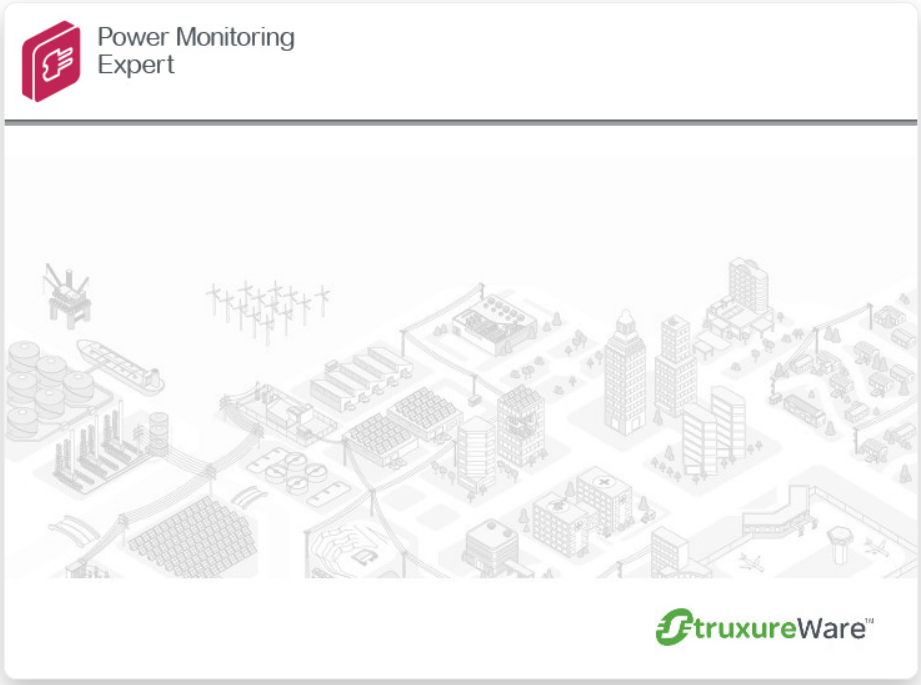
StruxureWare™

Power Monitoring Expert 8.2

Design Guide

7EN42-0141-00

03/2017



Schneider Electric

Legal Information

Safety information

Important information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury. The safety alert symbol shall not be used with this signal word.

Please note

Electrical equipment should be installed, operated, serviced and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

Contents

Safety precautions

During installation or use of this software, pay attention to all safety messages that occur in the software and that are included in the documentation. The following safety messages apply to this software in its entirety.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Do not use the software for critical control or protection applications where human or equipment safety relies on the operation of the control action.
- Do not use the software to control time-critical functions because communication delays can occur between the time a control is initiated and when that action is applied.
- Do not use the software to control remote equipment without securing it with an authorized access level, and without including a status object to provide feedback about the status of the control operation.

Failure to follow these instructions can result in death or serious injury.

⚠ WARNING

INACCURATE DATA RESULTS

- Do not incorrectly configure the software, as this can lead to inaccurate reports and/or data results.
- Do not base your maintenance or service actions solely on messages and information displayed by the software.
- Do not rely solely on software messages and reports to determine if the system is functioning correctly or meeting all applicable standards and requirements.
- Consider the implications of unanticipated transmission delays or failures of communications links.

Failure to follow these instructions can result in death, serious injury, equipment damage, or permanent loss of data.

⚠ WARNING

POTENTIAL COMPROMISE OF SYSTEM AVAILABILITY, INTEGRITY, AND CONFIDENTIALITY

- Change default passwords to help prevent unauthorized access to device settings and information.
- Disable unused ports/services and default accounts to help minimize pathways for malicious attackers.
- Place networked devices behind multiple layers of cyber defenses (such as firewalls, network segmentation, and network intrusion detection and protection).
- Use cyber security best practices (for example: least privilege, separation of duties) to help prevent unauthorized exposure, loss, or modification of data and logs, or interruption of services.

Failure to follow these instructions can result in death, serious injury, and equipment damage.

Introduction

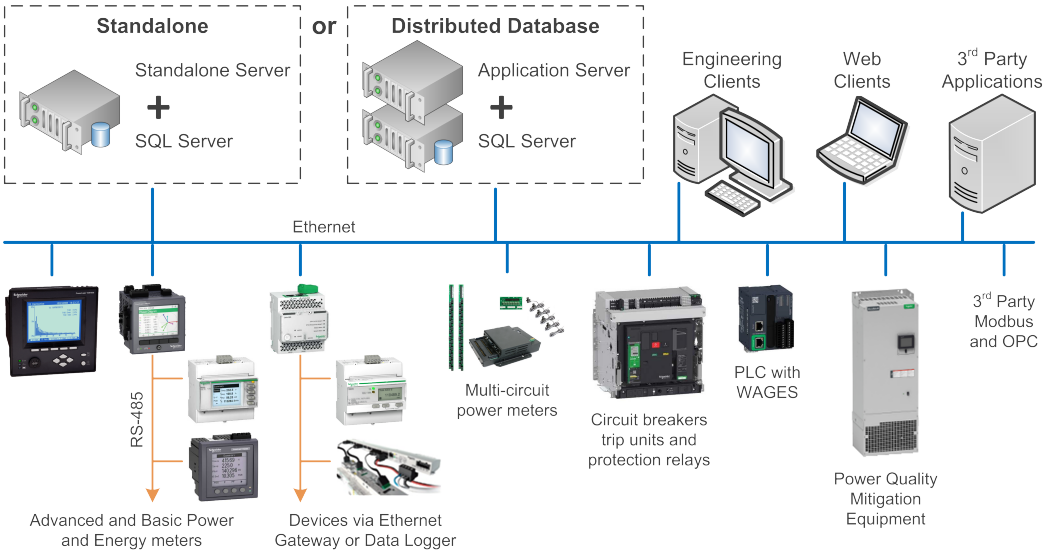
This Design Guide provides an overview of items to consider when designing a StruxureWare™ Power Monitoring Expert system. Most of the information in this document also applies to the segment editions of Power Monitoring Expert, however you should also consult the segment documentation when deploying those editions.

System Architecture

A Power Monitoring Expert system contains many components, but can only be installed in one of two methods:

- Standalone architecture
- Distributed Database architecture.

The difference between the two architectures is based on where the database engine, Microsoft SQL Server, is installed.

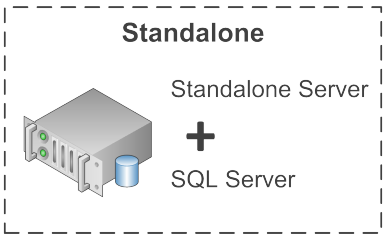


NOTE: Device types and communication topologies may vary.

Standalone Architecture

The preferred and most common type of Power Monitoring Expert architecture is called "standalone", where one computer contains:

- **Power Monitoring Expert** software – includes Engineering Client tools, configuration files, communication services, Web Applications server, Virtual Processor (VIP), a SQL Server connection, and so on.
- **Microsoft SQL Server** – hosts the historical databases for logged data.



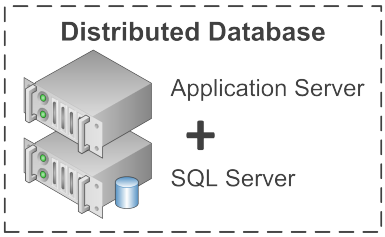
Unlike other software packages (for example, SCADA), all custom application logic, I/O management, alarm management, reports, and device communication for Power Monitoring Expert performs optimally when installed on a single server.

See "Server Specification" on page 13 for hardware recommendations.

Distributed Database Architecture

If the Standalone architecture is not possible due to customer requirements, it is possible to distribute the database to another server. This is called a "distributed database" installation, where two computers work together to create the Power Monitoring Expert environment:

- **Application Server** – hosts the Power Monitoring Expert software.
- **Microsoft SQL Server** – hosts the Power Monitoring Expert databases.



The Distributed Database architecture is less common than the Standalone architecture. See "Server Specification" on page 13 for hardware recommendations.

Standalone vs Distributed Database

The Standalone architecture is the preferred and most common installation method in use because it is cheaper (only one server required) and easier to commission. In some cases, however, a customer may want to use their existing SQL server, or the Distributed Database architecture may be required due to local IT policy:

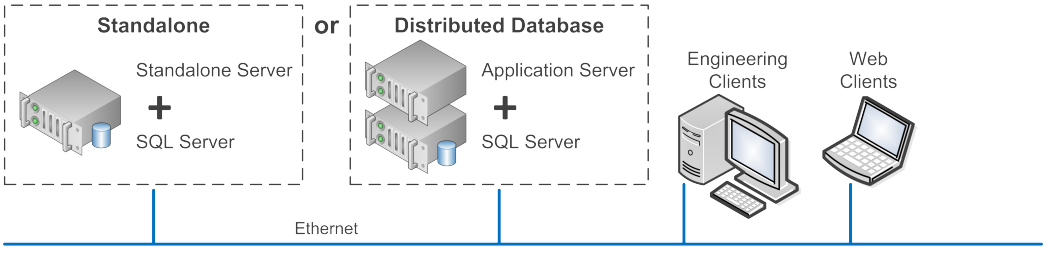
- Microsoft SQL Server cannot be installed with another application on the same server.
- Microsoft SQL Server redundancy requirements with SQL Clustering or other third-party tools.
- Specific rules for database management (for example, SQL jobs, back-ups, data security, and so on).

NOTE: There is no performance improvement by using the Distributed Database architecture over the Standalone architecture.

Client Types

The Power Monitoring Expert system contains two different types of client interfaces:

- The **Engineering Client** is the administrator interface that is used to manage, build, maintain, and customize the power monitoring system.
- The **Web Client** is the primary user interface that accesses the Web Applications. It provides access to energy dashboards and reports, real-time system monitoring tools, alarms, and custom graphical representations of the power monitoring system.



Engineering Client

An Engineering Client is the administrative interface of the Power Monitoring Expert system that is used to manage, build, maintain, and customize the power monitoring system.

The Engineering Client is installed on the main Power Monitoring Expert server, but it can also be installed on additional client computers where a user will administer the system. The following tools are included with the Engineering client:

- **Management Console** – manage communications to devices and open system configuration tools.
- **Vista** – design, manage, and monitor the power monitoring system.
- **Designer** – develop system-level and device-level applications in ION nodes.

See "Client Specification" on page 18 for hardware recommendations.

Web Client

The Web Applications component is the primary user interface of the Power Monitoring Expert system. It displays real-time data, historical information, and alarms in a single user interface, accessible anywhere on the network, and is most commonly used in day-to-day power management tasks. The Web Applications are hosted on the Power Monitoring Expert server and can be accessed from any computer on the network via web browser.

NOTE: For cybersecurity and performance reasons, it is recommended that you access Web Applications only from client computers and not from the Power Monitoring Expert server.

The following applications are included:

- **Dashboards** – displays historical data in an easily viewable gadgets.
- **Diagrams** – displays a custom graphical representation of the power monitoring system designed in Vista.
- **Tables** – displays real-time data from the system in a tabular format.
- **Trends** – monitors system conditions by displaying real-time and historical data in a graphical format.
- **Alarms** – serves as an alarm management portal in which you can view and acknowledge both active and historical alarms.
- **Reports** – provides energy, power quality, and generic system reports based on historical data collected from devices.

See "Client Specification" on page 18 for hardware recommendations.

Recommended Power Monitoring Expert Systems

Power Monitoring Expert can vary in size from just a few devices with limited logging to thousands of devices with extensive logging and custom applications. The following system specifications are sufficient for the majority of customers, but can be adjusted if needed.

Server Specification

The following server recommendation applies to:

- Standalone server – the server in a Standalone architecture.
- Application server – the server that holds Power Monitoring Expert applications in a Distributed Database architecture (SQL Server is not required on the application server).
- Database server – the server that holds Power Monitoring Expert databases in a Distributed Database architecture.

