GE
Energy

Summary

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POWERING POTENTIAL

The Smart Grid

imagination at work

Substation Integration and Automation Levels

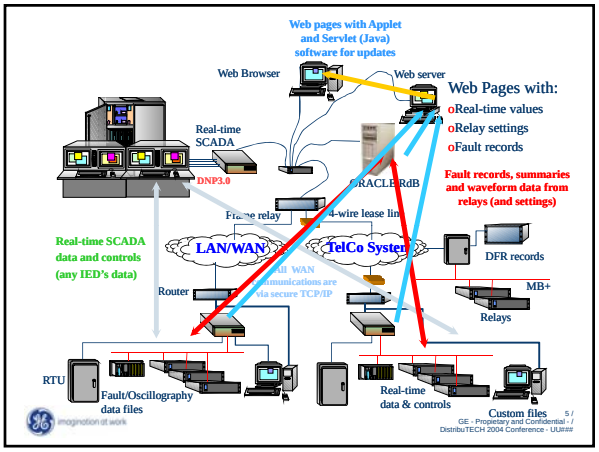
Utility Enterprise
Substation Automation Applications
IED Integration
IED Implementation
Power System Equipment (Transformers, Breakers)

Communication Paths From Substation

- Two second data to SCADA system (operational data)
- On demand data to utility information server or data warehouse (non-operational data)
- Dial up from remote site to isolate a particular IED (remote access - also called “pass through” or “loop through”)

Communication Paths From Substation (continued)

Utility Enterprise Connection		
SCADA Data to MCC	Historical Data to Data Warehouse	Remote Dial-In to IED
Substation Automation Applications		
IED Integration Via Data Concentrator/Substation Host Processor		
IED Implementation		
Power System Equipment (Transformers, Breakers)		



New Versus Existing Substations

- New Substations
  - IEDs With Digital Communications
  - PLCs for Direct I/O
  - No Conventional RTUs
- Existing Substations
  - May Integrate IEDs With Existing RTUs (Not Support Non-Operational and Remote Access Data Paths)
  - Integrate Existing RTU as IED or Eliminate Existing RTU and Use IEDs and PLCs for RTU I/O

Protocol Fundamentals

- Communication Protocol
  - Allows Two Devices to Talk to Each Other
  - Each Device Must Have the Same Protocol Implemented, and the Same Version of the Protocol
- Both Devices From Same Supplier, and Protocol
- Both Devices From Same Supplier, with Industry Standard Protocol
- Devices From Different Suppliers, with Industry Standard Protocol

Protocol Considerations

- North American Electric Utilities Specify the IEDs to be Used in a Substation
  - Chosen Based on IED's Standalone Capabilities (Relay for Protection of Power System) and Not IED's Integration Capabilities
  - IEDs From Various Vendors (Will Not Accept Turnkey Approach From One Vendor With All IEDs From that Vendor)

Protocol Considerations…(continued)

- Once IEDs Specified by Utility Based on Standalone Capabilities, Then Consider Each IED's Integration Capabilities
  - IED Protocol Support
    - Modbus, Modbus Plus, DNP3
    - IEC 61850
    - May Lose Some IED Functionality When Choose Other Than IED's Native Protocol
  - IED Networking Support
    - RS-232 and RS-485 (Serial)
    - Ethernet

Relevant Standards

- IEEE Std C37.1 – “SCADA Standard”
- IEEE Std C37.2 – Device Function Numbers – Two examples for showing multi-function IED on utility drawing
- IEEE Std 1379 – IED Protocol Recommendations
  - DNP3
  - IEC 870-5-101/103/104
- IEC 61850 – worldwide standard in substation automation communications
- Communication Protocols, IEEE Tutorial 95TP103, 1995
- Advancements in Microprocessor-Based Protection and Communication, IEEE Tutorial 97TP120-0, 1997, Chapter 9, Relay Communications