Developments in data communications

Connected know-how for smarter water management

Laurie Reynolds, C.Eng. MIET
Founder & Managing Director
My background

• 30 yrs with Thames Water, 10 of which as Principal ICA Engineer.

• London Water Control Centre & SCADA strategy. 1990

• DMA programme, lead design engineer.

• >3,000 ABB Aquamaster1 battery mag-meters.

• 1999 WRc Innovation Award

• 1st IOT application in water industry

• Vodafone PACnet network still operating 20 tears later!
WaterWorX – The smart water IOT platform
Monitoring, automation, energy efficiency, asset optimisation

SCADA as a Service
Capture best know-how in water sector.

Encapsulate in data models, described using specialist vocabulary.

- Domain Expertise
  - Experienced operators & users
  - Supply chain
  - R & D
    - Best research into action
  - Social Networks

- Structured Knowledge
  - Controlled vocabulary
  - Library of standard templates
    (Data models of water things)

- SWIM (the international water association)
- WaterWorx
- netWorx
- pumpWorx

LinkedIn
Industrial Internet of Things – WaterWorx (WWX)
Technology for Remote Service Management, monitoring, & optimisation of assets.

Sensors - pressure, temp, flow, + Secure wireless networks & satellite communications + Cloud Computing + Mobile

Low-cost, low-power Microcontrollers

Valves & Actuators

Real-time data analytics
Massive Growth in Connectivity Driving Need for Standards to Support Interoperability

70% Of value to come from Manufacturing & Healthcare**

50 Billion connected “things” by 2020*

$6.2 Trillion global market by 2025**
Water 5.0
Integrated network management
Water as a service – a circular ecosystem

- **Rainfall**
- **Rivers**
- **Groundwater**

**Water Resources**

**Water Treatment**

**Water Transmission (Trunk Mains)**

**Water Distribution**

**Water Use**

**Grey Water re-use**

**Losses**

**Networks**

**Wastewater Networks (Sewerage)**

**Wastewater Treatment**

**BioSolids Treatment & Disposal**

**CSOs**

**Infiltration**
Water 3.0 - today
Water 5.0 → The (near) future!

- Interoperable
- Agile
- Open
- Standardised
- Integrated
Data interoperability

Standards for data interfaces are as important as physical interfaces

Flow
Noise
Pressure

Interoperability

Temporal model
Network model
GIS model
Interoperability

Sensors

Actuators

Network Model

Asset register
Spoilt for choice.....

- AS-Interface
- CANopen
- CC-Link
- CIP
- EtherCat
- Profibus and ProfiNet
- Foundation Fieldbus
- Hart
- IO-Link
- Interbus
- ISA100

- IEC 870 – 5 - 103
- LON
- UCA
- IEC 61850
- DNP 3.0
- IEC 60670-6 (TASE .2)
- IEEE P1525
- Modbus
- SERCOS
- MQTT
- XMPP
- LoRa
Information communication protocols

Clear message

Common language

Something useful to say

Sensor
Publisher
System output

Channel - Connection

Listener
Subscriber
Another system input
NIST/SGiP 8-layer conceptual model

Organisational:
- Economic/ regulatory policy
- Business objectives

Informational:
- Business rules
- Business context
- Semantic understanding

Technical:
- Syntactic interoperability
- Network interoperability
- Connectivity
Internet standards - Layering

- **Message semantics** (flowTotalDay, timeToSpill, ...)
- **Message syntax** (HTML, XML, JSON, ...)
- **Application layer** (Telnet, FTP, STP, HTTP)
- **Transport** (UDP/TCP)
- **Network** (IP)
- **Link**
  - DSL
  - ISDN
  - Serial Mode
  - Sonet
- **Physical**
  - 802.15.4
  - Zigbee
  - 802.11n
  - WiFi
  - GPRS
iIOT system characteristics

• Real-time situational awareness. Control and interoperability, not just data-logging.
• Device-to-device will be required as well as device to cloud.
• Machines, enterprise systems and humans all connected.
• System robustness and agility (QoS) is important, transient nodes, dynamic discovery, recovery, traffic congestion
• Efficient use of bandwidth is important.
• Many protocols will co-exist in system of systems
Specific issues in water

- Highly distributed sensor locations
- Often off-grid, power and telecoms
- Underground chambers
- Heavy metal lids and deep confined spaces
- Legacy installations and proprietary telemetry
- Limited IT/OT architecture standards
- Lack of expertise/confidence in wireless communications standards
- Challenging specification & procurement practices
Time resolution vs quantise errors vs traffic
Time resolution – a case for intelligent analytics at the sensor.

- What does the industry need, why and when?
- Should it be dynamic?
- Who decides?
WITS - DNP  
(UK) Water Industry Telemetry Standard

- Objective: Decouple telemetry Master from RTU and move away from proprietary standards.
- Open market to increased competition!
- Drive a WI standard communications protocol

<table>
<thead>
<tr>
<th>Pros.</th>
<th>Cons.</th>
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<tbody>
<tr>
<td>A consistent standard</td>
<td>Wrong standard</td>
</tr>
<tr>
<td>Industry-driven</td>
<td>Expensive</td>
</tr>
<tr>
<td>Powerful concept</td>
<td>Less competition in market</td>
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<tr>
<td></td>
<td>Power</td>
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<td></td>
<td>Bandwidth</td>
</tr>
</tbody>
</table>
(W)ITS - IOT

- Heavily simplified
- Low-cost to implement
- Universal messaging/services model - valid in wider IOT market
- Based on very common IOT standards
  - JSON
  - XML
  - MQTT
- Opens up market in a very exciting way.
- Then we need to build the datamodels
Hypercat – Linking the silos

Horizontal integration

Resource Discovery

• Common, machine-readable API
• HTTPS, REST, JSON
• Annotate existing APIs
• A simple foundation
Vertical integration (silos)
Hypercat makes services browsable

What have you got?

This: X/Y/Z
Open architecturecs

Leakage use-case architecture

ODS OSI-PI
- Asset Framework
- Real-time visualisation

GIS
- Layered mapping
- visualisation

Hydraulic Distribution modelling
- Entity specific analytics
- AdaptiX.Waves

Waterworx:
- SWIM standard asset library
- Alert notification and routing
- Augmented reality

Asset Register

Maintenance Workflow

Customer

Social media streams.

Kepware API Manager

Thingworx®

Analytics Workbench

Users

Security

SCADA

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- Device manager
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Join me?

Let’s work together to build an open architecture together?

WATERLOSS EUROPE 2017
workshop, conference & exhibition

Laurie Reynolds, C.Eng. MIET
Founder & Managing Director

Smart solutions for a connected water industry