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## Entergy Tracks Trillions of SCADA Records with Real-Time Data Storage Solution

### Overview

**Country or Region:** United States

**Industry:** Utilities

### Customer Profile

Entergy produces and delivers electric power to 2.7 million customers in Arkansas, Louisiana, Mississippi, and Texas.

### Business Situation

Entergy needed a real-time historical data storage solution to help its analysts, dispatchers, and managers gain a better view into the trillions of records created by its more than 320,000 grid devices.

### Solution

Entergy deployed Pegasus RDS™, a real-time data storage system, created by Microsoft® partner Nobadeer Software, and deployed using the Microsoft Application Platform, including Microsoft SQL Server® 2008.

### Benefits

- Better view into the data
- Ability to be proactive
- Automated tracking
- Ease of database management
- Efficient development environment

"The ability to act proactively is the holy grail in our industry, and that is what we are gaining from our Pegasus RDS hosting of trillions of SCADA records on the Microsoft Application Platform."

Paul H. Cassingham, Manager of Application Management, Transmission Business Unit, Entergy

Entergy, a Fortune 500 company with 14,300 employees, produces and delivers electric power to 2.7 million customers in Arkansas, Louisiana, Mississippi, and Texas. The company has captured trillions of records from its supervisory control and data acquisition (SCADA) system and its more than 320,000 SCADA objects. To better extract value from SCADA data, the utility deployed a real-time data storage application, called Pegasus RDS™, which was created by Microsoft® partner Nobadeer Software, Inc. using the Microsoft Application Platform, including Microsoft SQL Server® and Microsoft Visual Studio®. The solution, which manages trillions of records, will soon be upgraded to SQL Server 2008. Pegasus RDS gives Entergy numerous benefits including a better view into its data which helps the utility to identify potential problems early so it can act proactively to protect its electrical grid.

**Nobadeer Software**  
Simplify Your Data

**Microsoft®**

## Fast Facts

Heading	Heading
Objects Tracked	320,000 SCADA objects
Total SCADA Records	2 trillion
Total SCADA Database	80 terabytes (compressed to 8 terabytes)
Annual SCADA Database Growth	20 terabytes (compressed to 2 terabytes)
Average Query Response Time	2/10ths of a second

### Situation

Entergy is dedicated to supplying the energy that enables so much of modern life. Based in New Orleans, the Fortune 500 company produces and delivers electricity to 2.7 million utility customers in Arkansas, Louisiana, Mississippi, and Texas.

Entergy owns and operates power plants with approximately 30,000 megawatts of electric generating capacity, and is the second-largest nuclear generator in the United States. The company has 14,300 employees, helping it achieve annual revenues of more than U.S.\$11.5 billion.

Electric utilities such as Entergy operate an electrical grid comprised of many interconnected devices that generate, transmit, and distribute electricity from the utility to its customers. Grid devices are disbursed across large geographical regions, often representing tens of billions of dollars of corporate investment. Stable, efficient operation of grid devices is critical to the utility's ability to deliver reliable electricity to customers at a reasonable cost.

The most important electrical grid devices—including generators, transmission lines, busses, transformers, switches and batteries—are connected to remote terminal units that transmit operational device measurements, every

few seconds from the electrical grid to a utility's operation & control centers that house highly available computers hosting an energy management system (EMS) application.

A utility uses its EMS application to help it control the minute-to-minute operation of the electrical grid. EMS systems are typically comprised of a supervisory control and data acquisition (SCADA) system with layered applications that apply advanced mathematical analysis to real-time data contained in the SCADA databases. SCADA databases are real-time databases that store (and update-in-place) current measurements from all electrical grid devices that have telemetry that sends real-time data to the EMS host computers. Because electrical grid changes occur quickly, and real-time mathematical analysis is very CPU intensive, most EMS advanced applications only use a very limited amount of history when performing their analysis.

Most SCADA systems have a very limited ability to capture and store history for a very small number of grid devices, so a separate real-time data storage (RDS) system is required to capture and analyze historical SCADA information.

In the 1990s Entergy developed its own RDS application for storing and analyzing historical SCADA data. The application was well received within the company, and performed well, but it had only limited analytic features, captured only a subset of SCADA data, and lacked data feed redundancy, which resulted in gaps in the data—a serious deficiency for the company's analysts.

