Acquiring Operational and Non-Operational Data from Substation IEDs

Smart Grid Tutorial

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“Operational” Data

- Data that represents the **real-time status, performance, and loading** of power system equipment
- This is the **fundamental information used by system operators** to monitor and control the power system
- Examples:
  - Circuit breaker open/closed status
  - Line current (amperes)
  - Bus voltages
  - Transformer loading (real and reactive power)
  - Substation alarms (high temperature, low pressure, intrusion)
“Non-Operational” Data

- Data items for which the **primary user is someone other than the system operators** (engineering, maintenance, etc.)
- Note that operators are usually interested in some data that is classified as non-operational
- Examples of “Non-Operational” data:
  - Digital fault recorder records (waveforms) (protection engineer)
  - Circuit breaker contact wear indicator (maintenance)
  - Dissolved gas/moisture content in oil (maintenance)
## Characteristics of Operational and Non-Operational Data

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Operational Data</th>
<th>Non-Operational Data</th>
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<tbody>
<tr>
<td>Data Format</td>
<td>Usually limited to <strong>individual time sequenced data items</strong></td>
<td><strong>Usually a data file</strong> that consists of a collection of related data elements</td>
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<tr>
<td>Real Time vs Historical</td>
<td>Usually consists of <strong>real-time or near real-time</strong> quantities</td>
<td>Mostly <strong>historical</strong> data: trends over time</td>
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<td>Data Integration</td>
<td>Easily transportable by conventional SCADA RTUs using <strong>standard (non-proprietary) protocols</strong></td>
<td>Typically use <strong>vendor specific (proprietary) formats</strong> that are not easily transported by SCADA communication protocols</td>
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Flow of Operational and Non-Operational Data

SCADA

SCADA Data Warehouse

Corporate Network

Planning

Engineering

Maintenance

Customer Services

Billing, Settlements

EMS/DMS Dispatchers

Secure Network

Substation Data Repository

Access to Operational and Non-operational Data

User Interface PC; Configuration, Monitoring, & Maintenance

Substation

Data Concentrator

Hardwired I/O

Transformer IEDs

DGA Monitors

Revenue Meter

GIS
Why Have Multiple Data Paths?

- Prevent “nuisance” alarms (alerts)
- Avoid burdening SCADA facilities
- Lack of SCADA support for file transfer and proprietary protocols
- Some useful IED non-operational data items use formats that may not be supported by legacy SCADA protocols
- Sheer volume of data (especially non-operational data)!
Acquisition of Operational Data Items

- SCADA protocol like DNP3 can be used to access most “simple” IED data items
- Data passed to SCADA supplier’s data warehouse (historian)

![Diagram showing the acquisition of operational data items](image)
Acquisition of Non-Operational Data Files – Basic Approach

1. Use manufacture specific software (or equivalent) to **extract data from the IED** (acSEl erator, TapTalk, etc)

2. **Capture the data** acquired by this software in a non-proprietary format

3. **Transmit (push or pull)** the resultant data file to a shared drive on the corporate network

4. **Enable authorized personnel to access the data** using standard analytical tools
Approaches for Obtaining Non-Operational Data

- **Approach 1**: Download directly from the IED

- **Approach 2**: Use “Pass through” capabilities of substation data concentrator

- **Approach 3**: Local data concentrator as non-operational data server
Approach 1 - Direct Download Approach

- Travel to the substation
- Plug laptop containing manufacturer specific data into PC
- Download data directly from the IED onto the laptop
- Transfer the data to the corporate network via docking station or other data off load mechanism
- Pro’s And Con’s
  + Low tech- low cost approach
  - Not continuous monitoring – delays in retrieving data
Approach 2 - “Pass Through”

- Copy of IED manufacturer specific software stored on IED access server
- End user connects to access server using multi-level authentication
- Access server establishes a “pass through” connection to IED in question via the substation data concentrator
- End user interacts with the IED and downloads the required data as though desktop PC was directly connected to the PC in the substation
- Downloaded data is then copied to a shared drive as necessary
- Pro’s/Con’s:
  + Technically simpler than network approach
  - Promotes data silos
  - Requires special IED software on each desktop PC

- Today, most systems use this approach!
Approach 3 - Data Concentrator as Non-Operational Data Gateway

- IED manufacturer software (acSELerator, Tap talk, etc) or equivalent loaded onto substation data concentrator

- Data concentrator communicates directly with the IEDs to acquire non-operational data files

- Data concentrator converts data files to standard format

- Converted data file “pushed” or “pulled” into ELSI
Approach 3 - Data Concentrator as Non-Operational Data Gateway

- Advantage of this approach:
  - Fewer field devices to manage from central location – 1 SDC versus multiple IEDs
  - Data files transferred over WAN using FTP, OPC or other standard method versus IED specific protocol

- Disadvantage
  - SDC must support the IED proprietary ASCII protocols
  - Not many do at this time