

Overview

PDQ TRACKER

phasor data quality alarming & reporting

J. Ritchie Carroll

October 23, 2014

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

- An open source project jointly funded by Dominion and PeakRC's new synchrophasor project
- Alpha Version now available which includes core functionality and two data quality reports
- Beta Version with increased functionality planned for release Spring 2015

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

Other PDQ Tracker Features

- System integration with an internal GPS clock to identify time-based issues
- Auto configuration of standard alarms as new PMUs are added
- Includes detailed alarm history and alarm logging data systems
- Documented API for real-time alarms – with filtering
- Ability for “comparison alarms” to be easily created
- Auto generation of email for specific alarms
- Creation of multiple auto-generated, periodic reports
- Auto emailing of periodic reports

Data Quality Tests

Completeness

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

PDQ Tracker maintains statistics on data completeness

Correctness

- **Time**
 - Reasonableness
 - Latency
- **Values**
 - Reasonableness
 - Latched Value
 - Signal/Noise Ratio
 - Comparison Tolerance
 - Off-Normal
 - Bad Data Pattern

PDQ Tracker raises alarms to flag incorrect data

PDQ TRACKER

phasor data quality alarming & reporting

© 2014 Grid Protection Alliance.



Comparison Made Easy

- Assumes comparison values from a state estimator or SCADA system are available via a file (e.g., every 10 seconds) where each value is identified with an EMS-based ID.
- Comparison adapter creates new calculated points within PDQ Tracker based on the difference between the PMU measurement and the comparison value.
- Alarms can be created based on these calculated comparison values.

What's "Off Normal" ?

- Values that are within valid ranges that can be indicators of potential data quality issues
- Off-Normal values can be caused by:
 - Failing measurement systems
 - Failing power system equipment
 - Valid, but rare system conditions
- Off-Normal limits and based on statistical analysis – e.g., values exceeding the annual 5 sigma for this measurement (normal occurrence < 30 minutes per year)

What's a bad data pattern?

- Values that are within valid ranges but which when analyzed as a waveform (or as a series of values) indicates measurement system problems.
- Examples include:
 - Rapidly cycling values
 - Independent step change in value

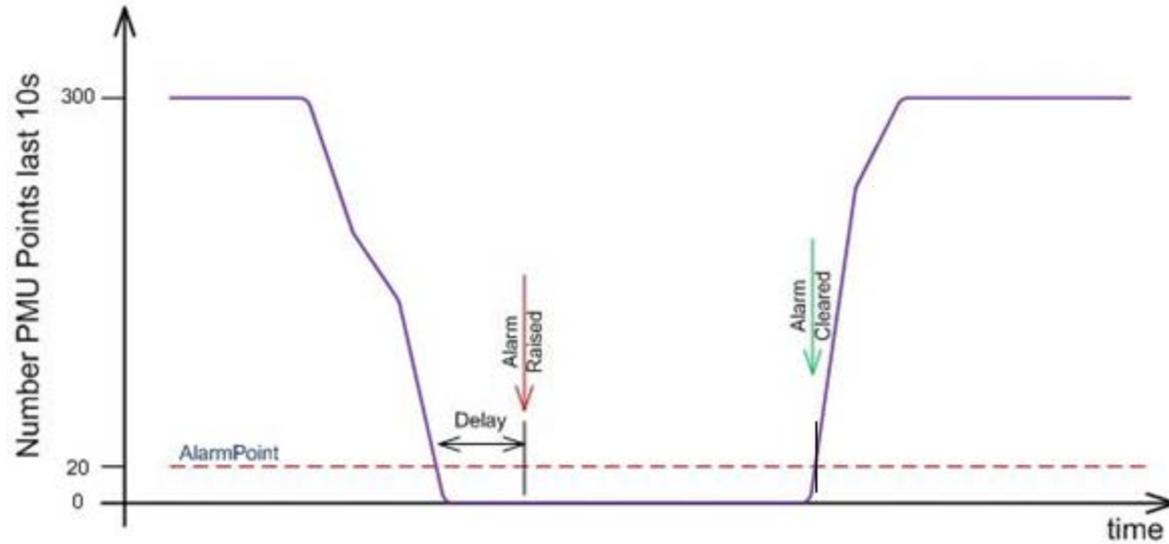
Hierarchy of Alarms

- A group of alarms is created for a “measurement point” provided to PDQ Tracker
- A measurement point can be:
 - A measured phasor magnitude or angle
 - A calculated value, such as
 - the difference between a measured value and a value from the state estimator
 - The rate of change of a measured value