Entergy determined that a new, industrial strength data storage system was needed, and surveyed the market to find the

“Sometimes our dispatchers or analysts will test the system to see how fast data is loaded from three years back and two states away, and they’ll kind of scratch their heads and say, ‘You’re breaking the laws of physics.’”

Douglas A. Dollar, Pegasus Project Lead, Entergy

solution that would best meet its needs. It required a solution that would, among other things:

- Capture all of the data, all of the time
- Support persistence to automatically adjust to changes in the grid
- Require virtually zero maintenance
- Provide easy, high-speed, programmatic access to the entire data store
- Enforce security

### Solution

After analyzing the market for RDS historical solutions, Entergy determined the best product for its needs was Pegasus RDS™, created by Microsoft® partner Nobadeer Software, and deployed using the Microsoft Application Platform, including Microsoft SQL Server® 2000 database software, which Entergy will soon upgrade to SQL Server 2008 Enterprise running on the Windows Server® 2008 Enterprise operating system.

Pegasus RDS uses highly specialized techniques to store, manage, and retrieve historical real-time data. While Pegasus includes its own custom data storage technology, SQL Server is used to store SCADA metadata and EMS events and alarms, and to support near real-time reporting and analytics. While RDS solutions traditionally require SCADA devices to be pre-selected for real-time data capture, Pegasus RDS eliminates this requirement by capturing all the data, all the time, ensuring that Entergy can retrieve historical data even for grid devices they may not have originally considered.

Nobadeer created Pegasus RDS using the Microsoft Visual Studio®, 2005 development system, which the team has since upgraded to Visual Studio2008. All Pegasus RDS applications use the Microsoft .NET Framework 3.5. Nobadeer upgraded

to Visual Studio 2008 to take advantage of features including enhanced IntelliSense® technology, Named Pipes, and LINQ to Objects.

### Architecture

Entergy’s Pegasus RDS solution, which relies heavily on SQL Server, provides a massive data warehouse for collecting and analyzing SCADA data streams. Pegasus RDS stores these data streams using a highly-integrated combination of proprietary binary file formats and SQL Server relational databases hosted on the Pegasus Hybrid Data Store. Once data is resident on Pegasus servers, it can be accessed by the Pegasus Smart Client, the Pegasus Exporter, or via two public application programming interfaces (PDA and PDA-RT).

Data Access is very fast—usually just 2/10ths of a second—and requires minimal network loading. Pegasus servers are massively scalable, using standard off-the-shelf hardware. Pegasus was initially deployed, in 2004, on 12 Dell server computers, each with two processors running at 3 Gigahertz (Ghz), 4 gigabytes (GB) of RAM, and approx 1.5 terabytes of RAID 10 SCSI disk arrays. Entergy plans on upgrading all Pegasus servers to Intel Nehalem-based Servers in 2009.

Data is collected and permanently stored on dual, redundant Pegasus servers at each of Entergy’s five regional control centers, covering a four-state area. Each regional control center receives SCADA data from about 60,000 grid objects, with more than 320,000 SCADA objects monitored in all.

The Pegasus server deployments at each of the five regional control centers are joined into a ring, enabling an authorized user at any center to access SCADA data collected from any or all of the other regions. Each

Figure 1 – Pegasus architectural overview, including the Pegasus Hybrid Data Store

regional center has a 2-server deployment for load balancing and to help ensure high availability.

Pegasus RDS uses multiple SQL Server databases, at each site, for a number of purposes including:

