An Integrated Flow and Pressure Metering solution with GPRS WITS Protocol
Agenda and Presenters

- Water Industry Telemetry Standards – History and Background
  - Charles Williams – Chairman of the WITS Protocol Standards Association

- An Explanation of WITS
  - Video

- An Integrated Flow and Pressure Metering Solution with GPRS WITS Protocol
  - Dr. Ray Keech – Development Manager, ABB Limited

- Implementation of the WITS based SCADA within Thames Water
  - Russell Wheadon – Telemetry Manager, Thames Water
Water Industry Telemetry Standards Group
A brief history

Supporters included
- Anglian Water
- Environment Agency
- Northumbrian Water
- Scottish Water
- Severn Trent Water
- Thames Water
- United Utilities
- Wessex Water
- Yorkshire Water

- In the water industry, telemetry system vendors developed proprietary protocols for communications between their field devices and master stations.
- Consequently end users of the telemetry system became locked in to the particular supplier.
- The Water Industry Telemetry Standards (WITS) group was created in 2003 to introduce change.
- The first project undertaken was to produce an open standard for transferring data between field devices and a telemetry master station.
Protocol Selection
What were the requirements?

- Communications between different equipment from different vendors
- A uniform approach to the structure, handling and presentation of data
- Single protocol to support multiple vendors
Protocol Selection
Distributed Network Protocol (DNP) 3

- DNP3 (Distributed Network Protocol) was selected
- Originally developed for use in power utility applications
- An internationally recognised standard
- DNP3 enables communication between different types of data acquisition and control equipment
- Includes secure authentication and encryption protection against hacking
- Supports a wide range of communication types
Protocol Selection
Development and Testing

- To provide the required interoperability and the water industry functionality, there was the need for a precise specification
- This was achieved through the development of the Application Notes and associated test specifications
- Six water industry telemetry suppliers developed both master stations and field devices to prove and enhance the specification.
- The WITS DNP 3 Protocol Standard was then released as an ‘open standard’
The WITS Protocol Standards Association has over 70 members mainly from the UK but also with a growing number from overseas.

The following UK water companies have adopted WITS as their standard:

- Anglian Water
- Northern Ireland Water
- Northumbrian Water
- Severn Trent
- South West Water
- Thames Water
- United Utilities
- Welsh Water

WITS telemetry master stations from:

- Schneider
- Servelec

WITS field device products from:

- ABB
- Brodersen
- Halma Water Management
- Metasphere
- Schneider
- Servelec
- Technolog
- Xylem
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ABB
AquaMaster 3 with WITS

- Integrated Single Package Flow Solution for remote locations
  - Flowmeter (Electromagnetic)
  - Pressure
  - Logger
  - Quad band GPRS radio
    - WITS Protocol

- Power
  - Mains, Battery or Renewable Energy
ABB AquaMaster 3 WITS

Key benefits

- Delivers Near Real Time Data from remote locations via GPRS radio
- High resolution accurate flow and pressure data
- WITS provides enhanced diagnostics capabilities
- Enables ‘in the ground’ diagnostics checking, with faults automatically pinpointed and reported
- Users can move to an ‘on demand’ maintenance regime
- Diagnostics include:
  - Empty pipe detection
  - Sensor diagnostics
  - Battery / Power diagnostics
- Customer configurable between WITS Ver 1.1, 1.2 & the latest Ver 1.3)
ABB AquaMaster 3 WITS
Key benefits - Near Real Time Data

- Enables Active Leakage control
- WITS is fully configurable for logged data averaging period (typically 15 mins)
- AquaMaster 3 support high speed logger retrieval (typically 1 min) – a WITS V1.3 feature.
  - Ideal for leak investigation, step testing etc
- Typical connection schedule
  - GPRS WITS
    - Say 15 mins for mains / renewable energy installations
    - Say every hour for battery powered.
  - Older SMS type systems typically deliver data once per day
- WITS allows a Water Utility to be aware of Network issues before the consumer reports it, enabling urgent remedial action.
  - It’s of limited use having a detailed telemetered log record of a burst 23 hours after it happened!
  - WITS delivers data in near real time
Highly Configurable WITS Compliant, advanced profile alarm functionality

- Flexible limit configuration with optional hysteresis and persistence
- Fixed limit (HH, H, L, LL) or daily/weekly profiles
- Downloadable time of day alarm profiles for Flow & Pressure
- Separate Weekday and Weekend Profiles
- Flow or Pressure values outside of these downloaded profiles trigger and immediate SCADA Alarm event connection, alerting the user to high or low profile alarm excursions
  - Can be used for Burst and Leak Detection Alarms
Why use an Integrated Solution, such as AquaMaster 3? Resolution

- Traditional solutions
  - WITS RTU +
  - Flowmeter connected via its pulse output to the RTU / Logger

- Such configurations significantly limit:
  1. Logged flowrate resolution
  2. Very limited ability to improve time resolution shorter than 15 mins

- Integrated solution combining in one digital solution
  - Accurate averaged high resolution flow and pressure readings
  - + GPRS WITS RTU

