Next Generation Telemetry Systems Improve Utility Effectiveness

2016 NC AWWA-WEA Spring Conference
Asheville, North Carolina
1:40pm Monday April 18th, 2016

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Next Generation Telemetry Systems

- What has changed?
- Why do I care?
- What can it do?

How come you don’t have comfortable seats like ours?

If I answer questions will I get free stuff?
Next Generation Telemetry Systems

Software
Leveraging the Power of Remote Assets

Communications
Reliability in Adverse Conditions

RTUs, rPACs, etc.
Advanced Features and Intelligence

Leveraging the Power of Remote Assets
Communications
Reliability in Adverse Conditions
RTUs, rPACs, etc.
Advanced Features and Intelligence
Next Generation Telemetry Systems

Traditional Uses of Telemetry

Who has a telemetry system?
Next Generation Telemetry Systems
Traditional Uses of Telemetry

What do you use it for?

... remote monitoring and alarming?
... remote control?
  ... advanced control?
  ... safety, security, and video?
... mobile workforce operations?
  ... Smart Water?
    ... energy management?
    ... asset management?
    ... asset condition assessment?
... distribution system forecasting?
... water loss management?
Next Generation Telemetry Systems

WHAT HAS CHANGED?
Next Generation Telemetry Systems
What has Changed?

• Telemetry Devices
  • Integrated Intelligence
  • Performance

• Communications
  • Options & Methods
  • Communication protocols

• Software
  • Better leverages assets and data
Next Generation Telemetry Systems
What has Changed?

Telemetry Devices
• Integration into devices
  • Ethernet Ports
  • Wireless Communication
  • CyberSecurity
  • Web Servers
  • Data Collection
  • Analytics
  • Remote Management
• Performance
  • Increased Memory and Processing
  • Low Power (12v PV)
Next Generation Telemetry Systems
What has Changed?

Communications
• Advanced Open Protocols
  • DNP3
• Comm. Device Integration
  • Security
  • Redundancy & Resiliency
  • Multi-Network and Protocol
• Improved Medium Choices
  • New Cell Data Plans
  • Availability of Fiber
  • High Speed Broadband
  Wireless
Next Generation Telemetry Systems
What has Changed?

Software
• Standard packages to utilize the new advanced telemetry protocols and features
• Standard packages available for Smart Water
• Integration of systems to leverage Big Data
• Telemetry and its software are a big contributor to smart water solutions
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WHY DO I CARE?
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Why Should I Care?

Resource Dilemma
• The need to do more with less
• Sustainable Practices
• Smart Water is…
  • Reliable
  • Efficient
  • Safe
  • Secure
  • Sustainable

How Do You Apply Smart Water to Remote Telemetry?
Next Generation Telemetry Systems
Why Should I Care?

- Savings in energy consumption: up to 30%
- Increase in operational efficiency: up to 25%
- Reduction in total cost of ownership: up to 20%

Actual Results
Next Generation Telemetry Systems
Why do I Care?

Effective Utility Management
A Primer for Water and Wastewater Utilities

June 2008
Next Generation Telemetry Systems

WHAT CAN IT DO?
Next Generation Telemetry Systems
What Can it Do?

• Advanced Communications
  • Standard Protocols
  • Advanced Features
  • Robust and Secure
  • Efficient Communications

• Advanced Control
  • Closed Loop
  • Productivity Enhancements

• Safety, Security, and Video
  • Cyber Secure
  • Personnel Safety
  • Security and Process Video

• Mobile Workforce Management
  • Mobile WAN Access
  • Mobile Work Order Management

• Smart Water
  • Energy Management
  • Asset Management
  • Asset Condition Assessment
  • Distribution System Forecasting
  • Water Loss Management
  • Demand Billing
Advanced Communication Protocol DNP3
Features and Benefits

• Open Standard Protocol
  • No customization needed to get functionality

• Advanced Features
  • Redundancy and routing features
  • Remote management of assets
  • Store and forward
  • Time stamped data

• Robust and Secure
  • Able to operate securely in harsh and noisy environment
  • Integrated cyber security

• Efficient Data Communications
  • Lower infrastructure costs and data rate charges
  • Ability to communicate across different network types
  • Unsolicited messaging
  • Report by exception messaging
  • Control of data flow and bandwidth
Advanced Communication Protocol DNP3

