Vision and Scope Document

for

AGPro

Version 4.0 approved

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<05/23/12>

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Revision History

Name	Date	Reason For Changes	Version
Team AGPro	10/24/11	Revisions to comments	2.0
Brandon Hamer	10/27/11	Revisions	3.0
Vinh Tran	05/22/12	Revisions	4.0

1. Business Requirements

1.1. Background

Alstom Grid currently uses a system, known as open source phasor data connector (openPDC), that is used to manage, process and respond to dynamic changes in fast moving streaming phasor data. More specifically, the openPDC can process any kind of data that can be described as "time-stamped measured values". These measured values are simply numeric quantities that have been acquired at a source device and are typically called points, signals, events, time-series values or *measurements*.

Examples of measurements include temperature, voltage, vibration, location, luminosity and, of course, phasors. When a value gets measured, an exact timestamp is taken, typically using a GPS-clock for accuracy – the value, along with its timestamp, is then streamed to the openPDC where it can be "time-aligned" with other incoming measurements so that an action can then be taken on a complete *slice* of data that was all measured at the exact same moment in time.

Phasor measurements complement traditional electric utility control systems and measure electrical information on the grid in order to determine its efficiency. The electric system information is sampled at very high speeds with individual measured values getting transmitted at 30 times per second.

1.2. Business Opportunity

While openPDC is an efficient tool for gathering synchrophasor measurement data, it doesn't provide an easy way to turn the data into information for Alstom Grid employees. Currently, openPDC has a playback tool that provides users a way to view stored data but this playback tool has been described as difficult to use, lacking features, and unable to deliver reliable results. To resolve this issue, a tool that can convert the data stored by openPDC into understandable models, visualizations, and statistics has been proposed. With this tool, Alstom Grid engineers and IT staff could be more productive when analyzing or assuring the quality of the synchrophasor measurement data stored by openPDC. Lastly, this system is being designed specifically for Alstom Grid employees, but, it has the potential to be distributed to Alstom Grid clients as the most efficient way to interpret openPDC synchrophasor data.

1.3. Business Objectives and Success Criteria

BO-1. To increase employee efficiency when analyzing or assuring the quality of synchrophasor data, measured by employee feedback comparing the new tool to the, currently available, openPDC tool

BO-2. To decrease the number of errors made by employees when analyzing synchrophasor data, measured by employee reporting of ability to use product without making errors as compared to the currently available openPDC tool

BO-3. To produce a tool that can be distributed by Alstom Grid to its clients, with the goal of improving client relations by sharing successful software

1.4. Customer or Market Needs

CN – 1. Currently, openPDC offers a very rudimentary file-historian playback tool. It is rudimentary in that the playback tool has been described as hard to use, unreliable, and lacking quality visualization tools to model the data stored by openPDC. What's needed is a tool that is user friendly and delivers reliable and useful graphical models and statistics to help analyze synchrophasor data.

1.5. Business Risks

RI-1. Development has a fixed timeline from the current date until the end of the spring school quarter; key features may not be implemented in time.

Mitigation: Iterative development will provide advance awareness of schedule problems to allow frequent re-prioritizing of scope.

RI-2. Employees not satisfied with system's provided visualization models and statistics.

Mitigation: Create multiple models that will be presented to the employees. See which models are preferred.

RI-3. The time required to process the data file is too long, thus eliminating increased employee efficiency.

Mitigation: Research on most efficient methods of processing the data which reduced processing time as much as possible to maintain employee efficiency.

2. Vision of the Solution

2.1. Vision Statement

For the employees of Alstom Grid dealing with the extraction and analysis of synchrophasor data, our system is a front-end data analysis tool that will enhance their ability to interpret the mass quantities of data while making the process quicker and simpler. The tool will provide valuable data modeling features for Alstom Grid engineers to view trends and patterns in the data as well as a variety of statistical analysis features to allow Alstom Grid IT staff to check the quality and consistency of the incoming data. Unlike the current tool available, openPDC file-historian playback tool, our system will be a user friendly way to reliably view meaningful models and statistics of synchrophasor data that will improve employee efficiency.