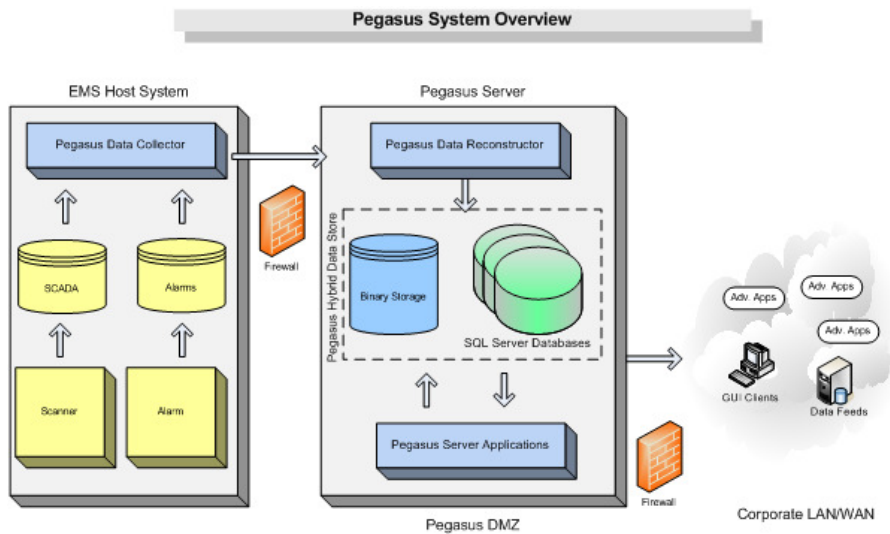
- Storage of all raw system alarms in highly partitioned tables/file groups.
- Storage of all processed system alarms to support real-time actionable reports. (highly partitioned by tables/file groups)
- Storage of all SCADA object metadata (current and historical changes) to support high integrity audit trail reporting.
- Storage of all SCADA status point changes and analog limit violations in real-time to support non-Pegasus downstream systems.
- Storage of a rolling buffer of real-time SCADA object values to the Pegasus Smart Client, other to-be-developed clients, and non-Pegasus down-stream systems.

- Support for secure client logins.
- Storage of Pegasus server applications logging and availability information to drive real-time Pegasus system monitoring tools.
- Storage to drive the Pegasus Smart Client 'profile' navigation. This enables Entergy to navigate through its more than 320,000 SCADA objects, build custom groups, and retrieve data either in real-time or through large historical data export jobs.

Pegasus RDS also uses SQL Server storage to house large historical data exports from the Pegasus Hybrid Data Store to drive downstream decision making tools, and for storage of processed real-time analog data exceptions to provide Entergy with reports showing volatile data values, data over-alarm limits, hourly analog averages, and other key measurements.

Some of the basic architectural elements of the Pegasus RDS solution include:

- **Pegasus Data Collector.** Collects real-time SCADA and alarm data from the EMS host systems.
- **Pegasus Data Reconstructor.** The Pegasus Data Reconstructor is an application that runs on the Pegasus Data Server, providing real-time data feeds. The purpose of the Reconstructor is to receive real-time SCADA and Event data from the Pegasus Data Collector (on the EMS host) and "reconstruct" the current hour's HSB and up to the minute event files. The Reconstructor gives Pegasus the ability to mirror the data being gathered and stored on the EMS hosts, on the Pegasus Servers. It also means that access to the EMS host, which is typically a high security concern, is limited to a single application on the EMS systems.



“Pegasus and SQL Server require virtually no maintenance . . . [This] has resulted in a miniscule burden on the staff, especially when considering the trillions of data records captured.”

Paul H. Cassingham, Manager of Application Management, Transmission Business Unit, Entergy

- **Pegasus Hybrid Data Store.** The Pegasus Hybrid Data Store, which works in conjunction with SQL Server, currently holds about 80 terabytes of Entergy’s SCADA data (compressed to 8 terabytes) and adds about 20 terabytes of new data each year (compressed to about 2 terabytes). Entergy plans to keep 5 or more years of Pegasus data online.
- **Pegasus Server Applications.** Pegasus RDS includes more than three dozen applications. All were created using Visual Studio and the .NET Framework and the developers note that all are “100 per cent .Net managed code.” These applications coordinate retrieval of real-time and historical SCADA data and integration with the SQL Server relational databases to support reporting, analytics, self-maintenance, and other critical functions.
- **SQL Server relational databases.** SQL Server, which works as an essential part of the Pegasus Hybrid Data Store, provides the relational database environment used to store metadata for defining SCADA elements and other functions. SQL Server also gives Entergy the ability to track grid changes for reporting and auditing.
- **Redundant deployment for high availability.** Each regional deployment has two identical Pegasus deployments on separate computer servers. Each server receives its own dedicated real-time data feed. While one is nominally identified as the production server, and the other the backup server, the two always contain identical data and can be used interchangeably. The two servers can also be used for load balancing. And if one server goes down, all its data can be easily rebuilt from the other server.
- **Role-based access.** Microsoft Active Directory® directory system is used to implement role-based access to Pegasus information, to enhance security efforts.

- **Reporting.** Pegasus RDS supports client-based and, optionally, Web-based reporting that enables authorized users to search SCADA data, drilling up and down in detail and scope to meet their needs.