Systems Up To 250 Devices

System[1]	Devices[2]	Users	Server Recommendations	Years of Logging[3]	OPC Tags	VIP Tags[4]
B1	≤ 50	≤ 5	**Computer Type**: Desktop **OS**: Windows 8.1 (64-bit) **SQL**: 2014 Express **CPU**: Intel Core i3 (2 core), or better **RAM**: 2+ GB **HDD**: 500+ GB	~4 years (10 GB)	1000	250
B2	≤ 100	≤ 5	**Computer Type**: Desktop **OS**: Windows 8.1 (64-bit) **SQL**: 2014 Express **CPU**: Intel Core i3 (2 core), or better **RAM**: 4+ GB **HDD**: 500+ GB	~2 years (10 GB)	1000	250
B3	≤ 100	≤ 5	**Computer Type**: Desktop **OS**: Windows 8.1 (64-bit) **SQL**: 2014 Standard SP1 **CPU**: Intel Core i3 (2 core), or better **RAM**: 4+ GB **HDD**: 500+ GB	~6 years (30 GB)	1000	250
A1	≤ 100	≤ 15	**Computer Type**: Workstation **OS**: Windows 8.1 (64-bit) **SQL**: 2014 Standard SP1 **CPU**: Intel Xeon E5 1603 (4 core), or better for all workstations **RAM**: 8+ GB **HDD**: x2 500+ GB	<6 years (30 GB)[5]	5000	1500

System[1]	Devices[2]	Users	Server Recommendations	Years of Logging[3]	OPC Tags	VIP Tags[4]
B4	≤ 250	≤ 10	**Computer Type**: Workstation **OS**: Windows Server 2012 R2 **SQL**: 2014 Standard SP1 **CPU**: Intel Xeon E56xx (4 core), or better **RAM**: 8+ GB **HDD**: x2 500+ GB	~2.5 years (30 GB)	5000	1000
A2	≤ 250	≤ 20	**Computer Type**: Server **OS**: Windows Server 2012 R2 **SQL**: 2014 Standard SP1 **CPU**: Intel Xeon E5 2603 (4 core), or better **RAM**: 16+ GB **HDD**: x4 300+ GB	<2.5 years (30 GB)[5]	10000	3000

[1] Basic or Advanced system (for example, B3 denotes the third of the basic systems in a larger order of magnitude). See "Basic Systems" on page 16 and "Advanced Systems" on page 17 for details.

[2] See "Devices in the Network" on page 33 for a definition of the devices.

[3] Years of data in the database is calculated based on a 10 GB database for SQL Server Express and 30 GB (or larger) for SQL Server Standard edition.

[4] VIP “tags” are measurements used for alarming and/or logging.

[5] Based on the following device mix: 10% advanced; 20% intermediate; 70% basic/entry.

It is recommended that you calculate the ION_Data size and number of years of logging using the DB Growth Calculator tool available in the Power Monitoring Expert Exchange community at https://exchangecommunity.schneider-electric.com/docs/DOC-10420.

Systems Up To 2500 Devices

System[1]	Devices	Users	Server Recommendations	Years of Logging[2]	OPC Tags	VIP Tags[3]
B5	≤ 600	≤ 10	**Computer Type**: Workstation **OS**: Windows Server 2012 R2 **SQL**: 2014 Standard SP1 **CPU**: Intel Xeon E5 2603 (4 core), or better **RAM**: 16+ GB **HDD**: x6 300+ GB	~1 year (30 GB)	5000	1000

System[1]	Devices	Users	Server Recommendations	Years of Logging[2]	OPC Tags	VIP Tags[3]
A3	≤ 600	≤ 35	**Computer Type**: Server **OS**: Windows Server 2012 R2 **SQL**: 2014 Standard SP1 **CPU**: x2 Intel Xeon E5 2603 (4 core), or better **RAM**: 24+ GB **HDD**: x6 300+ GB	<1 year (30 GB)[4]	30000	10000
B6	≤ 2500	≤ 10	**Computer Type**: Server **OS**: Windows Server 2012 R2 **SQL**: 2014 Standard SP1 **CPU**: x2 Intel Xeon E5 2603 (4 core), or better **RAM**: 24+ GB **HDD**: x5 300+ GB x1 1.5+ TB[5]	~2 years (200 GB)	10000	2500
A4	≤ 2500	≤ 50	**Computer Type**: Server **OS**: Windows Server 2012 R2 **SQL**: 2014 Standard SP1 **CPU**: x2 Intel Xeon E5-4607 (6 core), or better **RAM**: 32+ GB **HDD**: x6 300+ GB x2 1.5 TB[5]	<2 years (200 GB)[4]	50000	15000 (See Notes 6 and 7)

[1] Basic or Advanced system (for example, B3 denotes the third of the basic systems in a larger order of magnitude).

[2] Years of data in the database is calculated based on a 10 GB database for SQL Server Express and 30 GB (or larger) for SQL Server Standard edition.

[3] VIP "tags" are measurements used for alarming and/or logging.

[4] Based on the following device mix: 10% advanced; 20% intermediate; 70% basic/entry.

It is recommended that you calculate the ION_Data size and number of years of logging using the DB Growth Calculator tool available in the Power Monitoring Expert Exchange community at https://exchangecommunity.schneider-electric.com/docs/DOC-10420.

[5] Hard drive configurations are very important for performance of the Power Monitoring Expert system. Review the *Hard Drive Considerations* section before purchasing your desktop, workstation, or server.

[6] The need for using the VIP for PC alarming configuration is no longer required. Use the Alarm Configuration application to configure alarms.

[7] Contact your Regional Competency Center for large system design assistance.

Basic Systems

The majority of Power Monitoring Expert systems are basic systems with out-of-the box functionality that meets most customer needs. A basic system presumes the following:

- Factory default device logging
- No high-speed (that is, faster than 15 minutes) logging
- No custom applications.

A basic system contains a mixture of advanced and basic power meters. These basic systems use the following break down of devices:

- 70% Entry/Basic Meters
- 20% Intermediate Meters/Trip Units/Relays
- 10% Advanced/Power Quality/Utility Meters.

These systems do not include large numbers of BCPM or EM4800 device types. In cases where these device types are installed, use the Advanced version of that system.

NOTE: Basic system specifications cannot be used with the Power Quality Advisor module.

Small Basic System Example

A small basic system requires **System B1** above. The following table summarizes additional system usage and other details.

Server Requirements	Quantity	Details
Number of Devices	50	x35 PM1200 x10 PM8000 x5 ION7650
Hard Drive(465 GB available)	80 GB 93 GB 12 GB 50 GB **235 GB**	Windows OS 20% Free hard drive space Power Monitoring Expert and SQL Server ION_Data and its backups **Total Usage**

Large Basic System Example

A large basic system requires **System B6** above. The following table summarizes additional system usage and other details. See "Recommended Hard Drive Configurations" on page 21 for information about hard drive groups.

Server Requirements	Quantity	Details
Number of Devices	2500	x2200 PM3200 x200 PM8000 x100 ION7650

Server Requirements	Quantity	Details
Hard Drive Group 0 (279 GB available)	100 GB 56 GB 12 GB **168 GB**	Windows OS 20% Free hard drive space Power Monitoring Expert and SQL Server **Total Usage**
Hard Drive Group 1 (279 GB available)	56 200 **256 GB**	20% Free hard drive space SQL Server tempDB **Total Usage**
Hard Drive Group 2 (279 GB available)	56 200 **256 GB**	20% Free hard drive space ION_Data .mdf **Total Usage**
Hard Drive Group 3 (1397 GB available)	279 200 600 **1079 GB**	20% Free hard drive space ION_Data .ldf ION_Data backups **Total Usage**

Advanced Systems

An advanced system may be required to meet specific customer needs that cannot be met with a basic out-of-the box system. An advanced system might include one or more of the following:

- Power Quality Advisor module
- Custom applications in the VIP
- Non-default logging (shorter than 15 minute intervals)
- High concurrent system usage with report generation
- OPC server with thousands of tags
- High number of concurrent users accessing the system
- Mixture of different device types, including advanced PQ meters.

Which is More Important: CPU or RAM?

They are both important for different reasons. The CPU plays a critical role for executing Power Monitoring Expert operations. It is especially important when using a large number of translated devices. On the other hand, RAM is very important for SQL Server. SQL Server is a memory intensive program which requires more RAM for running reports, logging a large number of measurements, and other database-intensive operations. During deployment, it is important to cap SQL memory because the SQL Server can use all available RAM, which may impact the performance of other operations.

Virtual Environments

Power Monitoring Expert can be installed in supported virtual environments that have equivalent performance to a recommended physical computer (described in "Recommended Power Monitoring Expert Systems" on page 13

The FLEXnet License Administrator software, which is used to manage StruxureWare Power Monitoring Expert licenses, supports virtual machine licensing for the following hypervisors:

- VMWare Workstation 10
- VMWare ESX1 6.0
- Oracle Virtual Box 5.0.4
- Microsoft Hyper-V from Windows 8.1, Windows Server 2012
- Citrix XenServer 6.2
- Parallels Desktop 10
- QEMU-KVM

Consider these main points for the virtual environment:

- The combination of Windows operating system and SQL Server edition.
- The processor (CPU) performance and memory (RAM). The CPU and RAM must be dedicated to the virtual machine containing Power Monitoring Expert so that the performance is as expected. If no other virtual machines in the same environment take resources from the Power Monitoring Expert system, then performance may degrade.
- The hard drive group configuration and space.

Physical ports (that is, serial COM, modems, and USB) are not recommended in a virtual environment.

See the *StruxureWare Power Monitoring Expert 8.2 Installation Guide* for more information.

Server Redundancy

Server redundancy is accomplished by using PowerSCADA Expert. Redundancy is not supported directly through Power Monitoring Expert.

Client Specification

Engineering Client

The Engineering Client workstation should meet or exceed the following specification:

Client Recommendations
OS: Windows 8.1
CPU: Intel Core i3 (2 core), or better
RAM: 2+ GB
HDD Space: 2GB for software installation

Web Client

The Web Client computer should meet or exceed the following specification:

Client Recommendations
CPU: 2 GHz Dual Core, or better
RAM: 2+ GB
ResolutionHDD Space: 1024 x 768, or higher

For a list of supported Web browsers, see "Browsers" on page 31.

Hard Drive Considerations

The hard disk drives (HDD) in the Power Monitoring Expert server are critical to the operation of the software. The configuration of the hard drives and distribution of software components can have a significant effect on the performance of the server.

Hard Drive Space for Software Components

Each component on the server (that is, the Windows operating system, the page file, Power Monitoring Expert software, SQL Server databases, and so on) requires hard drive space. Aside from the main Power Monitoring Expert database, ION_Data, the remainder of the server components are relatively static in size and do not change much throughout the life of the system.

The following table summarizes the approximate hard drive space required for each component. All remaining space will be reserved for ION_Data.

Component	Hard Drive Space Required[1]
Windows OS[2]	80 – 100 GB
Power Monitoring Expert[3]	5 GB
Power Monitoring Expert databases[4]	5 GB
SQL Server	2 GB
Free hard drive space[5]	10% - 30% of the total hard drive space
TOTAL	**~ 100 GB + 30% of Total Hard Drive Space**

[1] The hard drive space requirements for each component have been rounded up to account for variations throughout the life of the system.
[2] Includes the Windows operating system, page file, temp directory, Windows updates, restore points, and so on. The initial hard drive space for Windows is between 16 GB and 40 GB, but it will grow over time.
[3] Accounts for future Power Monitoring Expert updates and service packs.
[4] Includes Power Monitoring Expert databases (that is, ION_Network, ION_SystemLog and ApplicationModules) and database backups. ION_Data is not included.
[5] Required for hard disk drive defragmentation and unexpected usage (that is, downloads, file copying, and so on). Solid state drives (SSD) do not require defragmentation and will require less available space.

NOTE: 1 GB = 1024 MB = 1,048,576 kB = 1,073,741,824 bytes on a NTFS formatted hard drive.

All remaining hard drive space will be reserved for the ION_Data database and its backups, and the SQL Server tempDB.

