Turning **insight** into **action**.

OSIsoft. USERS CONFERENCE 2011

Using IEC 61850 and IEC 61400 for Wind Power Systems

Presented by **Ralph Mackiewicz, SISCO**

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Agenda

- The integration and complexity dilemma
- Benefits of using IEC 61850 and IEC 61400-25-2 for power system communications.
- Application to wind turbine controls.
- View of IEC 61850 Client for the PI System

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Interoperability & Integration

The ability of multiple systems to exchange information interact with each other in order to perform a useful business function for the user.

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Interoperability and Integration

Easy to Achieve:

Nearly anything is possible with enough money and development effort

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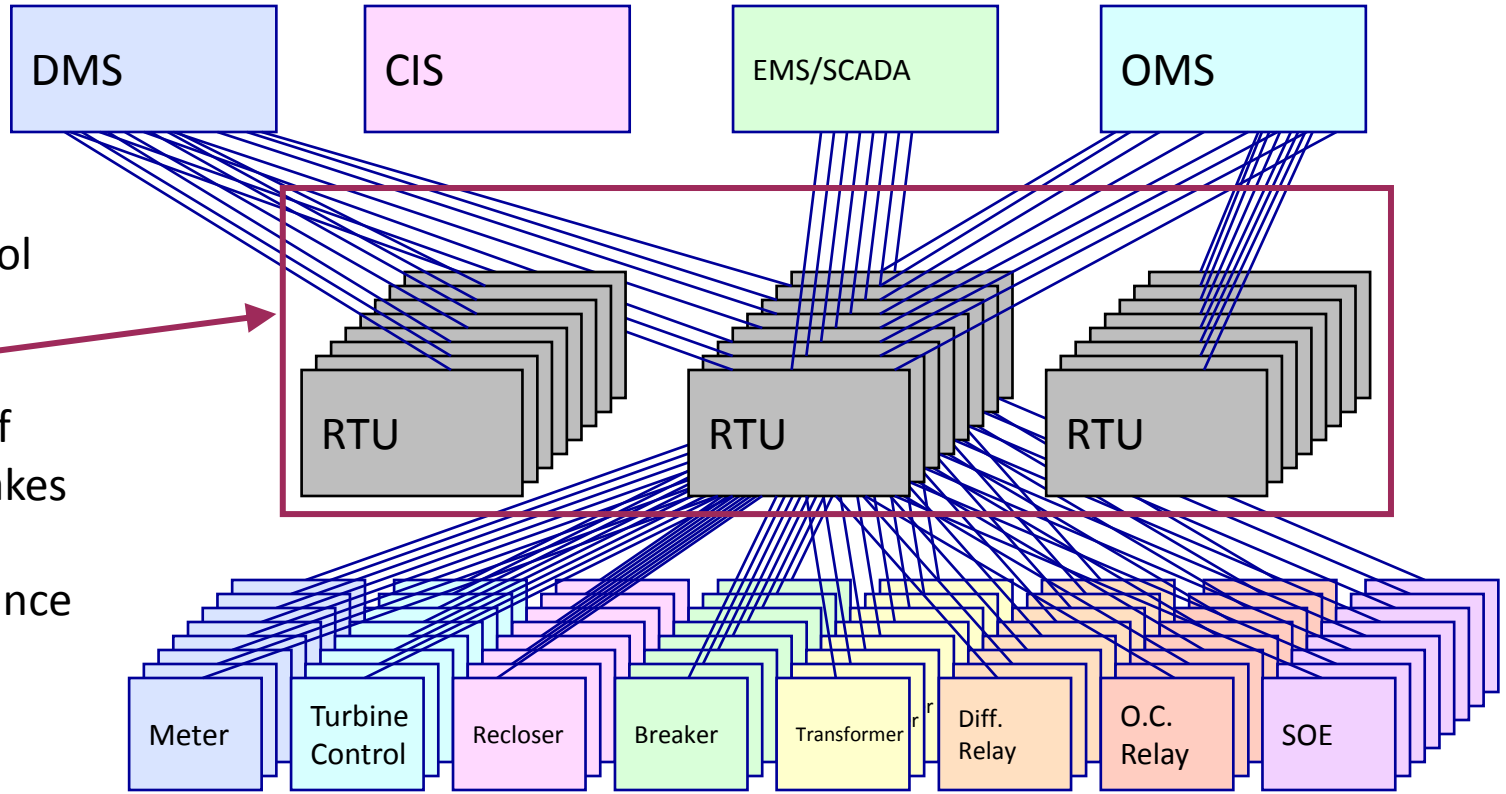
The Integration/Complexity Dilemma

Configuration, Mapping, Protocol conversion.

Multiple layers of configuration makes diagnostics and system maintenance difficult.



