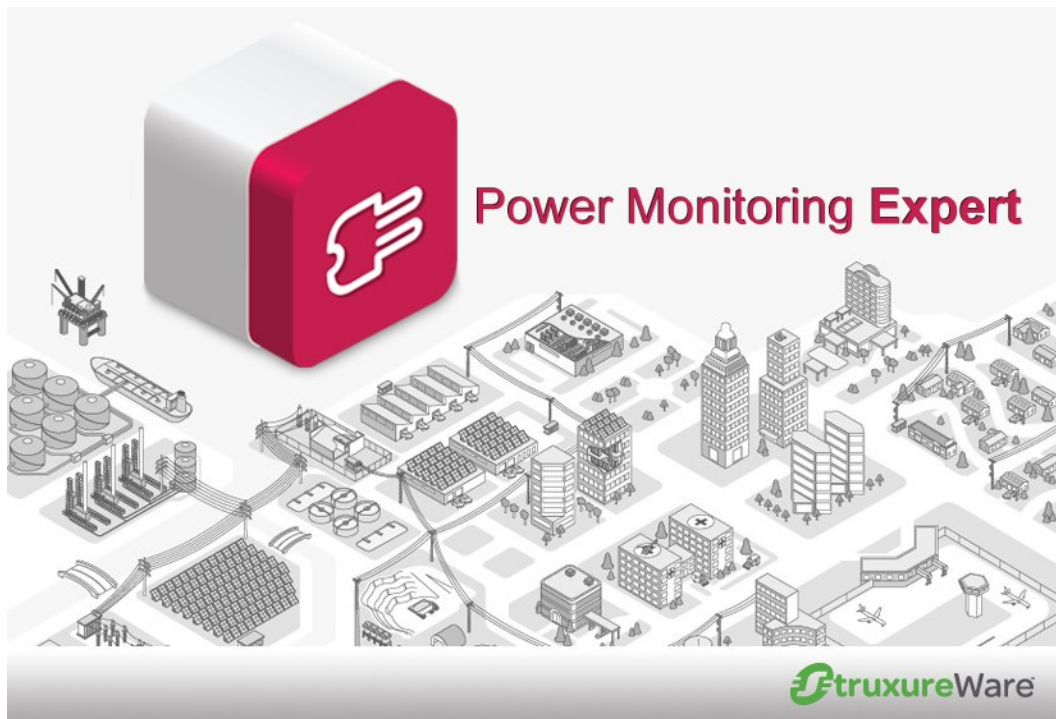


# StruxureWare Power Monitoring Expert 7.2

## System Design Guide

7EN02-0350-00

03/2014





# 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.

# 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.**

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# Introduction

This System Design Guide provides an overview of the elements involved in the design of a StruxureWare™ Power Monitoring Expert system.



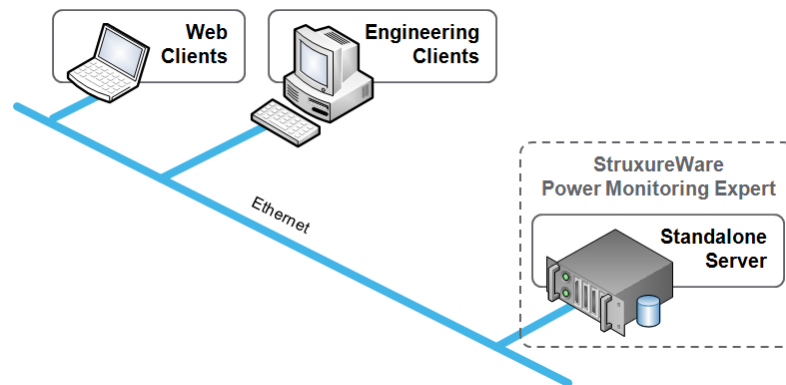
# Power Monitoring Expert Architecture

This section discusses the different server, client, and architecture types that can be used when setting up Power Monitoring Expert on your network.

## Client Types

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

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



### Note

The minimum display resolution for Power Monitoring Expert software is 1024 x 768.

## Engineering Client

An Engineering Client workstation provides administrators and power users access to the Power Monitoring Expert graphical user interface components (Management Console, Vista, Designer). You can use these components to:

- Manage communications to devices.
- Design custom user diagrams to represent the power monitoring system.
- Develop system-level applications.

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

Application	Description
Management Console	Manage communications to devices and open system configuration tools.
Vista	Design, manage, and monitor the power monitoring system.
Designer	Develop system-level applications.

See "[Engineering Clients](#)" on page 40 for the recommended hardware specifications.

## Web Client

The Web client is the primary user interface of the Power Monitoring Expert system. It displays real-time, historical information and alarms in a single user interface, accessible by any computer on the network and is most commonly used in day-to-day power management tasks. The Web client is a thin client and connects to the Power Monitoring Expert server via web browser.

It is not recommended to access the Web client from the Power Monitoring Expert server. The following applications are included in the Web client:

Application	Description
Dashboards	Displays historical energy data in an easily viewable dashboard.
Diagrams	Custom graphical representation of the power monitoring system (designed in Vista).
Tables	Real-time data from the system.
Alarms	Alarm management portal to view and acknowledge both active and historical alarms.
Reports	Generate energy, power quality, and generic system reports, based on data logged by the power meters.

### Recommended Web Client Specifications

Before connecting to the Web applications (Dashboards, Diagrams, Tables, Alarms, and Reports), you should ensure that the Web Client computer meets the following recommended specifications:

Processor	RAM	Minimum Display Resolution	Browser
2 GHz Dual Core	2GB	1024 x 768	Internet Explorer versions 9 or 10
			Google Chrome version 20 or later
			Apple Safari version 5 or later on Mac computers

Only the Diagrams application may be accessed on tablets:

- Safari on iPad tablets using iOS 5 or iOS 6.1 operating systems.
- All browsers using Android operating systems JB 4.1 or ICS 4.0

#### Note

The user will be prompted to install Microsoft Silverlight 4.0 or later if it has not already been installed on the computer.

## Architecture Types

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

- **Standalone** installation
- **Distributed Database** installation (optional, based on specific customer requirements for SQL Server)

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

### Note

A distributed architecture does not provide any performance gains over a standalone architecture and may, in fact, have lower performance.

## Standalone vs. Distributed

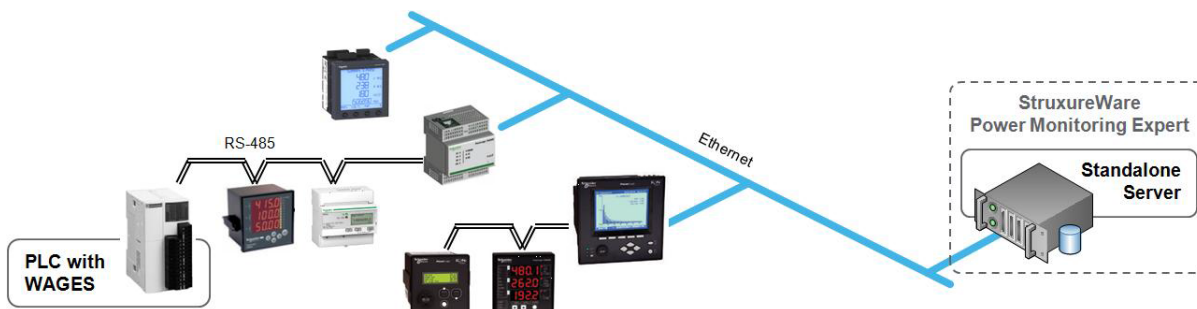
The standalone architecture is the preferred and most common installation method in use because it is cheaper (only one server required) and easier to commission. In some cases, however, the distributed architecture may be required due to local IT policy:

- May not install SQL Server with another application on the same server.
- 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).

## Standalone Architecture

The most common type of Power Monitoring Expert architecture is called "standalone" where one computer hosts:

- **Power Monitoring Expert** software (that is, configuration files, communication services, Web client server, Virtual ION Processor, SQL Server connection, and so on).
- **Microsoft SQL Server** to host 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 will perform optimally when installed on a single server.