Example

A server has two 500 GB hard drives configured using RAID 1 (that is, they are exact copies of each other – see *Hard Drives and RAID* below). However, there is only 465 GB of usable space. If all software components are installed on this hard drive group, there will be **225 GB** of hard drive space remaining for the ION_Data database and its backups, and the SQL Server tempDB.

$$\begin{aligned} Remaining\ HDD\ Space\ (GB) &= Total\ HDD - Software\ Components - \%\ Free\ Space \\ &= 465 - 100 - 0.3(465) \\ &= 225.5\ GB \end{aligned}$$

Hard Drive Contention

Hard drive contention is a term used when the hard drives cannot keep up with the read and write operations from the operating system or an application. Essentially, the hard drives become a bottleneck, causing the entire server to slow down even if the processors (CPU) and memory (RAM) are performing as effectively as possible. Two examples of this are:

- SQL Server read and write operations to the database (.mdf) and transaction log (.ldf).
- Operating system read and write operations to the pagefile.

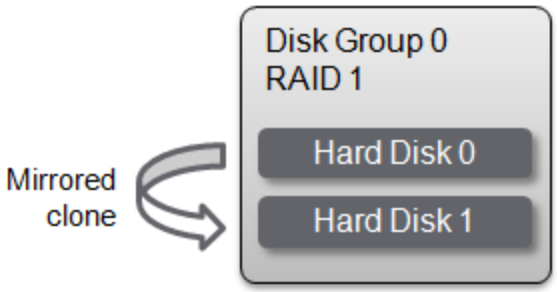
Hard Drive Groups

For a basic system, a single hard drive (or hard drive group with RAID 1) is sufficient to install the operating system, Power Monitoring Expert software, and SQL Server without causing any hard drive contention.

For improved hard drive and system performance, it is recommended (if possible) that you separate major components onto different hard drive groups.

Hard Drives and RAID

In addition to separating the software components onto different hard drive groups, RAID 1 can be used to add simple redundancy in case of an inoperable hard drive. RAID 1 is where one hard drive is a fully-mirrored clone of a second hard drive. If either hard drive stops operating, no data is lost and a new hard drive can be inserted to become the new clone.



It is possible to use other RAID configurations (that is RAID 0, RAID 5, and so on), but they are not addressed in this document.

Recommended Hard Drive Configurations

It is important to plan for system growth by having a chassis that will hold additional hard drives. The cost of the larger hard drive chassis is often minimal. Throughout the life of the system, additional hard drives can be added so that the software components can be moved as the system grows.

The following tables provide recommended standalone server configuration options for data redundancy (using RAID 1) and reduced hard drive contention. Other configurations are also possible.

Option 1 (2x Hard Drives)

The following configuration is sufficient for most applications.

Component	Group 0
	HDD1 + HDD2
OS[1]	✓
tempDB[2]	✓
MDF[3]	✓
LDF[4]	✓
Backups[5]	✓

[1] Includes the Operating System, page file, Power Monitoring Expert and any other applications.

[2] SQL Server temporary system database.

[3] SQL Server main databases.

[4] SQL Server transaction log files.

[5] Power Monitoring Expert database backups.

Option 2 (4x Hard Drives)

The following configuration is sufficient for most applications.

Component	Group 0	Group 1
	HDD1 + HDD2	HDD3 + HDD4
OS[1]	✓	
tempDB[2]		✓
MDF[3]	✓	
LDF[4]		✓
Backups[5]		✓

Option 3a (6x Hard Drives)

The following configuration is for data redundancy, but hard drive contention is not considered.

Component	Group 0	Group 1	Group 2
	HDD1 + HDD2	HDD3 + HDD4	HDD5 + HDD6
OS[1]	✓		
tempDB[2]	✓		
MDF[3]		✓	
LDF[4]			✓
Backups[5]			✓

Option 3b (6x Hard Drives)

The following configuration can reduce drive contention while providing data redundancy for the operating system and main database file.

Component	Group 0	Group 1	Group 2	Group 3
	HDD1 + HDD2	HDD3	HDD4 + HDD5	HDD6
OS[1]	✓			

Component	Group 0	Group 1	Group 2	Group 3
	HDD1 + HDD2	HDD3	HDD4 + HDD5	HDD6
tempDB[2]		✓		
MDF[3]			✓	
LDF[4]				✓
Backups[5]				✓

Option 4 (8x Hard Drives)

The following configuration is for minimized drive contention with data redundancy for all components.

Component	Group 0	Group 1	Group 2	Group 3
	HDD1 + HDD2	HDD3 + HDD4	HDD5 + HDD6	HDD7 + HDD8
OS[1]	✓			
tempDB[2]		✓		
MDF[3]			✓	
LDF[4]				✓
Backups[5]				✓

Database Considerations

SQL Server Editions

A supported version and edition of Microsoft SQL Server must be installed prior to installing Power Monitoring Expert. Power Monitoring Expert can install SQL Server Express 2014 to host the databases if no other SQL Server edition has been installed.

See "SQL Server" on page 31 for a list of supported versions.

SQL Server Express vs. Standard/Enterprise

SQL Server Express is the free version of Microsoft's SQL Server and is suitable for most users. However, there are some limitations in its capabilities:

- Maximum size of 10 GB per database (.mdf). Transaction logs (.ldf) are excluded from this limit.
- No SQL Server Agent service.
- Limited to lesser of 1 socket or 4 cores.
- Limited to use a maximum of 1 GB of the total system RAM.

NOTE: SQL Server Express cannot be used with the Power Quality Advisor module.

Example

Power Monitoring Expert is installed with SQL Express on a single powerful server with two physical quad core CPUs and 24 GB of RAM. SQL Server Express only uses one of the quad core CPUs and just 1 GB of RAM.

This server is far too large for SQL Server Express and does not provide any database performance gains.

Databases in Power Monitoring Expert

Power Monitoring Expert uses four databases to store device communication parameters, system configuration settings, and logged historical data.

Database	Description
ApplicationModules	Contains all of the configuration data for the Dashboards, Trends, and Tables applications in the Web Applications component.
ION_Data	Contains the logged historical data, events, and waveforms from devices.
ION_Network	Contains device communication information and general Power Monitoring Expert settings.
ION_SystemLog	Contains Power Monitoring Expert events that occur during the operation of the software.

Only the historical data database, ION_Data, is considered when calculating hard drive space requirements and growth. The other databases are relatively static in size and should not exceed 5 GB in size under normal operation (includes database backups).

See "Databases" on page 38 for further information.

Database Growth Calculations

The ION_Data main database (.mdf) size and growth is dependent on what is stored in the database and can be estimated by three primary types of measurements in the devices and/or software:

- "Factory Default Measurement Logging" on page 25.
- "Power Quality Events" on page 26.
- "Custom Measurement Logging" on page 26.

In addition, the database occasionally grows by 10% to create room for additional measurements. This growth operation can occur at any time and should be accounted for in database size calculations.

$$ION\_Data.mdf\ (GB) = Default\ Logging + 10\%\ for\ PQ + Custom\ Logging + 10\%\ for\ growth$$

These periodic database growth operations in larger systems (that is, +100 GB databases with +10 GB growth operations) can have a severe impact on server and database operation. Therefore, it is recommended that you pre-allocate the hard drive space for the database during the initial commissioning phase of the system. For example, if you calculate that a database will grow to 500 GB over 5 years, it is recommended that you pre-allocate the hard drive space to avoid the effects of the periodic growth operations.

Use the Database Growth Calculation Tool to estimate the database growth for a system. The tool is available in the Exchange Community at:

https://exchangecommunity.schneider-electric.com/docs/DOC-10420

Factory Default Measurement Logging

Each factory or custom logged measurement in the database uses approximately **75 bytes** for each record, which also accounts for indexing and other factors. From this value it is possible to estimate the **daily growth rate (kB)** based on the device type, the number of logged measurements, and the logging frequency (typically 15 minutes) for the factory default devices.

For a system where the devices only log factory default measurements, the database size can be calculated based on the number of each device type in the system.

Example

A Power Monitoring Expert system contains devices with the factory default measurement logging enabled with PQ frameworks. The estimated annual growth rate for the ION_Data .mdf is **11.84 GB**.

Device Type	Daily Growth Rate (kB)	Number of Devices	Total Daily Growth (MB)	Total Annual Growth (GB)
ION7650	780	10	7.62	2.72
PM8000	950	20	19.00	6.94
PM3200	85	70	5.81	2.07
TOTAL	**-**	**100**	**32.43 MB**	**11.84 GB**

$$ION\_Data.mdf\ (GB) = 11.84\ + 10\%\ for\ growth$$
$$= 13.02\ GB$$

Power Quality Events

Recording power quality (PQ) events and waveform captures are event driven, so it is impossible to predict the exact frequency of these records and how they affect database growth.

If there are devices in the network that have waveform logging and PQ detection enabled, they usually account for approximately 10% to 20% of the total database size. This estimation is based on observing hundreds of customer databases, but will vary depending on the frequency of PQ events in the electrical network and the specific configuration of the PQ enabled power meters.

In addition to the basic measurement logging, PQ events can be included in the estimate to get a better understanding of the possible range of database growth.

NOTICE
LOSS OF DATA Be sure to correctly configure PQ power meters. Excessive database growth and decreased system performance can occur with incorrectly configured PQ power meters. **Failure to follow these instructions can result in corrupt databases and an unusable system.**

Example

A Power Monitoring Expert system contains ten ION7650s enabled to record waveforms for PQ events. In an average system, this could contribute approximately 10% to the total database size.

Therefore, the new estimated annual growth rate for the ION_Data .mdf is **14.32 GB**.

$$ION\_Data.mdf\ (GB) = 13.02\ + 10\%\ for\ PQ\ events$$
$$= 14.32\ GB$$

Custom Measurement Logging

In addition to the factory default logging profiles for the devices, database size estimates can include custom measurement logging:

- In the devices
- In the Virtual Processor (VIP)

Accurate database size estimates should take into consideration the logging frequency for each measurement (that is, 1 minute logging, 15 minute logging, and so on). A single custom measurement that is logged every 15 minutes contributes approximately **2.5 MB** towards the annual database growth.

$$Single\ Measurement\ (MB) = \frac{365\ \frac{Days}{Year} * 24\ \frac{Hours}{Day} * 4\ \frac{Measurement}{Hour} * 75\ \frac{bytes}{Measurement}}{1{,}048{,}576\ \frac{bytes}{MB}}$$
$$= 2.51\ MB\ /\ YR$$

Example

The VIP is used to calculate and log ten key performance indicators (KPI) every 15 minutes. The annual contribution to the database size for those metrics will be:

$$Annual\ Growth\ (MB) = \frac{365\ \frac{Days}{Year} * 24\ \frac{Hours}{Day} * 4\ \frac{Measurement}{Hour} * 75\ \frac{bytes}{Measurement}}{1{,}048{,}576\ \frac{bytes}{MB}} \times 10$$
$$= 25.06\ MB/YR$$

Therefore, the new estimated annual growth rate for the ION_Data .mdf is **14.34 GB**.

$$ION\_Data.mdf\ (GB) = 14.32\ + 0.02\ GB$$
$$= 14.34\ GB$$

Hard Drive Space Requirements

The hard drive space requirements for ION_Data include more than just the main database file. Hard drive space is also required to hold the transaction log, database backups, and regular SQL operations in the tempDB. A simplified formula can be applied to quickly determine the hard drive space requirements for the ION_Data databases in a default Power Monitoring Expert system.

$$HDD\ Space\ for\ ION\_Data\ (GB) = 5 \times .mdf\ (GB)$$

The formula can be broken down into the following components:

Component	Component Details
Main database file (.mdf)	x1 .mdf
Transaction log file[1] (.ldf)	x1 .mdf
Backups[2]	x2 .mdf
Free Space for Backups or tempDB[3]	x1 .mdf
Total	**x5 .mdf**

[1] The .ldf is typically just 10% of the total .mdf size, but occasionally expands to 100% during normal operation. Each calculation presumes that the .mdf and .ldf are equal in size.

