

Phasor Data Quality Tracking Tools

March 24, 2016

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Phasor Data Quality Needs Attention

- Data quality assurance is becoming increasingly important for successful integration of synchrophasor data into utility operations.
 - Device (PMU) availability
 - Time quality issues
 - Value quality issues
- Alarms are needed to alert real-time analytics and operators of bad or missing phasor data.
- Reports are needed to support businesses processes to improve data availability and data quality

Phasor Data Quality Tracker

A Practical Tool

- An open source project jointly funded by Dominion and PeakRC
- Version 1.0 has been released and is now available which includes core functionality and two data quality reports

<http://github.com/GridProtectionAlliance/pdqtracker>

High Level Features

- Focus is on the two major dimensions of quality
 - Data Completeness (Availability)
 - Data Correctness (Accuracy)
- Stand alone product for use within any synchrophasor data architecture
- Outputs to support:
 - Business processes for correcting / improving data quality
 - Integration with applications to flag incorrect data

Data Quality Tests

Completeness

- Bad CRC
- Out-of-Order Frames
- Missing Frames

Correctness

- Time
 - Reasonableness
 - Latency
- Values
 - Reasonableness
 - Latched Value
 - Comparison Tolerance
 - Bad Data Pattern

PDQ Tracker maintains statistics on data completeness

PDQ Tracker raises alarms to flag incorrect data

Completeness Report

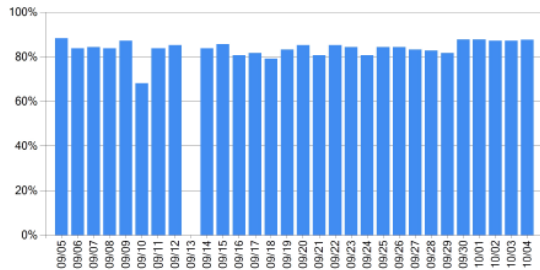
PDQTracker Completeness Report Grid Protection Alliance

Sunday, October 04, 2015

5-day Device Data Completeness

	09/30	10/01	10/02	10/03	10/04
L4: Good	156	141	160	163	163
L3: Fair	18	33	13	10	10
L2: Poor	17	12	12	10	9
L1: Offline	3	8	8	10	10
L0: Failed	4	4	5	5	5
Total	198	198	198	198	197

Percent of Devices with Acceptable Quality (30 days)



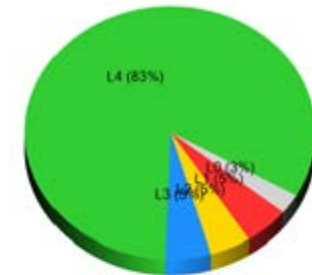
Definitions

- Level 4: Good - Devices which are reporting as expected, with a completeness of at least 90% on the report date.
- Level 3: Fair - Devices with a completeness of at least 90% on the report date.
- Level 2: Poor - Devices which reported on the report date, but had an completeness below 90%.
- Level 1: Offline - Devices which did not report on the report date, but have reported at some time during the 30 days prior to the report date.
- Level 0: Failed - Devices which have not reported during the 30 days prior to the report date.
- Completeness: Percentage of measurements received over total measurements expected, per device.
- Acceptable Quality: Devices which are in Level 4 or Level 3.

Sunday, October 04, 2015

Data Completeness Breakdown

Level 4 163
Level 3 10
Level 2 9
Level 1 10
Level 0 5



Level 0

Name	Completeness	Data Errors	Time Errors
_____N_01	0%	0	0
_____02	0%	0	0
_____01	0%	2,591,678	2,591,678
_____PE_01	0%	2,591,678	2,591,678
_____tC_01	0%	2,591,678	2,591,678

Level 1

Name	Completeness	Data Errors	Time Errors
_____R_01	0%	2,591,672	2,591,672
_____HN_01	0%	2,591,672	2,591,672
_____01	0%	2,591,672	2,591,672
_____PI_01	0%	2,591,749	2,591,749
_____p_01	0%	2,591,678	2,591,678
_____02	0%	0	0
_____01	0%	0	0
_____01	0%	0	0
_____01	0%	0	0
_____01	0%	0	0