## Distributed Architecture

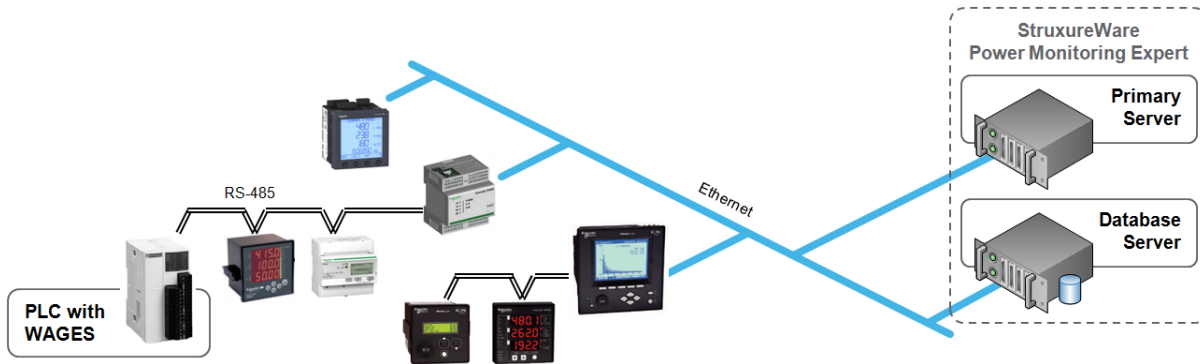
A distributed architecture is when system components are installed across multiple computers. Power Monitoring Expert supports the ability to distribute either a **Database** server or additional communication servers called **Secondary** servers. However, these distributed systems should only be used if the standalone architecture is not possible.

See "[Distributed Power Monitoring Expert Architectures](#)" on page 39 for examples of distributed architectures.

## Distributed Database

If the standalone architecture is not possible, due to specific 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:

- **Primary server** hosts the Power Monitoring Expert software.
- **Database server** hosts the SQL Server databases.



The distributed database architecture is less common than the standalone architecture.

### Note

There is no performance improvement by using the distributed database architecture over the standalone architecture.

## Distributed Web Server

Distributed Web Servers are not supported by Power Monitoring Expert.

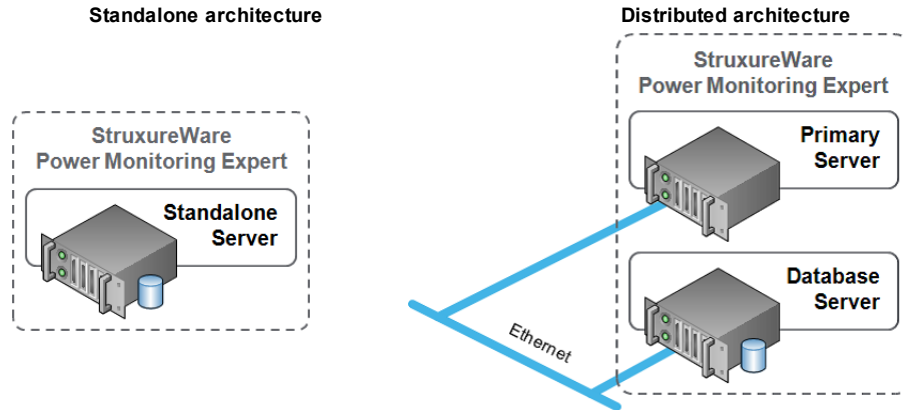
## Server Types

In a standalone architecture there is only one server: the **Standalone / Primary** server.

In a distributed architecture there are two servers: the **Primary** server and **Database** server.

## Standalone / Primary Server

Every Power Monitoring Expert system has a minimum of one server. In the standalone architecture it is called a **Standalone** server, but in the distributed architecture it is called a **Primary** server.

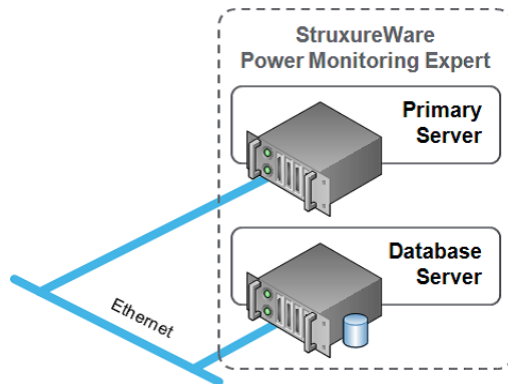


This single server hosts the Engineering client tools and a collection of services and configurations vital for the functioning of the system.

Component	Description	Standalone server	Primary server
Engineering Client tools	Management Console, Vista, Designer, Configuration files	✓	✓
Communication Services	Manage device communications Data management and routing 3rd-party software integration	✓	✓
Web Client server	Internet Information Services (IIS)	✓	✓
Microsoft SQL Server	Host historical data for logged data	✓	x

## Database Server

Due to specific customer requirements, an independent server can be used to host the Microsoft SQL Server engine. This type of server is called a **Database** server and is used in conjunction with a Primary server in a distributed architecture.



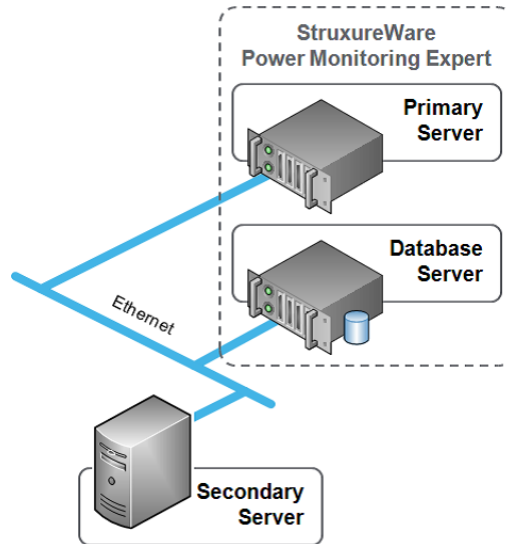
The Database server contains the following components:

Component	Description
Communication Services	Data management and routing
Microsoft SQL Server	Host historical data for logged data

See "[Database Servers](#)" on page 40 for more information about Database servers in a distributed architecture.

## Secondary Server

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



See ["When is a Secondary Server Needed?" on page 41](#) to calculate if a Secondary server is required.

---

### Note

In 2012, about 0.3% of new system deployments required a Secondary server.

---

# 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.

## Systems Up To 250 Devices

System <sup>1</sup>	Devices	Users	Server Recommendations	Years of Logging <sup>2</sup>	OPC Tags	VIP Tags <sup>3</sup>
B1	≤ 50	≤ 5	<b>Computer Type:</b> Desktop <b>OS:</b> Windows 7 (64-bit) <b>SQL:</b> 2012 Express SP1 <b>CPU:</b> Intel Core i3 (2 core), or better <b>RAM:</b> 2+ GB <b>HDD:</b> 500+ GB	~4 years(10 GB)	1000	250
B2	≤ 100	≤ 5	<b>Computer Type:</b> Desktop <b>OS:</b> Windows 7 (64-bit) <b>SQL:</b> 2012 Express SP1 <b>CPU:</b> Intel Core i3 (2 core), or better <b>RAM:</b> 4+ GB <b>HDD:</b> 500+ GB	~2 years(10 GB)	1000	250
B3	≤ 100	≤ 5	<b>Computer Type:</b> Desktop <b>OS:</b> Windows 7 (64-bit) <b>SQL:</b> 2012 Standard SP1 <b>CPU:</b> Intel Core i3 (2 core), or better <b>RAM:</b> 4+ GB <b>HDD:</b> 500+ GB	~6 years(30 GB)	1000	250
A1	≤ 100	≤ 15	<b>Computer Type:</b> Workstation <b>OS:</b> Windows 7 (64-bit) <b>SQL:</b> 2012 Standard SP1 <b>CPU:</b> Intel Xeon E56xx (4 core), or better <b>RAM:</b> 8+ GB <b>HDD:</b> x2 500+ GB	<6 years(30 GB) <sup>4</sup>	5000	1500
B4	≤ 250	≤ 10	<b>Computer Type:</b> Workstation <b>OS:</b> Windows Server 2012 R2 <b>SQL:</b> 2012 Standard SP1 <b>CPU:</b> Intel Xeon E56xx (4 core), or better <b>RAM:</b> 8+ GB <b>HDD:</b> x2 500+ GB	~2.5 years(30 GB)	5000	1000
A2	≤ 250	≤ 20	<b>Computer Type:</b> Server <b>OS:</b> Windows Server 2012 R2 <b>SQL:</b> 2012 Standard SP1 <b>CPU:</b> Intel Xeon E56xx (4 core), or better <b>RAM:</b> 16+ GB <b>HDD:</b> x4 300+ GB	<2.5 years(30 GB) <sup>4</sup>	10000	3000

<sup>1</sup> Basic or Advanced system (for example, B3 denotes the third of the basic systems in a larger order of magnitude).