Store and Forward

- Data transmission efficiency
- Large blocks of high frequency data available for Smart Water apps
- Data recovered on restoration of communications
Advanced Communication Protocol DNP3
Traditional Polling Protocol Architecture

- Master controls communications and prevents collisions
- Data Concentrators may be needed for repeaters and possibly for the Master
- Repeaters avoided
- No advanced features without custom programming
  - Current data only
  - Inefficient, all data transferred with possible separate transmissions for different data types
    - No time stamping
    - Little verification of actions or data quality
Advanced Communication Protocol DNP3 Polling

- Possible long delays between updates but data is “backfilled’
- Prevents collisions if only method used
- Different data classes may be polled at different rates
- Infrastructure avoids repeaters in architecture
- Report By Exception can shrink data packet size
- May be needed for integrity checks
Advanced Communication Protocol DNP3
Routing Without a Data Concentrator

- Known as Message Pass-Through or Routing
- Data concentrator may still be needed for outstation-to-outstation control
Advanced Communication Protocol DNP3
Unsolicited

- Unsolicited messages sent from Outstation by time and / or events
- Very efficient but collisions may occur on simultaneous communications
- Classes determine responses
- Data may be sent out on a state change or when a deadband is exceeded along with a hold time and count values to prevent spurious transmissions
- Report By Exception can shrink data packet size
Machine-to-Machine Data Plans

- One objection to Cellular Data is the recurring cost:
  - A 5 GB / Unlimited plan typically costs $45/month. Unattractive for SCADA.
  - M2M plans in the range of $10/month are attractive, compared to building and maintaining a private SCADA radio system.

- The M2M plans are very small...too small?

Excerpt from "Using Cellular Machine-to-Machine Solutions for Collection System SCADA: Is a Small Data Plan Big Enough?", Presentation by Dan Cote of McKim & Creed
### Advanced Communication Protocol DNP3

**Control of Data Flow and Efficiency**

<table>
<thead>
<tr>
<th>Description</th>
<th>ModBus (2 minute poll)</th>
<th>DNP3 (adjustable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetwell Level</td>
<td>720</td>
<td>720</td>
</tr>
<tr>
<td>Pressure</td>
<td>720</td>
<td>2880 (30 seconds)</td>
</tr>
<tr>
<td>Pump 1 Running</td>
<td>720</td>
<td>75 (actual start/stop time tagged)</td>
</tr>
<tr>
<td>Pump 2 Running</td>
<td>720</td>
<td>75</td>
</tr>
<tr>
<td>Pump 1 Hourly RT</td>
<td>720</td>
<td>24</td>
</tr>
<tr>
<td>Pump 2 Hourly RT</td>
<td>720</td>
<td>24</td>
</tr>
<tr>
<td>Pump 1 Hourly Starts</td>
<td>720</td>
<td>24</td>
</tr>
<tr>
<td>Pump 2 Hourly Starts</td>
<td>720</td>
<td>24</td>
</tr>
<tr>
<td>Hourly InFlow</td>
<td>720</td>
<td>24</td>
</tr>
<tr>
<td>Hourly OutFlow</td>
<td>720</td>
<td>24</td>
</tr>
<tr>
<td>Intrusion</td>
<td>720</td>
<td>5</td>
</tr>
<tr>
<td>Other Possible Alarms</td>
<td>720 x 20</td>
<td>3 (only when they occur)</td>
</tr>
<tr>
<td>Battery Voltage</td>
<td>720</td>
<td>20 (on deadband)</td>
</tr>
<tr>
<td>Discharge Pressure</td>
<td>720</td>
<td>1,200 (on deadband)</td>
</tr>
<tr>
<td>Rainfall</td>
<td>720</td>
<td>13 (only when changing)</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>24,480 events</strong></td>
<td><strong>5,135 events/day 8 MB/Month</strong></td>
</tr>
</tbody>
</table>

**FUTURE TAGS**

- **Pump Amperage**: 3,700 (every 10 seconds when running)
- **Pump Voltage**: 600 (on deadband)
- **Power Usage per Hour**: 24
- **Max Voltage per hour**: 24
- **Min Voltage per hour**: 24
- **Water System Pressure Monitor**: 8,640 (every 10 seconds)