Flowmeter RTU

E.g. 1 pulse / litre

System is for illustration only
Photographs courtesy of Elster and Broaderson
Resolution issues apply to all manufacturers using a separate flowmeter and RTU / Logger

Integrated AquaMaster 3 WITS Solution
Traditional Pulse Logger / RTU Based Solution Resolution

- **Illustration**
  - Flowmeter outputs 1 pulse / litre
  - Say flowrate is around 1 litre / min
  - Logger averaging period = 15 mins
  - For a simple pulse count logger:
    - Long term average is correct, but the reported 15 min logged values can have significant “quantisation” errors.
    - Modern RTU / loggers limit this effect by counting pulses and measuring the exact time period for one or more pulses, but flowmeters will have jitter (imprecise timing) in the generation of the output pulses, which creates additional inaccuracies when using such frequency (= flowrate) determination from flowmeter pulse outputs.
  - An Integrated flowmeter / WITS Logger solution totally removes the above “quantisation” errors

<table>
<thead>
<tr>
<th>Flowrate (l/min)</th>
<th>No of Pulses Collected in a traditional logger (Over 15 mins)</th>
<th>Quantisation Error (%)</th>
<th>Integrated Solution Result (with Zero error)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>15</td>
<td>0%</td>
<td>15</td>
</tr>
<tr>
<td>1.0666</td>
<td>15</td>
<td>6.25%</td>
<td>15.999</td>
</tr>
<tr>
<td>1.0667</td>
<td>16</td>
<td>0%</td>
<td>16</td>
</tr>
<tr>
<td>1.1333</td>
<td>16</td>
<td>5.9%</td>
<td>16.999</td>
</tr>
</tbody>
</table>
Integrated Flowmeter and WITS Solution (AquaMaster 3)  
Resolution - Amplitude

- Traditional solutions - result is quantised and incorrect values being reported
- This phenomena is worse at low flowrates, e.g. nightlines

Note: Nightline is reported incorrectly - too low!
Integrated Flowmeter and WITS Solution (AquaMaster 3) Resolution - Time

- 15 min log record, compared to 1 min high speed log records, results in significant “Aliasing”, loss of detailed flow information and under reading of peak flowrates.

- Note: High time resolution flow & pressure data can be read from AquaMaster 3 in its WITS V1.3 mode.
Integrated Flowmeter and WITS Solution (AquaMaster 3)
Resolution – Time

- Note erratic and low resolution information on 15 min data

Flowrate – Blue
Pressure - Red
ABB AquaMaster 3 GPRS WITS
An Integrated Flow and Pressure Metering solution with GPRS WITS Protocol

- Integrated Single Package Flow Solution for remote locations
  - Flowmeter
  - Pressure
  - Logger
  - GPRS WITS (Ver 1.1, 1.2 & 1.3 supported)

- Applications
  - Irrigation
  - Leakage Management
  - Remote Metering
  - Revenue Metering
  - Water Distribution
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Thames Water

- UK's largest water and wastewater services provider

- 9 million clean water customers in London and the Thames Valley

- An average of 2,600m litres of drinking water supplied per day

- Operation and maintenance of 100 water treatment works, 30 raw water reservoirs, 288 pumping stations and 235 clean water service reservoirs

- 15 million wastewater customers

- Operation and maintenance of 350 sewage works treating an average of more than 4.2bn litres per day
Thames Water SCADA Estate

- 3 regional SCADA systems monitoring 800,000 i/o points
- 80 site based SCADA systems
- 4200 PLC type controllers
- 5000+ RTUs
- 10000+ Loggers
- 1000+ SCADA data users
The SCADA project - District Metering

- Integrate the District Metering data into the SCADA environment, to facilitate near real time monitoring and control of the water supply network. Combining the district metering data with other SCADA asset data, enabling the supply network visualisation within one environment improving event management decisions.

- Upgrade the existing 3000+ AquaMaster (DMs) both hardware and software.

- Migrate from the legacy communications infrastructure Vodafone Paknet.

- Early equipment installation with proven remote upgrade path to WITS firmware.

- Provide an open standards solution (DNP3 WITS).
WITS SCADA Objectives

- Obtain consistent data sets and alarm/event reporting.
- Standardise data/alarm/logging configuration for all asset types.
- Minimise the number of SCADA interfaces for RTU types.
- Remove the bespoke development required for each of the vendor RTUs on the estate.
- Reduce the support requirement to maintain the RTU standard configurations.
- Improve SCADA security. (RTU / SCADA communications secure authentication).
WITS provides a common SCADA interface and standard data sets

- SCADA templates share common protocol and WITS features
- Common WITS alarm/event reporting supports robust asset alarm management process
- WITS data reporting features constructed to create asset centric data sets for SCADA control & monitoring
- WITS configuration management (incremental) provides the capability to obtain consistent data and alarm reporting
- WITS configuration management (incremental) provides the mechanism to change the configuration as business requirements change
- WITS configuration management (Bulk & Inc) provides consistent deployment and efficient RTU recovery
- The WITS standard will increase the RTU choice across asset types from multiple vendors. WITS simplifies the migration from one vendor to another if required.
- Questions?