The Cost of Water: Private Wireless Networks vs. Cellular Connectivity for Water/Waste Water SCADA Communications
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Wireless Sales Director, Americas

Based in Scottsdale, AZ, Mike is responsible for business development for Siemens’ RUGGEDCOM WIN wireless product portfolio. Mike’s background with wireless solutions includes over 25 years of selling a wide variety of point-point, point-multipoint, and mesh wireless product for various industry leading manufacturers, while addressing multiple critical infrastructure markets that successfully employ these solutions (utility, water, oil and gas, ITS, enterprise).
Todd Wedge
Business Development Manager, CrossBow Secure Remote Access Solutions

Todd Wedge is a Business Development Manager at Siemens Industry responsible for the CrossBow secure remote access solution in the U.S. Region. Prior to his current role, he led a global program at Siemens PLM Software accountable for market share of fluid dynamics software to universities and research centers. Todd has a 15-year sales and business development background in network and application security for enterprise, government and industrial markets. He holds a Bachelors in Business Administration from the University of Texas at Dallas and a Masters in International Business from the University of London.
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Topics:
Review and compare the costs and benefits of a private wireless solution vs. cellular connectivity for critical infrastructure SCADA communications
SCADA Communications for Water Wastewater Operations

- Reliability and timely secure data delivery are a must
- Direct control over operations via real-time info
- Data demand/multiple applications using same communications medium
- QOS is important with multiple applications
- Connectivity options: Cellular, fiber, telco, wireless
- Ever-growing IIOT demanding more bandwidth
Connectivity Challenges

• Number of sites to connect

• Distances involved

• CAPEX or OPEX approach

• LOS and freq band decisions when private wireless network is chosen

• Is cellular best effort good enough - or is QOS for optimal application performance preferred

• Overall network reliability
  - Redundancy options
  - Maintenance and repair
  - Shared or private network
The Case for a Cellular Communications Connectivity Approach

• Cellular is easy to implement – modem and SIM card, acceptable 1-time upfront costs

• Quickly deployed and in service

• Sometimes OPEX is tolerable – annual budgeting can be preferable to some companies
The Case for a Private Wireless Network Approach

- Critical infrastructure companies want better control over the network than a carrier typically delivers
- One-time CAPEX cost is generally preferable
- 802.16e standard delivers consistent performance via QOS and prioritization for applications
- Private network has better redundancy options
- In a natural disaster, you have primary control over repair cycles
### Wireless Communications

**Private Networks**

<table>
<thead>
<tr>
<th>Private Network Options</th>
<th>Wi-Fi Mesh</th>
<th>Narrowband</th>
<th>Low Power Mesh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput</td>
<td>Green</td>
<td>Red</td>
<td>Yellow</td>
</tr>
<tr>
<td>Range</td>
<td>Red</td>
<td>Green</td>
<td>Red</td>
</tr>
<tr>
<td>Deterministic latency</td>
<td>Yellow</td>
<td>Green</td>
<td>Red</td>
</tr>
<tr>
<td>Security</td>
<td>Green</td>
<td>Orange</td>
<td>Yellow</td>
</tr>
<tr>
<td>Ecosystem of interoperable suppliers</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
</tr>
</tbody>
</table>

**RUGGEDCOM WIN**

- Wireless industry coalition, IEEE 802.16e standards based for broadband wireless access (BWA) networks.
Siemens RUGGEDCOM WIN – Private Broadband Wireless Solution for Water/Wastewater communications networks

**Applications**
- SCADA Connectivity
- Mobile Workforce
- Video surveillance
- VOIP

**Reliability**
- -40°C to +75°C, IP67
- IEC 61850-3
- Class 1 DIV 2 Compliant
- MIL-STD-810F 509.4
- Redundancy options

**Performance/Security**
- Broadband capacity (10 miles)
- Private network (4.9GHz)
- Dedicated bandwidth
- Standards Based, 802.16e
- AES encrypted, AAA authenticated

**Benefits**
- Greater bandwidth
- Less network interference
- Low latency/repeatable performance
- Scalability
- Greater security
Private Wireless Networks - spectrum choices - USA

- **2.3 – 2.4 GHz**: Special Carrier WIMAX Freq - Licensed
- **2.5 – 2.7 GHz**: Standard Carrier WIMAX Freq - Licensed
- **3.5 – 3.7 GHz**: Newly Created CBRS Freq Band – FCC now finalizing
- **4.9 – 4.99 GHz**: Public Safety and Municipal bands
- **5.1 GHz**: Airport Only (AeroMACs)
- **5.72 – 5.82 GHz**: Unlicensed Freq Band
Wireless Private Network Solutions
RUGGEDCOM WIN Portfolio