<sup>2</sup> 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.

<sup>3</sup> VIP "tags" are measurements used for alarming and/or logging.

<sup>4</sup> Based on the following device mix: 10% advanced; 20% intermediate; 70% basic/entry.  
It is recommended to calculate the ION\_Data size and number of years of logging.

## Systems Up To 2500 Devices

System <sup>1</sup>	Devices	Users	Server Recommendations	Years of Logging <sup>2</sup>	OPC Tags	VIP Tags <sup>3</sup>
B5	≤ 600	≤ 10	<b>Computer Type:</b> Workstation <b>OS:</b> Windows Server 2012 R2 <b>SQL:</b> 2012 Standard SP1 <b>CPU:</b> Intel Xeon E56xx (4 core), or better <b>RAM:</b> 16+ GB <b>HDD:</b> x6 300+ GB	~1 year(30 GB)	5000	1000
A3	≤ 600	≤ 35	<b>Computer Type:</b> Server <b>OS:</b> Windows Server 2012 R2 <b>SQL:</b> 2012 Standard SP1 <b>CPU:</b> x2 Intel Xeon E56xx (4 core), or better <b>RAM:</b> 24+ GB <b>HDD:</b> x6 300+ GB	<1 year(30 GB) <sup>4</sup>	30000	10000
B6	≤ 2500	≤ 10	<b>Computer Type:</b> Server <b>OS:</b> Windows Server 2012 R2 <b>SQL:</b> 2012 Standard SP1 <b>CPU:</b> x2 Intel Xeon E56xx (4 core), or better <b>RAM:</b> 24+ GB <b>HDD:</b> x5 300+ GB x1 1.5+ TB	~2 years(200 GB)	10000	2500
A4	≤ 2500	≤ 50	<b>Computer Type:</b> Server <b>OS:</b> Windows Server 2012 R2 <b>SQL:</b> 2012 Standard SP1 <b>CPU:</b> x2 Intel Xeon E5-2xxx (6 core), or better <b>RAM:</b> 32+ GB <b>HDD:</b> x6 300+ GB x2 1.5 TB	<2 years(200 GB) <sup>4</sup>	50000	15000

## Basic Systems

The majority of Power Monitoring Expert systems are basic with out-of-the box functionality and will meet 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 will contain a mixture of advanced and basic power meters. These basic systems use the following devices:

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

These systems do not include large numbers of BCPM or EM4800 device types.

### Small Basic System Example

A small basic system will use **System B1** from above. The following table outlines additional system usage and other details.

Server Requirements	Quantity	Details
Number of Devices	50	x35 PM1200 x10 PM820 x5 ION7650
Hard Drive(465 GB available)	80 GB 93 GB 12 GB 50 GB <b>235 GB</b>	Windows OS 20% Free hard drive space Power Monitoring Expert and SQL Server ION_Data and its backups <b>Total Usage</b>

## Large Basic System Example

A large basic system will use **System B6** from above. The following table outlines additional system usage and other details.

Server Requirements	Quantity	Details
Number of Devices	2500	x2200 PM3200 x200 PM820 x100 ION7650
Hard Drive Group 0 (279 GB available)	100 GB 56 GB 12 GB <b>168 GB</b>	Windows OS 20% Free hard drive space Power Monitoring Expert and SQL Server <b>Total Usage</b>
Hard Drive Group 1 (279 GB available)	56 200 <b>256 GB</b>	20% Free hard drive space SQL Server tempDB <b>Total Usage</b>
Hard Drive Group 2 (279 GB available)	56 200 <b>256 GB</b>	20% Free hard drive space ION_Data .mdf <b>Total Usage</b>
Hard Drive Group 3 (1397 GB available)	279 200 600 <b>1079 GB</b>	20% Free hard drive space ION_Data .ldf ION_Data backups <b>Total Usage</b>

## 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:

- Custom applications in the VIP
- Non-default logging
- High system usage with report generation
- OPC server with thousands of tags
- High number of users
- 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 amount of translated devices. On the other hand, RAM is very important for SQL Server. SQL Server is

a memory intensive program and will require more RAM for running reports, logging large number of measurements, and other database intensive operations.

## Support Matrix for Operating Systems and SQL Server

The following tables summarize the combinations of 32-bit and 64-bit versions of Microsoft Windows operating systems and SQL Server editions that support Power Monitoring Expert installations.

### Note

Power Monitoring Expert software 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 Windows Operating Systems	32-bit Microsoft SQL Server Editions	Standalone Server	Distributed Database Server
Windows 7 Professional/Enterprise, SP1	SQL Server 2008 R2 Express, SP2	Yes	No
	SQL Server 2008 R2 Standard/Enterprise, SP2	Yes	No
	SQL Server 2012 Express, SP1	Yes	No
	SQL Server 2012 Standard/Enterprise, SP1	Yes	No
Windows Server 2008 Standard/Enterprise, SP2	SQL Server 2008 R2 Express, SP2	Yes	No
	SQL Server 2008 Standard/Enterprise, SP3	Yes	Yes

64-bit Windows Operating Systems	64-bit Microsoft SQL Server Editions	Standalone Server	Distributed Database Server
Windows 7 Professional/Enterprise, SP1	SQL Server 2008 R2 Express, SP2	Yes	No
	SQL Server 2008 R2 Standard/Enterprise, SP2	Yes	No
	SQL Server 2012 Express, SP1	Yes	No
	SQL Server 2012 Standard/Enterprise, SP1	Yes	No
Windows Server 2008 Standard/Enterprise SP2, and R2 SP1	SQL Server 2008 R2 Express, SP2	Yes	No
	SQL Server 2008 R2 Standard/Enterprise, SP2	Yes	Yes
Windows Server 2012 / R2 Standard/Enterprise	SQL Server 2012 Express, SP1	Yes	No
	SQL Server 2012 Standard/Enterprise, SP1	Yes	Yes

See the *StruxureWare Power Monitoring Expert Installation Guide (7EN02-0349)* for more information.

### 32-bit versus 64-bit Operating Systems

It is recommended to use a 64-bit operating system for any size Power Monitoring Expert system. The gain in using 64-bit comes from the better performance for what complements Power Monitoring Expert (for example, SQL Server 64-bit can perform much faster than SQL Server 32-bit).

In addition, 32-bit operating systems are limited to just 4 GB of RAM, whereas a 64-bit operating system can use a theoretical maximum of approximately 16 EB (that is, exabytes) of RAM!

---

### Note

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

---

## Windows 7 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 add more RAM as needed. Windows 7 is limited to just two physical CPUs.
- Windows Server offers better performance for running Power Monitoring Expert services.

## 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 will 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 <sup>1</sup>
Windows OS <sup>2</sup>	80 – 100 GB
Power Monitoring Expert <sup>3</sup>	5 GB
Power Monitoring Expert's databases <sup>4</sup>	5 GB
SQL Server	2 GB
Free hard drive space <sup>5</sup>	10% - 30% of the total hard drive space
<b>TOTAL</b>	<b>~ 100 GB + 30% of Total Hard Drive Space</b>

<sup>1</sup> The hard drive space requirements for each component have been rounded up to account for variations throughout the life of the system.

<sup>2</sup> 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 will grow over time.

<sup>3</sup> Accounts for future Power Monitoring Expert updates and service packs.

<sup>4</sup> Includes Power Monitoring Expert databases (that is, ION\_Network, ION\_SystemLog and ApplicationModules) and database backups. ION\_Data is not included.

<sup>5</sup> 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 RAID1* 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.