The alarm group

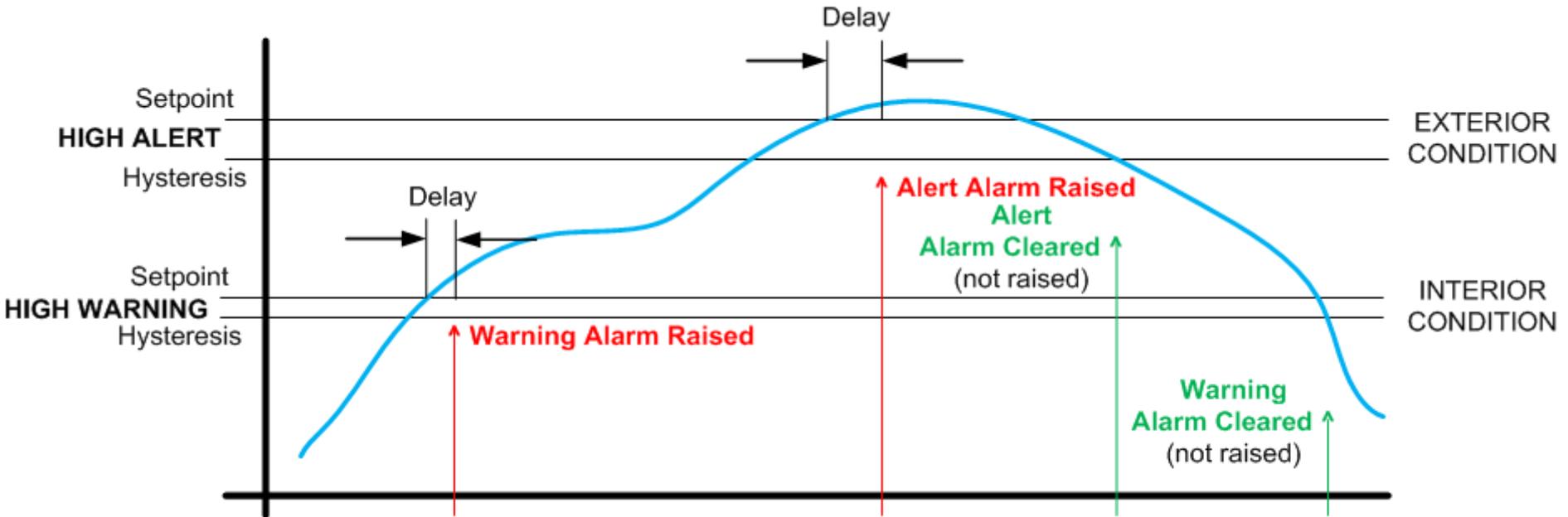
- Can be any number of alarms that fall into a severity hierarchy.
 - The presence of a higher severity alarm for a measurement suppresses lower severity ones.
 - Critical Error – 1000
 - Bad Time -- 990
 - Latched Value – 980
 - Bad Data Pattern – 970
 - Engineering Reasonableness - 900
 - Alert – 700
 - Warn – 500
 - Off-Normal – 100
- } ≥ 900 Data Accuracy Alarms
- } May be Data Accuracy related
e.g., warning alarms based on comparison values

Simple Alarming



Alarm Set Point and Delay

More Complex Alarming Example



Warning and Alert Alarms are raised at set points and are cleared only after falling below a specified hysteresis.

Automated Reporting

- Multiple reports will be included
 - Daily Reporting
 - Existing 5-day availability plus list of PMUs sorted by duration of outage
 - Infrastructure summary stats – alarms and data flow
 - PMUs added / not-reporting
 - Relative Stream Latency
 - Absolute Stream Latency
 - Monthly reporting
 - Worst performing devices (PMUs)
 - Infrastructure summary stats – alarms and data flows
 - Relative Stream Latency
 - Absolute Stream Latency