[2] The system default is to keep two database backups.

[3] Free space is required for database backups and requires 100% of the total .mdf size. The tempDB will occasionally expand to 100% of the total .mdf size, but not at the same time as a backup. If the backups and tempDB are on different hard drive groups, they each require x1 .mdf in hard drive space.

Example

Based on the previous example, the Power Monitoring Expert installation is estimated to require **71.7 GB** of hard drive space to account for the live database, database backups, and regular SQL operations each year.

$$\begin{aligned} HDD\ Space\ for\ ION\_Data\ (GB) &= 5\ \times .mdf\ (GB) \\ &= 5 \times\ (14.34) \\ &= 71.7\ GB \end{aligned}$$

Database Backups

A backup is a copy of a live database (for example, ION_Data, ION_Network and ApplicationModules) and is used to recover the live database if it becomes corrupt (resulting from manual database editing, unexpected server shutdown, an inoperable hard drive, and so on).

By default, the system automatically backs up the databases on a daily (ION_Network) or weekly (ION_Data and ApplicationModules) basis, and **keeps two backups** of each database in the main installation folder:

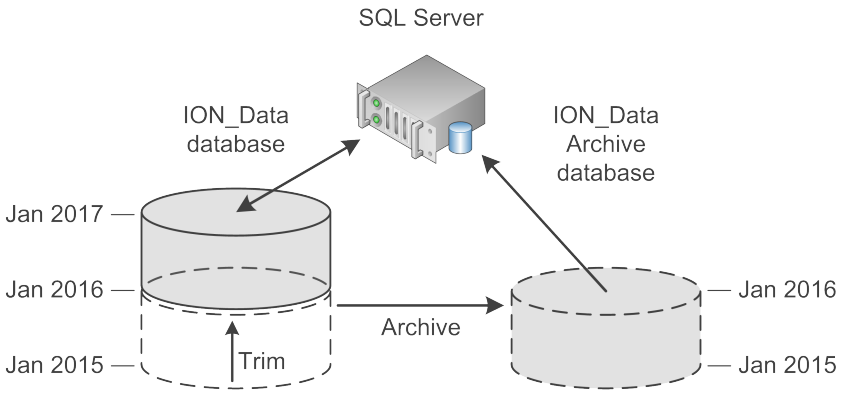
...\Schneider Electric\Power Monitoring Expert\Database\Backup

If there is limited hard drive space available for the live database, it is recommended that you change the folder location of the database backups to a different hard drive group.

See "Recommended Hard Drive Configurations" on page 21 for details.

Database Archives

The purpose of the archive is to remove data from the live ION_Data database to reduce its overall size. An archive is a copy of a subset of data from the live ION_Data database based on a date range and the type of data (Data Records, Waveforms and Events). When an ION_Data archive is created it remains attached to the SQL Server database engine so that its data is still accessible to Vista and Diagrams. However, the data is not available to other applications in the Web Applications component.



Considerations for Archives

In most cases archiving is **not recommended** since it fractures the data into multiple databases. Power Monitoring Expert is unable to query multiple databases at the same time to make comparisons in the data. (It is possible to run reports against an archived database, but it can only be done on one database at a time.)

However, the ION_Data database may need to be reduced in size for two reasons:

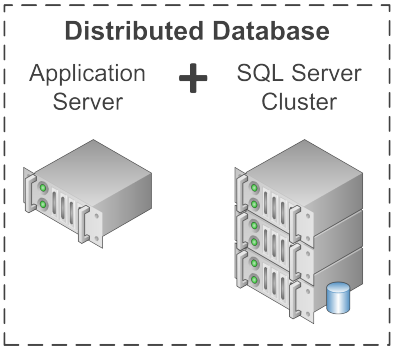
- SQL Server 2014 Express is used as the database engine, which has a limit of 10 GB for the .mdf file.
- SQL Server (Standard or Enterprise edition) is used as the database engine and the ION_Data database has become so large that query performance (in Vista for example) is not acceptable to the Power Monitoring Expert system users. It is also important to ensure that the ION_Data database is trimmed well within the hard drive size, as it can affect the operation of Power Monitoring Expert.

SQL Server Clustering

Clustering allows one physical server to automatically take over the tasks and responsibilities of another physical server that is no longer in operation. More specifically, clustering refers to a group of two or more servers (generally called nodes) that work together and represent themselves as a single virtual server to a network. When a client connects to clustered SQL Servers, it appears that there is only a single SQL Server. Using clustering helps ensure that applications that are running have little or no downtime when a node becomes non-operational.

Power Monitoring Expert software can function in a clustered environment when deployed in a Distributed Database architecture.

- The **Application Server** is deployed in a non-clustered environment.
- The **SQL Server** component is deployed in the clustered environment.



NOTE: Power Monitoring Expert software cannot function in a clustered environment when deployed in a Standalone architecture.

Schneider Electric representatives and certified partners should refer to FA282158 *Installing Power Monitoring Expert in a SQL Cluster Environment* in the Schneider Electric Knowledge Base for additional information.

Software Compatibility

This section describes the Windows operating systems, SQL server editions, and browsers that support Power Monitoring Expert installations.

Operating systems

You can install Power Monitoring Expert server and client software on the following Windows operating systems.

- Windows 7 Professional/Enterprise, SP1
- Windows 8.1 Professional/Enterprise
- Windows 10 Professional/Enterprise
- Windows Server 2008 R2 Standard/Enterprise, SP1
- Windows Server 2012 Standard/Enterprise
- Windows Server 2012 R2 Standard
- Windows Server 2016 Standard

Windows versus Windows Server

It is also recommended that Microsoft Windows Server operating systems be used, for two important reasons:

- Windows Server has the ability to utilize server-class hardware, which means being able to run more CPUs and to add more RAM as needed. For example, Windows 8.1 Professional/Enterprise is limited to two physical CPUs.
- Windows Server offers better performance for running Power Monitoring Expert services.

NOTE: Power Monitoring Expert software can be installed on servers in a domain environment, however it cannot be installed on domain controllers. If Power Monitoring Expert software is installed on a server that is subsequently changed to a domain controller, the software ceases to function correctly.

32-bit versus 64-bit systems

When choosing an operating system and SQL server, make sure that the combination is supported by Microsoft. This applies to edition, version, and 32/64 bit. For example, a 32-bit SQL Server edition is not supported on a 64-bit Windows operating system.

It is recommended that you use a 64-bit operating system for any size Power Monitoring Expert system. The gain in using a 64-bit operating system comes from the better performance of software that works with Power Monitoring Expert. For example, a SQL Server 64-bit edition can perform much faster than a SQL Server 32-bit edition.

In addition, 32-bit operating systems are limited to just 4 GB of RAM, whereas 64-bit operating systems are not restricted to the same extent.

NOTE: Power Monitoring Expert is a 32-bit software package. However, 64-bit operating systems support 32-bit software.

SQL Server

Microsoft SQL Server must be installed on either a Database server or Standalone server before installing Power Monitoring Expert. If using Microsoft SQL Server Express, Power Monitoring Expert will install it during regular installation of the Standalone server. The following SQL Server editions are supported:

SQL Server Editions	Standalone Server	Distributed Database Server
SQL Server 2008 R2 Express, SP3	Yes	No
SQL Server 2012 Express, SP3	Yes	No
SQL Server 2014 Express, SP1, SP2	Yes	No
SQL Server 2016 Express, SP1	Yes	No
SQL Server 2008 R2 Standard/Enterprise, SP3	Yes	Yes
SQL Server 2012 Standard/Enterprise/Business Intelligence, SP3	Yes	Yes
SQL Server 2014 Standard/Enterprise/Business Intelligence, SP1 SP2	Yes	Yes
SQL Server 2016 Standard/Enterprise/Business Intelligence, SP1	Yes	Yes

If no supported SQL Server version is detected during the installation of Power Monitoring Expert on a Standalone Server, then SQL Server 2014 Express is installed.

See the *StruxureWare Power Monitoring Expert Installation Guide* (7EN02-0392-00) for more information.

Browsers

The following browsers are supported:

- Microsoft Internet Explorer versions 10 and 11.
- Microsoft Edge*
- Google Chrome version 42 and later*.
- Mozilla Firefox version 35 and later*.
- Apple Safari versions 7 or 8 and later versions, respectively, on Mac computers.

* The browsers support the web application framework, and Dashboards, Diagrams, and Trends applications. Alarms and Tables are dependent on browser support of the Silverlight plugin.

NOTE: For cybersecurity and performance reasons, it is recommended that you access Web Applications only from client computers and not from the Power Monitoring Expert server.

Other software

- .NET Frameworks:
  - 4.6 for Power Monitoring Expert (included in the installer)
  - 3.5 (or 3.5 SP1) for the Power Monitoring Expert installer (See the "Installing .NET Framework" topic in the *Installation Guide.*)
  - 4.0 for the Power Monitoring Expert licensing component (included in 4.6)
- Microsoft Silverlight version 5.0 and later for the Alarms and Tables web applications.
- Microsoft Excel 2010, 2013, or 2016 is required for reports exported in Excel format in the Web-based Reports application, or for the Excel-based Reporter application.

Communication Network Design

Devices in the Network

The Power Monitoring Expert system is used to communicate primarily with the following devices:

- Power and energy monitoring devices.
- Contactors and protection relays.
- Circuit breaker trip units.
- Smart panel communications.
- Power quality mitigation equipment.
- Programmable Logic Controllers (PLCs).

Many devices have an Ethernet port for direct connection to Power Monitoring Expert via the network, but low cost devices only have a serial port (typically RS-485). These serial devices require an intermediate converter or gateway (for example, Link150, ION7650, ION8800, PM8000, and so on) to establish a network connection with Power Monitoring Expert.

Ethernet port

The communication speed is much higher when a device is connected to Power Monitoring Expert via Ethernet, compare to a serial connection. It is recommended to always use Ethernet if the device supports it.

Serial port

Serial communication can be the bottleneck of the overall system performance. Care must be taken when designing daisy chains during communication design. The Daisy Chain Calculator should be used to design a daisy chain with sufficient capacity.

Daisy Chain Calculator for Serial Devices

The Daisy Chain Calculator is designed to help estimate communication utilization for serial daisy chains. It can be used for both new system design and for optimizing existing Power Monitoring Expert systems for existing serial daisy chains. The tool is available in the Exchange Community at:

https://exchangecommunity.schneider-electric.com/docs/DOC-10422

Supported Protocols

Power Monitoring Expert supports the following protocols to communicate to devices and gateways:

- Modbus™ TCP
- Modbus RTU (via Ethernet gateway)
- ION™
- OPC DA

For more information about these protocols, see the "Glossary" on page 53.

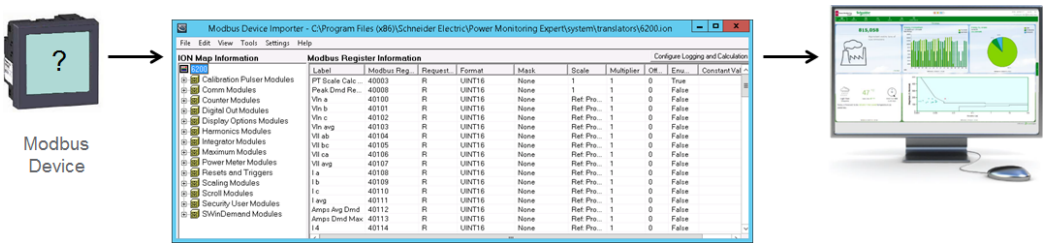
Connect to user-defined Modbus Devices

Power Monitoring Expert has an extensive library of pre-defined device types included with the installation and available for download. For applications that require communication to Modbus devices where a pre-defined device type does not exist, a user-defined device driver can be configured.

Power Monitoring Expert can communicate with any Schneider Electric or 3rd-party Modbus device (either RTU or TCP). The user-defined device driver can include:

- Read/Write access to device registers for basic monitoring.
- Historic logs generated from real-time data, and saved in the database.

