Electronic Health Records Deployed Using SQL Server 2005 for Multi-Terabyte Databases

Overview

Country or Region: United States
Industry: Healthcare

Customer Profile

Based in Chicago, Allscripts makes clinical software, connectivity and information solutions that more than 30,000 physicians and other healthcare professionals use to enhance patient care.

Business Situation

Allscripts needed to ensure that Microsoft® SQL Server™ 2005 could provide the scalability required to support its largest healthcare companies as their electronic medical records grow to multi-terabyte sizes.

Solution

Allscripts tested its application and found that SQL Server 2005 provided the scalability and processing power its customers need to grow into the future.

Benefits

- Enhanced scalability
- Faster query processing
- Disaster recovery
- Easier database tuning with Dynamic Management Views

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Ron Keen, Vice President of Software Development, Allscripts

Allscripts is leading the healthcare industry into a new era where paper-based patient files are replaced by electronic health record (EHR) solutions that can be securely accessed to provide improved quality of care at a lower cost. With more than 30,000 physicians at 3,500 health organizations using its EHR, practice management, electronic prescribing, and document imaging solutions, the company needed to verify that Microsoft® SQL Server™ 2005 could scale to keep pace with multi-terabyte patient record growth. Allscripts found that SQL Server 2005 easily scaled well, and gained a 50 percent boost in query performance. The Database Mirroring feature of SQL Server 2005 is also a critical component of the company's disaster recovery and business continuity solution. The company deployed SQL Server 2005 Enterprise Edition (64-bit) using Intel® Itanium® 2 processors.

Situation

Allscripts, based in Chicago, is the leading provider of clinical software, connectivity and information solutions that physicians and other healthcare professionals use to improve patient care. The company's electronic health record (EHR) solutions are used by more than 30,000 physicians in some 3,500 health organizations ranging from solo doctor's offices to acute care hospitals to deliver improved quality of care at lower cost. With 1,000 employees, Allscripts generated U.S.$228 million in revenue for 2006.

The company is comprised of three business groups:

- **Clinical Solutions Group**. Provides electronic medical record, practice management, electronic prescribing, and document imaging for ambulatory physicians; emergency department and care management solutions for acute care hospitals.
- **Physicians Interactive Group**. Provides clinical information, physician education, and patient adherence solutions that enhance the physician-patient relationship.
- **Medication Services Group**. Provides comprehensive prescribing and dispensing solutions for physician practices, improving patient care and practice management.

All of these solutions are aimed at resolving a problem common to medical care throughout the world: The inefficiency of traditional paper-based records that may be incomplete, and that can only be used at one location at a time. Additionally, medical orders and prescriptions are typically handwritten and are too often misunderstood, which can lead to potentially deadly errors in healthcare delivery.

Using Allscripts solutions, electronic health records are centrally stored, and can be securely accessed, so that a full patient history - including past treatments, test results, lists of prescribed medications, X-rays, scans, and other diagnostic results—can be used by healthcare workers to help the patient.

With some of the largest physician practices and academic medical centers in the United States implementing Allscripts solutions, and with some of the databases approaching the terabyte size and larger, scalability is an ongoing concern. Some of the company's largest customers wanted to upgrade their self-hosted deployments to Microsoft® SQL Server™ 2005 Enterprise Edition (64-bit) from their existing SQL Server 2000 databases.

"Some of our larger customers are seeing the benefit of moving to SQL Server 2005 in other areas of their IT infrastructure, and wanted to do the same to support their Allscripts solutions," says Ron Keen, Vice President of Software Development at Allscripts. "Large medical centers like the fact that SQL Server 2005 (64-bit) provides native 64-bit support allowing it to utilize significantly higher amounts of memory. We needed to test our application on SQL Server 2005 to see how well it scaled and to also see how well it improved performance."

Solution

Allscripts conducted scalability and performance testing at its own facilities, as well as at the Microsoft SQL Server Customer Lab in Redmond, Washington. The testing confirmed that even moving to the 32-bit version of SQL Server 2005 provided substantial improvements in both scalability and performance for its flagship TouchWorks™ application.

"Our goal in testing was to demonstrate that we could support 10,000 patient interactions an hour. … We found that SQL Server 2005 easily met these loads and from what we've seen we believe that it can scale far beyond."

Robert Maiella, Senior Software Quality Engineer, Critical Solutions Group, Allscripts

This improvement in performance is good news for Allscripts clients because a robust relational database is at the center of the solution. Allscripts TouchWorks has a tiered solution architecture that includes:

- **Presentation Tier**. Allscripts supports browser-based access to its applications using Microsoft Internet Information Services version 6.0. The presentation tier was created using Microsoft Visual Studio® 2005 and the Microsoft .NET Framework. This Web application framework uses .NET Windows® Form controls, ActiveX controls, and DHTML.
- **Application Tier**. A Web application server hosts the TouchWorks application that was created using Visual Studio and the ASP.NET and Web Services components of the .NET Framework version 2.0Relational Data Tier. Allscripts TouchWorks is designed for deployment using SQL Server database. The database communicates with the application using the ADO.NET component of the .NET Framework. Allscripts has upgraded its database to Microsoft SQL Server 2005 (64-bit) running on Windows Server 2003 Datacenter Edition for Itanium-based Systems as well.
- **Storage Tier**. Large blocks of non-relational data, such as document images and other diagnostic waveforms are stored on a file server, and pointed to from the SQL Server database.
- **Analytics Tier**. Allscripts deployments use an analytics tier. This enables a large medical center or physician's practice to mine their data to determine which treatment strategies yield the best outcomes for patients. The company uses SQL Server 2005 Integration Services to perform extract, transform, and load (ETL) processes to move data into a data warehouse. The company is exploring use of SQL Server 2005 Analysis Services for creating and managing multidimensional cubes for faster analytics.

