GE Wind Energy

Overview of Windfarm Communications Using DNP3

NREL
November 17, 2003

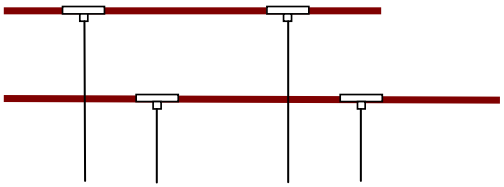
GE Wind Energy

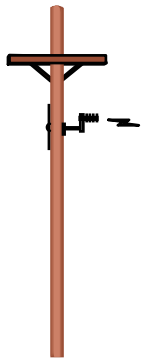
Windfarm High Level Communications Requirements

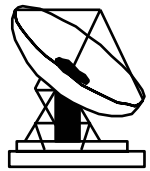
- Acquire quality and reliable real time and historical data on turbine and windfarm operations
- Integrating all windfarm assets' data (substation, met mast, relays, meters…) data into the system so one integrated homogeneous database for all windfarm assets
- Integrated data for remote monitoring and diagnostics, asset management, advanced diagnostics, condition based maintenance
- Allow for choosing "best-in-class" software and hardware
- Optimize system maintenance & configuration processes and costs
- Improved functional reliability… improved availability
- Improved secure real time access to data… anyone, anywhere, anytime
- Ability to reduce project configuration time
- Support advanced security technologies

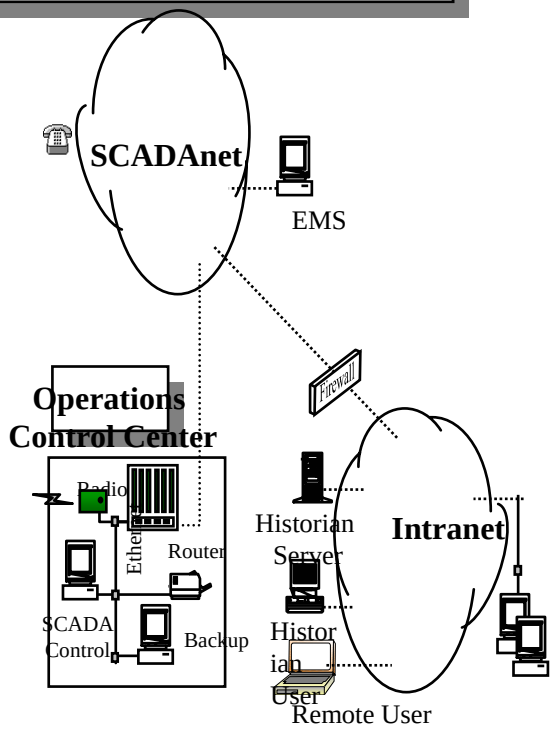
Windfarm LAN Protocol Requirements

- Flexible polling schemes, ability to poll by device, by class, by database points, unsolicited (report by exceptions)
- Multimedia: seamless integration across multiple physical media: Ethernet, serial, radio licenses / unlicensed RF, phone, … =
- Seamless integration across corporate LAN / WAN and Intranets / Internet
- Supported by multiple vendors, open, well documented, deployed in the field
- No significant processor requirements on slave devices (low overhead)









Future Protocol Requirements

- Self description, auto-configuration
- Device based object models
- Access security: encryption
- Peer to Peer communications

What to Watch Out for..

- Still a lot of low bandwidth systems… the “last mile” scenario
- Cost of implementation, learn from experiences of electric utilities with UCA, IEC 68150, millions of $$ have been and still not widely adopted by the industry
- Is the protocol stack too heavy for simple devices… processor requirements, $$
- Size, complexity and licensing issues of the protocol stack
- The learning curve for a complex protocol for windfarm implmentors

GE Wind Energy's Implementation of DNP3

- GEWE required a windfarm LAN protocol that was already deployed, well documented and supported by companies (source code, OPC drivers, test sets, defined subets, etc…)
- DNP3 met these requirements, today
- Promised migration path for future enhancements