The Modbus Device Importer (MDI) is an advanced tool of the Engineering client that creates the required files to communicate with Modbus devices.



See the “Modbus Device Importer” topic in the *StruxureWare Power Monitoring Expert User Guide* for more details.

System Performance

There are two types of transactions between Power Monitoring Expert and the devices:

- Real-time data requests through Power Monitoring Expert tools (for example, OPC Server, Vista, Designer, and so on).
- Periodic polling and uploading of new data logs, events, and waveform records. This is managed by the ION Log Inserter Service and can be scheduled by device type or individual device.

The performance of a Power Monitoring Expert system is not only dependent upon the communication design, but also directly related to how the user interacts with the system: does the user actively monitor real-time data and expect one second updates, or do they want historical data and alarm conditions to be downloaded quickly from devices after an event occurs?

The system can be tuned to provide optimized performance according to the user requirements. See "Performance Tuning" on page 45.

System Integration

In addition to direct communications to devices, Power Monitoring Expert can connect and share data with other systems or software, as either a server or client. Power Monitoring Expert supports the following standards and technologies:

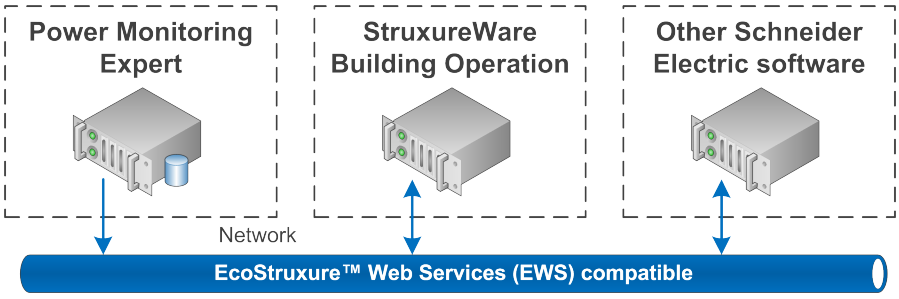
- EWS
- OPC

EcoStruxure Web Services (EWS)

EcoStruxure™ Web Services (EWS) is the Schneider Electric standard for sharing data among various StruxureWare software platforms to facilitate the creation of EcoStruxure solutions. EWS is based on conventional Web Services technology (SOAP, WSDL) and provides a way for solution architects and solution development teams to build solutions that require data to be shared among different StruxureWare software platforms.

Power Monitoring Expert has an EWS 1.1 server to share data with other Schneider Electric systems. The EWS client is not implemented.

For example, Power Monitoring Expert serves real-time, historical, and alarm data to StruxureWare Building Operation via EWS.

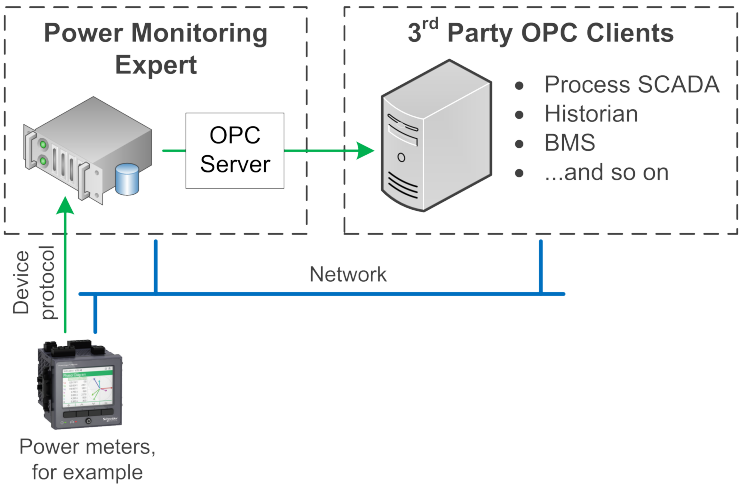


OPC

The Power Monitoring Expert OPC server and client enables interaction between other Schneider Electric and 3rd-party systems using the industry-standard real-time data interface, OPC DA 2.05a.

OPC Server

Once enabled, the OPC server will publish basic power and energy measurements from the power meters. Additional configuration will allow an administrator to publish any real-time measurements from the system.

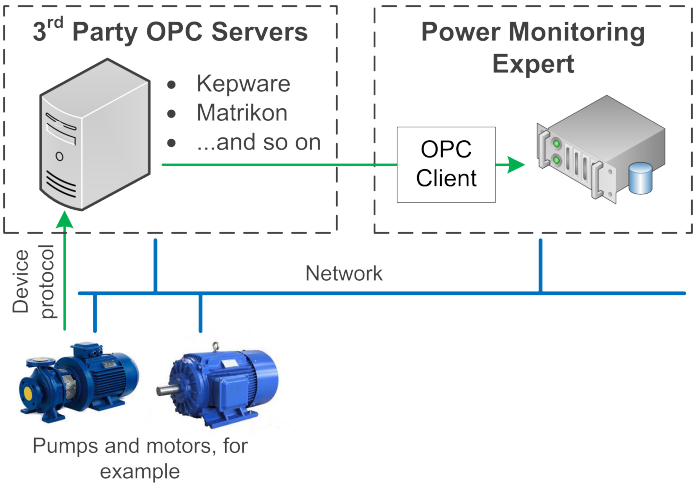


NOTE: The OPC Server license is required for server functionality.

For additional information regarding the configuration and operation of the OPC server component of Power Monitoring Expert, see the *StruxureWare Power Monitoring Expert User Guide*.

OPC Client

The OPC client mapping must be manually defined by the engineer using the Modbus Device Importer and other tools. Once configured, the OPC client will read tags from other OPC servers in the system.



NOTE: Device licenses and custom engineering is required for OPC Client functionality.

Other supported standards

Power Monitoring Expert also supports the following:

- ODBC
- PQDIF
- XML

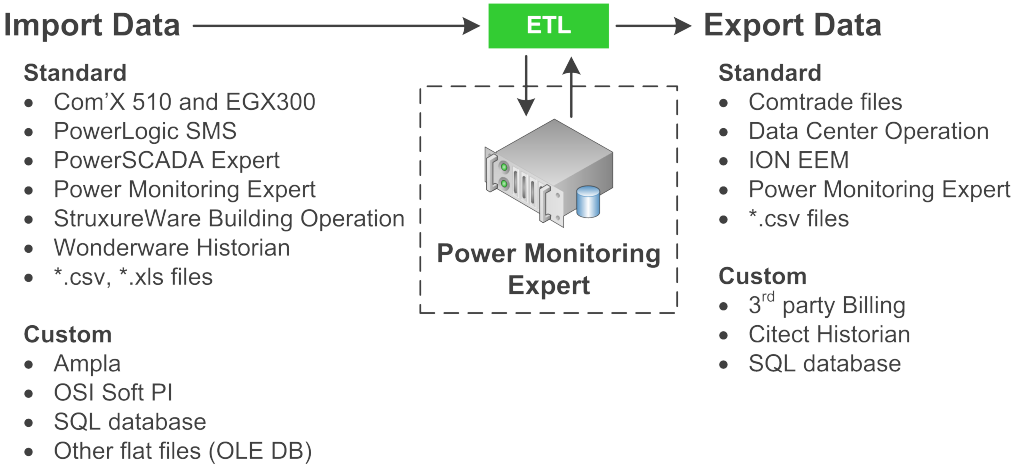
For more information about these standards, see the "Glossary" on page 53

Tools and Utilities

To share data with other systems, Power Monitoring Expert uses specific tools like the Extract Transform Load (ETL) tool and Virtual Processor.

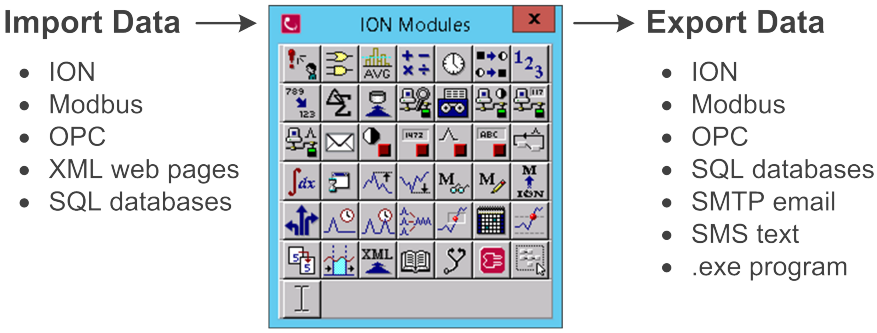
Extract Transform Load (ETL) Tool

The Extract Transform Load (ETL) tool is used to import data from external sources into the Power Monitoring Expert database, or to export data from the Power Monitoring Expert database to external destinations. The tool supports many products and data stores.



Virtual Processor (VIP)

The Virtual Processor is a Windows-based service that operates on the Power Monitoring Expert server. It provides coordinated data collection, data processing, and control functions using a variety of protocols and standards. Distributed operations, customized solutions, and data exporting for a variety of industrial, commercial, and power utility needs are possible.



For additional information regarding the configuration and operation of the Virtual Processor of Power Monitoring Expert, see the *StruxureWare Power Monitoring Expert User Guide* and the *ION Reference*.

Appendix A: Power Monitoring Expert Components

This section shows the different components of the Power Monitoring Expert system, such as:

- Databases.
- Windows Services.

See "Historical Data Flow Details" on page 41 and "Real-time Data Flow Details" on page 43 for details on how these components interact to provide data to the user interfaces.

Databases

Power Monitoring Expert uses four databases to store device communication parameters, system configuration settings, and logged historical data.

ION_Network database

Sometimes called the NOM (that is, Network Object Model), the ION_Network database stores device information, such as, device name, device type and connection address (for example, IP address and TCP/IP port or device/Modbus ID). It also contains information about the optional Application Module settings, other ION Servers, Sites, Dial Out Modems, and Connection Schedules. There is only one ION_Network per system.

ION_Data database

The ION_Data database contains the historical data, events and waveforms from devices connected to the system. This includes: onboard logging configured on devices; and, PC-based logging configured in the device translators and the Virtual Processors.

Application Modules database

The Application_Modules database contains configuration settings (for example, layouts, colors, application events, and so on) and cached historical data for some of the Web Applications (for example, Dashboards and Trends).

ION_System log database

The ION_SystemLog database holds system events and their timestamps, which is accessible to view in Management Console. Event priorities can range from 0-255 and are grouped into Diagnostic (0 - 5), Information (6 - 20), Warning (21 - 63), Error (64 - 191), and Critical (192 - 255) categories. System events can include:

- ION Service stopped or is starting or user connection to an ION Service is lost.
- Device has been declared offline / online.
- ION Site Service connected, disconnected or failed to a Site in Management Console.
- ION User logs on / off Vista or Designer.
- ION User saves a Vista or Designer node diagram.
- Plus many other Warnings and Errors relating to Power Monitoring Expert system functions.

Windows Services

Many of Power Monitoring Expert's core components run as Windows Services. This allows Power Monitoring Expert to continue monitoring your power management system when no users are logged on. As these components play a critical role in the operation of Power Monitoring Expert, it is important to understand what they do.

The following table summarizes the Power Monitoring Expert services:

NOTE: ION Network Router Service has many dependent Power Monitoring Expert services. For example, the ION Virtual Processor, ION Log Inserter Service, and ION Site Service cannot start and operate without the ION Network Router Service running.