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A Better Way

- Interoperability and Integration without having to program it all yourself:
  - Where applications and devices are inherently capable of interoperating with other systems and performing integrated application functions in a cooperative and distributed manner.
- A **model driven approach** that provides a means of dealing with the complexity of systems.
- This is only possible if there are standards to enable it.
  - This work is progressing.
- This is the goal of the IEC TC57 standards

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IEC 61850 & IEC 61400-25-2 Key Features

- Object oriented standardized device and object models and naming conventions.
- Self-describing devices allow all object definitions to be retrieved over the wire.
- Highly functional supporting more power system functions than just SCADA.
- Standardized configuration language to improve the engineering and configuration process.
- Uses Ethernet and TCP/IP networking.

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Comparison of IEC 61850 vs.. Legacy Protocols

IEC 61850	Legacy Protocols
• Real-time data exchange	• Real-time data exchange
• Report by exception	• Report by exception
• Mapped to MMS Protocol	• Pick your protocol
• Device Control	• Device Control
– Enhanced	– Basic
• Minimal client configuration	• Manual or a priori knowledge configuration
• Protection messaging	• None
• SOE recording and query retrieval	• Proprietary implementation
• Security	• Proprietary, if supported.

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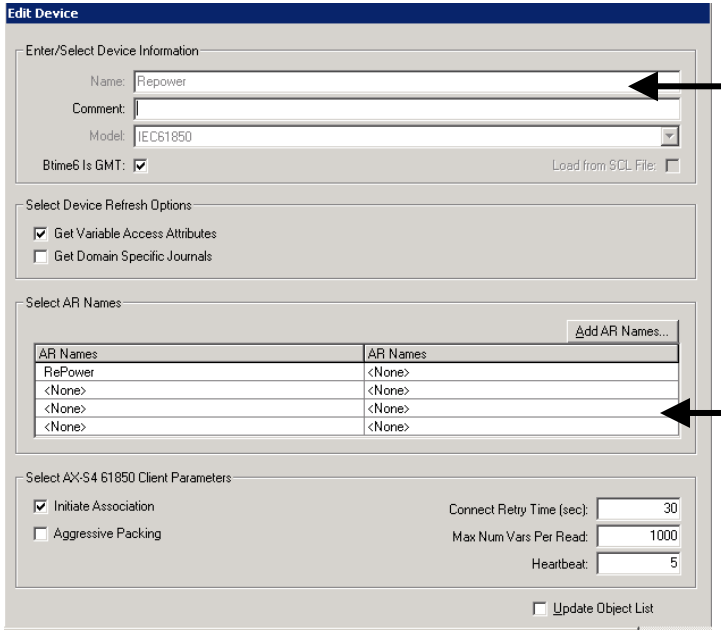
Basic Service: Connection Establishment



Device/IED

Multiple Access Points for redundancy

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Security Services

	ED.1	ED.2
Identity Authentication	Username/ Password*	Digital Certificates
Encryption (confidentiality)	—	SSL/TLS
Tamper Detection	—	TLS Message Authentication Code

Access Point password file

```
<ARNamePassswords>
  <ARName Name="RePower"><Password>![CDATA[-user#"iecdemo.eon" -pass#"e3zkzqaqz5v05"]]</Password></ARName>
  <ARName Name="RePo    -old-pw"><Password>![CDATA[-user#"iecdemo.eon' -pass#"v2icwj5a28ek2"]]</Password></ARName>
  <ARName Name="Wayn  "><Password>P"#ALy</Password></ARName>
  <ARName Name="Herb "><Password><![CDATA[!@#<>$%^&*()_{}[]'Herb]]></Password></ARName>
  <ARName Name="Mike "><Password><![CDATA[MiKE]]></Password></ARName>
</ARNamePassswords>
```

Access Point Name

Username and password string for REpower devices (ACSE authentication password)