WIN5200
Subscriber radio with integrated antenna

WIN7000
High Power Base Station

WIN7200
Standard power Base station

WIN5100
Subscriber radio without antenna

RP-100, RP-110
Rugged POE Injectors
RUGGEDCOM WIN Solution – Where it Fits…

Remote SCADA Sites
Pipeline routes
Water/Wastewater Pump Stations
Master Meter Locations
Wastewater Lift Stations
Operations yard sites
Mobile Fleet Workforce
Mobile data Subscribers

4G Private Wireless Networks
## Private Network vs. Public Network – Calculations

### Approach #1 – Cellular Connectivity via SIM Cards from AT&T or Verizon

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (one time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrier Gateway Set-up Fee</td>
<td>$625</td>
</tr>
<tr>
<td>RM1224 Cell Modems</td>
<td>$50,000</td>
</tr>
<tr>
<td>Modem install</td>
<td>$7,500</td>
</tr>
</tbody>
</table>

**Total one-time costs**: $58,125

<table>
<thead>
<tr>
<th>Monthly Cost</th>
<th>Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>5GB/mo/device plan</td>
<td>$83.33</td>
</tr>
<tr>
<td>50 devices (50 x 83.33) x 12 months</td>
<td>$49,998</td>
</tr>
<tr>
<td>1/10 of one time costs or $5,812 to annualize</td>
<td>$5,812</td>
</tr>
</tbody>
</table>

**Total ongoing annual costs**: $55,810

### Approach #2 – RUGGEDCOM WIN Private Wireless System

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (one time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ea. Base stations with sector antenna</td>
<td>$22,707</td>
</tr>
<tr>
<td>50 each subscriber radios</td>
<td>$65,000</td>
</tr>
<tr>
<td>Misc. cabling, surge, etc.</td>
<td>$14,586</td>
</tr>
<tr>
<td>Installation</td>
<td>$75,000</td>
</tr>
</tbody>
</table>

**Total private wireless approach (one-time)**: $177,293

**Payback ROI for Private Wireless Network Approach**: 3.2 yrs
Other Problems Solved #1 - Upgrading from Legacy Private Wireless Networks

Challenges with Legacy Networks

• Aged 900MHz radio system for SCADA
• Unreliable: RF interference due to high noise floor
• Low throughput: < 1Mbps max
• Best effort bandwidth – no true QOS capabilities
• Replacement radios/parts: many legacy products discontinued

Siemens’ Private Wireless Network Solution

• Municipalities can apply for the use of the FCC’s licensed 4.9 GHz frequency band
• RF interference issues are eliminated
• 10~ times the throughput of 900MHz systems
• Prioritization and QOS as part of the radio standard used (802.16e)
• Eliminate outdoor enclosures for radio equipment
• Mobile applications supported (fleet vehicles)
• Siemens support commitment
Town of Queen Creek, AZ
Water

Problems:
• Old 900MHz radios could not adequately support basic SCADA communication
• 1-5 minute response times
• RF interference at 900MHz
• Old radios were a bottleneck for new sites and video

• 3 base station towers
• Four 4.9 GHz Base station radios with sector antennas
• 24 subscriber radio locations
• Rugged POE injectors
• Designed for clear LOS
• 3 new towers required

Siemens Solution Partner involved
Remote Monitoring of Lift Stations

Other Problems Solved #2 - Upgrading from Manpower Alone

New Port Richey, FL Wastewater

Problems
- No remote comms – all manual reporting
- Daily waste of manpower
- Time intensive

- 4.9 GHz frequency band used
- 67 Lift Stations
- Increased bandwidth
- Implementing video surveillance

Siemens Solution Partner involved

Source: Siemens Industry, Inc.
City of New Port Richey, FL Water/Wastewater Authority
Summary

• Application growth is propelling through-put requirements beyond just SCADA

• In general, critical infrastructure companies (Water, Electric, O&G) prefer a CAPEX model
  ▪ However - SCADA comms connectivity can take several forms and hybrid approaches are common

• Secure and reliable private wireless networks can be implemented with a reasonable ROI

• Professional system integrators are an important must when designing a private wireless network

• FCC licensed spectrum (4.9GHz) can often be used in the W/WW market
Access Control in Water/Wastewater Networks

Todd Wedge
Siemens Industry - RUGGEDSOLUTIONS
The principle of least privilege (PoLP) is an information security term that refers to a user or program that should have the least authority possible to perform its job.
RBAC defines the users’ security roles, permissions, authorization, and role hierarchy to access critical systems in an industrial control system (ICS).
Factors of Authentication

What is a factor?

A factor is a type of authentication. When you claim to be someone, you need to provide further information to prove that you are who you say you are.