### Benefits

The Pegasus RDS solution running on the Microsoft Application Platform has provided Entergy a more robust view of its SCADA Data. While Entergy will use a number of tools for various planning and analysis tasks, a viable historical system adds another dimension to more fully understand the actual performance of the grid objects. The enhanced visibility is helping Entergy gain the ability to be more proactive in protecting its electrical grid assets. Pegasus also provides automated tracking of SCADA database changes, which enhances EMS database maintenance. The Microsoft Application Platform provided Nobadeer with an efficient development environment.

### Better View into the Data

Pegasus RDS, built on the Microsoft Application Platform, gives Entergy a complete view into the nearly 2 trillion records generated by its SCADA devices. And it does this by providing a read-only copy of the EMS SCADA system so Entergy doesn’t have to worry about original records being altered.

“The scope of the data is amazing,” says Paul H. Cassingham, Manager of Application Management for the Transmission Business Unit at Entergy. “Pegasus gives us the ability to examine data on a regional or state level, or drill right down to the historical performance of a single device, all without seeing any delay in the delivery of the data. We call it an integrated system because we’re showing which node the data came from, as well as

the quality codes and limits for each data point.”

Though dealing with trillions of records, Pegasus typically returns queries within 100 milliseconds to 300 milliseconds (1/10th of a second to 3/10ths of a second.)

“Pegasus is designed as a real-time system, and it is amazing how instantaneously the data is delivered,” says Douglas A. Dollar, Pegasus Project Lead at Entergy. “Our internal customers are amazed by the fact that whether they’re looking at data from today or going back two years, the retrieval time seems immediate. Sometimes our dispatchers or analysts will test the system to see how fast data is loaded from three years back and two states away, and they’ll kind of scratch their heads and say, ‘You’re breaking the laws of physics.’”

Entergy values the fact that Pegasus RDS delivers a read-only copy of critical EMS data, ensuring that the original data can’t be inadvertently changed by users touching

the EMS system. “We refer to Pegasus as providing an outer ring of data,” says Dollar. “With our old system we sometimes had to give users direct access to the EMS host. Now that can be an untouched inner ring dedicated to collecting the SCADA information. All reporting is done against the outer ring hosted on a secure network.”

Even dispatchers and asset management personnel working at transmission and distribution (T&D) control centers, with direct access to the EMS host, prefer to use Pegasus because it provides a better view into the information, including the ability to chart data and export it to spreadsheet software such as Microsoft Office Excel®.

“Raw data can be overwhelming,” says Dollar. “If you are looking at thousands of records for a single device, or billions of records for a region, you want to have a graphical representation to help you immediately see the variations and concerns, and that is what we can see with Pegasus which stores alarm data on SQL Server. Our dispatchers and analysts like Pegasus because it is so much easier to identify what they are looking for. Instead of our T&D folks burying themselves in print outs, they can call up a single chart showing variances and spot the problems.”

The data visibility provided by Pegasus RDS has helped Entergy accomplish a number of goals, including:

- Fine-tune alarm levels
- Identify “chattering” alarms to speed up repairs
- Determine which transducers are out of calibration
- Obtain data to support load balancing decisions that have a direct effect on reliability
- More effectively support the operations and analysts

Figure 2 – Pegasus Smart Client provides access to read-only SCADA data, and an integrated data platform.