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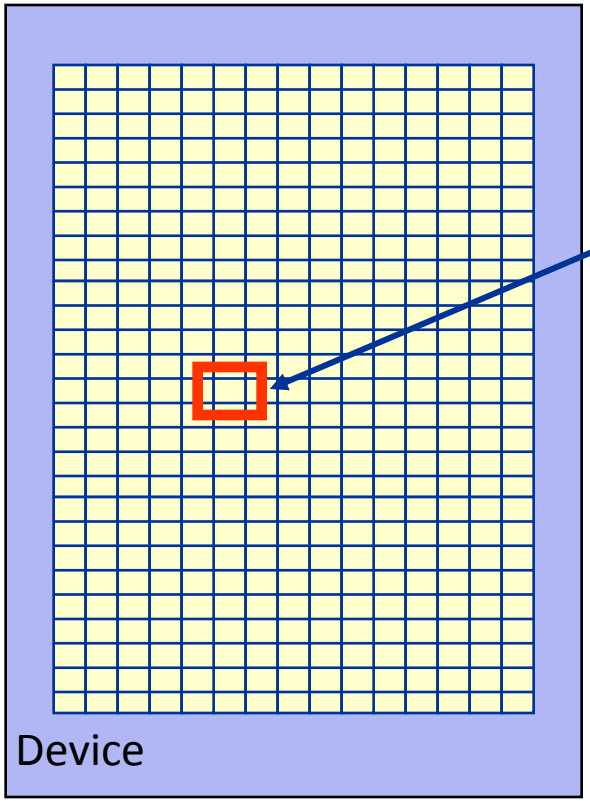
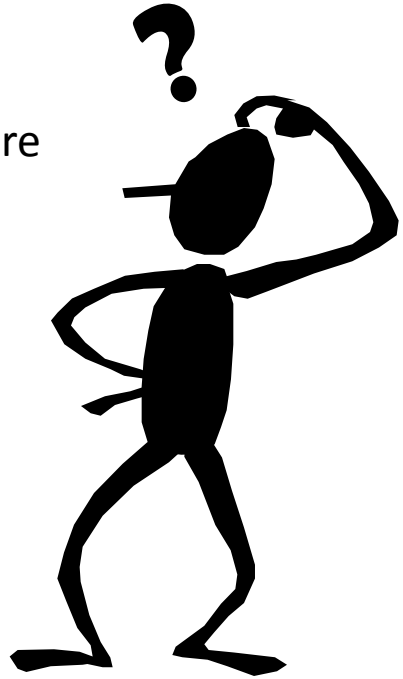
Data Access: Legacy Approach



Feeder #2 Current is here in Register 400020.

That's intuitive!?



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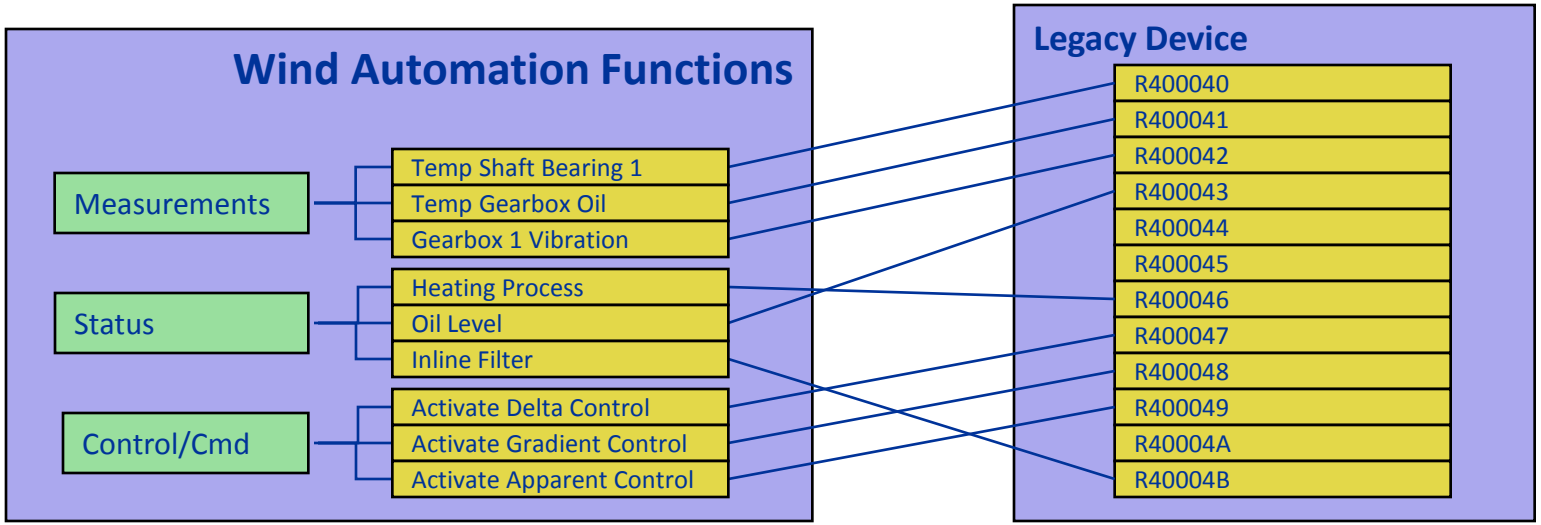
Legacy Object Mapping

Legacy data objects must be manually mapped to power system for each different device, application, and vendor.