Benefits

Allscripts found that migrating from SQL Server 2000 to SQL Server 2005 provided a number of benefits including enhanced scalability, faster query processing, improved disaster recovery/business continuity, and easier database tuning with dynamic management views.

Enhanced Scalability

The nature of electronic health records demands scalability. Unlike online transaction processing databases, where information can be deleted after a defined period, or moved from the database to long-term storage, everything that enters the electronic health record could be significant, and needs to remain in the relational data store.

"Some of our deployments are supporting more than 1,000 physicians, and their storage needs are already growing beyond a terabyte, and will grow continuously," says Keen. "As they plan for multi-terabyte loads, we were happy to see the scalability our testing demonstrated against single-instance SQL Server 2005 databases."

There is generally a four-to-one multiplier on system users. If a system supports 1,000 physicians, there will be about 4,000 users as physician assistants, nurses, support staff, and other authorized personnel interact with the patient and access electronic medical records. The company measures usage in terms of supporting patient encounters per hour.

One patient encounter can involve a number of SQL Server interactions, as healthcare workers connect to the database to review existing patient information, and to add new information. Typically 10 to 20 percent of healthcare users are accessing the database concurrently.

"Our goal in testing was to demonstrate that we could support 10,000 patient interactions an hour," says Robert Maiella, Senior Software Quality Engineer, Critical Solutions Group, at Allscripts. "This is about double the workload of our current largest deployment. We found that SQL Server 2005 easily met these loads and from what we've seen we believe that it can scale far beyond."

The company's internal testing used a computer with eight Intel® Dual-Core Itanium® 2 processors, though only 12 cores were used for the testing. "We put through 9,270 patient encounters an hour with the processors operating at an average of 48.81 percent utilization," says Maiella. "This provides plenty of scaling for our customers—including adding more processors and memory."

Although the computer was equipped with 192 gigabytes (GB) of RAM, and all was made available to the application, monitoring showed that only 32 GB was used during the testing.

Testing at the SQL Server Customer Lab used 490 GB of data from more than 2.5 million patients, and included 10.3 million results and information on 5.7 million medications. The test database included 1,100 tables, the largest of which included 13 million documents.

"Our testing at the SQL Server Customer Lab used an even larger data set and different baselines than our internal testing, but found the same thing," says Maiella. "The net finding is that SQL Server 2005 offers our users the scalability they need to grow their deployments at whatever pace they can achieve."

Faster Query Processing

Allscripts testing found that moving from SQL Server 2000 to SQL Server 2005 provided an immediate boost in query processing. To ensure an even comparison the company tested the two versions of SQL Server using the same hardware and operating system.

"We saw a 50 percent increase in processing throughput when we compared the 32-bit versions of SQL Server 2000 and SQL Server 2005 running on the 64-bit version of Windows Server 2003 Enterprise Edition operating system," says Maiella. "We used the same hardware, the same memory. These were hard numbers. It simply appears as if the SQL Server 2005 query engine has gotten substantially faster."

Faster processing can mean a better experience for the patients.

"Many physicians include Tablet PCs or Windows Mobile PDA devices to access their Allscripts solutions," says Keen. "The faster processing that SQL Server 2005 gives us on the database side means an even more seamless and real-time experience during the all-important patient-physician encounter."

Disaster Recovery

Disaster recovery is a top priority in healthcare because when actual disasters strike, healthcare personnel and facilities are at the center of disaster response. Whether the disaster is technical, such as a hardware failure, or natural, such as a fire, hurricane, tornado, or other cause of mass destruction, part of preparation means having access to patient health records.

After Hurricane Katrina struck New Orleans, many hospitals and physician practices permanently lost patient records that were submerged in water for days. With electronic health records, copies can be stored across a city, country, or around the world.

To gain continuous and uninterrupted access to health records, many Allscripts customers are expressing an interest in the Database Mirroring feature of SQL Server 2005. Database mirroring allows continuous streaming of the transaction log from a source server to a single destination server. In the event of a failure of the primary system, applications can reconnect to the database on the secondary server almost immediately.

"Disaster recovery is a big priority throughout healthcare," says Keen. "We are seeing a lot of interest in Database Mirroring. You can't argue with the benefits of having uninterruptible access to medical records."

Easier Database Tuning with Dynamic Management Views

Allscripts enjoys easier database tuning using the Dynamic Management Views (DMVs) of SQL Server 2005. DMV Reports give Allscripts DBAs a greater transparency across multiple aspects of database health and performance. SQL Server 2005 includes over 70 DMV Reports for comprehensive views of performance data and recommendations for improving database performance.

"With DMVs you can monitor for long-running queries or a number of other performance indicators," says Keen. "DMVs not only flag areas for tuning, but give you the deep visibility to easily identify and fix whatever is causing the delay. We see DMVs as a really big bonus."

In conclusion, Allscripts found that SQL Server 2005 provided the scalability and enhanced processing power that it sought to help the healthcare industry provide better care through the use of electronic medical records and its associated clinical practice tools.

Microsoft

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Microsoft SQL Server 2005

Microsoft SQL Server 2005 is comprehensive, integrated data management and analysis software that enables organizations to reliably manage mission-critical information and confidently run today's increasingly complex business applications. By providing high availability, security enhancements, and embedded reporting and data analysis tools, SQL Server 2005 helps companies gain greater insight from their business information and achieve faster results for a competitive advantage. And, because it's part of Windows Server System, SQL Server 2005 is designed to integrate seamlessly with your other server infrastructure investments.

For more information about SQL Server 2005, go to:
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