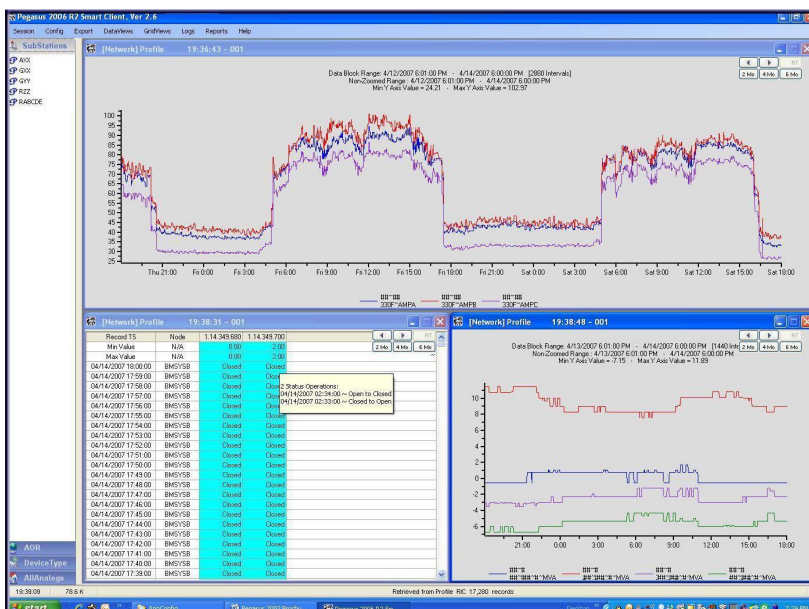


Figure 3 – Proactive action can be taken when a device, such as J0434 shown below, requires multiple close commands before the breaker operation was completed. Note that SCADA Device names are blocked out in this document for security purposes.

System Event Object Details for December, 2007								
Drag column headers here to create groups								
TIME STAMP	DAY	CATEGORY	AOR	PCCODE	SUBSTATION	DEVICE TYPE	DEVICE	EVENT MESSAGE
12/05/2007 14:01:06	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 14:01:04	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 13:19:33	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 13:19:27	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 13:18:35	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 13:18:17	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 13:18:13	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 13:17:35	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 13:06:35	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 13:06:11	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 13:04:50	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 13:04:05	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 12:13:00	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 12:11:09	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 11:56:55	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 11:51:48	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 11:50:41	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 11:46:15	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 11:45:35	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 11:43:32	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 11:43:24	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 11:42:29	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04
12/05/2007 11:41:45	5	Sw	DOCMSTAA	1	[REDACTED]	MODS	J0434	[REDACTED] MODS J04

Cassingham offered a recent example of using Pegasus RDS and the Microsoft Application Platform to identify and repair devices that were flooding the EMS system with spurious alarm reports. Called “chattering alarms,” some devices send a constant stream of alarm messages for devices that are properly working, because the device monitoring their actions is malfunctioning.

“We call it our Chatter Report,” says Cassingham. “We are now able to identify devices that are generating false alarms, and we are able to send someone out into the field to solve the problem. This is significant because just one device can generate tens of thousands of false alarms over a period of time. But finding these devices in a sea of data, without something like Pegasus, is overwhelming. We found one device that had generated 50,000 spurious alarms. Any time you can correct a device like that you are cleaning up the data to make it easier for our dispatchers to

identify and correct the real problems.”

### Ability to be Proactive

With millions of people depending upon the utility to deliver uninterrupted electric power, managers at Entergy are extremely interested in mining EMS data to gain the predictive insights required to act proactively to avoid delivery disruptions.

“The ability to act proactively is the holy grail in our industry, and that is what we are gaining from our Pegasus RDS hosting of trillions of SCADA records on the Microsoft Application Platform.” says Cassingham. “We expect this solution is going to give us an additional analytic foundation we need to enhance our ability to identify early and prevent problems that could otherwise disrupt service.”

During one meeting, while demonstrating Pegasus Smart Client to an Entergy engineer, the engineer asked to see a set of data from two days earlier so he could see an activity chart of a device that had recently failed. “He was able to point to the chart, and watch the data build up to the point at which the device failed,” says Dollar. “He was extremely impressed because Pegasus can provide the early warning required to help prevent that type of a failure in the future.”

Cassingham has a similar story. “We were demonstrating the system to some of our distribution engineers, and one engineer asked to see some specific data traces for equipment he was responsible for. He then stepped out of the room, made a phone call, and instructed his team to change the power pack on a transformer before it failed. Everyone was amazed, but there isn’t anything magical about the Pegasus software, other than the fact that it runs beautifully and makes data visible in a way that people can understand and act upon.”

RPT\_WestMonroe\_SCADACHanges\_2007080114\_2007082310.txt - Notepad

File Edit Format View Help

WESTMONROE SCADA Metadata Differences Between the Baseline SCADA DB: 8/1/2007 2:18:00 PM and the Compa