Level 2

Name	Completeness	Data Errors	Time Errors
_____01	4.85%	2,465,957	2,465,957
_____CM_04	84.24%	0	0
_____CM_05	84.24%	0	0

Correctness Report

PDQTracker Correctness Report

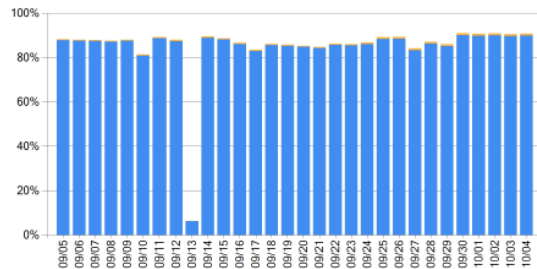
Grid Protection Alliance

Sunday, October 04, 2015

5-day Correctness Summary

	09/30	10/01	10/02	10/03	10/04
Good	90.10%	89.82%	90.03%	89.72%	89.93%
Latched	0.52%	0.53%	0.52%	0.60%	0.61%
Unreasonable	0.39%	0.39%	0.34%	0.22%	0.22%

30-day Correctness Overview



Definitions

Good: Measurements received which are neither latched nor unreasonable.
 Latched: Measurements received which have maintained the same value for an extended period of time.
 Unreasonable: Measurements received whose values have fallen outside of the range defined by reasonability constraints.
 Correctness: Percentage of good measurements over total measurements expected, per device.

Sunday, October 04, 2015

Data Correctness Breakdown

Name	Correctness	Latched	Unreasonable	Total
E_09	78.71%			
Name E_09-FQ		2,194,781	0	2,194,781
N_02	68.09%			
Name N_02-PM2		0	2,591,872	2,591,872
Name N_02-FQ		8	0	8
DX_03	68.44%			
Name DX_03-PM2		0	2,591,872	2,591,872
N_03	68.09%			
Name TN_03-PM2		0	2,591,872	2,591,872
N_03	68.43%			
Name N_03-PM2		0	2,591,872	2,591,872
DX_04	68.44%			
Name DX_04-PM2		0	2,591,871	2,591,871
IT_03	83.34%			
Name NT_03-PA1		2,589,574	0	2,589,574

Configuring Alarming

PDQTracker Manager - GPA\rcarroll

PDQTracker Manager Current Node: Default

Home Devices Monitoring Alarms Reports Diagnostics Advanced

Manage Alarm Configuration

Tag Name* AL-HIGH:GPA_DEFAULT!SYSTEM:ST3

Signal* GPA_DEFAULT!SYSTEM:ST3 ...

Operation Greater than Alarm Point 85

Tolerance

Delay 10 seconds Hysteresis

Description High CPU Alarm Severity High

Enabled

Load Order* 0 Create Associated Measurement

Delete Add New Save

TagName	Operation	Severity	Description	Enabled
AL-HIGH:GPA_DEFAULT!SYSTEM:	GPA_DEFAULT!SYSTEM:ST3 > 85	High	High CPU Alarm	<input checked="" type="checkbox"/>

Page Size: 15 << < 1 of 1 > >>

Version 1.0 Available

<http://www.PDQTracker.com/>

The screenshot displays the PDQTracker Manager web interface. The top navigation bar includes Home, Inputs, Outputs, Actions, Metadata, Monitoring, Reporting, and System. The main content area is divided into several sections:

- Quick Links:** A vertical list of buttons for Graph Measurements, Stream Statistics, Input Device Wizard, Browse Input Devices, Concentrator Output Streams, Remote System Console, and Restart Service.
- Completeness:** A section titled "2-Day Completeness Report" showing data for 10/22 and 10/23.
- Current Configuration:** A section providing system details such as Instance Type (64-bit), Server Time, Local Time, Current User (swills-PCswills), and Version Information for the Server and Manager (both 2.0.167.0). It also includes Database Information (Type: SQLServer, Name: PDQTracker).
- Correctness:** A section titled "2-Day Correctness Report" showing data for 10/22 and 10/23.