2.2. Major Features

MF-1. Intuitive graphical representations of synchrophasor data
- MF-1a. Line Graph
- MF-1b. Pie Graph
- MF-1c. Bar Graph

MF-2. An inference tool that spots trends in the data over time

MF-3. Exportation of openPDC synchrophasor data to CSV format

MF-4. Easily extendable (Sample extensions could be pattern frequency analysis)

2.3. Assumptions and Dependencies

With respect to the initial release, the stakeholders agree on the following assumptions:

AS-1. Alstom Grid will provide data files for use
AS-2. Alstom Grid provides API to get input data.
AS-3. AGPro will not distribute its product to any users besides Alstom Grid sponsors

The project depends on the following external factors outside of its control:

DE-1. Availability of Alstom Grid sponsors to give timely feedback on user interface and data modeling features

3. Scope and Limitations

3.1. Scope of Initial Release

MF-1. User friendly interface which users can get tasks done simply and quickly
MF-2. Intuitive graphical and statistical representations of synchrophasor data, providing different options of graphing data

MF-2a. Line Chart: Good for observing dataflow
MF-2b. Pie Chart: Good for overviewing data statistic
Md-2c. Bar Chart: Good for observing abnormal data on statistic

MF-3. Exportation of openPDC synchrophasor data to CSV format with faster file processing

3.2. Scope of Subsequent Releases

MF-4. An inference tool that spots trends in the data over time

3.3. Limitations and Exclusions

None to date 05/23/12

4. Business Context

4.1. Stakeholder Profiles

Stakeholder	Major Value	Attitudes	Major Interests	Constraints
Power Systems Engineer	Easier data analysis	See product as effective data modeling tool	Visualization tool is meaningful and easy to understand	Data processing speed
IT employees	Quality control	See product as effective data quality assurance	Statistical representations of incoming data from	Data processing

		tool	openPDC	speed
Alstom Grid company	Employee efficiency	Increased employee effectiveness	Quick data analysis times	None to date 10/14/11

4.2. Project Priorities

Dimension	Driver (state objective)	Constraint (state limits)	Degree of Freedom (state allowable range)
Schedule	Release 1.0 to be available by 2/1, release 1.1 by 3/1	Individual schedules limiting availability	As of now the degree of freedom is fairly high, an acceptable range would be + or – 30 days
Features	All major features will be implemented on release 1.0	Ability to produce results quick enough to include all features on first release	All major features will be implemented by release 1.1
Quality	Reliability will be first priority with extendibility being second	openPDC software could have issues that could cause reliability problems for our software. Not enough time for extendibility.	The software will not crash. Extendibility, in terms of developers easily adding new graphical models, will be focused on once reliability is achieved
Staff	Maintain 4 developers and 3 client contacts	maximum team size is 4 developers	No degree of freedom
Cost	Cost, in terms of hours worked, should be 10 hours per person per week	Individual schedules could limit time available	Acceptable range is between 8 or more hours per week on average

4.3. Operating Environment

OE-1. openPDC file-historian back-end database

OE-2. C#, Visual Studio

Software Requirements Specification

for

Alstom Grid

Version 1.2

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5/22/2012

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Revision History

Name	Date	Reason For Changes	Version
Team AGPro	11/8/2011	First Draft	1.0
Team AGPro	11/28/2011	Initial Changes to first draft	1.1
Team AGPro	5/22/2012	Major Changes to sections 2, 3, 4, and 5	1.2

5. Introduction

5.1. Purpose

This document describes the functional and nonfunctional requirements for the Alstom Grid openPDC data analysis tool. The described functionalities stated within this document will be implemented by team AGPro and used to verify all requirements are being met successfully.

5.2. Intended Audience and Reading Suggestions

The primary audience for this document is intended to be developers of the openPDC data analysis tool. The Use Cases section contains the behaviors the system will be capable of performing. Those behaviors, along with the non-functional requirements found in section 5, should be viewed by developers.

5.3. Project Scope

Please refer to the Vision and Scope document

5.4. References

Please refer to the Vision and Scope document

6. Overall Description

6.1. Product Perspective

The program that we will be developing will be a replacement for the file historian on openPDC. The current file historian is difficult to use and does not produce a good visual output for understanding the data. The program will access the data from binary files stored on the end-users computer.

6.2. Product Features

Please refer section 2.2 Major Features in the Vision and Scope document for information on product features.

