SCADA & IoT
The Similarities and Differences
Ben Yee, P. Eng

Ben has led Bentek Systems as the President for over 30 years and has worked on many Wireless SCADA Communications, EFM/RTU and SCADA Projects over this time involving systems and equipment for over 20,000 Nodes. Ben has expertise in Wireless Technologies including Licensed and Unlicensed Radio, Cellular and Satellite Communications. His current focus is on growing the company’s SCADALink Product line which include SCADA & Telemetry Solutions such as SCADA Terminal Servers, Multiplexers, Wireless I/O, Wireless Modems and the SatSCADA Satellite Based Remote Monitoring Platform.

In his spare time, Ben enjoys spending time with his family, playing hockey and performing stand-up comedy.
SCADA & IoT
IoT Terminology Zoo

- IoT, IIoT, IT/OT
- Edge Devices
- Big Data
- MQTT
- Industry 4.0
- M2M
- SCADA
- Blockchain
- Data Analytics
- Artificial Intelligence
- Wireless Sensors Networks

SCADA History

• SCADA - became popular in 1960’s for Pipelines, Power, and Water Systems
• Central Computer “SCADA Host” communicates RTU (Remote Terminal Units) via multi dropped serial network
• Communications - 1200 Baud BEL202 on Leased Line or Radio Modems
SCADA History

- SCADA utilizes Polling Mechanism
- De facto Standard protocol - Modbus (ASCII/RTU)
- Proprietary Protocols for PLC/RTU - AB DF1, ROC, Totalflow
- DNP3, Profibus
- Ethernet Protocols - Encapsulated ...or Modbus TCP, Ethernet IP
- SCADA Protocols not Tag Based
History of IoT

• In 1999 Kevin Ashton coined the term “IoT”
• The **Internet of Things (IoT)** is the network of physical devices, vehicles, home appliances and other items **embedded** with **electronics**, **software**, **sensors**, **actuators**, and **connectivity** which enables these objects to connect and exchange **data**.
• Most pervasive example of IoT - Nest Smart Thermostat
Industrial Internet of Things

- The Industrial Internet of Things (IIoT) is the use of Internet of Things (IoT) technologies in manufacturing.
- Industry 4.0 originates from High Tech Strategy of German Government (Hannover Fair 2011)
Industrial Internet of Things

**Industry 4.0** is a name for the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of things, cloud computing and cognitive computing.

**Industry 4.0** is commonly referred to as the fourth industrial revolution.

Image Source, Wikipedia.org. ([Link](https://en.wikipedia.org/wiki/Industry_4.0)).
Industrial Internet of Things

- Manufacturing
- Infrastructure
- Environmental Monitoring
- Preventative Maintenance
- Logistics
SCADA .. Now

• SCADA Hosts - Distributed, Virtualization, Cloud
• SCADA Communications - IP Based Networks - Radio, Cellular, Satellite, Fiber, Ethernet
• Smarter Devices - PLC, RTU, Smart Transmitters
• Edge Devices - IoT Gateways, Web, VPN Routers
• Increasing Security - Private Networks, Security Layers
IoT Technology Drivers

- Cloud Connectivity
- Pervasive Use of Smartphone, Tablets
- Enabling Technologies
  - Microelectronics
  - IoT Hardware / Software Platform
  - Software Tools, Languages
  - Voice Recognition, Image Recognition
IoT Technology Stack

- Device Hardware
- Device Software
- Communications Technologies
- Cloud Platform
- Cloud Applications

Image Source, Daniel Elizalde (https://danielelizalde.com/iot-decision-framework/).
Devices Hardware

- Sensors, Actuators or Both - Connect to Physical World
- Low Power, Small Size, Often Battery Powered
- IoT Gateway to Connect non-IoT Devices to Cloud
Device Hardware

- IoT Gateways
- MultiSensor Devices - i.e. Cameras
Device Software

- IoT Operating Systems and Development
- IoT Application Code - IoT Protocols, Analytics
- Internet Oriented Languages - C, Java, Javascript, PHP, Python
- IoT Development Hardware/Software Platforms
IoT Communication