Daily PMU Data Completeness Report

PDQTracker Completeness Report Grid Protection Alliance

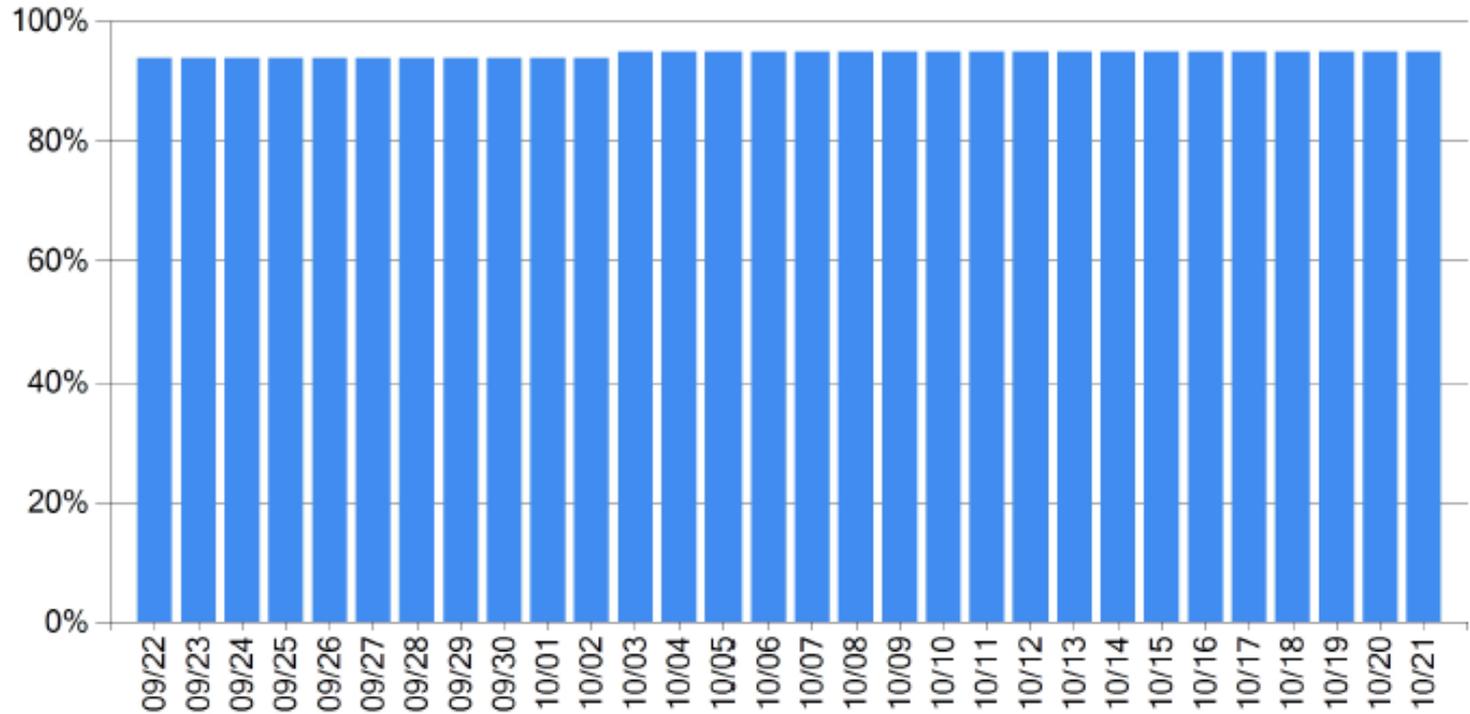
Tuesday, October 21, 2014

5-day Device Data Completeness

	10/17	10/18	10/19	10/20	10/21
L4: Good	21	24	22	21	24
L3: Fair	73	70	72	73	70
L2: Poor	5	5	5	5	5
L1: Offline	0	0	0	0	0
L0: Failed	0	0	0	0	0
Total	99	99	99	99	99

Daily PMU Data Completeness Report

Percent of Devices with Acceptable Quality (30 days)