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

## 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.

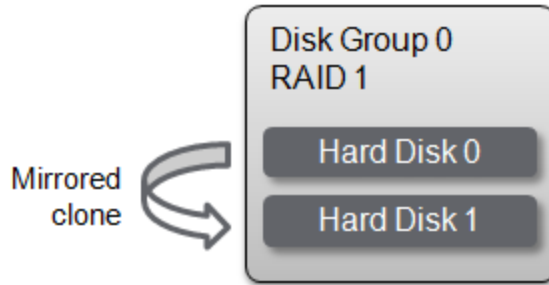
## Hard Drive Groups

For a basic system, a single hard drive (or hard drive group with RAID 1) will be 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) to 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 may 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 may be added so that the software components may 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 <sup>1</sup>	✓
tempDB <sup>2</sup>	✓
MDF <sup>3</sup>	✓
LDF <sup>4</sup>	✓
Backups <sup>5</sup>	✓

<sup>1</sup> Includes the Operating System, page file, Power Monitoring Expert and any other applications.

<sup>2</sup> SQL Server temporary system database.

<sup>3</sup> SQL Server main databases.

<sup>4</sup> SQL Server transaction log files.

<sup>5</sup> 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 <sup>1</sup>	✓	
tempDB <sup>2</sup>		✓
MDF <sup>3</sup>	✓	
LDF <sup>4</sup>		✓
Backups <sup>5</sup>		✓

### 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 <sup>1</sup>	✓		
tempDB <sup>2</sup>	✓		
MDF <sup>3</sup>		✓	
LDF <sup>4</sup>			✓
Backups <sup>5</sup>			✓

### Option 3b (6x Hard Drives)

The following configuration is for reduced drive contention and 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 <sup>1</sup>	✓			
tempDB <sup>2</sup>		✓		
MDF <sup>3</sup>			✓	
LDF <sup>4</sup>				✓
Backups <sup>5</sup>				✓

### 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 <sup>1</sup>	✓			
tempDB <sup>2</sup>		✓		
MDF <sup>3</sup>			✓	
LDF <sup>4</sup>				✓
Backups <sup>5</sup>				✓

## Database Considerations

### SQL Server Express vs. Standard/Enterprise

Power Monitoring Expert comes available with SQL Server Express 2012 SP1 to host the databases. 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 a single physical CPU, but multiple cores allowed
- Limited to use a maximum of 1 GB of the total system RAM

### 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 will only use one of the quad core CPUs and just 1 GB of RAM.

This server is far too large for SQL Server Express and will 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 and Tables applications in the Web Applications.
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, will be 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).

## Database Growth Calculations

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

- Factory default measurement logging
- Power Quality (PQ) events
- Custom measurement logging

Each factory or custom logged measurement in the database uses approximately **75 bytes** of hard drive space. 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.

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

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

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 to 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 to pre-allocate the hard drive space to avoid the effects of the periodic growth operations.

Device Range	Device Type	Daily Growth Rate (kB)	Has Waveforms <sup>1</sup>
Utility Meter	ION8800A (with IEC 61000-4-30 <sup>2</sup> )	560 (745)	Yes
	ION8800B	560 (680)	No
	ION8800C	30	No
	ION8650A (with IEC 61000-4-30 <sup>2</sup> )	525 (710)	Yes
	ION8650B (with IEC 61000-4-30 <sup>2</sup> )	525 (645)	Yes
	ION8650C	30	No
	ION8600A	525	Yes
	ION8600B	525	Yes
	ION8600C	30	No
Advanced Meter	ION7650 (with IEC 61000-4-30 <sup>2</sup> )	565 (780)	Yes
	ION7550	545	Yes
	CM4000 series	800	Yes
Intermediate Meter	CM3000 series	765	Yes
	PM870	110	Yes
	PM850	110	Yes
	PM820	85	No
	PM810 (PM810LOG)	140 (85)	No
	ION7350	410	Yes
	ION7330	195	No
	ION7300	0	No
Multi Circuit Meter	BCPM (42 circuits)	1060	No
	EM4800-24	2900	No
	EM4800-12	2220	No
	EM4800-08 Wye	1830	No
	EM4800-08 Delta	1830	No
Basic Meter	PM5350	225	No
	PM700 series <sup>3</sup>	0	No
	PM3200 series	85	No
	ION6200 <sup>3</sup>	0	No
	PM200 <sup>3</sup>	0	No
Entry Meter	EM1200	50	No
	PM1200 / DM6200	50	No
	PM9c	170	No
	iEM3000	70	No
Circuit Breaker Trip Units	Micrologic H	350	Yes
	Micrologic A, E, and P	70 / 295 / 350	No
	Micrologic Compact NSX A and E	170	No
Protective relays	Sepam series 80	565	Yes
	Sepam series 48 and 40	270	Yes
	Sepam series 20	50	Yes
	Sepam series 10	40	No

<sup>1</sup> Devices with waveforms will contribute approximately 10% - 20% to the total size of the database. See below for details.

<sup>2</sup> Includes IEC 61000-4-30 (10 minute and 2 hour logging). IEC 61000-4-30 3 second logging must be enabled manually and will contribute 14.4 MB of logs per day. EN50160 (weekly logging) contributes approximately 2 kB per day.

<sup>3</sup> The default factory device drivers do not have PC-logging enabled. PC-logging must be enabled manually using the Modbus Device Importer.

These numbers may change with any meter logging configurations and should only be used as an estimated baseline.

## Factory Default Measurement Logging

For a system where the devices only log factory default measurements, the database size may 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 **5.92 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
PM820	85	20	1.66	0.59
PM3200	85	70	5.81	2.07
<b>TOTAL</b>	-	<b>100</b>	<b>15.09 MB</b>	<b>5.38 GB</b>

$$\begin{aligned} \text{ION\_Data.mdf (GB)} &= 5.38 + 10\% \text{ for growth} \\ &= 5.92 \text{ GB} \end{aligned}$$

## Power Quality Events

If there are devices in the network that have waveform logging and PQ detection enabled, they will 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**

Do not incorrectly configure PQ power meters, otherwise excessive database growth and decreased system performance can occur.

**Failure to follow these instructions can result in corrupt databases and an unusable system.**

### Example

A Power Monitoring Expert system contains twelve 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 **6.51 GB**.

$$\begin{aligned} \text{ION\_Data.mdf (GB)} &= 5.92 + 10\% \text{ for PQ events} \\ &= 6.51 \text{ GB} \end{aligned}$$

## Custom Logging Profiles

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

- In the devices
- In the Virtual ION 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 will contribute approximately **2.5 MB** towards the annual database growth.

$$\begin{aligned} \text{Single Measurement (MB)} &= \frac{365 \frac{\text{Days}}{\text{Year}} * 24 \frac{\text{Hours}}{\text{Day}} * 4 \frac{\text{Measurement}}{\text{Hour}} * 75 \frac{\text{bytes}}{\text{Measurement}}}{1,048,576 \frac{\text{bytes}}{\text{MB}}} \\ &= 2.51 \text{ MB} \end{aligned}$$

### 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:

$$\begin{aligned} \text{Annual Growth (MB)} &= \frac{365 \frac{\text{Days}}{\text{Year}} * 24 \frac{\text{Hours}}{\text{Day}} * 4 \frac{\text{Measurement}}{\text{Hour}} * 75 \frac{\text{bytes}}{\text{Measurement}}}{1,048,576 \frac{\text{bytes}}{\text{MB}}} * 10 \\ &= 25.06 \text{ MB} \end{aligned}$$

Therefore, the new estimated annual growth rate for the ION\_Data .mdf is **6.53 GB**.

$$\begin{aligned} \text{ION\_Data.mdf (GB)} &= 6.51 + 0.02 \text{ GB} \\ &= 6.53 \text{ GB} \end{aligned}$$

## 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.

$$\text{HDD Space for ION\_Data (GB)} = 5 * \text{.mdf (GB)}$$

The formula can be broken down into the following components:

Component	Component Details
Main database file (.mdf)	x1 .mdf
Transaction log file <sup>1</sup> (.ldf)	x1 .mdf
Backups <sup>2</sup>	x2 .mdf
Free Space for Backups or tempDB <sup>3</sup>	x1 .mdf
<b>Total</b>	<b>x5 .mdf</b>

<sup>1</sup> The .ldf is typically just 10% of the total .mdf size, but will occasionally expand to 100% during normal operation. Each calculation will presume that the .mdf and .ldf are equal in size.