- Device to Cloud Connectivity
- Wired - LAN (via Router/Gateway) and Wireless
- Wireless - Short, Middle and Long Distance
- RFID, GPS
- ZigBee
- Bluetooth, BLE
- WiFi
- LPWAN - LoRaWAN, SigFox
- Cellular 3G/4G & Cellular LTE Cat M1
- Proprietary Wireless - 900 Mhz
- Satellite - Inmarsat, Iridium
Cloud IoT Platforms

- Place to Send, Store, and Process Info
- Cloud API, and Web Services - Ease Interface to Devices
- Secure Scalable Platforms

- AWS
- IBM Cloud
- Google Cloud Platform
- Microsoft Azure IoT Platform
- GE Digital
- PTC
Cloud Platforms

- Complete Range of IoT Cloud / SaaS Providers
- Infrastructure or Industry Centric
Cloud IoT Applications

- Solution Specific or Industry Specific
- Intelligent Use of Data (Save or Make more $$$)
- Solution Categories
  - Asset Monitoring
  - Production - Batch / Continuous
  - Fleet (Vehicles)
  - Worker
  - Environmental
  - Security
- Analytics - Splunk, Seeq, Cloudera, PTC, Thingworx, Tableau
- Historians - Honeywell
- Operations Digitalisation
Key IoT Concepts

• Cloud Connectivity
• Use of Structured Data Object Models - XML, JSON
• Publish/Subscribe Model - One to Many Connections (MQTT)
• Event Based Transmission (Push)
Structured Data Objects

- XML, JSON
- Human and Machine Readable Formats
- Allow Decoupling of Device(s) & Application(s)

Tag

```
{  
    "configId" : 988238887,  
    "tag" : [ {  
        "type" : "analog",  
        "name" : "PT101",  
        "tagId" : 665308309,  
        "register" : 0,  
        "units" : "PSI",  
        "value" : "1000.1",  
        "time" : 1525472507,  
        "alarm" : false,  
        "sup" : false,  
    } ]  
}
```
MQTT

- Message Queuing Telemetry Transport (MQTT)
- Invented by 1999 by Andy Stafford Clark at IBM and Arlen Nipper (Eurotech)
- Lightweight Protocol on Top of TCP/IP
- Publish/Subscribe Model

Temperature Sensor → MQTT Broker → Laptop
Publish: 21°C

Temperature Sensor → MQTT Broker → Mobile Device
Publish: 21°C

Laptop

Mobile Device

Subscribe to topic: Temperature
Publish to topic: Temperature
MQTT URI

- Data Access via Hierarchical URI(s)

Wildcards

**Single Level: +**

- only one level

**Multi Level: #**

- only at the end
- multiple topic levels

Image Source, 2018 dc-square GmbH (Link).
Industrial Pub/Subscribe Example

- Device to Device AND Device to Web Browser
- Connectivity Independent of Media - Cellular at Tank, Satellite at Pump
Event Based Reporting

- Event Based Reporting Reduces Bandwidth Requirements and Decreases Response Time
- Scheduled and Demand Updates Supported
## SCADA & IoT

### Similarities and Differences

### Summary

<table>
<thead>
<tr>
<th></th>
<th>SCADA</th>
<th>IoT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>Close Coupled Systems</td>
<td>M2M</td>
</tr>
<tr>
<td><strong>Architecture</strong></td>
<td>Centralized</td>
<td>Decentralized</td>
</tr>
<tr>
<td><strong>Approach</strong></td>
<td>Polling</td>
<td>Publish / Subscribe</td>
</tr>
<tr>
<td><strong>Security</strong></td>
<td>High</td>
<td>Low to High - Depending on Implementation</td>
</tr>
<tr>
<td><strong>Usage</strong></td>
<td>Mission Critical, Real-Time</td>
<td>Diagnostics, Monitoring, PM</td>
</tr>
</tbody>
</table>
The Future

• More IoT Technology Use into SCADA
• IoT Technology enables MES, OEE, & BI Integration
• Finally IT meets Automation
Questions.
Thank You.