OPC Unified Architecture (UA) Analyzer Device Integration (ADI) and the Potential Application to NeSSI™ Systems
Introduction

OPC 1995

Object Linking and Embedding for Process Control

- Delivers standard interface for exchanging information from disparate suppliers providing automation enabling applications

- Designed for:
  - App to app communication (COM)
  - PC to PC communication (DCOM)

- Microsoft OS centric

- Three interfaces, three distinct functional specifications
  - DA, HDA and A&E
Introduction
OPC UA 2006

OP\text{en} \text{ Connectivity} \text{ Unified} \text{ Architecture}

- Delivers standard interface for \textit{securely} and \textit{more efficiently} exchanging information \textit{including complex data} according to the specific needs of the automation industry

- Designed for:
  - Portability across platforms including embedded RTOS
  - Plant floor (remote sensors) through to enterprise level intelligence apps (dashboard)
  - Non-MS centric, service oriented architecture (SOA)
  - One interface, one distinct functional specification
  - Companion specs for Device and “ADI”
Introduction
ADI 2008

- **Analyser Device Integration**
  - Logical extension of OPC UA specification for Process Analytical Technology (PAT)

- **Born of Frustration**
  - PAT presents a relatively unique challenge for analyzer data exchange and control
    - Many analyser types, from various vendors with many different types of data, including complex arrays (spectra) and structures
    - Even analysers producing exactly the same data, do not use the same format
    - Many vendors do not publish the raw data forbidding final users to use generic tools to improve their data analysis
  - Common data exchange method for process and laboratory analysers needed

- **Standard data model**
  - For integration of many different analysers with proprietary protocols
  - Enables several levels of device integration from simple data acquisition to configuration and control
Many Types of Analysers

- Provide support for a wide range of existing and future analyzers including but not limited to:
  - Light Spectrometers
  - IR/NIR spectrometers (dispersive)
  - UV/VIS spectrometers
  - FT-IR/NIR spectrometers
  - Raman Spectrometers
  - Imaging spectrometers
  - Terahertz spectrometers
  - Radiometers
  - Light Induced Fluorescence spectrometers
  - Particle size monitoring systems
  - Particle Size Analyzer - Laser Diffraction
  - Particle Size Analyzer - Dynamic Light Scattering
  - Zeta Potential - Laser Doppler Electrophoresis
  - Focused Beam Reflective Measurement
  - Imaging particle size monitoring systems
  - Particle Size Definition
  - Automated Microscopy
  - Cell Counting
  - Acoustic spectrometers
  - Mass spectrometers
  - Chromatographs
  - Gas chromatographs
  - Liquid chromatographs (HPLC, UPLC …)
  - Imaging systems
  - NIR Chemical Imaging
  - Nuclear Magnetic Resonance spectrometers
Introduction
Some Data Interface Examples

- FTIR: Provides a DLL that gives access to instrument functionality with a series of method calls
- Matrix-F: Provides a DLL that gives access to instrument functionality through a generic 3 letter ASCII command code
- FBRM: No DLL or driver of any form, need to use proprietary RS232 protocol or full laboratory FBRM software
- Diode Array: Provides an OPC/DA interface with tags for array data, scalar data and instrument control
- MonARC: Embedded computer provides access to commands and data through SQL server databases
OPC-ADI builds on the OPC-UA Specifications.

OPC-ADI is one of many possible OPC UA Information Model Extensions.
OPC-ADI Analyzers in the Process
Standard Interfaces – Standard Data

- **FBRM used to monitor particle size**
  - Detect prevent clumping
  - Detect presence of fines that can clog filters
  - Provide data to allow closed loop control to optimize drying

- **NIR used to monitor moisture**
  - Determine end-point
  - Moisture profile used for asset monitoring
  - Provide data to allow closed loop control to optimize drying

- **Integration at Process Controller is standard and easier**
  - Complex data types available from analyzer controller to process controller in a standard format
Current Analyzers in the Process
Proprietary Interfaces – Non Standard Data