<sup>2</sup> The system default is to keep two database backups.

<sup>3</sup> Free space is required for database backups and will require 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 will each require x1 .mdf in hard drive space.

### Example

A new Power Monitoring Expert installation has been estimated to require **32.7 GB** of hard drive space to account for the live database, database backups and regular SQL operations each year.

$$\begin{aligned}
 \text{HDD Space for ION\_Data (GB)} &= 5 \times .\text{mdf (GB)} \\
 &= 5 \times (6.53) \\
 &= 32.7 \text{ GB}
 \end{aligned}$$

## Hard Drive Space for 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 (that is, due to manual database editing, unexpected server shutdown, an inoperable hard drive, and so on).

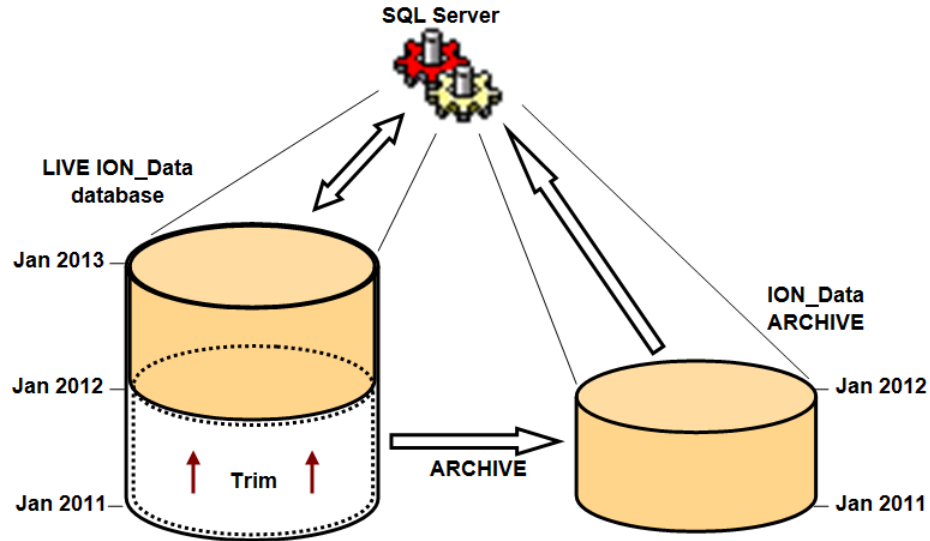
By default, the system will automatically backup the databases on a daily (ION\_Network) or weekly (ION\_Data and ApplicationModules) basis and **keep two backups** of each database in the main installation folder:

C:\Program Files\Schneider Electric\Power Monitoring Expert\config\cfg\DBBackups

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

## Database Archives

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 client.



## Considerations for Archives

The purpose of the archive is to remove data from the live ION\_Data database to reduce its overall size. In most cases this is **not recommended** since the archive 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 2012 Express SP1 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. In this case, archiving may only need to be done once a year or less to maintain large intact data sets.

## Advanced Architectures

### 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 15).

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

- VMware ESX 4.1/ESXi 4.1 and 5.0
- Microsoft Hyper-V
- Citrix XenServer 6.0
- VMware Workstation 8.

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 hard drive group configuration and space.

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

See the *Power Monitoring Expert 7.2 Installation Guide* for more information.

## 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 there is only a single SQL Server. Using clustering helps ensure that applications running have little or no downtime when a node becomes nonoperational.

Power Monitoring Expert software can function in a clustered environment. Note that it is only the Database Server component that is deployed in the clustered environment. The Primary Server must reside in a non-clustered environment.

Schneider Electric representatives and certified partners should refer to RESL207774 *Installing Power Monitoring 7.0 on a SQL 2008 R2 Cluster* in the Schneider Electric Knowledge Base for additional information.



# 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
- Protection relays and trip units
- PLCs (Programmable Logic Controllers)
- WAGES devices via PLC I/O

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, EGX100, EGX300, ION7650, ION8800, and so on) to establish a network connection with Power Monitoring Expert.

## Supported Protocols

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

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

For more information about these protocols, see the ["Glossary" on page 49](#).

## Ethernet Devices

Follow commonly recommended practices for Ethernet design when connecting Ethernet devices to the network.

## Serial Devices

Follow commonly recommended practices for RS-485 serial daisy chain wiring according to the device installation guides.

## Design a New Communication Network

A tool has been designed that helps estimate communication utilization for serial daisy chains. This tool can be used for both new system design and for optimizing existing Power Monitoring Expert systems for existing serial daisy chains.

See the ["Daisy Chain Calculator" on page 32](#) for more information about tuning serial daisy chain performance.

## Power Monitoring Expert Performance

The performance of Power Monitoring Expert is dynamic and 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? There are two types of transactions to devices that consume network bandwidth:

- 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.

The system and daisy chain should be tuned to give improved performance as required by the user.

## Daisy Chain Calculator

The Daisy Chain Calculator is available for use by Schneider Electric representatives and certified partners. Customers should contact their local representative for additional information.

The daisy chain calculator takes into account the following parameters that may be individually adjusted:


- Log Inserter Polling Period
- Number and type of devices on the daisy chain
- Number of Diagrams and/or Tables open, displaying real-time data
- Diagram real-time update period (in seconds)

Each parameter may be adjusted to calculate the daisy chain utilization. A common **target is 50% utilization**, which will accommodate periods when there are more users in the system or when events are being downloaded to the software. Lower targets should be used if faster real-time performance is needed.

### Example

A daisy chain has 20 MicroLogic H Trip Units. In a default installation of Power Monitoring Expert, the daisy chain is utilized **124% of the time**, meaning that request and responses for data are constantly delayed giving the appearance that the system is not performing.

By adjusting the Log Inserter Polling Period from 30 seconds (system default) to 90 seconds, the daisy chain is now **only 62% utilized**. This means that 38% of requests for data to any device on the daisy chain will be processed immediately, while 62% of requests must wait behind a previous request.

		<b>Daisy Chain Calculator</b>		Version 1.0	
		For PME 7.2.2			
<b>Global Tuning Parameters</b>					
The following setting(s) are global to the entire Power Monitoring Expert system and will affect all devices (both serial and Ethernet). It's recommended to adjust these global parameter(s) for the worst performing daisy chain in the system.					
<b>Log Inserter</b>	LI_PollingPeriod_s	90	seconds		
See the StruxureWare Power Monitoring Expert 7.2.2 System Design Guide for more information about adjusting these setting(s).					
<b>Daisy Chain Configuration</b>					
<b>Devices</b>		<b>Vista Diagrams Open*</b>		<b>Real-Time Tables*</b>	
<b>Count</b>	<b>Type</b>	<b># Open</b>	<b>Update Period (s)</b>	<b># Devices</b>	<b>Update Period (s)</b>
20	Micrologic H	1	5		
<b>Daisy Chain Utilization**</b>		62	%		
<b>Untuned Daisy Chain Utilization**</b>		124	%		
Last Updated: February 28, 2014					
*Usage applied simultaneously for entire daisy chain; estimated only, as results will differ by diagram or table.					
**All utilizations are estimated, based on lab results. Actual results may vary.					