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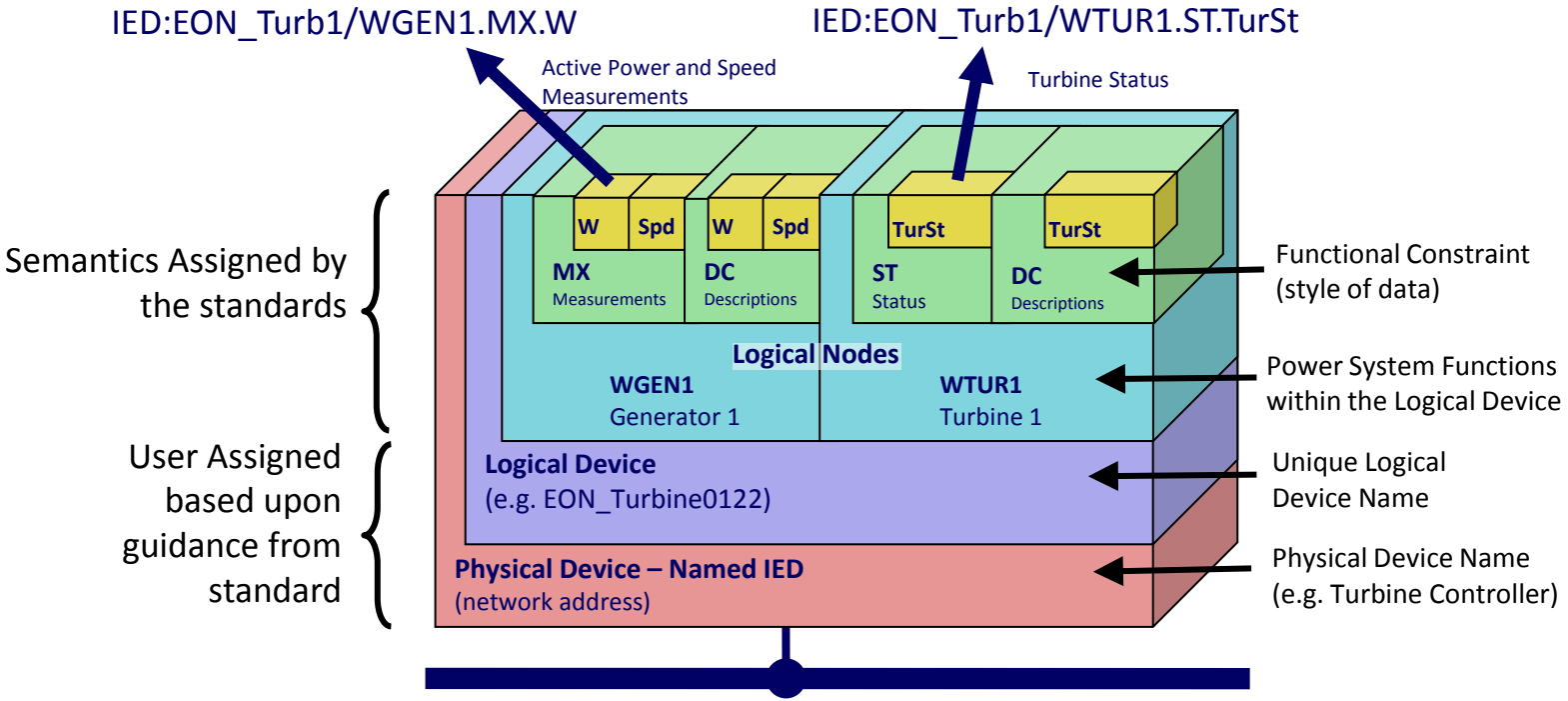
Anatomy of an IEC61400 Object Model



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A Wind Turbine – IEC 61400-25-2

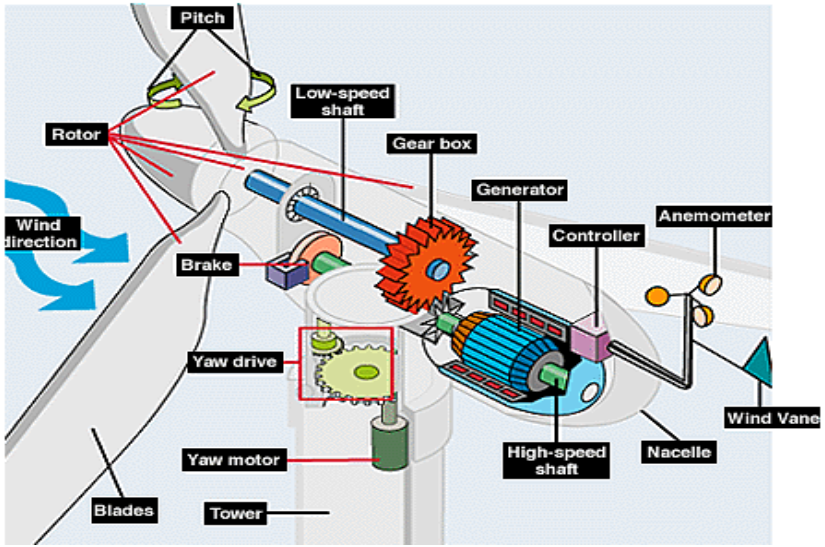

Table 1 – System specific logical nodes

LN classes	Description	M/O
LLN0	Logical Node Zero	M
LPHD	Physical Device Information	M

Table 2 – Wind power plant specific logical nodes

LN classes	Description	M/O
WTUR	Wind turbine general information	M
WMET	Wind power plant meteorological information	O
WAPC	Wind power plant active power control information	O
WRPC	Wind power plant reactive power control information	O

