Implementing Real-Time Statistical Analysis of Power Quality in a Distributed Generating Environment (multiple wind farm sites)

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SCADA systems involved in a wind farm project:
• Wind turbine SCADA.
• Substation SCADA.
• Meteorological tower data acquisition system.
• Transmission company’s SCADA.
• Teleprotection SCADA (in charge of isolating a specific part of the transport/distribution network in case of a fault).
• Distribution company’s data acquisition system (that analyses the wind production in function of its external parameters and defines a model to use in the planning of its available power from the production companies).

Needs of the transporters in general:
• Time latency of less than 1 second for a specific category of points.
• Utilization of a specified protocol of communication.
• Real-time monitoring of the state of the turbines and some devices of the substation.
• Real-time monitoring of the alarms of the substation.
• Statistical information from the weather and the production.
• Conversion algorithm to standardize the information from different turbine manufacturers.
• 2 separated network interfaces to isolate the SCADA LAN from the transporter’s private link.

SCADA Architecture Proposition:
(Case study of a wind farm that is connected to Hydro-Quebec’s network)

This approach, centralized on the SMP gateway to concentrate the data, pre-process the information and be the final interface with the transporter’s installations, will now be a standard requirement for all new wind farm sites being connected to Hydro-Quebec’s network in the next few years.

Advantages:
• Remote access to the IEDs directly (configuration, porturbation, state of communication, ...)
• Flexibility in the calculations that could not be done into the wind turbine SCADA or the Substation SCADA.
• Possibility to either use the Substation SCADA as a Central SCADA or add a 3rd SCADA systems to interface directly with the gateway and be the Central points of the operators.
• Time Latency < 500 ms end to end.
• This approach covers both the Transporter’s and the Producer’s needs.

Case study, Hydro-Quebec’s requirements since 2007:
• Time latency of less than 900 ms for the status and alarms, 3 seconds for the real time measurements and 10 minutes for the statistical data.
• Usage of the unsolicited reporting functionality of the DNP3 protocol over TCP/IP.
• Real-time monitoring of 70 measurement points from the substation and the turbines.
• Statistical information that represents 50 points per met mast, 20 points per turbine and 25 points in general in regards to the production.
• A total of more than 1700 points transmitted for a wind farm of 60 turbines.
• Requirements of some specific calculations derived from the information that is available into the different systems (vectors statistics, available power seen at the substation, at the turbines and for the park at large, number of turbine stopped for low temperature, high wind and low wind).

Needs of the producers:
• Centralisation of the different SCADA systems on a site.
• High resolution archiving of the mission critical information.
• Condition based monitoring when possible.
• Monitoring and archiving the raw data of the critical information from the turbine SCADA that usually, for most of the manufacturer, archives on a 10 minute average base.
• Possibility to export all the data to a remote Control Center.
• Remote access to the system and specially to the IEDs directly, to get a remote support from the specialists to the local team.
• Efficient system of alarm pager to inform/alert the operation personnel.
• Redondancy on mission critical devices.
• Modem backup lines on routers and gateways.
• Good understanding of its own needs as well as the power company’s ones to include the central SCADA system into the initial construction of the wind farm as much as possible.

Example of requirement in term of Time Latency of the critical information

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>DNP3</th>
<th>RTU</th>
<th>gateway processing (in ms)</th>
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<tr>
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<td>300</td>
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<tr>
<td>GE</td>
<td>200</td>
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