## Assess Power Monitoring Expert Performance

There are two operating conditions that Power Monitoring Expert will experience 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)

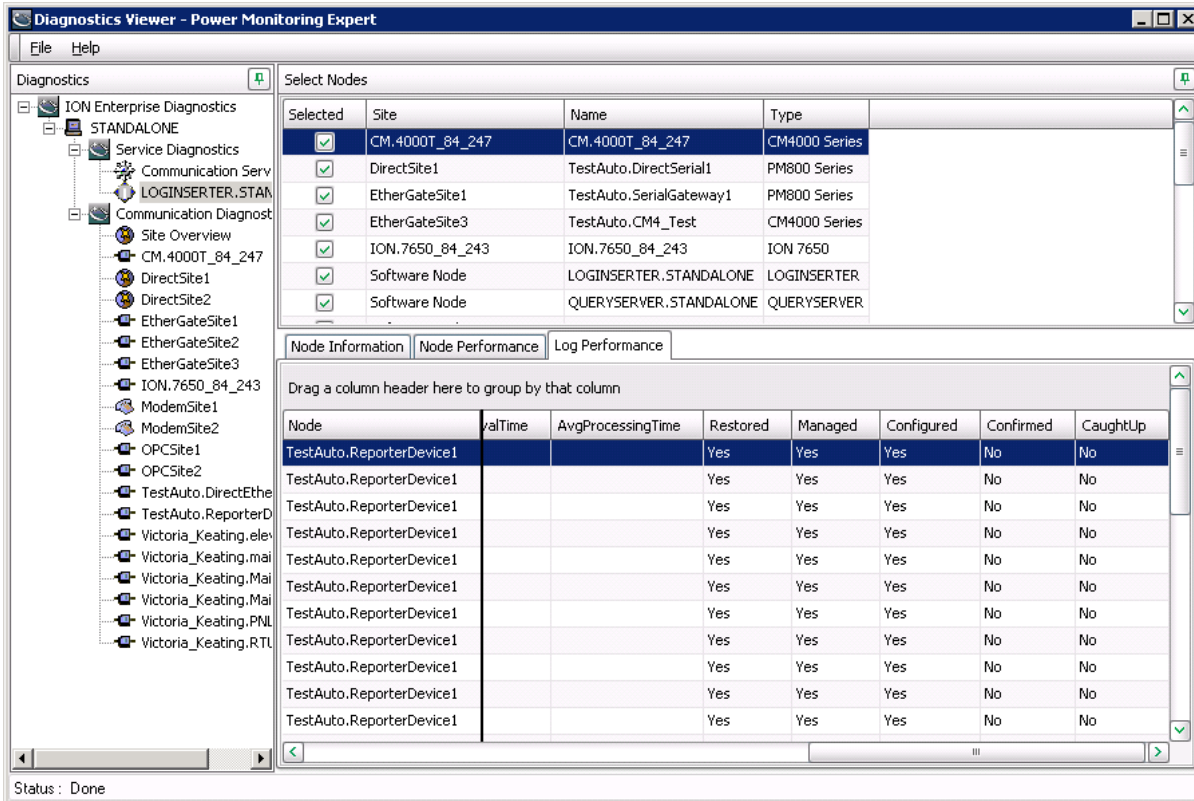
During system start-up it is normal for the software to perform slowly as it communicates to devices in the network and downloads the available historic logs. Depending on how long the device has been in service there could be over a month of historic logs, PQ events and waveforms to download. This behaviour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

Once 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 Diagnostic** 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 will display **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 will change to **Yes**. At this point the software will be in steady-state operation.



## Recommendations to Improve Power Monitoring Expert Performance

To improve the overall performance of Power Monitoring Expert, it is recommended to reduce or control the communication traffic as much as possible. The following points must be addressed to manage the overall communication traffic for serial daisy chains:

- 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.

During the initial start-up of a large system the devices in Management Console should be disabled. To manage the large volume of historic logs that will be downloaded from devices, it is recommended to enable small numbers of devices (for example, <50) at a time. Devices with PC-logging can be enabled at the same time. Monitor the devices in Diagnostics Viewer to ensure the logs have been downloaded before enabling the next group of devices.

## Improve an Existing Communication Network

In many cases, the devices and communication network will already be installed and wired long before the software is even specified. For sites where the communication network is already wired, some adjustments and tests may be performed by the software to make improvements or to make recommendations with minimal re-wiring.

The Daisy Chain Calculator tool (see ["Daisy Chain Calculator" on page 32](#)) may be used to determine how to tune Power Monitoring Expert for improved performance.

## What Settings Can Improve Performance?

Due to network architectural limitations, it may not be possible to reduce the number of the devices on a daisy chain. In cases like these, there are things that could help improve performance:

- The **ConnectedThreadPoolSize** is a registry key that should be equal to or greater than the number of sites plus Ethernet devices in Management Console.
- The **LI\_PollingPeriod\_s** is a registry key that controls how often the Log Inserter checks for logs from devices. The Daisy Chain Calculator accounts for this.
- 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.
- Real-time data clients (for example, Vista, Diagrams, Tables, OPC, VIP, and so on) polling periods can be adjusted.

See ["Performance Tuning" on page 47](#) for details about these settings.



# Applications and System Integration

## Virtual ION Processor (VIP)

The Virtual ION Processor (VIP) is a Windows service that operates on the Power Monitoring Expert server (and Secondary server), providing coordinated data collection, data processing, and control functions for groups of devices. The VIP is capable of collecting and processing data from several power monitoring devices, analyzing the information and performing control functions using a wide selection of ION modules.

Multiple VIPs may be created to manage server load and improve system performance (for example, one VIP for logging and another for alarming). Each VIP has a global polling period for real-time data, which can be tuned based on the VIP's application. In addition, a single application may be split across multiple VIPs if it is very large.

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### Note

A single VIP is sufficient for most systems.

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The size of the VIP may be determined by the size of the VIP files (that is, the vip.cfg and vip.bak) that reside in the following location:

C:\Program Files (x86)\Schneider Electric\Power Monitoring Expert\config\cfg\vip\

Each file should be no more than 2 MB (that is, approximately 350 loaded Arithmetic Modules). The number of VIP instances on the server is limited by the power of the CPU and not the software.

## EWS 1.1

EWS is a set of Schneider Electric corporate web services that facilitates data exchange between software applications. Power Monitoring Expert is an EWS v1.1 server that is able to share real-time, historical and alarm data with StruxureWare software and other third-party software applications.

## Export Data from Power Monitoring Expert

### Power Monitoring Expert and OPC DA v2.05A

OPC is a set of open standards for connectivity and interoperability between industrial automation and the enterprise system. OPC is not a native protocol for Schneider Electric devices; however, Power Monitoring Expert can act as a translator and host metering data as an OPC server as well as an OPC client.

When acting as an OPC server, Power Monitoring Expert translates ION data into OPC data, for exporting and viewing in other third-party OPC client systems. The Power Monitoring Expert OPC client, on the other hand, takes OPC standardized measurements from third-party systems and translates them into a data format that Power Monitoring Expert can use.

For additional information regarding the configuration and operation of the OPC server component of Power Monitoring Expert, please see the *StruxureWare Power Monitoring Expert 7.2 User Guide*.

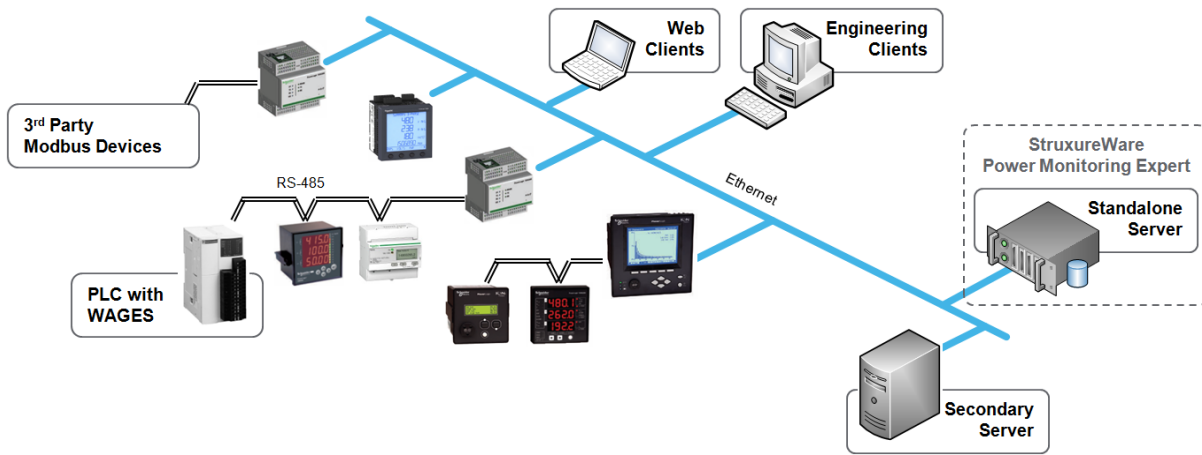
# Appendix A: Distributed Power Monitoring Expert Architectures

A distributed system is one that has components of Power Monitoring Expert installed on multiple computers.