6.3. User Classes and Characteristics

The following table lists the types of end-users that will be using our application as well as how they interact with the application

End-User	Usage
Alstom Grid Power Systems Engineer	An Alstom Engineer is an Alstom employee that monitors electrical data in the synchrophasors. These viewers are expected to access data for reporting and analysis purposes. It is most likely that the Alstom Engineers viewers will request data in existing report formats.
IT personnel	IT personnel are Alstom employees that monitor technical data in the synchrophasors. These viewers are expected to access data for reporting and analysis purposes. It is most likely that viewers will request data in existing report formats.

6.4. Operating Environment

OE-1: C#, Windows Forms, Microsoft Visual Studio 2010 integrated development environment
OE-2: API module provided by openPDC software
OE-3: TortoiseSVN with Microsoft Visual Studio 2010 integration for subversion/source control

6.5. Design and Implementation Constraints

CO-1: The code for this application and all extensions will be written in C#
CO-2: The application runs only on Windows OS.
CO-3: Interaction between our application and openPDC is restricted by the API provided by openPDC

6.6. User Documentation

UD-1: The tool will be delivered with tutorial information.

6.7. Assumptions and Dependencies

Please refer section 2.3 Assumptions and Dependencies in the Vision and Scope document.

7. Use Cases

7.1. Analyze Data

Use Case ID:	UC-1		
Date Created:	10/10/11	Date Last Updated:	10/24/2011

Actors:	Power Systems Engineer / IT staff
Description:	Syncrophasor data is extracted from openPDC binary data

	files and analyzed by our application. Visual models (line graph, bar graph, pie chart) and statistics will be available for the user of the system.
Preconditions:	1. None
Postconditions:	1. Visual models are displayed
Normal Flow:	1. User selects "Select Root" button and selects a root location for the binary data files 2. User selects preferred measurements provided by the selected syncrophasor(s) 3. User selects **time_period**[i] 4. User selects analysis options (statistics, models, etc..) 5. System displays estimated run-time and prompts for confirmation 6. System outputs results
Alternative Flows:	5a. User does not confirm run-time 5a.1 Return to Normal Flow step 1
Exceptions:	1.0.E.1 Data files not found (at step 5) 1. System displays error "no associated data files" 2. Return to Normal Flow step 1 1.0.E.2 Connection to data files lost during run-time(at step 6) 1. System halts analysis and displays error message 2. Return to Normal Flow step 1
Priority:	High
Frequency of Use:	High
Special Requirements:	1. Performance/Efficiency of Normal Flow step 6 (measured by user satisfaction with wait times in proportion to amount of data being requested)
Notes and Issues:	i. Exact **time_period** units will be determined at later date. For now, only one **time_period** can be selected per run. System will force an appropriate time period selection by not allowing second time selection to be at an earlier time than the first selection.

7.2. Export to CSV

Use Case ID:	UC-2		
Date Created:	10/24/2011	Date Last Updated:	10/24/2011

Actors:	Power Systems Engineer / IT staff
Description:	After the system has been run the user will have the option to export the data to a CSV file for further examination
Preconditions:	1. UC-1 has run successfully
Postconditions:	1. CSV file is saved to computer
Normal Flow:	1. User select "Export to CSV file" 2. User names the file and chooses save location 3. System converts data to CSV file format and saves
Exceptions:	2.0.E.1 File being saved will not fit in save location (at step 3) 1. System will display error message stating file did not fit in desired location 2. Prompt for a different save location or cancel
Includes:	UC-1
Priority:	High
Frequency of Use:	Medium