Table 3 – Wind turbine specific logical nodes

LN classes	Description	M/O
WTUR	Wind turbine general information	M
WROT	Wind turbine rotor information	M
WTRM	Wind turbine transmission information	O
WGEN	Wind turbine generator information	M
WCNV	Wind turbine converter information	O
WTRF	Wind turbine transformer information	O
WNAC	Wind turbine nacelle information	M
WYAW	Wind turbine yawing information	M
WTOW	Wind turbine tower information	O
WEVT	Wind power plant event information	M
WSLG	Wind turbine state log information	O
WALG	Wind turbine analogue log information	O
WREP	Wind turbine report information	O

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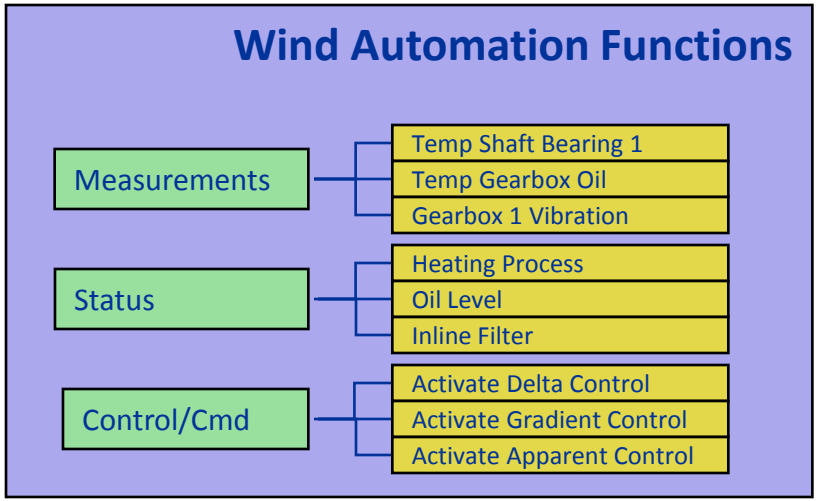
IEC 61400 Object Mapping

No Mapping Needed. Data is in Context Already



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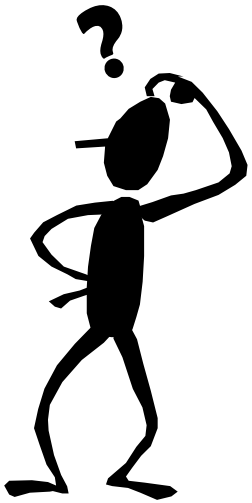
Why Is This Important?

Wind Farm



Which turbines are generating the most power?

Where are they located?

How are they configured?

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How do I know what data is present in the device?

- Standardized configuration file format (SCL).
- All IEDs are self-describing and support information discovery over the network.

Provides major benefit for Auto Point Synch (APS).