<table>
<thead>
<tr>
<th>Something You Know</th>
<th>Something You Have</th>
<th>Something You Are</th>
</tr>
</thead>
<tbody>
<tr>
<td>Username, password, PIN or security questions</td>
<td>Smartphone, one-time passcode or Smart Card</td>
<td>Biometrics, like your fingerprint, retina scans or voice recognition</td>
</tr>
</tbody>
</table>
Factors of Authentication

Factor #4: Somewhere You Are
- Internet Protocol (IP) address
- Media Access Control (MAC) address
- Geolocation services

Factor #5: Something You Do
- Windows 8 Picture Password
- SureSwipe login from Capital One
Secure Remote Access

Good Practices for Secure Remote Access

- Eliminate all direct connections to critical assets
- Use multifactor authentication where possible
- Use only full tunneling cryptographic technology
- Establish user-specific authentication servers
- Require role-based authorization levels
Water/Wastewater Cybersecurity Guidelines

- AWWA using National Institute of Standards & Technology (NIST) as a guide
- Updated guideline issued in 2017
- Security framework includes best practices from NIST, AWWA, WaterISAC and others

<table>
<thead>
<tr>
<th>Practice Categories:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governance and Risk Management</td>
</tr>
<tr>
<td>Business Continuity/Disaster Recovery</td>
</tr>
<tr>
<td>Server and Workstation Hardening</td>
</tr>
<tr>
<td>Access Control</td>
</tr>
<tr>
<td>Application Security</td>
</tr>
<tr>
<td>Encryption</td>
</tr>
<tr>
<td>Telecom, Network Security &amp; Architecture</td>
</tr>
<tr>
<td>Physical Security</td>
</tr>
<tr>
<td>Service Level Agreements (SLAs)</td>
</tr>
<tr>
<td>Operations Security (OPSEC)</td>
</tr>
<tr>
<td>Education</td>
</tr>
<tr>
<td>Personnel Security</td>
</tr>
</tbody>
</table>
CROSSBOW Secure Remote Access

Sample of Network Architecture to Remote Site

Client

CROSSBOW Secure Access Manager

Corporate or Control Center

Active Directory Controller

Network

Upstream Reporting
i.e. Security Information & Event Management

RSA SecurID
Authentication Server

Station Access Controller

Remote Site

Client

IED

Gateway

IED

IED

IED

IED
CROSSBOW Starter Edition

What Is It?

- Lower cost entry point for water/wastewater plants

- Starter Edition includes:
  - 5 Users
  - 100 IEDs
  - CROSSBOW Secure Access Manager and Client Software
  - Installation and User Manuals

- Priced just under $25,000 in above configuration
Chemical Dosing: What is improper dosing costing you?
Presented by Eric Heilveil, Flow Marketing

Similar to poor efficiencies in pumping routines, inaccurate dosing of chemicals in wastewater can result in increased operating costs and fines. Chemical treatment in water can represent a considerable cost in the operating budget; yet it is important to balance this cost with the reassurance of safe water supply.

Key takeaways include:
• How to monitor and improve chemical dosing accuracy
• Identify how much can be saved by improving the accuracy and repeatability of your dosing systems
• Learn how to minimize costs with strict adherence to government regulations

The recording of this webinar is available on the following website:
usa.siemens.com/cost-of-water
Leak Detection: What is lost water costing you?
Presented by Jack Roushey, Flow Marketing

In addition to energy costs, the loss of treated water either through leakage or theft is a significant cost associated with the operation of a water treatment facility and distribution network. It is estimated that upwards of 18% of all treated water is lost due to these two issues. This webinar introduces Siemens’ “Cost of Water” calculator for leak detection to help users identify the amount of lost revenue you may be experiencing.

Key takeaways include:
• How much water is lost by local municipalities
• How can they calculate the potential losses
• What can they do to help reduce this loss

The recording of this webinar is available on the following website: usa.siemens.com/cost-of-water
Economy Pumping: What are your daily pumping routines costing you?
Presented by Herman Coello, Level Marketing

One of the biggest costs associated with the operation of a water treatment facility and distribution network is the energy consumed in pumping systems. It is estimated that optimization of a facility’s pumping systems can lead to a reduction in energy costs by 20% or more. This webinar will show you how implementing an energy cost savings strategy through economy pumping routines can contribute to your optimization efforts.

Key takeaways include:
- How to calculate the overall cost of your pumping systems
- How much you can save by operating pumps during off-peak energy pricing
- How to optimize pumping routines with pump controllers and level measurement technology

The recording of this webinar is available on the following website: usa.siemens.com/cost-of-water
Resiliency of water service is becoming increasingly difficult to achieve with an aging infrastructure, rapid population growth and a lack of resources. However, these challenges can be overcome through digital enhancements delivering more efficient processes and preservation of supply.

Siemens is a global leader in electrification, automation and digitalization solutions capable of enhancing the performance of water delivery and treatment processes. Join our webinar to learn about scalable solutions that deliver resiliency of supply through asset performance optimization and automation solutions for future-proof facilities.

Key takeaways include:
• How to build resiliency within your network
• How to reduce resource needs and costs
• How to establish a Digital Twin
Contact Information

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