7.3. Save Selections

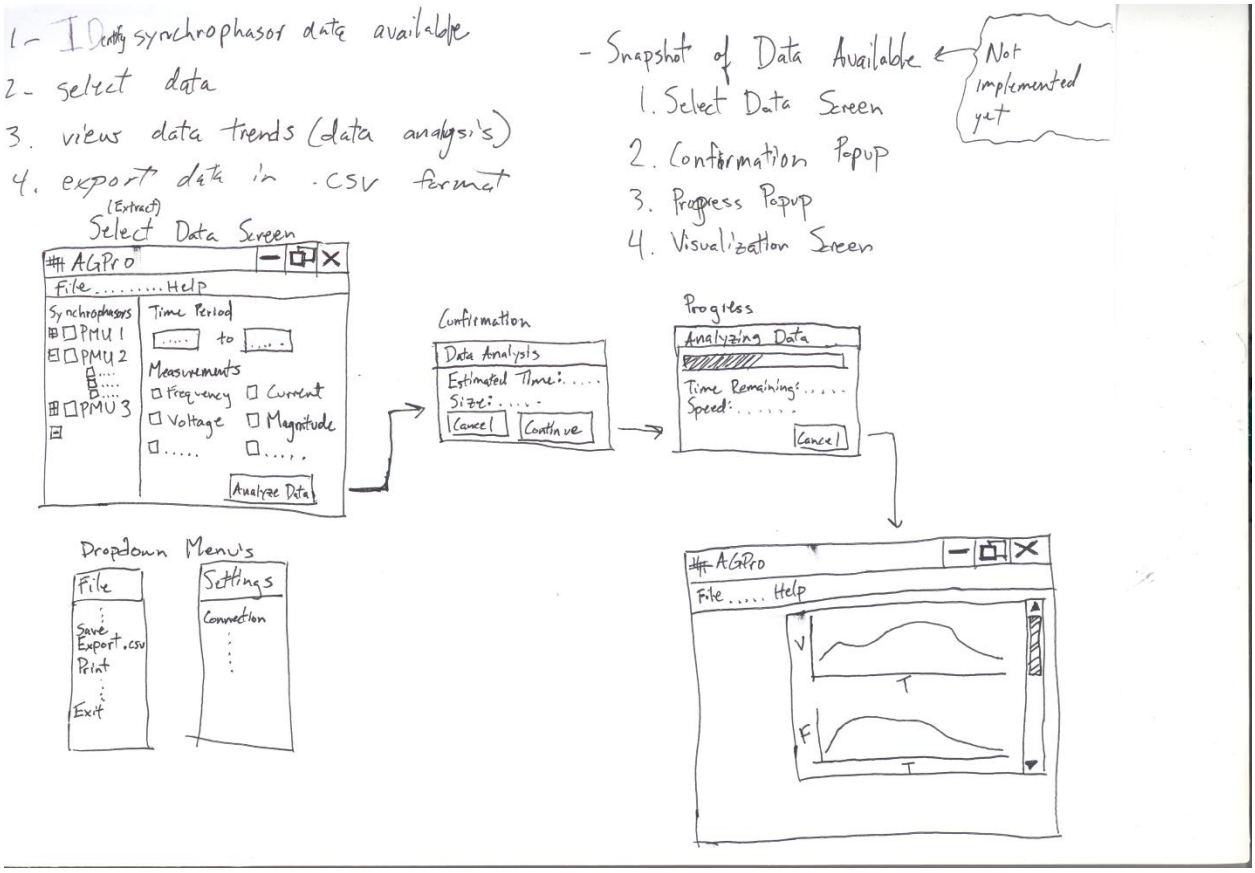
Use Case ID:	UC-3		
Date Created:	10/24/2011	Date Last Updated:	10/24/2011

Actors:	Power Systems Engineer / IT staff
Description:	Save frequently used system selections as "presets" to save time and increase ease of use
Preconditions:	1. UC-1: Normal Flow 1-4
Postconditions:	1. Preset is saved to system
Normal Flow:	1. User selects to save the current search parameters 2. User enters name to associate with saved parameters 3. Preset is available for later use
Priority:	Medium
Frequency of Use:	Low

8. External Interface Requirements

8.1. User Interfaces

The user interface must allow the user to select what data they are interested in. The data selection screen should be very flexible so that it can accommodate any of the user's needs. On this data selection screen there will be a standard button that allows the user to take the data that they have chosen and then have that data displayed in a visualization/graphical screen. Once a visualization/graph has been created and displayed to the user, they should have the option to save the visualization or export a .csv file of the data.



Select Data UI Screenshot

The first GUI screenshot shows a tree hierarchy structure to display the available data on the left side of the Select Data Screen. Then the user can select the measurements they are interested in via the checkbox layout on the center of the Select Data Screen. Once measurement selections have been made the user can select their desired time frame at the top and use the "Graph Data" button to advance to the next screen.