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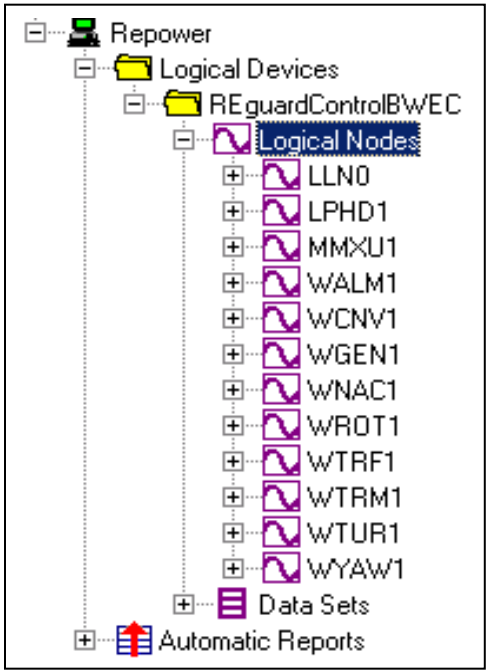
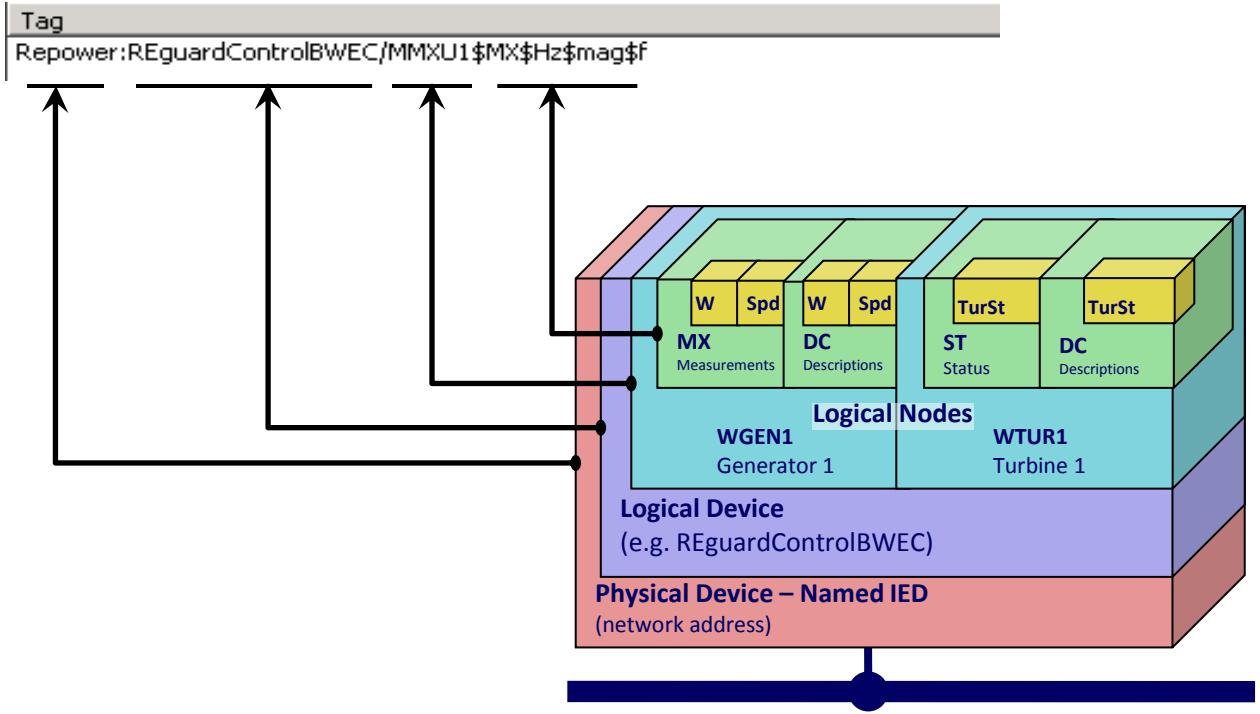
What do the results look like?





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Reporting

- Allows scalability at interfaces and minimizes use of bandwidth
- Unbuffered Reporting allows clients to receive data from the server without polling.
  - If network connection between client and server is lost, data is lost.
- Buffered reporting enables the server to retain data if comms are lost enabling the client to retrieve ALL data after reconnecting

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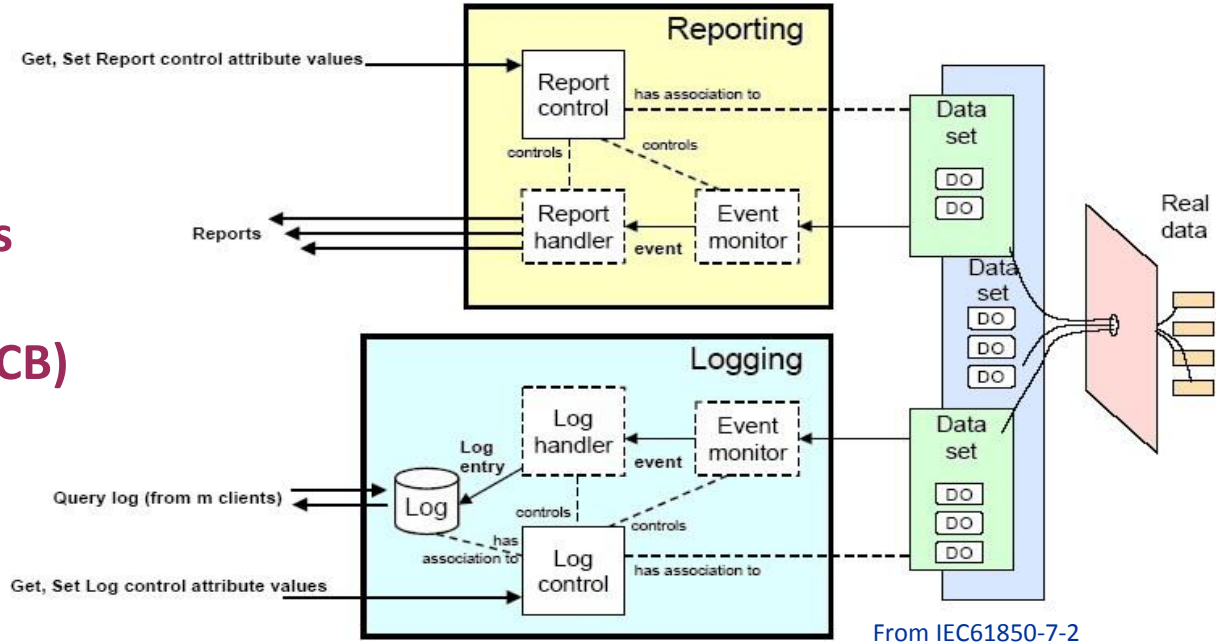
IEC 61850 Report/Log Model