History of DNP3

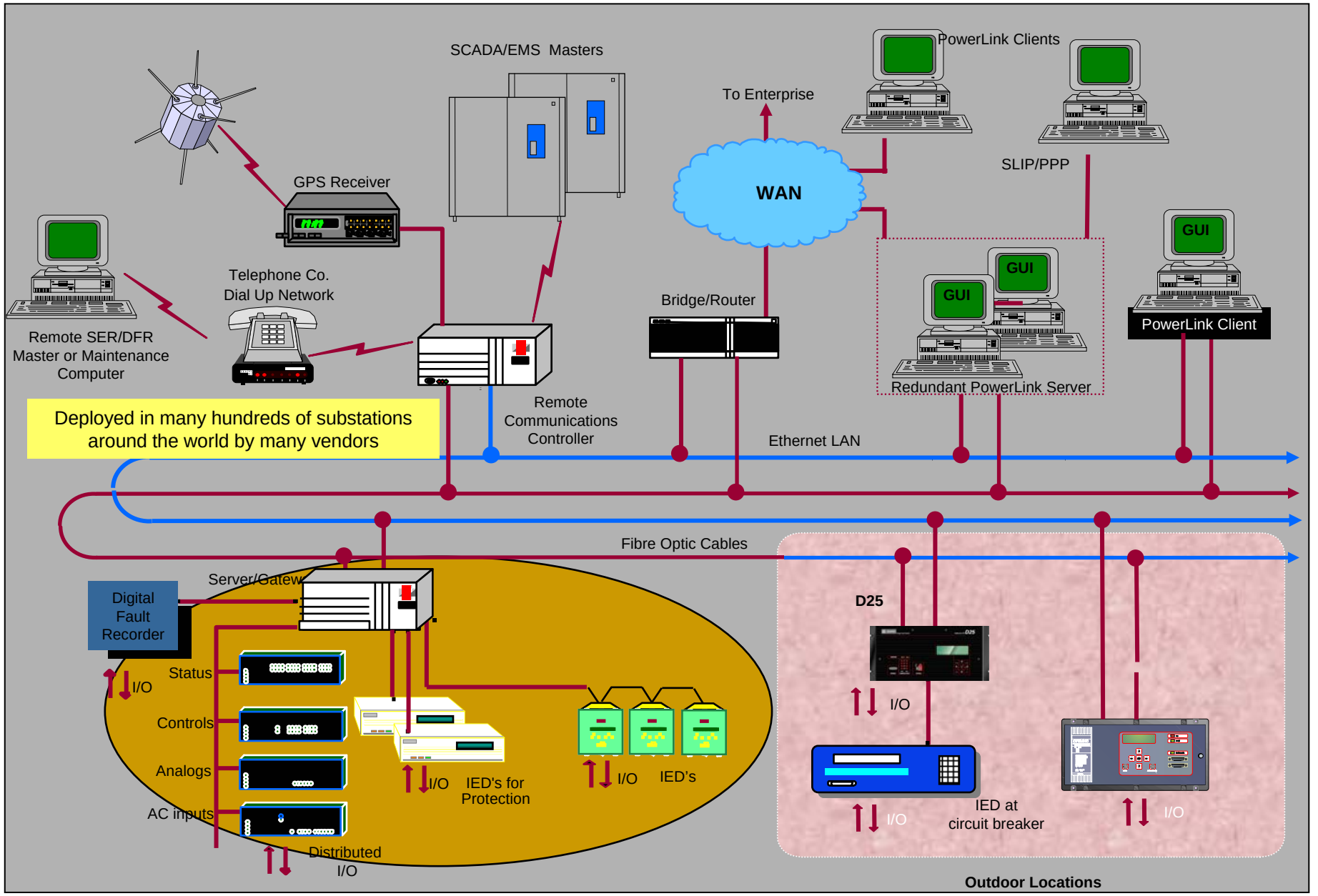
- Distributed Network Protocol, completely open protocol, extremely well documented and supported, has reached a level of maturity that makes deployment risk-free
- Based on early parts of IEC 870-5
- Turned over to Users Group in 1993
- DNP and IEC 870-5-101 have been specified in IEEE P1379

