Orchestrating a brighter world

NEC

Gunma University Hospital

群馬大学
GUNMA UNIVERSITY

NEC provides an All Flash (SSD) environment from servers to clients and constructs a highly responsive, robust medical record system to move the customer closer to realizing a big data platform optimized for the medical field.

Customer

- Gunma University Hospital

Industry

- Medicine/Healthcare

Challenges

- Growing need by doctors to see an overview of all clinical data for each patient.
- Requires a high degree of operational continuity as a critical emergency hospital for the region.
- Medical information must be communicated quickly within the hospital.
- Need a system capable of quickly aggregating large amounts of medical data and performing medical analysis in real time.

Solution

- Use All Flash (SSD) for servers, storage, and client data storage.
- Use Oracle Database clustering feature RAC (Real Application Clusters) to enhance availability and operational continuity.
- Use NEC's EXPRESSCLUSTER X middleware to monitor Oracle Database health and automatically send alerts if problems occur.
- Adopt NEC Storage M510 with a RAID10 configuration to enhance the performance, restoration speed and resilience of SSD storage.

Results

- All Flash (SSD) platform significantly improved responsiveness.
- Operational continuity guaranteed by combining RAID10 with proven middleware.
- Smartphones linked to the electronic medical record system distributed to all staff, speeding up hospital administration.
- All Flash (SSD) platform enabled utilization of enormous amounts of past data.

Introduction

Gunma University Hospital, established in 1949, has 731 beds, employs over 1700 staff, serves approximately 2,000 outpatients per day and 13,000 inpatients per year, and is a core hospital in North Kanto, a mountainous region north of Tokyo.

Like many hospitals in Japan, Gunma University Hospital is faced with meeting the increasing medical needs of an aging population. With advances in clinical guideline development and the increased use of standard clinical pathways, patients are being hospitalized for fewer days, but this has led to an increase in the number of outpatient visits, and a higher workload for hospital staff who have to perform a much more diverse and complex range of tasks.

"We felt that we needed to come up with innovative new medical processes and solutions to keep pace with these environmental changes," said Yuichiro Saito, Head of the Systems Integration Center at Gunma University Hospital. "So we decided to overhaul the hospital's information management system, starting with our electronic medical record and medical accounting systems."

Challenges

In the six years since the hospital introduced an electronic medical record system, the amount of data had increased considerably, and there was concern about the possible effect this was having on system usability.

"In a hospital, to properly and safely diagnose a patient's condition, data which is collected for different purposes must be displayed as an overview," explained Kota Torikai from the System Integration Center at Gunma University Hospital. "We wanted an overview screen that could be displayed very quickly. Also, because in an electronic medical record system patient clinical histories need to be recorded in a tree-like data structure, doctors had to be able to randomly access more than one table to obtain specific information.

Meeting these needs with a hardware-based solution was the key issue for this system overhaul."

Regional core hospitals require high levels of operational continuity. The existing system used server clustering for redundancy and was operated in an active-standby configuration, but these systems can take time to fail over when a failure occurs. The hospital wanted to improve operational continuity while increasing system speeds.

Another challenge was that the existing servers required a certain period of time to restart during server maintenance since they were based on HDD storage.

Moreover, doctors, nurses and administrative staff were using the personal handy phone system (PHS; a simplified mobile phone system standard developed in Japan) to communicate with each other. PHS can be used for voice calls, but it does not support text messaging, creating an obstacle to accurate communication between hospital staff. There was also the problem that urgent medical data recorded in the electronic medical record system could only be accessed from special terminals.

The hospital's aim was to build a hospital information management system that would become a world standard for future generations. They therefore decided to completely overhaul the existing system configuration and design a new architecture that would integrate the hospital information management system (server infrastructure) with the networks and peripheral equipment.

After considering proposals from multiple vendors, Gunma University Hospital chose NEC Group's proposal based on the company's strengths in all three fields—server infrastructure, networking, and peripherals.

"As the company in charge of maintaining and operating our current electronic medical record and medical accounting systems, we have had frequent contact with NEC staff, both sales reps and engineers, who often come to the hospital to find out what kinds of problems we were facing and to provide technical support," said Kota Torikai. "NEC's familiarity with our systems helped them to come up with a proposal that met our needs."

Solution

NEC deployed All Flash for the electronic medical record system storage to accelerate random access performance.