Action		MD TimeStamp	Station	DType	Device	Meas	MValue
Modified	Analog (New)	8/23/2007 10:47:00 AM	#####	XFMR	1R26_VCB	MVA	MW
	Analog (old)	4/4/2007 10:11:00 AM	#####	VCB	1R26	MVA	MW
Modified	Analog (New)	8/23/2007 10:47:00 AM	#####	XFMR	1R26_VCB	MVA	MX
	Analog (old)	4/4/2007 10:11:00 AM	#####	VCB	1R26	MVA	MX
Modified	Analog (New)	8/23/2007 10:47:00 AM	#####	XFMR	1R26_VCB	MVA	MVA
	Analog (old)	4/4/2007 10:11:00 AM	#####	VCB	1R26	MVA	MVA
Modified	Analog (New)	8/23/2007 10:47:00 AM	#####	XFMR	1R26_VCB	MVA	PF
	Analog (old)	4/4/2007 10:11:00 AM	#####	VCB	1R26	MVA	PF

Figure 4 – Pegasus provides a high integrity audit trail of all SCADA object actions. Example above shows four analog data points had their Device Type changed from VCB to XFMR on 8/4/2007.

Entergy uses Pegasus RDS to help it assess Electrical Grid needs and planning for the future. Recently Entergy planners in Arkansas pulled 10 billion EMS records covering thousands of devices from a four-state region to help them visualize one year's electrical demand across the region in 15-minute increments. The Pegasus Exporter could have provided the same data in smaller increments, down to 1-minute intervals.

The same type of data helps the utility plan for disaster responses. Pegasus provided a stunning minute-by-minute look at what happened to the grid as the Category 3 Hurricane Katrina came ashore near New Orleans in 2005. "Across a four-state region you can see where the line breakers were opening at 30 or 50 an hour, and then a few hundred an hour and then more than 3,000 an hour," says Dollar. "Pegasus kept recording until the last communications link went down."

Historical usage information helps Entergy re-route power distribution around grid disruptions.

"Tornadoes aren't uncommon in our area," says Cassingham. "A few years ago we had a tornado that literally twisted one of our huge 500 kV [kilovolt] towers 360 degrees, tearing down several other towers in the process. When big disruptions occur, we can use historical data from Pegasus to determine the most efficient way to handle the load shifting in working around such disruptions until the damage can be repaired."

#### Automated Tracking of SCADA Database Changes

With more than 320,000 SCADA devices being tracked by the Pegasus RDS, Entergy values the solution's ability to automatically audit and update its records when SCADA database changes are made

"You need an application that is essentially a model of the electrical grid," says Cassingham. "But the model is continually changing as one class of circuit breaker is replaced by another, as sub stations are upgraded, and as a host of other changes are made to the system. We needed a solution that provided persistence, meaning that it didn't require human intervention in updating the model for analytics."

The Pegasus RDS platform uses an invariant key to identify all SCADA database objects, which enables the utility to track the functions of a device even when it has been renamed or replaced with a different model—for example if a gas circuit breaker is replaced by a vacuum circuit breaker. This is possible because Pegasus detects and manages all changes in EMS SCADA database objects, while retaining the SCADA object's invariant key, to insure all SCADA Database Objects retain their full data history.

**“If we had created our solution using Java or some other development environment, I believe we would have to charge two or three times as much, and that the solution would be much more expensive to deploy and maintain.”**

Keith Taylor, Software Architect, Nobadeer Software

“The use of the invariant key gives the database the resilience required to maintain the historical reference of an individual measurement point that’s out there in the field,” says Cassingham. “This means that as long as Pegasus has been collecting the data, no matter what we have called a device through its lifetime, we can go back and find all of its data.”

The same functionality also provides auditing value. “One of the unanticipated benefits we’ve gained is that we get a historical record of whenever we make a change to the metadata of the original measurement,” says Cassingham. “This is helpful when upgrading devices in the field.”

The automated remapping saves what would otherwise be a considerable effort required for manually updating changes across the hundreds of thousands of SCADA devices used across Entergy’s Grid. Whenever a new SCADA database is put online, Pegasus RDS automatically stores the contents of the new database and all data collection and storage applications run through the update without further staff involvement, handling all necessary re-mapping on the fly.

“Every utility experiences frequent name changes across the hundreds of thousands of devices they manage,” says Dollar. “Because Pegasus works with SQL Server to automatically remap devices to the appropriate database keys there is little if any staff intervention in this process. Without automatic updates, it would take a huge effort to keep the database current and relevant.”

#### **Ease of Database Maintenance**

At the beginning of the project, Entergy defined a goal of creating a system that required extremely little maintenance.

Nobadeer accomplished the goal by creating within Pegasus the ability for SQL Server to automatically handle database partitioning, indexing, trimming, log deletion, and other functions to virtually remove the need for database administration time.