Daily Data Correctness Report

PDQTracker Correctness Report Grid Protection Alliance

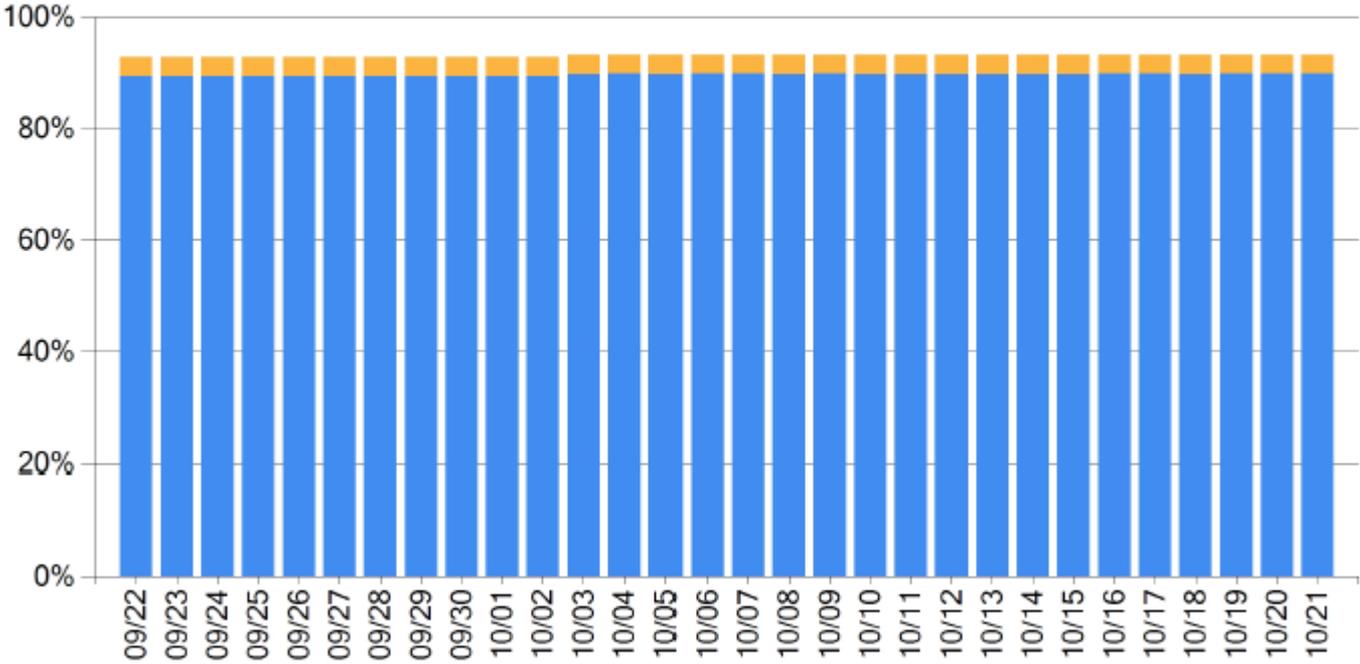
Tuesday, October 21, 2014

5-day Correctness Summary

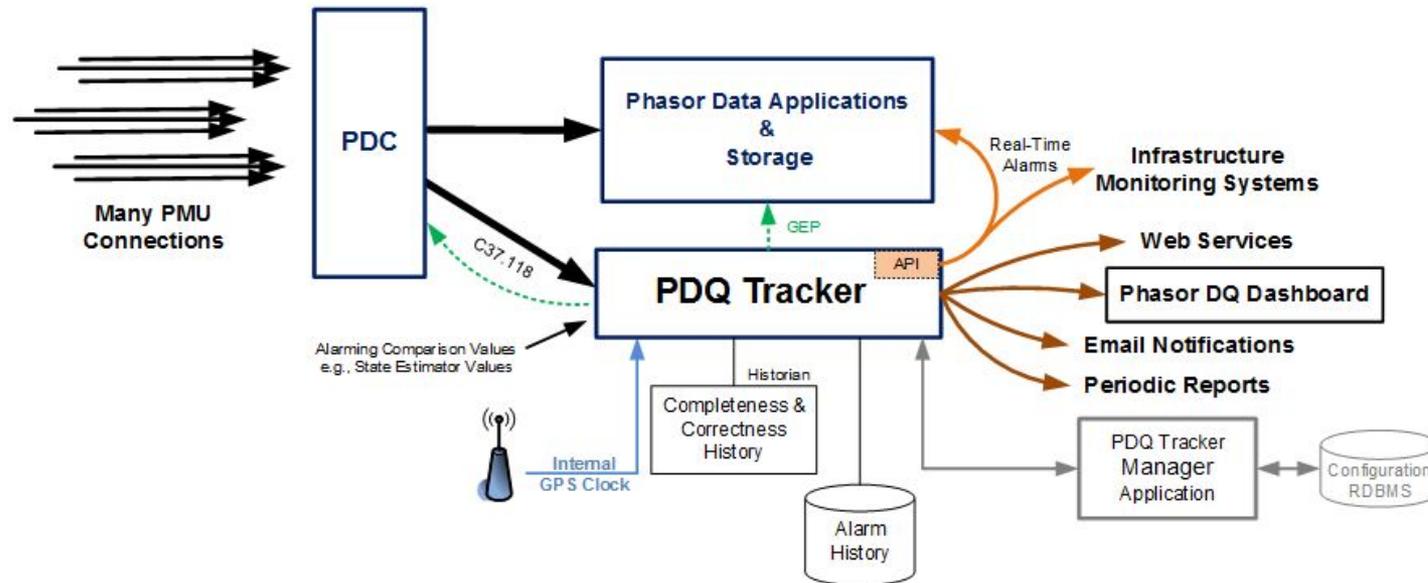
	10/17	10/18	10/19	10/20	10/21
Good	89.91%	89.88%	89.90%	89.89%	89.90%
Latched	1.84%	1.84%	1.84%	1.84%	1.83%
Unreasonable	1.57%	1.57%	1.57%	1.57%	1.57%

Daily Data Correctness Report

30-day Correctness Overview



Typical Installation



PDQ Tracker is installed in parallel to existing infrastructure, can be used with any vendor's PDC and by default is self-configuring.

PDQ TRACKER

phasor data quality alarming & reporting

© 2014 Grid Protection Alliance.

Alpha Version Available

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

The screenshot shows 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 showing instance type (64-bit), server and local times, current user (swills-PCswills), and version information for the server and manager (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%

PDQ TRACKER

phasor data quality alarming & reporting

© 2014 Grid Protection Alliance.