"The problem that we really wanted to solve with our current system was random access latency," said Torikai. "NEC's engineers achieved this by bringing in NEC Storage M510 SAN storage to store the 18 terabytes of data in our electronic medical records system in an All Flash SSD architecture."

SSD storage was also implemented for the Express5800 series, the server that hosts the hospital's electronic medical records system, and for the internal memory of all client terminals. The hospital also decided to improve network performance for the accelerated storage platform.

"By connecting backend servers, the existing 1 Gbps metal network could be upgraded to 10 Gbps optical fiber, which hugely boosts transmission speed," explained Torikai. "We have additionally employed FTTD for outpatient and other terminals that require a particularly high processing performance during busy times by directly connecting the terminals to the server with 10 Gbps optical fiber."

To realize enhanced availability and operational continuity, NEC proposed a combination of highly successful solutions.

"The solution we adopted uses the Oracle Database clustering feature RAC (Real Application Clusters) to realize higher operational continuity than our existing active-standby configuration" said Torikai. "The solution also uses the Oracle Database ActiveDataGuard feature which implements real-time storage synchronization with a reference system. In the event of a system failure, storage operations fail over to this reference system, providing us with a robust backup mechanism."

NEC's EXPRESSCLUSTER X middleware product was deployed to provide monitoring and operations functionality for the system's operating environment. Based on a rich menu of monitoring options, EXPRESSCLUSTER X constantly monitors the operating status of the Oracle Database and sends alerts when problems occur.

NEC Storage M510 with a RAID10 configuration was also employed to enhance the performance, restoration speed, and resilience of the SSD storage.

"If you think in terms of response, there are two drawbacks to the widely used RAID6," explained Torikai. "The first is that a striping operation is required to generate parity when writing data. Secondly, the long time required for reprocessing during recovery affects the responsiveness. RAID10, on the other hand, leverages the speed of RAID1, since data is written directly without arithmetic processing, and the responsiveness and fast recovery features of SSD and RAID0."

The PHS phones that all staff had been using were replaced with smartphones that provided voice call and nurse call functionality, as well as labor-saving work apps. In addition, by linking the e-mail feature that was built in to the electronic medical record system ("Communicate" function), it became possible to provide notifications of emergency response for exceptional results of medical tests and instantly share important information.

Results

By implementing All Flash (SSD), RAID10 and a 10 Gbps network, the new system has created an environment that demonstrates the highest levels of responsiveness possible today. Evaluating the effects on each of the electronic medical record system's features, the improvements are obvious—the overview list displays five- to twelve-times faster than the previous system, and the system is much more responsive. This allows doctors to quickly access the medical examination results for a particular patient, contributing to smoother patient consultations.

In addition, with the virtualization of the department system servers linked to the electronic medical records, almost all department systems can be operated on fat/thin client terminals. Wireless single channel USB bootable thin client laptops and full HD dual display thin client dedicated terminals are now installed around the hospital wards.

"In helping to advance the digitization of healthcare, it is always important to optimize the throughput of all processes and design a high-speed information management system," emphasized Torikai.

Moreover, with the introduction of resilience measures based around Oracle RAC, even if one server stops due to a failure, the system instantly fails over to a backup server and continues operating—a capability that is vital in the event of a natural disaster.

"In a hospital, it is essential to provide an environment in which medical staff can focus on keeping patients safe and protecting their lives," said Torikai. "From past experience, I feel that improvements in responsiveness and communication will lead to more reliable medical practice."

Systems Integration Center head Yuichiro Saito agrees. "Building on the system we have now developed, we hope to deepen cooperation with other medical institutions in the region. Currently, referral rates from hospitals and clinics in the region are at about 90%, and the reverse referral rate is about 80%. These figures are very high. Therefore in the near future, we plan to link our system to the portal system created by our local medical association and provide a solution that enables us to easily share patient information."