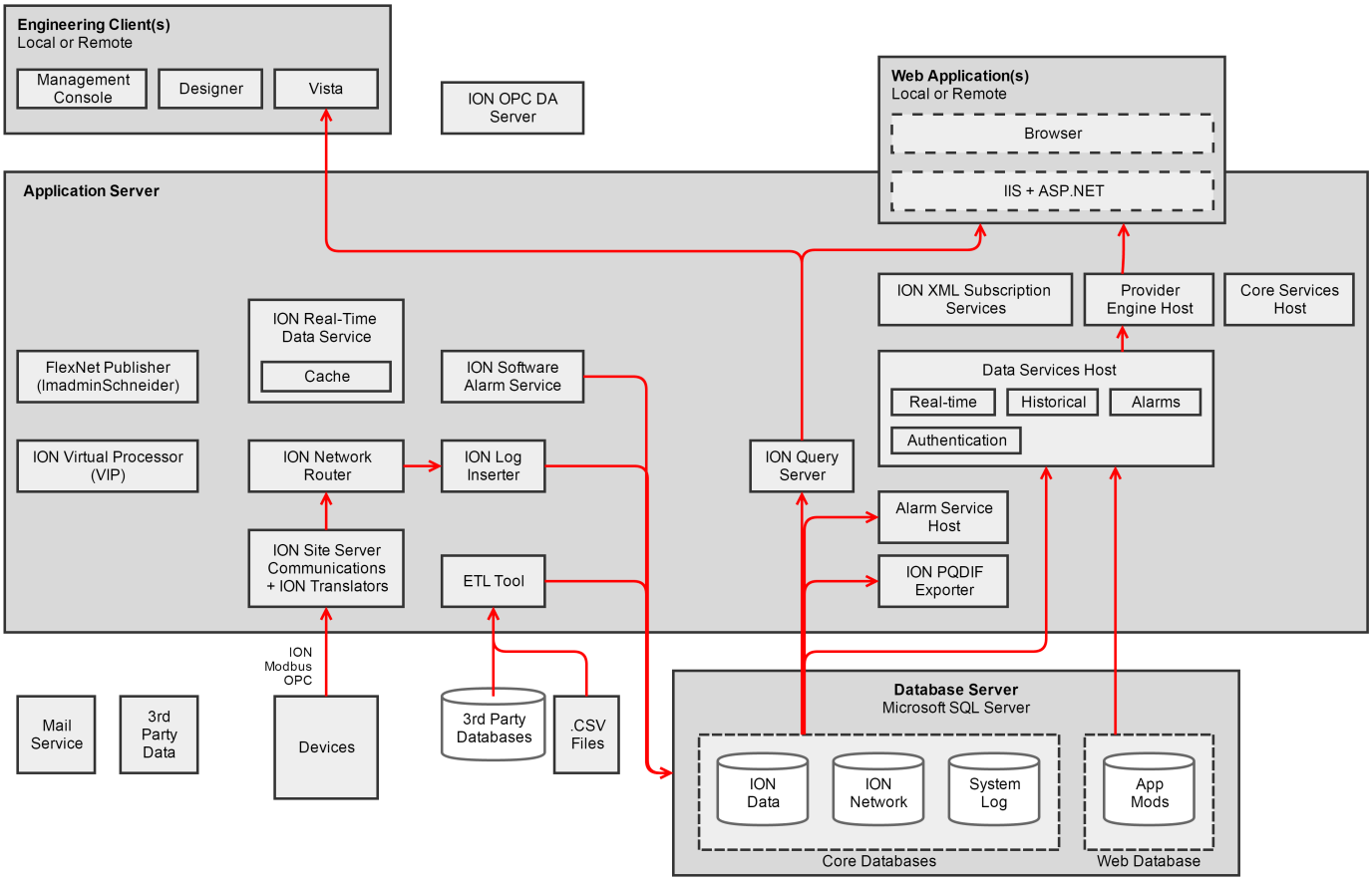
Service Name	Description	Manual/Automatic
ApplicationModules AlarmServiceHost	Allows the Event Notification Module (ENM) to read alarms directly from the ION_Data database. Starts on demand from other services (for example, from the Event Notification Module).	Manual
ApplicationModules CoreServicesHost	Hosts common web services used by the Web Applications component.	Automatic
ApplicationModules DataServicesHost	Hosts web services that provide low-level access to system data (that is, real-time, historical, alarming, and authentication) for the Web Applications component	Automatic
ApplicationModules ProviderEngineHost	Hosts web services that provide data processing for the Web Applications component.	Automatic
ION Alert Monitor	Receives and processes high-priority alarm and event notifications coming from modem connected meters on remote power monitoring locations. When this happens, the Alert Monitor initiates a communications connection to the remote modem site to download additional logged data (for example, data, events, and waveforms).	Manual
ION Component Identifier Service	Locates local and remote product components. Starts shortly after startup by request of ION Connection Management Service.	Manual
ION Connection Management Service	Determines the connection status of sites and devices in the system, and handles allocation of resources such as modems. This service manages the state of site and device connectivity for the system. In order to establish the most appropriate state for the system, each connection and disconnection request is evaluated against the overall state of the system and availability of communications channels. Starts shortly after startup by request of ION Network Router Service.	Manual
ION Diagnostics and Usage Service	Collects basic, non-identifying information from the Power Monitoring Expert system and uploads it to a secure location on the cloud for data mining by Schneider Electric. Customers can opt-in or opt-out at any time.	Automatic

Service Name	Description	Manual/Automatic
ION Event Watcher Service	Monitors system events for conditions specified in Event Watcher Manager. See the "Event Watcher Manager" topic in the "Management Console tools" chapter of the *StruxureWare Power Monitoring Expert 8.2 User Guide*.	Automatic
ION Log Inserter Service	Provides historical data collection for the power monitoring system (that is, devices and Virtual Processor) and stores it in the ION_Data database. See the "Log Inserter" topic in the Database Manager and Windows Task Scheduler chapter of the *User Guide*.	Automatic
ION Managed Circuit Service	This service is used to create individual real-time and historical data sources for multi-circuit meters.	Automatic
ION Network Router Service	Routes all ION requests between the software components, such as client workstations, the Real Time Data Service, Log Inserter, and the Query Server. The service dynamically detects changes to the network configuration, including the addition of new servers. It can also recognize new software nodes, such as Vista, that are added to an existing server.	Automatic
ION OPC Data Access Server	Serves real-time OPC data (that is, OPC DA) to OPC client applications. Starts on an OPC client request for data if the OPC DA server license has been activated.	Manual
ION PQDIF Exporter Service	Translates power quality data from the ION_Data database into PQDIF file format and manages scheduled PQDIF exports.	Manual
ION Query Service	Provides historical data retrieval from the ION_Data database for client applications (for example, Vista and Diagrams). See the "Linking a Data Log Viewer or Event Log Viewer" topic in the Vista chapter of the *User Guide*.	Automatic
ION Real Time Data Service	Manages and provides access to real-time data for all client applications (that is, Vista, Diagrams, Trends, and so on).	Automatic
ION Report Subscription Service	Manages report subscriptions in the Reports application. This service is only available if you are using a supported edition of SQL Server Standard or Enterprise with the software product. Starts several minutes after the server starts.	Automatic (Delayed Start)
ION Site Service	Manages communication links to and from the product. ION Site Service is responsible for handling packet communications to system devices and controlling direct device communications. The service reacts to changes in network configuration: for example, changes to certain channels, configuration parameters, ports, or device parameters can often interrupt a connection.	Automatic
ION Software Alarm Service	Performs alarm evaluation based on real-time data from the power monitoring system. It writes the alarm results back to the ION Real Time Data service and the ION_Data database for use by the client applications.	Automatic

Service Name	Description	Manual/Automatic
ION Software Modbus Gateway Service	Enables software data services to be available via Modbus TCP/IP, and is treated like a device in Management Console. For example, the Circuit Breaker Aging Service and Telvent Weather Data Import feature use this service.	Manual
ION Virtual Processor Service	Provides coordinated data collection, data processing, and control functions for groups of devices in the system. See the "Virtual Processor setup" topic in the Management Console tools chapter of the *User Guide*.	Automatic
ION Virtual Processor Service – NVIP.PQADVISOR	Serves data for Power Quality Advisor diagrams. Functions only when Power Quality Advisor Module is licensed and configured.	Automatic
ION XML Subscription Service	Manages subscriptions to XML data for Vista user diagrams. This service is used only by the Diagrams application. When you open a Vista user diagram in a web browser, the ION XML Subscription Service creates a subscription and delivers the real-time data in XML format.	Automatic
ION XML Subscription Store Service	Stores XML data subscriptions for the power monitoring devices on the network. This service is used only by the Diagrams application.	Automatic
ImadminSchneider	Manages the product's licenses. For example, when opening a software interface, adding devices, or accessing a licensed component of the software, a license request is made from the ION Network Router.	Automatic
SQL Server (ION)	Provides storage, processing and controlled access of data, and rapid transaction processing for the ION_Data, ION_Network, ION_ SystemLog, and ApplicationModules databases.	Automatic

Historical Data Flow Details

The following diagram depicts the main component interactions when inserting or retrieving historical data from the databases. Components not involved with these interactions are included on the diagram for completion (for example, the ION Real-Time Data Service is not used for historical data).



Inserting historical data, events, and waveforms from devices

1. The **ION Network Router Service** and the **ION Site Service** (along with other ION Services) read information from ION_Network to determine how to connect to the devices.
2. The **ION Log Inserter Service** connects to devices listed in the ION_Data dbo.Device table, via the **ION Network Router Service** and **ION Site Service**. If log data (Data Recorder, Waveform, or Event) is available from the device it will be retrieved and stored in the database.
3. The **ION Log Inserter Service** verifies that the device has an entry in the ION_Data dbo.Source table. If the device name is not found, then it will add it as a new source.
4. The data is inserted into the following tables, depending on the data type:
   - Most historical measurement data (for example, current, voltage, power, energy, and so on) is inserted into dbo.DataLog2.
   - Events (for example, meter powered up, PT ratio changed, time synchronization, and so on) are inserted into dbo.EventLog2.
   - Waveform data is inserted into dbo.WaveformLog2.

Viewing historical data in Vista

1. Vista uses Data Log Viewer and Event Log Viewer objects to construct SQL queries for sources, measurements and timeranges.

2. The **ION Query Service** uses these SQL queries to retrieve data from the dbo.DataLog2, dboEventLog2 and dbo.WaveformLog2 tables in ION_Data.
3. The data is returned to Vista in a tabular format.

View historical data in Diagrams

1. Diagrams accesses the Data Log Viewer and Event Log Viewer objects that were created in Vista.
2. The **ION Query Service** retrieves data from the database.
3. The data is returned to Diagrams in a tabular format.