- FBRM used to monitor particle size
  - Detect prevent clumping
  - Detect presence of fines that can clog filters
  - Provide data to allow closed loop control to optimize drying

- NIR used to monitor moisture
  - Determine end-point
  - Moisture profile used for asset monitoring
  - Provide data to allow closed loop control to optimize drying

Integration at Process Controller is expensive and proprietary
- Limited data types from analyzer controller to process controller in non-standard format
ADI Analyzer Model
Extensible Data Model

- Represents a generic analyzer as a measuring device with n channels
- Models the slots for sample accessories and the actual installed accessories
- The model is flexible enough to represent analyzer systems made up of many discrete analyzers
NeSSI™ Applications
Gen 2 and 3 Systems

- Endeavors to arrive at a standard **Gen 2** communication bus brought us to:
  - Two standard protocols: CANopen and Foundation Field Bus
  - One proprietary protocol: I²C
- The concept of OPC UA ADI is to bring disparate standard and proprietary protocols to one analyzer data and control integration model
  - This, of course, does not address the physical layer
- With the advent of **Gen 3** systems, we will hopefully have myriad micro-analyzer technologies on board an SHS
NeSSI™ Applications
Gen 2 and 3 Systems

Analyser Network

- GC Oven
- GC Controller
- Gateway
- OP UA ADI Server 1
- OP UA ADI Server 2
- Server
- Accessories
- u Analysers
  - uH2O
  - uMS
  - uGC
- Gen 2
- Gen 3

Connections:
- CAN F/O Link
- CU F/O Link
- Ethernet

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NeSSI™ Applications
Gen 2 and 3 Systems

OPC UA Server $n$
ADI Server $n$

OPC UA Server 2
ADI Server 2

Analyzer Device Type

GC Device Type
- Channel
- Stream
- Sample
- Point

SHS Device Type
- Slot
- Accessory
- Heater

Analyzer Device Type
- uH20 Device Type
- uMS Device Type
- uGC Device Type

Flow 1
Flow 2
DVM

Gen 3

Gen 2

Creates address space in the UA server for the data templates
Proposed Connectivity Model
DCS Datalink Client/Server Topologies

Anlzr Level 1
Sensor Bus (CAN)

Anlzr Level 2 FLAN
(Private IP Addresses)

Anlzr Level 2 FLAN

Analyzer Control
Sampling Systems

Virtual Analyzer

Level 3 c-LAN
DCS Level 2 LAN (TDC=LCN)
GP Area - Control/Analyzer/RIB Room
Field

OPC Client Bridge (CB)
Router

DCS OPC Server

Server

Fiber-optic link

ADI Server

Data Aggregate

FTNIR
Raman

SAM

GC

Embedded SAM

OPC Client Bridge (CB)

Embedded

SAM
Conclusion
Takeaways

- Generation 3 will demand very high amounts of data including complicated data such as spectra
  - OPC UA provides compressed and binary data transfer, while managing secure access through Security Certificates like a web interface
- Different standard and proprietary protocols become transparent, with respect to data, at the OPC UA ADI server
- OPC UA is cross-platform focused as opposed to MS OS centric which pulls in the embedded device and remote sensor layer
- OPC UA is very flexible in where the server can reside allowing full flexibility in what and how much data gets moved around
Conclusion

Status

- Has OPC UA been released?
  - 2006, however while the companion spec for ADI has been released, that of the Device has not
- Where does the ADI specification stand?
  - Last meeting in November 2009. Meeting in August 2009 finalized the common data template for the GC.
- Has an OPC UA ADI server been implemented yet?
  - ABB Quebec demonstrated one at the ACHEMA exhibition in May 2009
  - Subject of presentation in Thursday AM IIB session
- How big is OPC UA? What hardware do I need to install it and the ADI server?
  - Smart module? Process analyzer? Server?
- Do I need to write any additional software to make it work?
  - OPC UA client