	10/22	10/23
L4: Good	21	24
L3: Fair	73	70
L2: Poor	5	5
L1: Offline	0	0
L0: Failed	0	0
Total	99	99

	10/22	10/23
Good	89.89%	89.90%
Latched	1.84%	1.83%
Unreasonable	1.57%	1.57%

phasor data **open
ECA** platform

New Tool for Analytic Development
Including Data Quality Analyses



DOE FOA 970
DE-OE-778

Project Partners

- Dominion Virginia Power
- Oklahoma Gas and Electric
- Southwest Power Pool
- Northwestern Energy
- Bonneville Power Administration
- Virginia Tech
- T&D Consulting Engineers
- Grid Protection Alliance
- DOE – Office of Electricity

Analytics Development is Simplified

Today's Approach

- “Signal” paradigm
- Use IEEE C37.118
 - Socket management
 - Protocol parsing
 - Exception handling
- Local data buffering to support analytic cycle times
- Local configuration management

Using openECA

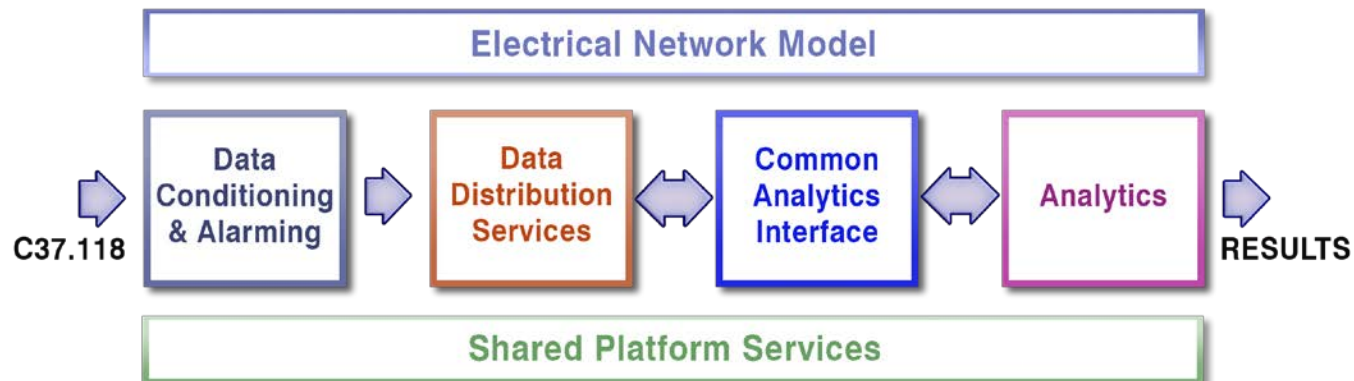
- Both standard and custom data objects
- An API (the CAI) that provides
 - Hi-performance pub/sub data access using standard messaging (e.g., Zero MQ)
 - Access to meta data services
 - Local data buffering options
- Starter templates provided
 - Matlab
 - F#
 - C#

Value to the Industry

- Lowers cost of addition of new production analytic tools
- Simplified end-to-end configuration and change management
- Improved availability of phasor data with greater visibility of phasor data quality
- Robust scalable solution to support phasor data infrastructure of any size
- Complements current phasor data architecture and supports integration with other data sources such as SCADA

Architectural Elements

- Data Conditioning / Alarming (*Quality Check!*)
- Data Distribution Service
- Common Analytics Interface (CAI)
- Electric System Model
- Shared Platform Services
- Analytics



Provided Analytics

1. Localized Voltage-VAR Controller
2. PMU Instrument Transformer Calibration
3. PMU Synchroscope
4. Real-Time Impedance Calculator
5. Regional Voltage Control
6. Topology Estimator
7. Transmission Line Impedance Calibration
8. Oscillation Detection
9. Oscillation Mode Meter
10. Synchronous Machine Parameter Estimation
11. Acceleration Trend Relay Improvement

Other Data Quality Tools

- EPG Synchrophasor Data Validation and Conditioning Application
- Alstom Data Quality tools (built-in)