Design Sheet

COLLEGE OF SCIENCE AND ENGINEERING

Project Atom Bird By Brandon Hames

Location Client Date

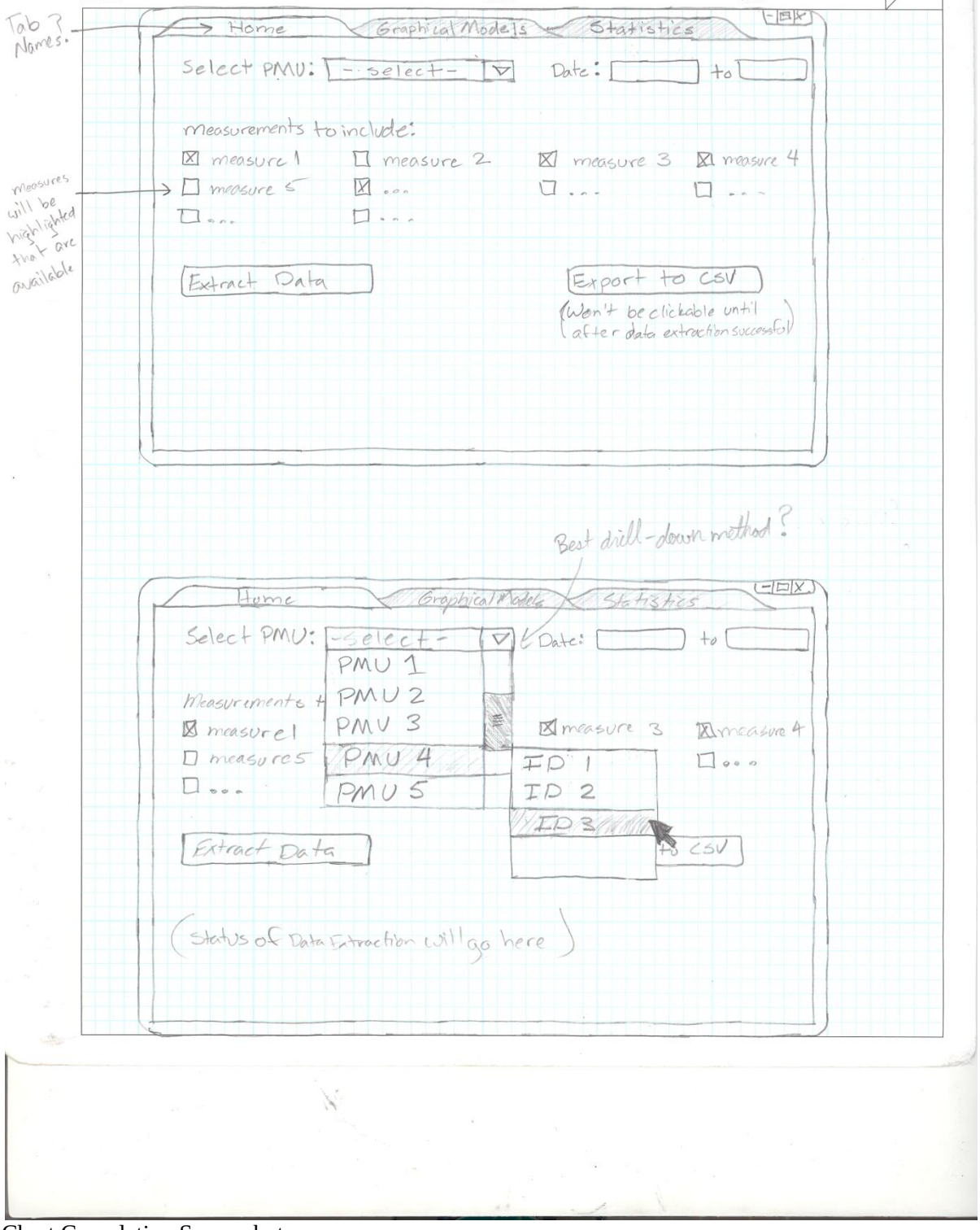


Chart Completion Screenshot

Once a valid time period button has been selected and "Graph Data" has been hit, a progress bar will display the chart creation progress at the bottom of the interface. Once complete you will see a screen shot like the one above.

8.2. Hardware Interfaces

There are no interfaces between our software product and the hardware components of the system.

8.3. Software Interfaces

The system will read in data files that are created via the openPDC Historian Playback Utility. The openPDC Historian Playback Utility is a component of the openPDC v1.4. Data files are saved on the local computer hard drive, read in by our system, and analyzed and displayed by our system.

There is no direct connection between our system, openPDC, and openPDC components (openPDC Historian Playback Utility). The openPDC software is only required to connect to synchrophasors to receive real-time data and write that data into data files. If an end-user has access to specified binary data files, they will only need our system to run data analysis of those files.