**Total:** **18,147 events/day 13 MB/Month**

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Excerpt from “Using Cellular Machine-to-Machine Solutions for Collection System SCADA: Is a Small Data Plan Big Enough?”, Presentation by Dan Cote of McKim & Creed
Advanced DNP3 RTU Features
Event Logging: Smart Dead Band

Create Time-Stamped Generated Events for the Past

“SMART” Dead Band Algorithm

260 Events Per Day

Excerpt from “Using Cellular Machine-to-Machine Solutions for Collection System SCADA: Is a Small Data Plan Big Enough?”, Presentation by Dan Cote of McKim & Creed

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Next Generation Telemetry Systems

Advanced Control

• No separate controller needed
• Closed loop control is based on process feedback for optimal control
  • Energy efficiency
  • Reduced chemical consumption
• Energy Demand Management

RTUs, rPACs, Controllers, Data Loggers, etc.
Next Generation Telemetry Systems
Safety Security, and Video

- Cyber Secure
- Personnel Safety
- Security and Process Video
  - Video Analytics
  - Infrared Cameras
  - Network transmission optimization
Next Generation Telemetry Systems
Mobile Workforce Management

• Mobile WAN Access
  • SCADA and Alarm Access
  • GIS, Asset Management, CMMS access
  • Etc…

• Mobile Work Order Management
  • Condition Assessments
  • Sampling
  • Etc.
Next Generation Telemetry Systems
Smart Water

- Energy Management
- Asset Management
- Asset Condition Assessment
- Distribution System Forecasting
- Water Loss Management
- Demand Billing
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Lowering Pump Life Cycle Costs

Typical pump life-cycle cost profile (Courtesy of Hydraulic Institute and Pump Systems Matter)
Next Generation Telemetry Systems
Lowering Pump Life Cycle Costs

System Curve | Tested Head | Tested Efficiency | Factory Head | Factory Efficiency

- Pump Damage
  - Excessive Vibration
  - Recirculation
  - Cavitation

- Preferred Operating Range
  - 70% to 120% of BEP

- Pump Damage
  - Cavitation
Lowering Pump Life Cycle Costs
Effect of Pump Impeller Wear

System Curve | Tested Head | Tested Efficiency | Factory Head | Factory Efficiency
Prioritize Repairs with Financial Metrics

**Monthly Summary Report**

**Aqua Water Supply Corp.**

**September, 2014**

**Monthly Summary**

<table>
<thead>
<tr>
<th>Total Water</th>
<th>Optimized Saved (%)</th>
<th>Total Energy Saved (kWh)</th>
<th>Energy Saved (%)</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>245.9</td>
<td>86%</td>
<td>203,120</td>
<td>10.7%</td>
<td>$2,437.68</td>
</tr>
</tbody>
</table>

**Energy Saved - Year in Review**

**Past 12 Months**

- Energy Saved (kWh): 314,683 kWh
- Energy Saved (dollars): $31,468.29

**Pump Station Health Data**

**Pump Repair Recommendations:**

<table>
<thead>
<tr>
<th>Pump Station Name</th>
<th>Capacity</th>
<th>Pump Wear Cost Per Year</th>
<th>Station Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>TU/S Pump Station</td>
<td>86%</td>
<td>$413 / year</td>
<td>Highview Pump Station</td>
</tr>
<tr>
<td>TU Pump Station</td>
<td>94%</td>
<td>$5,399 / year</td>
<td>TU Pump Station</td>
</tr>
<tr>
<td>SR Pump Station</td>
<td>101%</td>
<td>$0 / year</td>
<td>SR Water Well</td>
</tr>
<tr>
<td>SW Water Well</td>
<td>103%</td>
<td>$0 / year</td>
<td>SW Water Well</td>
</tr>
<tr>
<td>SK Pump Station</td>
<td>105%</td>
<td>$667 / year</td>
<td>SK Pump Station</td>
</tr>
<tr>
<td>TU/S Pump Station</td>
<td>106%</td>
<td>$205 / year</td>
<td>TU/S Pump Station</td>
</tr>
</tbody>
</table>

**Top Recommended Repairs**

- **Pump1**
  - TU/S Pump Station
  - ROI: 233.7%
  - Present Value: $47,737
  - Payback Period: 2.9 years

