2003, Transportation Transport Profile Published September 2005
NTCP 2202-2001, Internet (TCP/IP and UDP/IP) Transport Profile Published December 2001
NTCP 2201-v02L, Simple Transportation Management Framework (STMIF) Application Profile (AP) (ATSP) Published July 2010
NTCP 2202-2001, Simple File Transfer Protocol Application Profile Published December 2001
NTCP 2203-2001, File Transfer Protocol Application Profile Published December 2001
NTCP 2204-2002, Application Profile for DATEX-III (AP-DATEXIII) Published September 2005 | NTCIP 2204 will no longer be updated. Please direct to ITI TMID standard for updates.
NTCP 2205-v01, Application Profile for XM2P Message Encoding and Transport (Published December 2008) | NTCIP 2205 will no longer be updated. Please direct to ITI TMID standard for updates.
NTCP 2203-2013, Content Outline for NTCIP 2200 Series Documents (for Standards Engineering Process (SEP) Content) Published September 2014
NTCP 2209-2001, Profile Framework Published December 2001
NTCP 2204-v03, Structure and Identification of Management Information (SMI) Published June 2010
NTCP 2205-v01, Procedures for Creating Management Information Base (MIB) Files Published June 2010
NTCP 2207-v01, Testing and Conformance Assessment Documentation within NTCIP Standards Published May 2008
NTCP 2201-v04, The NTCIP Guide Published January 2020
NTCP 2201-v01, Testing Guide for NTCIP Center-to-Center Communications December 2008
NTCP 2204-v01-20, National Transportation Communications for ITS Protocol, Infrastructure Standards Security Assessment (ISSA) Published August 2023

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High Level Integration Scheme

Integrating LCS, DMS, AID, SNAPs, Video, PAVA, LPR, etc., into RO&M SCADA through Application Aggregation & Integration.

- Integration Server
  - Web APIs, SOAP, REST
  - SNMP, SOAP, REST and custom socket APIs

- Webserver
  - DLLs
  - URLs for webpages

- Operating System
  - RO&M SCADA
  - Operators
  - Managers
  - Mobile Users

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Integrations

NTCIP & Other Integrations for ITS devices

- LCS (Lane Control sign) - NTCIP Protocol
- DMS (Dynamic Message Sign) - NTCIP Protocol
- AID (Automatic Incident Detection) - SOAP
- SNAPs - SOAP
- ONVIF (Open Network Video Interface Format) - SOAP
  - Video Streaming
  - PTZ (Pan, Tilt, Zoom) Controlling
- PAVA (Public Address & Voice Alarm Systems) - SOAP
- LPR (License Plate Recognition System) - SOAP
- AiTek NVR Integration (Decoder for Videos) - REST API

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Response Plans (RPs) / Scenarios

- RP/ERP: Predefined list of actions performed in a sequence to manage traffic in case of planned/unplanned events.

- Some examples of response plans are:
  - Full tunnel closure / slow
  - Zone 01 Lane 01 Closure
  - No trucks allowed

- We wanted the ability to create and modify these response plans without the need for scripting and coding.

- We wanted the ability to activate a specific plan either manually or via triggers received from the field.
Response Plans (RPs) / Scenarios

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Emergency response plans steps</td>
</tr>
<tr>
<td>2</td>
<td>Play button to execute the plan</td>
</tr>
<tr>
<td>3</td>
<td>Pause button to stop the execution temporarily. Button will be enabled once the plan is started</td>
</tr>
<tr>
<td>4</td>
<td>Reset button to reset the plan after it is completed. Operator may need to reset a plan so it is ready for future execution</td>
</tr>
<tr>
<td>5</td>
<td>Preview button to view a graphical representation of the plan</td>
</tr>
<tr>
<td>6</td>
<td>A pop-out screen showing a preview of the selected plan</td>
</tr>
</tbody>
</table>
GIS View – Level 01
GIS View – Level 01
GIS View – Level 02
GIS View – Level 04
GIS View – Level 05
Operational Changeover

![Diagram of Operational Changeover Process]

- Control Request from Local TMS
  - Request Pending with Operator
    - Timeout
    - Confirm & Forward by RMC Oper
      - Yes: Accepted by RMC Oper
        - Accepted
        - Rejected
      - No: Verified by RMC Sup
        - Yes: Accepted
        - No: Rejected
    - No: Request Pending with Supervisor
      - Verified by RMC Sup
        - Yes: Accepted
        - No: Rejected
      - Timeout
- Control Release from Local TMS
  - Request Status Pending
    - Accepted by RMC Oper
      - Accepted
      - Rejected
    - Timeout
  - Information to Supervisor for Acknowledgement

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Single touchpoint for all systems

AVEVA™ System Platform as the focal point

- 12 Remote sites connected
- 50+ tunnels and underpasses
- 15+ integrated subsystems
- ~11464 total integrated assets
Tunnel Management System
“Cyber Security compliance & enhancing the communication suite to include customized ITS Equipment drivers were critical success factors for the project. They [Avanceon] helped us achieve this.”

Manzoor Maqbool A. Ansari – Senior ITS Engineer, Roads Design Dept., Ashghal
“The system has successfully contributed to the success of the FIFA event by providing a smooth and enjoyable transportation experience for spectators, minimizing disruptions and optimizing overall traffic operations”

Abdulrahman A S Ansari - RMC Operations Manager, Ashghal.
Ashghal improves incident management with single pane of glass view of critical road tunnels

Challenge

• Qatar is a host to regional and international public events like the FWC, Asian games, etc. These are attended by a significant number of spectators. This results in increased traffic volume around stadiums and host areas.
• Handling traffic scenarios entailed interacting with multiple systems (MEP, Intelligent Transportation (ITS) System devices, GIS, etc.). There was no Single Pane of Glass (SPoG) view available to operators for this.

Solution

• All ITS subsystems were integrated using AVEVA™ System Platform
• Customized drivers (e.g. NTCIP) were developed for this purpose
• 1100+ traffic plans with 5500+ steps were programmed
• Increased situational awareness by using GIS map views with real-time statuses

Results

• Reduced response times to handle incidents and emergencies
• Ramp up time for bringing new operators to operations has reduced from weeks to days as they only have to train themselves on a single platform.
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Questions?

Please wait for the microphone.
State your name and company.

Please remember to...

Navigate to this session in the mobile app to complete the survey.

Thank you!
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