Creating or Viewing Dashboard gadget and Trends

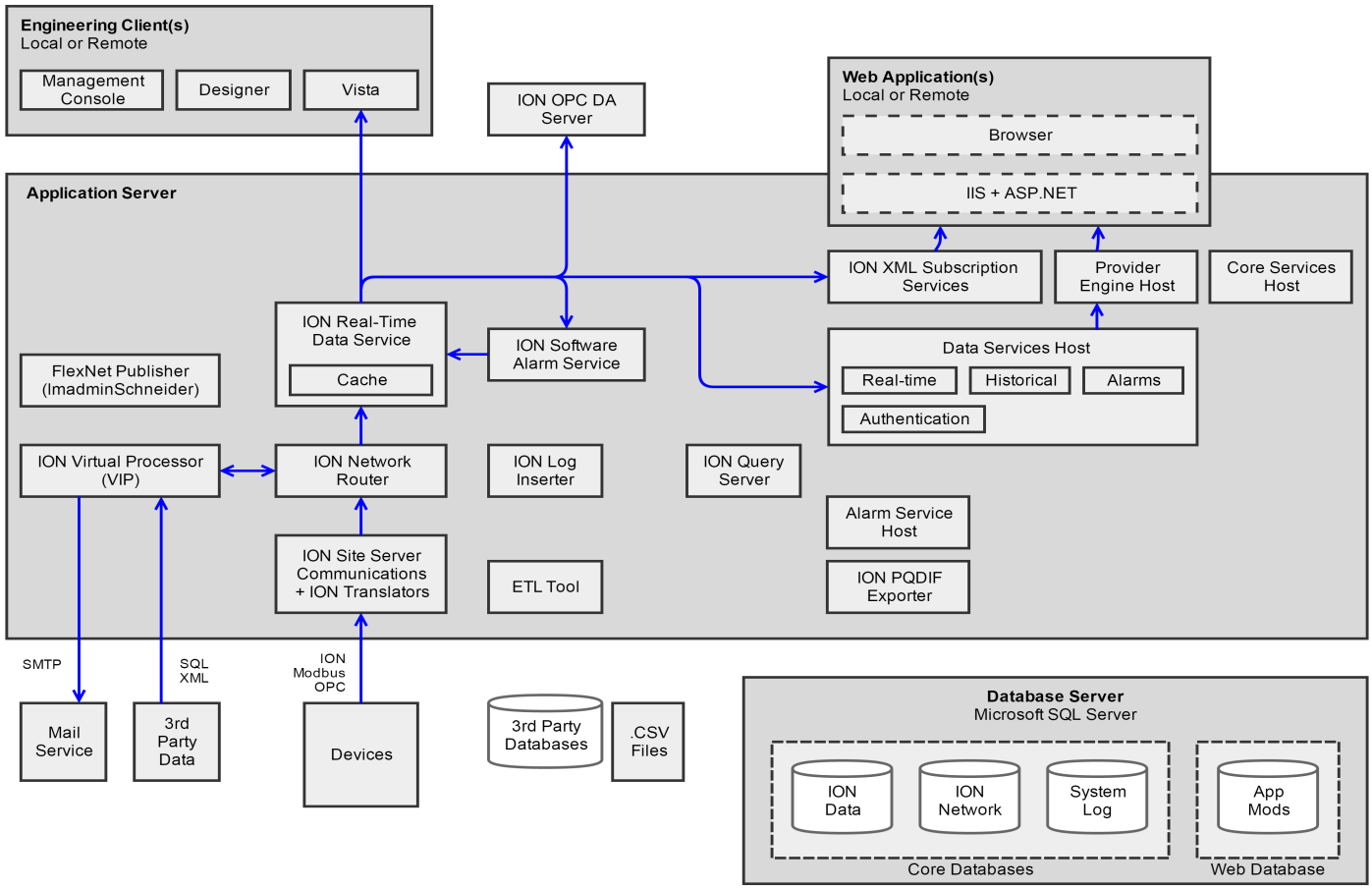
1. A request for source, measurements and timerange is made to the ApplicationModules database via the **ApplicationModules Provider Engine Host** and **ApplicationModules Data Services Host** services.
2. If the source and data is not found, a new query is made to ION_Data with the results aggregated and cached in the ApplicationModule database. This allows for faster responses to the Web Applications when it is asked for the same data again in the future.

Viewing Reports

1. A request for source, measurements and timerange is made to the ION_Data database directly. The **ApplicationModules** services are only used when requesting hierarchy data.
2. The data is returned to the report for viewing.

Real-time Data Flow Details

The following diagram depicts the main component interactions when viewing real-time data from devices or other sources. Components not involved with these interactions are included on the diagram for completion (for example, the ION Log Inserter Service is not used for real-time data).



Viewing real-time data in Diagrams

1. When a user diagram is opened, the **ION XML Subscription** and **ION XML Subscription Store** services creates a subscription and delivers the real-time data in XML format.
2. The data is requested from the **ION Real Time Data Service** which will either:
   - Return the real-time data for the source and measurement, if it is available in the cache, or
   - Request the data from source, through the **ION Network Router**.

Viewing real-time data in Trends or Tables

1. A request for real-time data is made through the **ApplicationModules Provider Engine Host** and **ApplicationModules Data Services Host** services.
2. If the data is not found, the data is requested from the **ION Real Time Data Service** which will either:
   - Return the real-time data for the source and measurement, if it is available in the cache, or
   - Request the data from source, through the **ION Network Router**.

Appendix B: Performance Tuning

Power Monitoring Expert is installed with a number of factory default settings that should be acceptable for most installations. However, the needs of individual systems can be different from one another and there are several parameters that can be used to fine-tune Power Monitoring Expert (for example, real-time or historic polling periods).

General Recommendation to Improve Performance

To improve the overall performance of Power Monitoring Expert, it is recommended that you reduce or manage the communication traffic as much as possible. The following points should be addressed to manage the overall communication traffic:

- Real-time data clients (for example, Vista, Diagrams, Tables, OPC, VIP, and Trends) polling periods should be adjusted properly. Do not poll with high speed when it is not needed.
- Disable devices in Management Console that are not presently commissioned or functional (for example, devices that are inoperable, devices that have a communication error rate >5%, or not physically connected, and so on).
- Connect high-end PQ meters which can generate events and waveforms directly to the Ethernet. If this is not possible, isolate them to a smaller daisy chain (one or two devices).
- Do not log measurements that are not needed.
- Schedule log upload to occur at times when system usage is less intensive.

Operating Conditions

There are two operating conditions that Power Monitoring Expert experiences when communicating with devices in the network:

- **System start-up** (when first connecting to devices in Management Console).
- **Steady-state** (during normal operation of the software).

System Start-up

During system start-up it is normal for the software to perform slowly as it communicates to devices in the network and downloads the available historic logs. Depending on how long the device has been in service there could be over a month of historic logs, PQ events, and waveforms to download. This behavior is particularly noticeable on long daisy chains that include meters with a high quantity of on-board logged data.

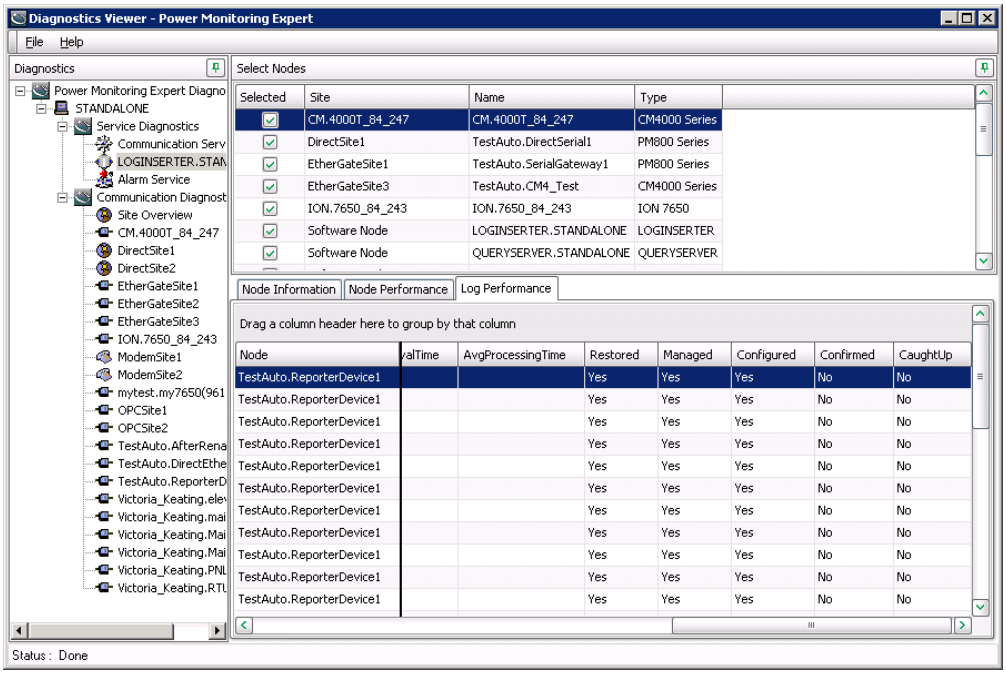
After the system has downloaded the available logs from devices, the performance of Power Monitoring Expert can be measured and, if necessary, appropriate action can be taken to improve it. The Diagnostics Viewer in Management Console should be used to determine when the historic logs have been downloaded from devices.

1. In Diagnostics Viewer expand **Service Diagnostics** and click

   LOGINSERTER.<server_name>.

2. Select the available devices in the **Select Nodes** list.

3. Select the **Log Performance** tab to display the status of the historic logs in the devices.
4. Scroll to the right to show the **CaughtUp** column.



During system start-up the **CaughtUp** column displays **No**, indicating that there are historic logs on the devices that have not yet been downloaded to the database. As the logs are downloaded the individual rows change to **Yes**. Continue to monitor this column for several minutes to verify that the logs have been completely downloaded. At this point the software is in steady-state operation.

Steady State

After system is completely started up, you can u se the Diagnostics Viewer to diagnose and tune the field-level communication.

1. In Management Console, ensure that all of the devices on the daisy chain to be tested are enabled.
2. Apply the desired test load to the devices on the daisy chain (for example VIP, Vista, OPC, Diagrams, Tables, or Log Inserter).
3. In the Diagnostics Viewer, expand **Communications Diagnostics** and select the site of the associated daisy chain.
4. Select the **Communication Status** tab.
5. Right-click the **Communication Status** pane and select **Reset**.
6. Let the system gather metrics. For real-time data loads, a few minutes is usually enough. For logging, it is better to leave it for an hour or more, depending on logging intervals.

For each site (either a daisy chain with a gateway or an Ethernet device), the Time Util (%) column indicates how utilized the communication channel is:

Time Util (%)	Description
0 - 70	Increase the real-time and historical requests to the site without losing performance. Still have bandwidth for periods of heavy usage.
70 - 99	Heavy usage. Potential to saturate the bandwidth if more clients connect or power quality events occur.
100	Communication channel is saturated.

A value at 100% indicates that the daisy chain is saturated and may not be providing responses as quickly as all requesting clients are configured to meet. For example, this could mean that instead of 5 second updates in Vista, you may see it as 6 or more seconds depending on how saturated the site is.

Conversely, a low percentage indicates room for more data requests. The user can set the software components (Real-time clients, LogInserter) to poll more quickly to achieve better user experience, or put more devices on the same daisy chain.

See the *StruxureWare Power Monitoring Expert 8.2 User Guide* for more information about the Diagnostics Viewer.

What Settings Can Improve Performance

Power Monitoring Expert is installed with a number of factory default settings that should be acceptable for most installations. However, the needs of individual systems can be different from one another and there are several parameters that can be used to fine-tune Power Monitoring Expert.

Registry Settings

The registry keys itemized below can be used to make adjustments to Power Monitoring Expert's performance. These keys should be located under HKEY_LOCAL_MACHINE\SOFTWARE\Schneider Electric\StruxureWare Power Monitoring Expert in the registry. If the impact of the change is not well understood, then consider an alternate fix or consult Technical Support for guidance.

NOTICE

IRREVERSIBLE OPERATING SYSTEM DAMAGE OR DATA CORRUPTION

- Do not modify system registry keys without sufficient knowledge or experience in these procedures.
- Before making any changes, back up your system registry in a network folder or other remote location.
- Obtain assistance from knowledgeable and qualified personnel.

Failure to follow these instructions can result in irreparable damage to your computer's operating system and all existing data.

ConnectedThreadPoolSize (DWORD; default 200): The number of sites ION SiteServer service sends requests to simultaneously. Ideally, this value is equal to or greater than the number of sites in the system (that is, serial sites, Ethernet gateway sites, and Ethernet devices) up to a maximum of 400.

LI_PollingPeriod_s (DWORD; default 30): The minimum time (in seconds) between polls for a historic log position of a given log. This is a global setting used to adjust the amount of Log Inserter driven communication traffic for the entire system.

LI_MaxPollingPeriod_s (DWORD; default 60): This is the maximum value that LI_PollingPeriod_s can be set to. If you increase LI_PollingPeriod_s beyond 60, you also need to increase this setting.

NOTE: Other performance tuning settings may be available. Contact a Technical Support representative to look at your specific needs.

Scheduled Log Upload

Power Monitoring Expert has an xml file that can be used to control how and when the Log Inserter uploads logged data from the devices to the database. It is possible to define which device logs are uploaded on a per-device basis. and when they are uploaded. By reducing Log Inserter-generated communications traffic, real-time performance can be improved.

This control is achieved by editing the **LogAcquisitionControl.xml** file. The file includes examples of required syntax and possible configurations. Note that this feature is for advanced users only.