  Recommended Practice for Data Communications Between Intelligent Electronic Devices and Remote Terminal Unit
- DNP3 protocol is now the most popular protocol in use by global electric utilities
- DNP LAN implementation leads the way for use by both North American and international utilities.
- Vendor Products
  - >100 vendors, +250 DNP products and services, global
- Utilities/Industrials
  - used by >300 utilities and industrials worldwide

www.dnp.org

- Countries
  - used in over 32 countries. National standard in many
- Total Industry
  - $250 Million / year of DNP products and services
- Industries
  - Electric, Oil & Gas, Water and Industrial
- DNP Users Group: >300 active members, controlsthe protocol and migration, support web site, active Technical Committee, evolving documentation, technical bulletins

DNP3 in Substation LAN

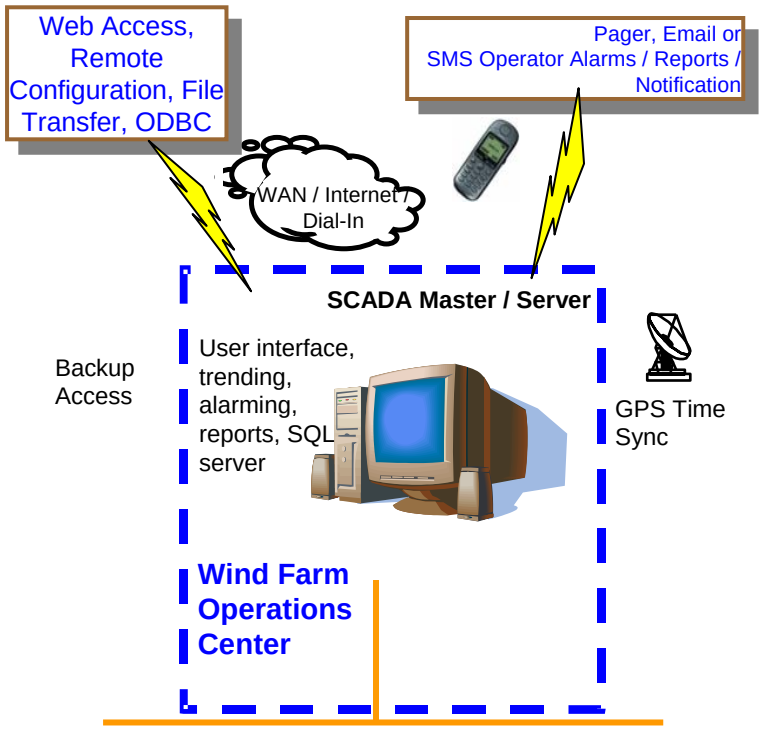


Wind Turbines with "Turbine Communications Server"