9. Other Nonfunctional Requirements

Performance Requirements

PERF-1: The system shall have a run-time that is acceptably proportionate to the amount of measurement data being analyzed. This meaning, the Alstom Grid employee is willing to accept the run-time length based on the amount of measurement data being analyzed by the system. This will be measured by Alstom Grid employees giving approval or disapproval of the run-time lengths based on the amount of data they select to analyze.

Safety Requirements

No safety requirements have been identified

Security Requirements

No security requirements have been identified

Software Quality Attributes

SQ-1: The system shall be useable after ten to fifteen minutes or less of either verbal or written instruction. More specifically, running the system and use of all major functions shall be comprehensible in five minutes or less.

SQ-2: The system shall have self-documenting code along with well-written documentation to assist in the potential extension of more analysis features. (models, stats, etc..)

SQ-3: Installation and setup of the system shall be able to be completed in five minutes or less. Easy installation and setup is required due to Alstom Grid potentially distributing the system to clients.

10. Other Requirements

<Define any other requirements not covered elsewhere in the SRS. This might include database requirements, internationalization requirements, legal requirements, reuse objectives for the project, and so on. Add any new sections that are pertinent to the project.>

Appendix A: Glossary

<Define all the terms necessary to properly interpret the SRS, including acronyms and abbreviations. You may wish to build a separate glossary that spans multiple projects or the entire organization, and just include terms specific to a single project in each SRS.>