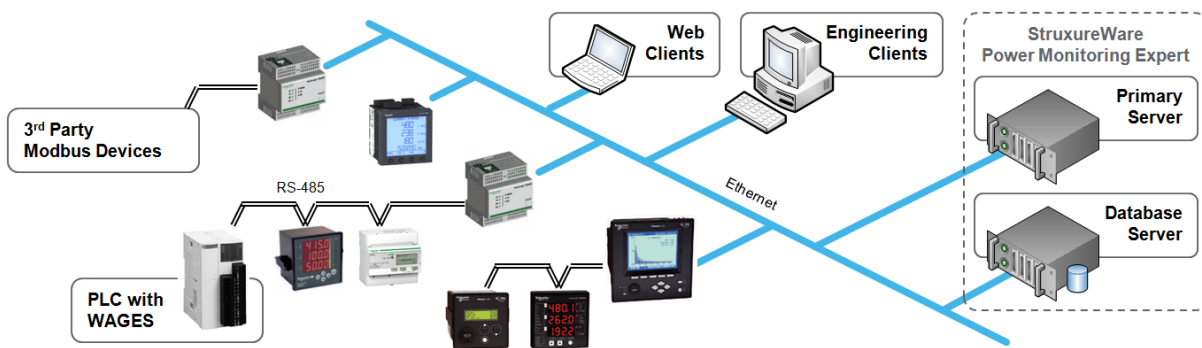
## Distributed Architecture Examples

Here are three examples of distributed system configurations showing Engineering Clients (optional) and Web Clients (optional).

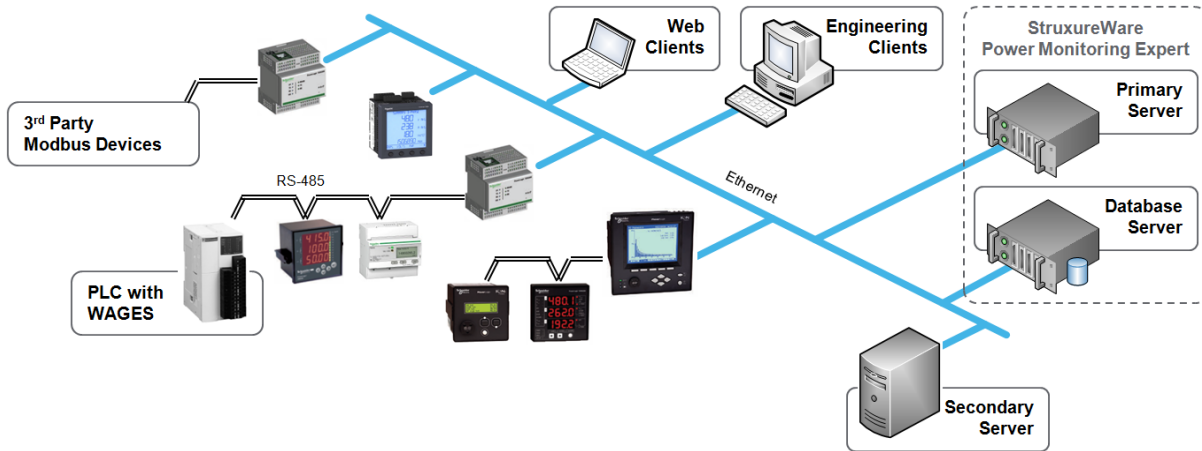
### Standalone Architecture with Secondary Server



### Distributed Database Architecture



## Distributed Database Architecture with Secondary Server



## Engineering Clients

An Engineering client may be installed in addition to the Primary server to allow an administrator or power user to access the system (for example, connect to new devices, edit Vista diagrams, program the VIP, and so on).

## Recommended Engineering Client

Server Recommendations
<b>OS:</b> Windows 7
<b>CPU:</b> Intel Core i3 (2 core), or better
<b>RAM:</b> 2+ GB
<b>HDD Space:</b> 2GB for software installation

## Database Servers

In some cases, a Database server may be required due to local IT policy. It is recommended that both the operating system and SQL Server are 64-bit since it greatly improves SQL Server performance.

## Recommended Database Server

Refer to "[Recommended Power Monitoring Expert Systems](#)" on page 15 to determine the appropriate database server size. The database server should have the same specification as the primary server.

## Secondary Servers

In very rare cases, Secondary servers are used to reduce the ION SiteServer load on the Primary Server. However, there is only ever one ION RealTime Data service, which runs on the Primary Server. A Secondary server contains the following components:

Component	Description
Engineering Client tools	Management Console, Vista, Designer Configuration files
Communication Services	Manage device communications Data management and routing 3 <sup>rd</sup> -party software integration

## When is a Secondary Server Needed?

A simple formula is used to determine when a Secondary server might be needed: multiply the **Device Type Weight** by the number of devices in the system. If the result is greater than 100%, then a secondary server is required.

Device Range	Device Type	Device Type Weight (%)
Utility Meter	ION8800	0.10
	ION8650	0.10
	ION8600	0.10
Advanced Meter	ION7650 / 7550	0.10
	CM4000 / CM3000	0.15
Intermediate Meter	PM800 series	0.06
	PM500	0.06
	ION7300 series	0.06
Multi Circuit Meter	BCEM series	0.20
	BCM42	0.04
	EM4800	0.10
Basic Meter	PM5100	0.04
	PM5300	0.05
	PM5350	0.05
	PM700 series <sup>1</sup>	0.03
	PM3200 series	0.03
	ION6200 <sup>1</sup>	0.03
	PM200 <sup>1</sup>	0.03
Entry Meter	EM1200	0.03
	PM1200 / DM6200	0.03
	PM9c	0.04
	iEM3100/3200 series	0.03
Circuit Breaker Trip Units	Micrologic E, P and H	0.07
	Micrologic A	0.05
	Micrologic Compact NSX A and E	0.06
Protective Relays	Sepam series 80 and 60	0.08
	Sepam series 48 and 40	0.07
	Sepam series 20	0.06
	Sepam series 10	0.05
Custom Modbus <sup>2</sup>	Real-time only	0.015
	Real-time with PC-logging (up to 16 logged registers)	0.03

<sup>1</sup> Device does not have any historical logging or PC-logging enabled by default. These device weights presume that PC-logging has been enabled for up to 16 measurements.

<sup>2</sup> Custom Modbus device drivers must be created in the Modbus Device Importer.

## Examples

Device Type	Device Weight (%)	System 1		System 2		System 3	
		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
<b>TOTAL</b>		<b>1000</b>	<b>43 %</b>	<b>2500</b>	<b>88 %</b>	<b>3150</b>	<b>101 %</b>

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 is **required**.

Device Type	Device Weight (%)	System 4		System 5	
		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
<b>TOTAL</b>		<b>1000</b>	<b>83 %</b>	<b>2500</b>	<b>143 %</b>

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.