“Pegasus and SQL Server require virtually no maintenance by Entergy or Nobadeer,” says Cassingham. “Our zero-maintenance design target has resulted in a miniscule burden on the staff, especially when considering the trillions of data records captured.”

Entergy looks forward to upgrading to SQL Server 2008 to take advantage of new database compression technology and the programmatic bulk copy feature which cuts I/O activity in half by removing the need to first write data to a file for SQL Server to bulkload data from.

“With SQL Server programmatic bulk copy, the data goes from the application that has the data directly into SQL Server without having the intermediate step of writing to the disk and reading off the disk,” says Dollar. “This is a big deal for us because our planners, analysts, and others tend to be big bulk data users. These folks may want to look at a year or more of data for thousands of analog devices. We have users who need to look at billions of records at a time.”

Once configured and installed, Pegasus RDS requires virtually no manual intervention, maintenance, or tuning, notes David Allen, Senior Consulting Engineer at Nobadeer. Retrieving stored data using the Smart Client is simply a matter of dragging-and-dropping or double-clicking named sets of SCADA Objects.

"Pegasus Data Servers do not need to be taken offline for routine RDS maintenance," says Allen. "They operate 7x24 for months or years at a time, between reboots. I don't think we could do this without having built our solution on SQL Server and the rest of the Microsoft Application Platform."

Keith Taylor, Software Architect at Nobadeer notes it's not unusual for electric utilities to have a dozen or more staff devoted to maintaining an EMS real-time data storage system (sometimes called an "Historian"), which often requires the utility to re-enter the names of SCADA objects and other key information such as analog limits and dead-bands. In contrast, Taylor says, Entergy has less than one full-time equivalent employee devoted to Pegasus operational maintenance.

"We have trillions of records, so we're very excited about the low maintenance for Pegasus," says Dollar. "It's incredible that we can have that much data in our system and enjoy such low maintenance costs."

#### **Efficient Development Environment**

Nobadeer developers enjoy working with the Microsoft Application Platform, including Microsoft Visual Studio development tools and the Microsoft .NET Framework. Currently working with Visual Studio 2008, Nobadeer developers are looking forward to upgrading to SQL Server 2008.

"Pegasus includes about three dozen applications, and these are big, very complicated multi-threaded applications with multiple data streams coming in, lots of sophisticated processing going on, before writing data out to SQL Server," says Allen. "I've been writing code for 30 years, so I've used a lot of different languages and development environments. Visual Studio is the best development environment I've

ever worked with and the Microsoft Application Platform is the first environment that I've seen that's truly integrated. Everything works really well together."

Nobadeer was an early adopter of Visual Studio 2008 to take advantage of the expanded IntelliSense technology. "We've worked with the pre-release version of Visual Studio 2008 and really liked the expansion of IntelliSense," says Taylor. "It does such a great job of filling in as you type that it reduces the number of keystrokes by at least 60 percent. IntelliSense makes a dramatic difference in the speed at which we can write code."

The efficiency with which Nobadeer can create solutions using the Microsoft Application Platform translates directly into lower costs for the customer. "If we had created our solution using Java or some other development environment, I believe we would have to charge two or three times as much, and that the solution would be much more expensive to deploy and maintain," says Taylor. "This is because the development is easier and faster with Microsoft development tools, and because Visual Studio and SQL Server are so well integrated that we were able to create a virtually zero-maintenance solution."

#### **Summary**

Entergy has gained the real-time access to historical EMS data it needed to gain a more detailed view into its operations and to identify opportunities to proactively identify and resolve transmission and distribution problems before they can cause outages.

## For More Information

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## Windows Server 2008, SQL Server 2008, and Visual Studio 2008

Windows Server 2008, SQL Server 2008, and Visual Studio 2008 provide a secure and trusted foundation for creating and running your most demanding applications. Combined, the products offer advanced security technology, developer support for the latest platforms, improved management and Web tools, flexible virtualization technology to optimize your infrastructure, and access to relevant information throughout your organization.

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### Software and Services

- Microsoft Servers
  - Windows Server 2008 Enterprise
  - Microsoft SQL Server 2008 Enterprise
- Microsoft Visual Studio 2008
- Technologies
  - Microsoft Active Directory
  - Microsoft .NET Framework 3.5

### Hardware

- Dell server computers
- HP server computers

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- Nobadeer Software