API

openPDC

PMU

Synchrophaser

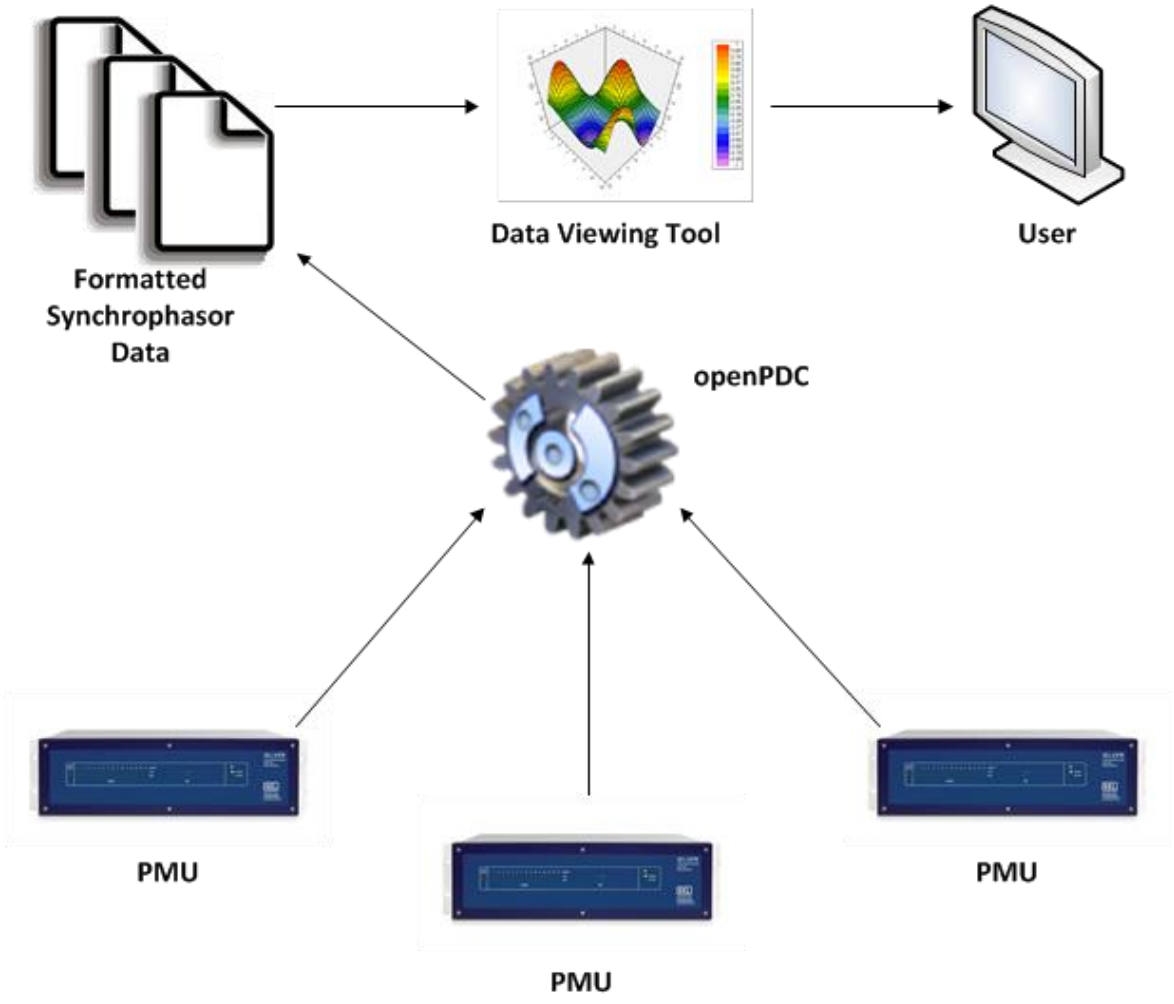
Appendix B: Analysis Models

<Optionally, include any pertinent analysis models, such as data flow diagrams, class diagrams, state-transition diagrams, or entity-relationship diagrams.>