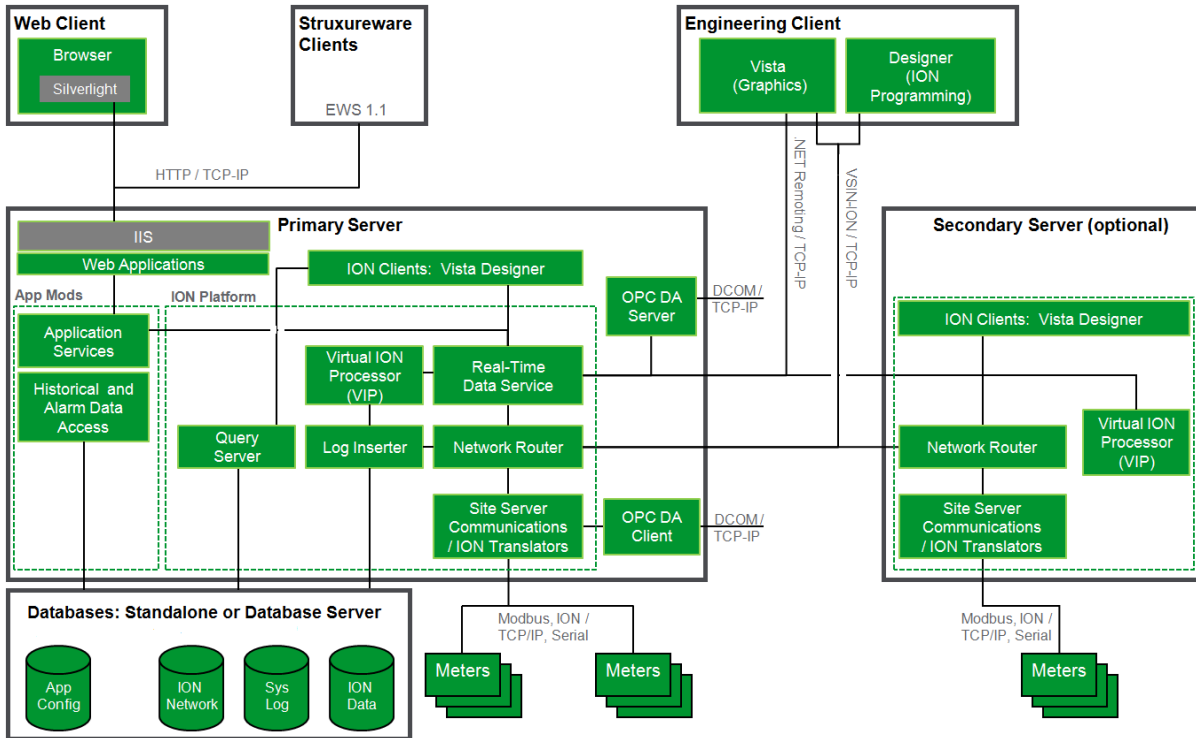
## Recommended Secondary Server

The following server specification is sufficient for any Secondary server.

Server Recommendations
<b>Computer Type:</b> Server <b>OS:</b> Windows Server 2012 R2 <b>CPU:</b> Intel Xeon E56xx (4 core), or better <b>RAM:</b> 8+ GB <b>HDD:</b> x2 300+ GB

# Appendix B: Power Monitoring Expert Components

This section shows the different components of the Power Monitoring Expert system, including databases, windows services and web applications.



The diagram above shows much of the Power Monitoring Expert architecture, but the following internal connections are not shown:

- WebReach (which is logically in “Web Applications”) has a connection indirectly to Query Server and Real-time services
- Vista/Designer on the primary to Network Router (netman)

Additional communication notes:

- Designer uses VSIN only, Vista uses both, VSIN (comm to designer) and .Net Remoting (communication to ION Services)
- Platform components typically use netman (Network Router) to route ION-related requests except for stand-alone engineering client where no netman service is running locally
- VIP uses .NET remoting to subscribe to real-time data from ION Services (Real-Time Data Service)
- Vista uses .NET remoting to subscribe to real-time data and VSIN for everything else (including historical requests to Query Server)

**Note**

VSIN is a proprietary application-layer protocol (ION) that runs on TCP/IP.

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## 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 table below outlines the Power Monitoring Expert services:

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**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 ION Network Router Service running.

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Service Name	Description	Manual/Automatic
ION Alert Monitor	Checks the computer's communications ports continuously for high priority events occurring at remote modem sites. When this happens, Alert Monitor initiates a communications connection to the remote modem site.	Manual
ION Component Identifier Service	Locates local and remote product components. Although this service is configured as Manual, the service starts when the client attempts to connect to it.	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.	Manual
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 <i>StruxureWare Power Monitoring Expert 7.2 User Guide</i> .	Automatic
ION Log Inserter Service	Provides historical data collection and storage for your power-monitoring system. See the "Log Inserter" topic in the Database Manager and Windows Task Scheduler chapter of the <i>User Guide</i> .	Automatic
ION Managed Circuits	This service is used to create individual real-time and historical data sources for multi-circuit meters	Automatic
ION Network Router Service	Routes all information between the software components, such as client workstations and the Log Inserter. 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	Manages and is responsible for supplying OPC data to client applications. Although this service is configured as Manual, the service starts when the client attempts to connect to it.	Manual
ION Power Quality Aggregation Service	Periodically processes and aggregates new Power Quality event data.	Automatic
ION PQDIF Exporter Service	Translates data from the product's databases to PQDIF file format and manages scheduled PQDIF exports.	Manual
ION Query Service	Provides historical data retrieval for your power-monitoring system. See the "Linking a Data Log Viewer or Event Log Viewer" topic in the Vista chapter of the <i>User Guide</i> .	Automatic
ION Real Time Data Service	Manages and provides access to real time data from the power management system.	Automatic
ION Report Subscription Service	This 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.)	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, often changes to certain channels, configuration parameters, ports, or device parameters can interrupt a connection. You can add, delete, or change channels, configuration parameters, ports, and devices without restarting the ION Site Service, ION Network Router Service, and ION Connection Management Service.	Automatic
ION Virtual Processor Service	Provides coordinated data collection, data processing, and control functions for groups of meters. See the "Virtual Processor setup" topic in the Management Console tools chapter of the <i>User Guide</i> .	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
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 for the Web Applications component.	Automatic
ApplicationModules ProviderEngineHost	Hosts web services that provide data processing for the Web Applications component.	Automatic



# Appendix C: 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).

## How to Measure the Utilization of a Daisy Chain?

If the performance is still poor after making the improvements suggested above, the software can measure how saturated the daisy chains are. This will state how saturated/utilized a given daisy chain is based on how the customer uses the system (that is, the customer may prefer real-time data over historical data).

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, drill down into the Communications Diagnostics and select the site of the associated daisy chain.
4. Select the **Communication Status** tab.
5. Make note of the time, right-click in the **Communication Status** panel, 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, depending on logging intervals.
7. Make note of the value in the **Util (%)** column. A value at or near 100% indicates that the daisy chain is saturated and it most likely exhibits poor performance.

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### Note

If the communication % error rate is >0%, further investigation may be required.

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See the *StruxureWare Power Monitoring Expert 7.2 User Guide* (7EN02-0348) for more information about the Diagnostics Viewer.

## Registry Settings

Below are the registry keys that 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.

**IONServicesCachePollingRate** (DWORD; default 10): This is a multiplier that controls how often the software checks the ION Real Time Data Service cache for real-time data updates. This reduces jitter to 10% of the polling period. Jitter, in this context, means inconsistency of data "age" by the time the user or processing component (for example, the VIP) "sees" the new value. Increase this value if there are long polling periods and you wish to minimize jitter.

# Glossary

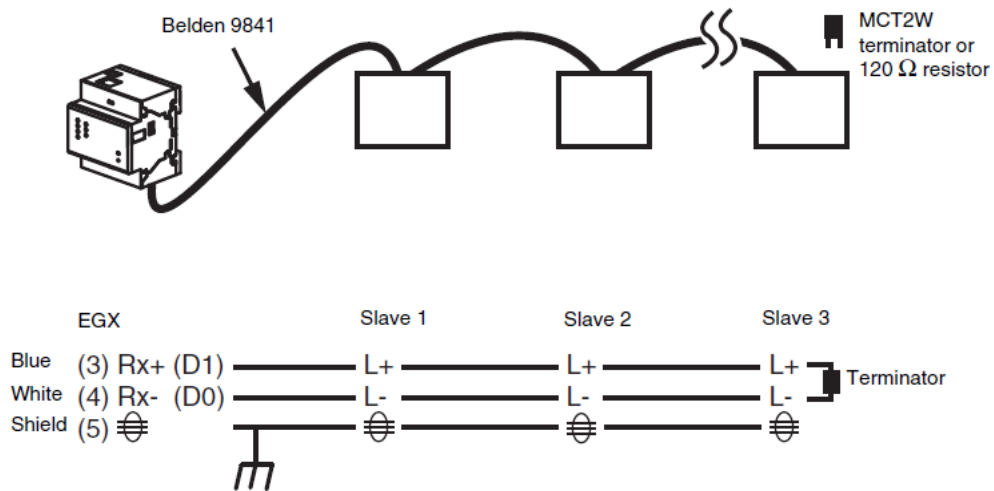
## Ethernet devices

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, waveforms 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.



StruxureWare™ Power Monitoring Expert 7.2  
System Design Guide

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