The client controls reporting characteristics by interacting with a Report Control Block (RCB)



From IEC61850-7-2

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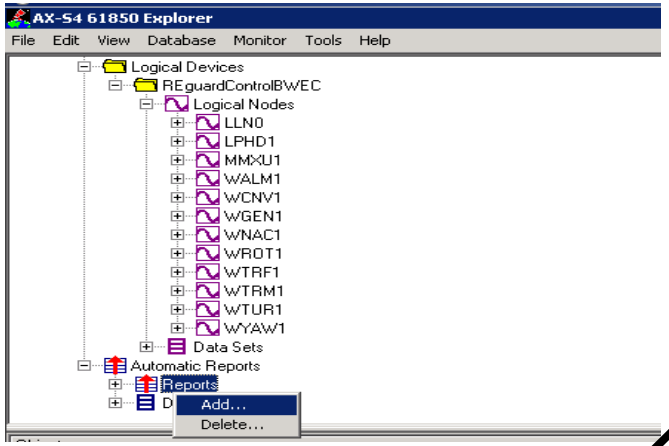
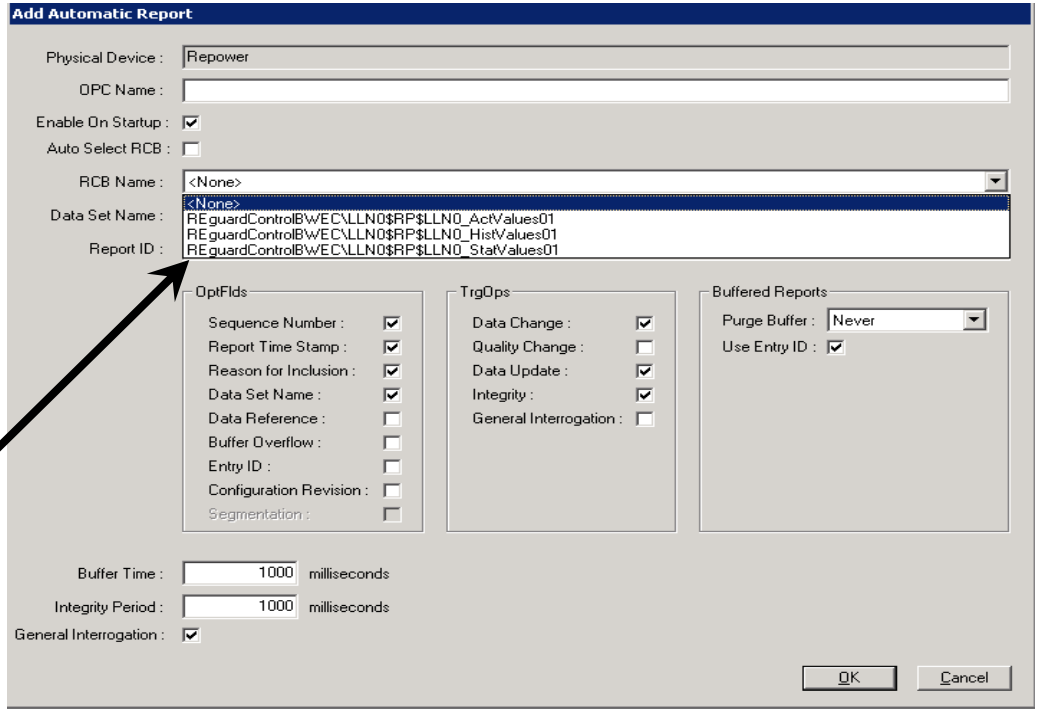
Auto-Report Configuration