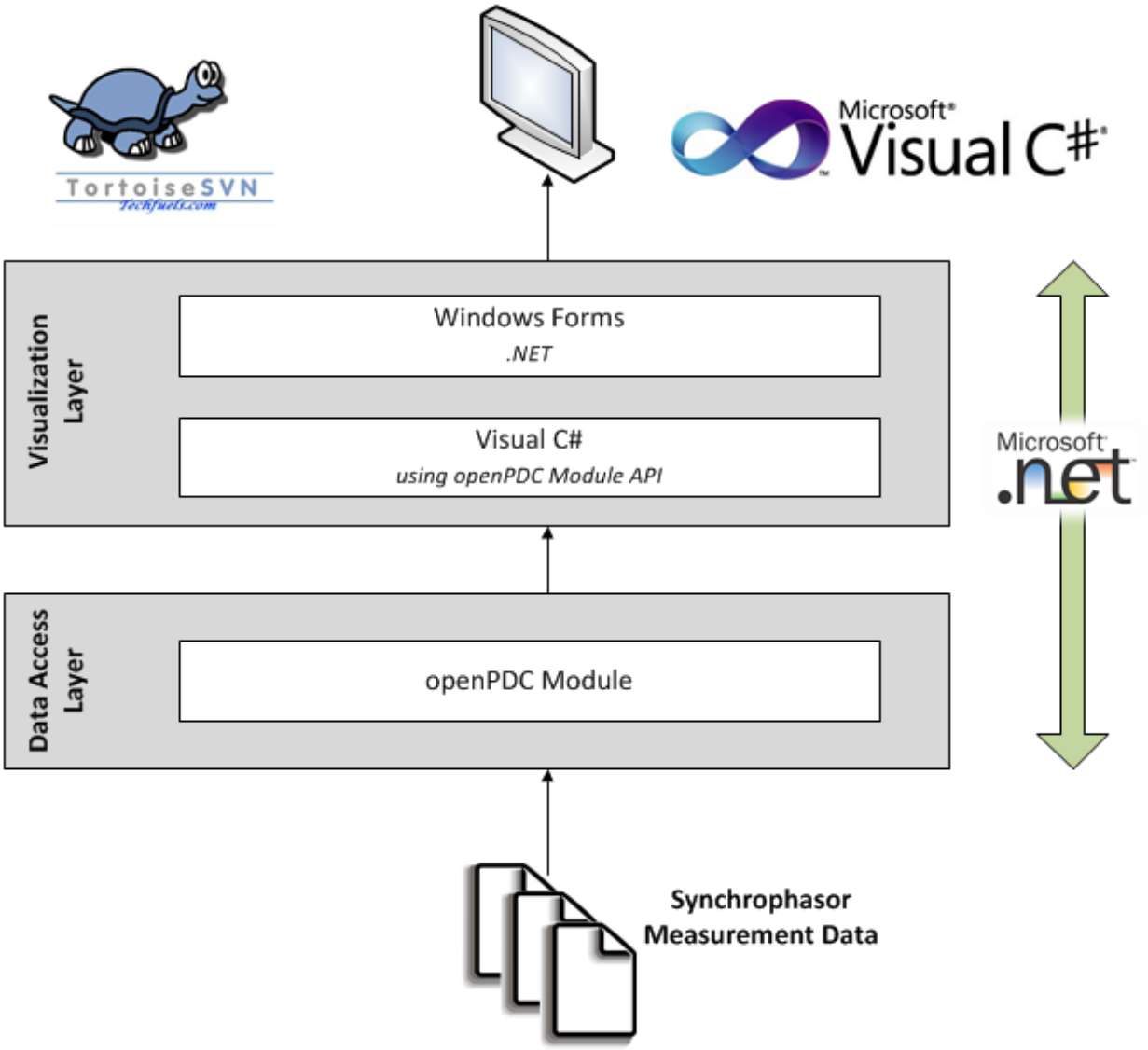
Appendix C: Issues List

< This is a dynamic list of the open requirements issues that remain to be resolved, including TBDs, pending decisions, information that is needed, conflicts awaiting resolution, and the like.>

Physical View



System Architecture



User Manual

1. **(Select Root Button):**
   On opening the application the user must click the Select Root Button to populate the File Tree View (2) with PMU's. When it is clicked a folder selection dialog box will open. When a folder is selected it will update the File Tree View (2) with the root of the folder name, and the names of all the PMU's that are inside the first .dat file. If no .dat file is found the File Tree View (2) will display nothing. If there are more than one .dat files, the program will only examine the first one. Each time the Select Root Button is clicked, the previous data in the File Tree View (2) will be removed.

2. **(File Tree View):**
   The File Tree View will be empty at the start of the program. When a Root has been selected from the Select Root Button (1) the root folder will become the root of the tree, and all the PMU's that have data in that folder will have their names underneath the root. Each object in the File Tree View has a checkbox; these checkboxes are for the use of the Update Control Button (3).

3. **(Update Control Button):**
   When the Update Control Button is clicked is will go though the File Tree View (2) and display all different controls in the Control List (4) that lies inside each checked PMU. Checking the root in the File Tree View (2) will do nothing. The Control List (4) will not be updated with new controls until the Update Control Button is clicked. If there is no root then the Update Control button will display a warning.

4. **(Measurement List):**
   The Measurement List is contained in the Main Tab and has a list of all the measurements in the selected PMUs. Each measurement can be checked so that their data will be examined during processing.

5. **(Start Date, End Date):**
   The Start Date and End Date are used to specify the time range in which data values will be measured. If the End Dates has a time that is equal to or less than the Start Date the program will display a warning.

6. **(Graph Data Button):**
   The Graph Data Button is contained in the Main Tab and will, when clicked, read the data of the selected controls in the Control List (4) over the time interval specified by the Start Date and End Date (5). After reading in the data, it will be displayed in the Chart (10) with the graph being of the form specified by the Graph Selection (8). Any data that was previously charted will be removed.

7. **(Export To CSV):**
   The Export To CSV button, when clicked, will write the selected measurements from the measurement list (4) to a user specified CSV file. The writing will take place on a background thread allowing the user to continue with other tasks while the writing is taking place. Clicking the cancel button will cancel the exporting process.

8. **(Graph Selection):**
The Graph Selection will tell The Chart (10) is what form to display the data the options are:

Line Graph: The Line Graph option is meant to be used for observing data flow. It will plot all data points associated with its time stamp on the graph. If more than one measurement is chosen, both will be graphed, as described above, on the same chart area.

Pie Chart: The pie chart option takes unique data values or statistics and shows a percentage of how frequent that unique value or statistic occurs over an entire time period. For each type of data you select to visualize, a new pie chart is created. The example on the right compares how many frames were received from the input stream over the specified time frame.

Bar Graph: The Bar Graph option is meant to be used for statistics for which a large amount of data is 0. The Bar Graph will plot all non-zero data points on the graphing tab with their corresponding dates. If more than one statistic is chosen to be graphed, both will be graphed, as described above, on the same chart area.

9. **(Chart Tab):**
The chart is contained in the Chart Tab and displays the data that has been selected in the main tab. If the Chart type is a Line Graph or Bar Graph, the user can zoom into the graph by clicking and dragging the mouse over the area they wish to zoom into. To zoom out, a button will appear on the axis that will zoom out when clicked.