- **Pump3**
  - TU Pump Station
  - ROI: 112.9%
  - Present Value: $28,214
  - Payback Period: 5.6 years

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**Pump Name**

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Next Generation Telemetry Systems

Smart Water

- Leakage Calculation
- Active Leakage Control
- Pressure Management
- Repair Management
- Asset Management
- Business Intelligence
Distribution Network Visualization

- Realtime and Forecasted Visualization
- Pressure Management

Themes:
- HY Demand / Flow
- HY Flow Control Zones
- HY Pressure Map
- HY Velocity
- LD Leakage Level - 1
- LD Leakage Level - 2
- Motor Readings
- Status
- WQ Max Age
- WQ Mean Age
- WQ Trace

Views:
- Historical
- Future

Aspects:
- Realtime and Forecasted Visualization
- Pressure Management
Distribution Network Visualization

- Water Quality
- Water Age
- Water Supply Sources
Leakage Calculation

- Leakage calculation and alarms for selected zones in tabular format
- Quick view of zone boundary and network with customer’s information
- Quick view of leakage and distribution input trends in mini-charts
Questions?

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Telemetry Related Links

- Telemetry Products
- Wireless Communications
- RTU, rPAC & other Controllers
- Telemetry PLCs
- Wireless Instrumentation
- ClearSCADA
- Wonderware
- Water Intelligence Suites
- Remote Monitoring and Control
- Remote Monitoring and Control PlantStuxure
Short Presentation Abstract

Remote unmanned facilities represent unique challenges to utilities. Because of this, they are often segregated from treatment operations with utility management focused only on their primary purpose. Unfortunately, as utilities strive to “do more with less”, these facilities remain an underutilized and unleveraged part of a utility’s assets. Assets that could be providing additional reliability, efficiency, operational flexibility, early warnings, pretreatment, post treatment, and resource management.

This paper will explore some of the next generation telemetry technologies and how utilities can use them to leverage their assets for improved operational efficiency, energy management and to effectively manage their facilities. As new technologies are discussed, relevant examples will illustrate their innovative application.

So what are some of these advanced technologies? We can break down them into 3 groups: means of communications, communication protocols, and the smart remote telemetry devices that use them. These technologies provide monitoring, control, no loss sampled data, lower infrastructure costs, communications, resource management, etc.
Remote unmanned facilities represent unique challenges to utilities. Because of this, they are often segregated from treatment operations with utility management focused only on their primary purpose. Unfortunately, as utilities strive to “do more with less”, these facilities remain an underutilized and unleveraged part of a utility’s assets. Assets that could be providing additional reliability, efficiency, operational flexibility, early warnings, pretreatment, post treatment, and resource management.

So what’s changed and how can utilities use them in their roadmap to doing things smarter? Many advanced telemetry capabilities have been around for some time, but expensive implementation, one-off customizations, dead end technologies, unreliable complexity and the lack of integration with process knowledge, have caused these technologies to either be avoided or used unproductively. Luckily, not only has the cost been driven down on telemetry devices, but more and more intelligence is being integrated into them as well. Coinciding with these improvements have been open industry standards that ensure that the advanced features are standardized, less complex, and have technical longevity.

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So what are some of these advanced technologies? We can break down them into 3 groups: means of communications, communication protocols, and the smart remote telemetry devices that use them. Means of communications such as dialup, lease line, wireless, fiber optic cables, satellite, and cell have been around for a while, but new high speed wireless communications and new cellular data plans have changed the game when it comes to telemetry and what can be done. Modern communication protocols like DNP3, WITS, and IEC 60870-5 may sound like mumbo jumbo that only techies should care about, but these open standards allow the secure control and optimization of data while providing advance features such as store and forward, message routing, unsolicited messaging, report by exception, etc. Smart RTUs or Remote Process Automation Controllers (rPACs) combine the capabilities of PLCs and RTUs and then take them a step further, providing integrated higher level device functionality, advanced process controls, asset management, reliable and secure communications, and savings of resources.

These technologies provide monitoring, control, no loss sampled data, lower infrastructure costs, communications, resource management, etc. This presentation will be valuable to engineers but also to end users and other industry professionals who need to understand how these technologies can be incorporated into their smart city road map to provide a cost effective migration path to doing things smarter.