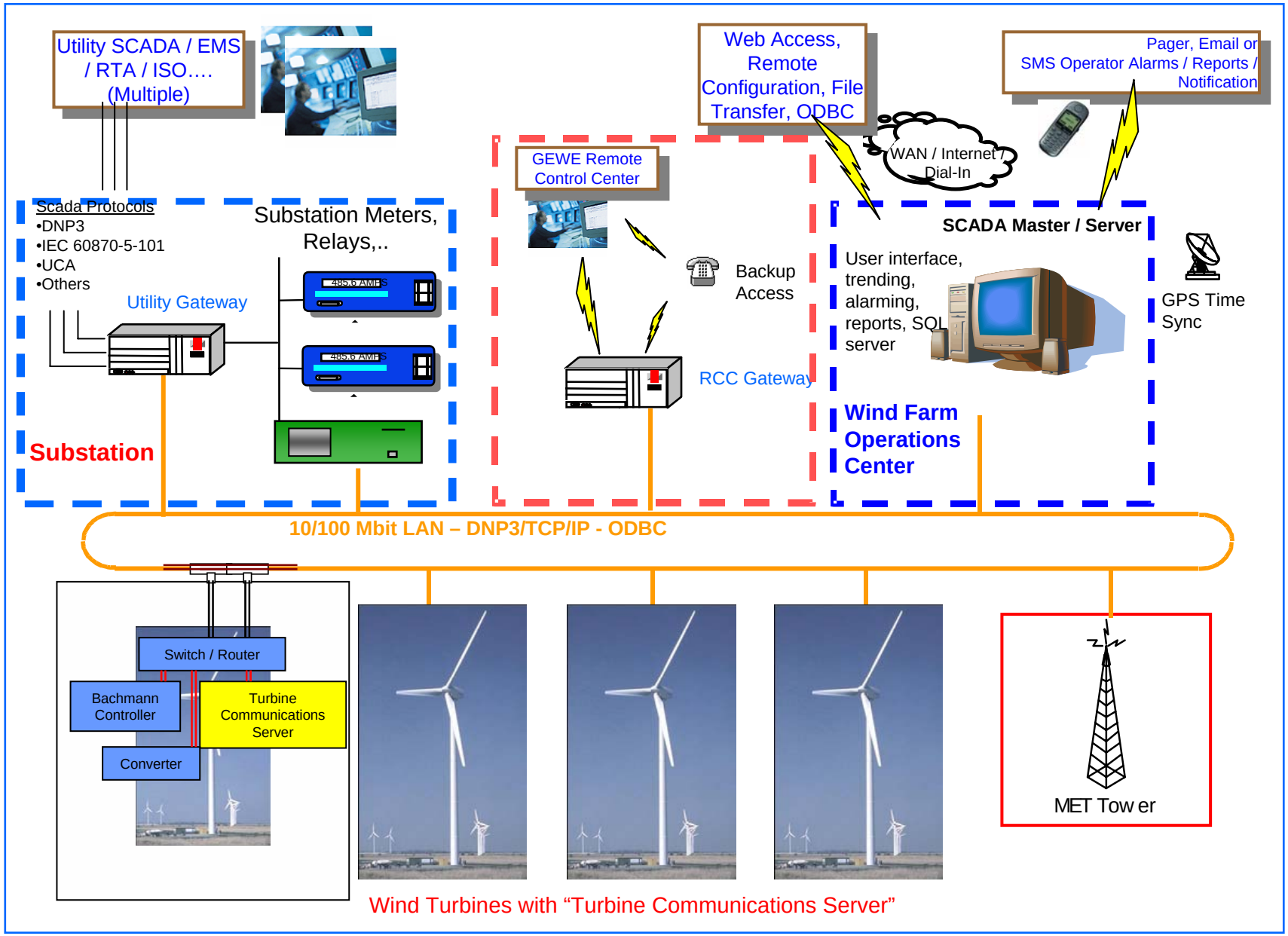
- Embedded PC platform… no hard drive or fan
- Linux operation system, embedded web server
- Real time interrupt driven database manager
- Polls data from wind turbine intelligent devices (Controller, meters, intelligent sensors, etc.)
- Secondary data processing, compression, alarming
- SQL database for local data archiving
- **DNP3 server for real time mission critical data**
- ODBC server for historical data
- OPC client or server for interface to other devices

SCADA Master Station

- **Graphical User Interface Screens**
  - Park / Turbine overview: animated
  - Annunciator
  - Communications network overview, alarms
  - Configuration screens
- **SQL Database**
- **Report Generation**
- **Real Time or Historical Trending**
- **Alarm Management**
  - Email, SMS, voice, fax
- **Remote User Interface**
- **Communications to Windfarm**
  - DNP3 for real time mission critical data
  - ODBC for historical data
  - High configurable and “tunable”



Next Gen SCADA & Automation Program



DNP3 and IEC 61400-25

- Many members of the DNP Technical Committee also on IEC 61850 committee
- Many discussions ongoing regarding migration / melding of DNP3 and 61850
- 61400-25 can leverage from these activities, many similarities and much larger focus ($$) associated with 61850 activities and years of work
- DNP3 and 61400-25 can run concurrently on the same physical LAN, an ideal migration strategy

Substation Automation after IEC 61850