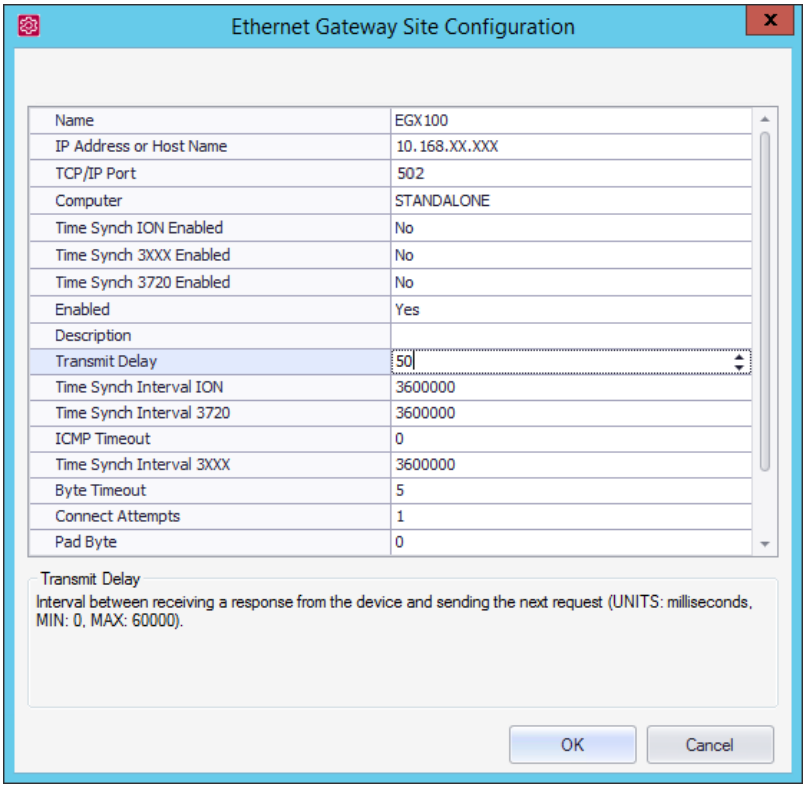
LogAcquisitionControl.xml is located in the \config\cfg\logsrv folder in Power Monitoring Expert.

To begin, open the control file **LogAcquisitionControl.xml**. It specifies:

- Which device types or device instances you want to exclude from the device polling list. Excluding a device from the polling list has the same effect as disabling it in Management Console as far as Log Inserter is concerned. If a device is disabled in this file, the Log Inserter will no longer check it for current log position counters or other device properties that Log Inserter usually cares about (aggregate setup counter, device type, and serial number).
- It is possible to exclude specific recorders from specific devices from the polling ION request.
- Polling intervals can be set for any device type or device instance. They can also be set to change based on a schedule. The schedules used by this feature are defined using the TOU Editor tool that is available from the **Tools** menu in Management Console.

Gateway Transmit Delay

The transmit delay for gateways in Management Console (for example, an EGX100 site) can be reduced from the default of 50ms to 0ms in some cases. Check the % error rate in Diagnostics Viewer to help ensure that problems have not been introduced. Note that some devices, CM2000 in particular, should not have the transmit delay set lower than 50ms to avoid over- loading the device and potentially resulting in bad logged data.


Ethernet Gateway Site Configuration
Name
EGX100
IP Address or Host Name
10.168.XX.XXX
TCP/IP Port
502
Computer
STANDALONE
Time Synch ION Enabled
No
Time Synch 3XXX Enabled
No
Time Synch 3720 Enabled
No
Enabled
Yes
Description
Transmit Delay
50
Time Synch Interval ION
3600000
Time Synch Interval 3720
3600000
ICMP Timeout
0
Time Synch Interval 3XXX
3600000
Byte Timeout
5
Connect Attempts
1
Pad Byte
0
Transmit Delay
Interval between receiving a response from the device and sending the next request (UNITS: milliseconds, MIN: 0, MAX: 60000).
OK
Cancel

Appendix C: Secondary Server

In extremely rare circumstances for very large systems, additional communication servers may be installed as part of either a Standalone or Distributed Database architecture. These servers are known as Secondary servers.

NOTE: If the Application server is sufficient to handle the communication load, distributing the load to a Secondary server does not improve system performance.

A Secondary server contains the Engineering Client tools, configuration files, and communication services for data management and 3rd-party software integration.

When is a Secondary Server Needed?

Use the Secondary Server Calculator to help determine if a secondary server is required for the Power Monitoring Expert installation. It is available in the Exchange Community at:

https://exchangecommunity.schneider-electric.com/docs/DOC-10422

The calculator multiplies the **Device Type Weight** by the **Number of Devices** in the system. If the result is greater than 100%, then a secondary server may be required.

Examples

		System 1		System 2		System 3	
Device Type	**Device Weight (%)**	**Num. of Devices**	**Total Usage (%)**	**Num. of Devices**	**Total Usage (%)**	**Num. of Devices**	**Total Usage (%)**
ION7650	0.10	100	10	100	10	50	5
PM820	0.06	200	12	200	12	100	6
PM3200	0.03	700	21	2200	66	3000	90
TOTAL		**1000**	**43 %**	**2500**	**88 %**	**3150**	**101 %**

In the first two systems, the total device weight is **43%** and **88%** respectively; therefore a Secondary server **is not required**. In the third system, the total device weight is **101 %**; therefore a Secondary server **may be required**.

		System 4		System 5	
Device Type	**Device Weight (%)**	**Num. of Devices**	**Total Usage (%)**	**Num. of Devices**	**Total Usage (%)**
CM4000	0.15	100	15	100	15
BCPM	0.20	200	40	200	40
BCM42	0.04	700	28	2200	88
TOTAL		**1000**	**83 %**	**2500**	**143 %**

For the fourth system, the total device weight is **83%**; therefore a Secondary server is still **not required**. The fifth system will require a Secondary server.

If your system exceeds 100%, contact your Regional Competency Center to discuss specific needs to determine if a Secondary Server is required.

Server Recommendation

The following server specification is typical for a Secondary server. If a Secondary Server is required, contact your Regional Competency Center to discuss specific needs.

Server Recommendations
Computer Type: Server **OS**: Windows Server 2012 R2 **CPU**: Intel Xeon E5 2603 (4 core), or better **RAM**: 8+ GB **HDD**: x2 300+ GB

Glossary

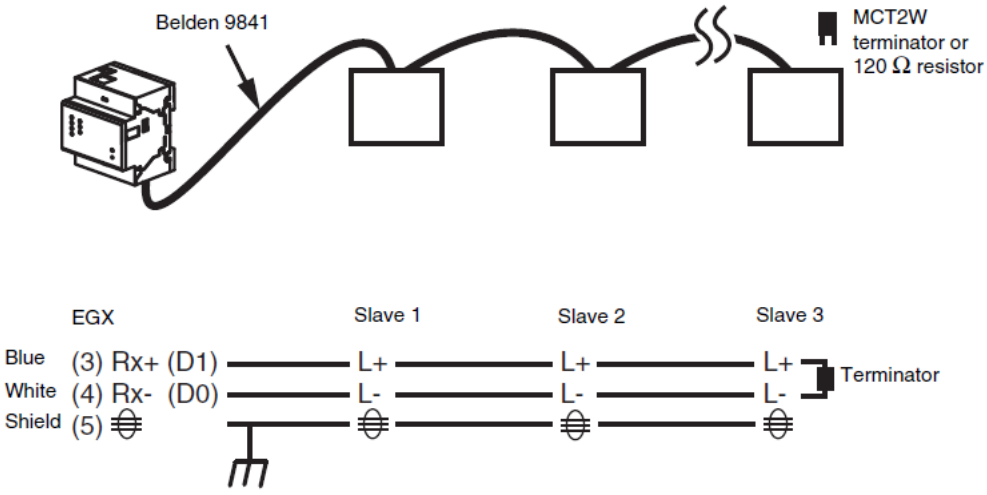
Ethernet devices

An Ethernet device is a type of device that can directly connect to an Ethernet network (as defined by IEEE 802.3). Ethernet devices typically have an 8P8C modular connector (commonly called RJ-45) and can usually transmit data at either 10 (10BASE-T), 100 (100BASE-TX) or 1000 (1000BASE-T) Mbits/s, depending on what both the device and network supports.

Serial devices

A serial device sends data on a communications cable one bit at a time, making it slower than an Ethernet device. Serial devices with RS-485 can communicate over long distances in electromagnetically noisy environments, making them ideal in industrial and commercial applications.

The following diagram shows RS-485 2-wire slave devices connected to an EGX master (on the left).



Converters

A converter (for example, EtherGate) is a device that enables an RS-485 chain of serial devices to communicate with an Ethernet network. They change the physical network from serial RS-485 to Ethernet, but do not change the communication protocol.

Gateways

A gateway (for example, EGX, PM8ECC, or Modbus Gateway) is a type of device that enables an RS-485 daisy chain of serial devices to communicate with an Ethernet network. They change both the physical network from serial RS-485 to Ethernet and the communication protocol.

Example:

An EGX100 allows a serial RS-485 daisy chain of Modbus devices (using Modbus RTU protocol) to communicate via Ethernet to a Power Monitoring Expert server (using Modbus TCP).

RS-232 Standard

RS-232 is a common physical communications network, allowing the connection of two devices using a cable no longer than 15 m (50 ft). To connect to more than one device, this physical standard must be converted to RS-485.

RS-485 Standard

RS-485, as defined by the Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA), is a common standard that defines the electrical characteristics of the serial devices, but does not specify or recommend any communication protocol (for example, Modbus). RS-485 supports a multi-drop network, where a single driver (that is, a Modbus Master) can communicate to multiple receivers (that is, Modbus Slaves) in a single line, without "T" or "star" connections.

Modbus RTU

A serial communication protocol developed by Modicon™ (now Schneider Electric) in 1979. Modbus is an open protocol and commonly accepted across the industry. It is a simple and robust protocol that allows for the communication of field devices to supervisory monitoring or control software.

Modbus TCP

A variant of the MODBUS family of simple, vendor-neutral communication protocols intended for supervision and control of automation equipment. Specifically, it covers the use of MODBUS messaging in an "Intranet" or "Internet" environment using the TCP/IP protocols. The most common use of the protocols at this time are for Ethernet attachment of PLCs, I/O modules, and "gateways" to other simple field buses or I/O networks. Connected over Ethernet port 502; it does not require a checksum calculation as lower layers already provide checksum evaluation. Modbus TCP/IP specification was developed in 1999 combining a ubiquitous physical network (Ethernet) with a universal networking standard (TCP/IP) and a vendor-neutral data representation. Modbus TCP/IP uses the Modbus instruction set and wraps TCP/IP around it.

ION

Stands for “Integrated Object Network” and is a proprietary communication protocol developed by Power Measurement Ltd. (now Schneider Electric) for use between Power Monitoring Expert and PowerLogic™ ION power meters. The ION protocol allows for real-time communication, historical data logging, waveform data, and custom framework programming. The packet structure of ION is the same for both serial communication (RS-232, RS-485) and Ethernet, making it very versatile.

ODBC

Stands for Open DataBase Connectivity and is a standard C programming language interface that is used to access any type of database, independent of specific database systems or operating systems.

OPC

Is a standards specification developed in 1996 by an industrial automation task force (OPC Foundation) that specifies the communication methods for real-time plant data between control devices from different manufacturers. In November 2011, the OPC Foundation dropped the acronym (OPC originally stood for Object Linking and Embedding (OLE) for Process Control) to reflect the modern applications that use OPC technology including XML, Microsoft's .Net Framework and the OPC Foundation's binary encoded TCP format.

PQDIF

The Power Quality Data Interchange Format allows for the exchange of power quality data between devices and software from different vendors using a non-proprietary standard developed under the guidelines of IEEE P1159.3.

XML

Stands for Extensible Markup Language and is a set of rules for encoding documents in a file format that is readable by both humans and computers. The primary design goals of XML is simplicity and usability over the Internet. XML is defined by the XML 1.0 specification, produced by the World Wide Web Consortium (W3C).

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