Choose a REpower RCB



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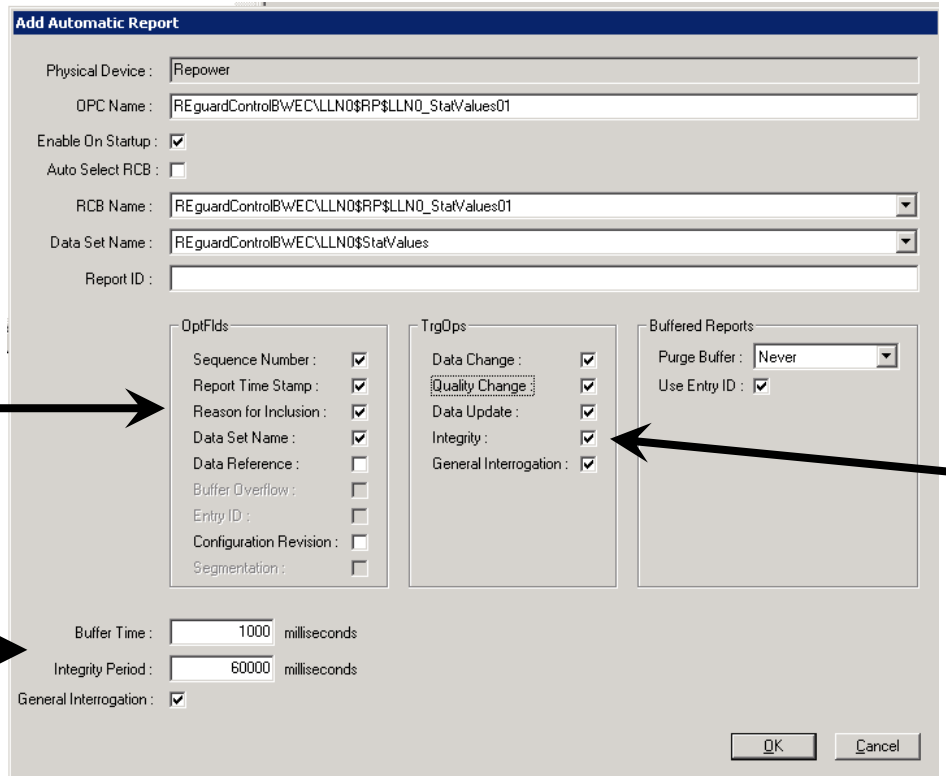
Report Configuration

What gets sent in report

Timing
(Consider Carefully!)



What triggers a report

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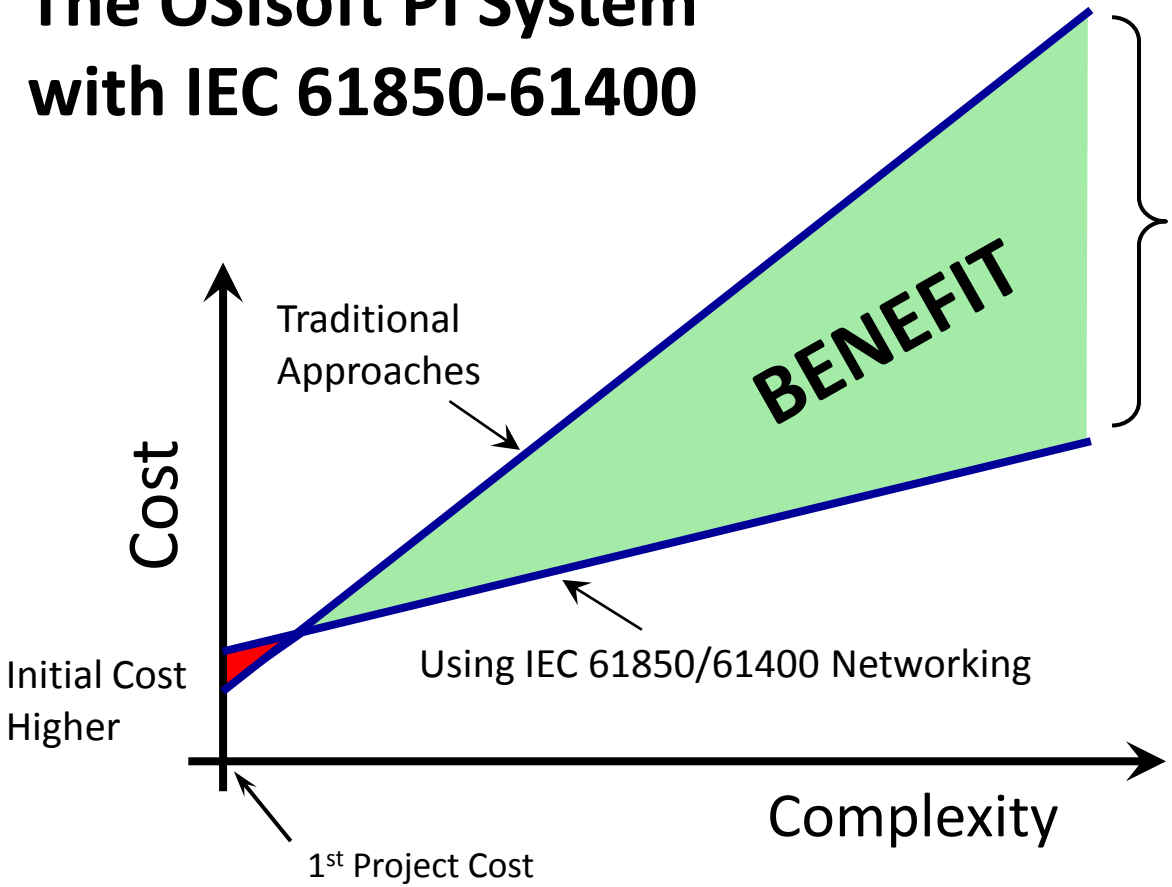
The OSIsoft PI System with IEC 61850-61400



Value that is lost by ignoring the long-term impact.

The complexity of Smart Grid systems like Wind, DER, etc. makes traditional approaches problematic.

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Questions?

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Thank you