Torikai hopes to take advantage of the hospital's new, evolutionary
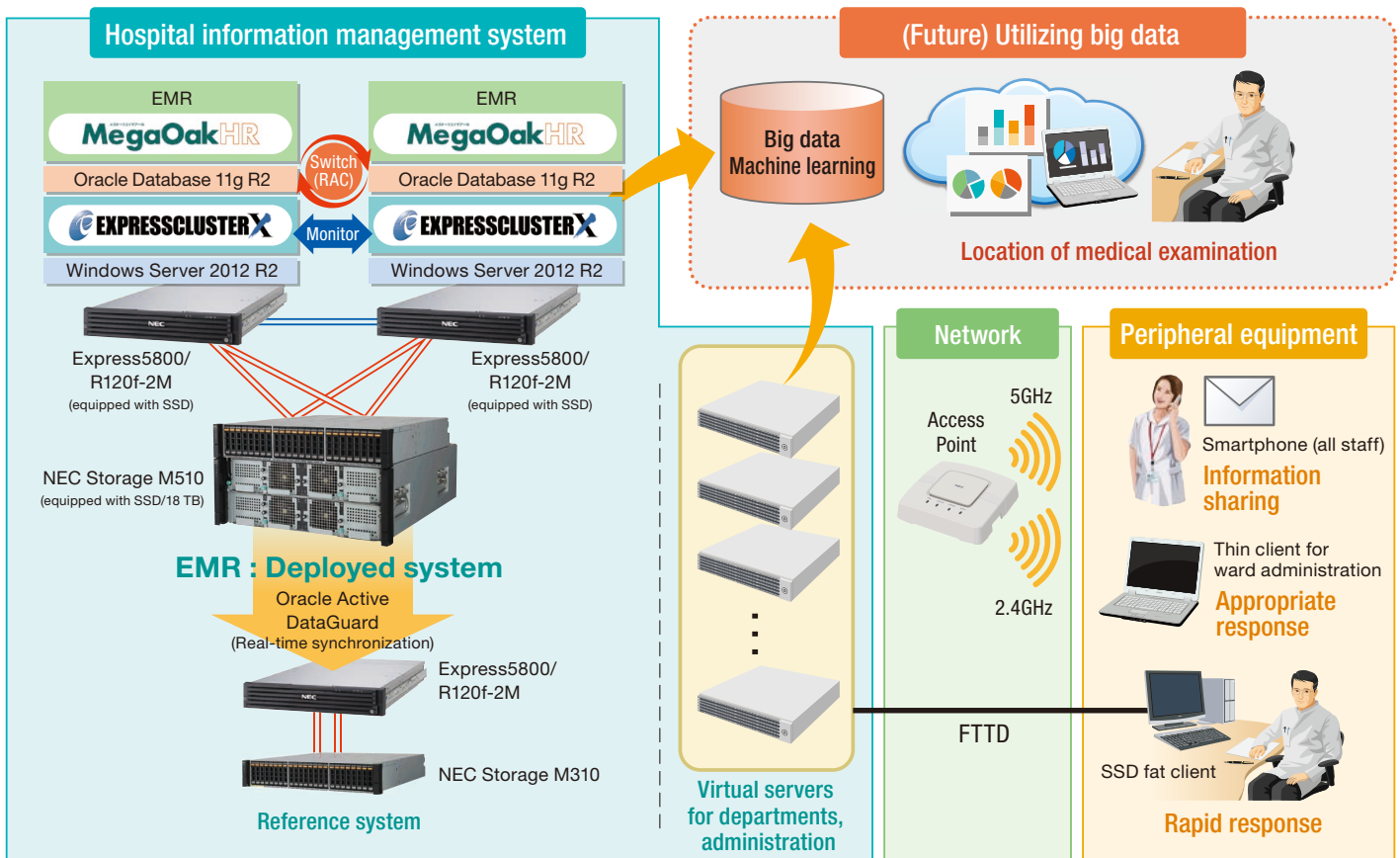
EMR: Electronic medical records

system to develop strategic solutions for supporting doctors working on the front line.

"Big data is currently attracting a great deal of attention in the medical world. If we can utilize big data analysis techniques to identify similar cases in vast amounts of clinical data, we will be able to discover and identify diseases at an early stage, leading to significant advances in healthcare. But the current problem with big data analysis is processing speed. For example, 10 years' worth of clinical data from our hospital comes to about 10 TB of data. It would take at least one week to search, extract and analyze this data in a text-based format. This might be an acceptable latency if you were conducting research, but is not practical for clinical medicine. The processing speed bottleneck is disk access. The real reason that we insisted on All Flash (SSD) in our new system is that we hope to develop infrastructure that can realize the kind of advanced medical environment we need."

"There are also Hadoop performance bottlenecks in the network," he continued. "Even if the database uses distributed processing, if the network is slow, you cannot get results immediately. This is why for our in-house network we extended everything to 10 Gbps. Also, because we have equipped all 600 fat client terminals with SSD, we will be able to use these terminals as a distributed computing resource and create a clinical system that can operate at practical speeds without having to install an expensive computing server for analysis."

The hospital has also implemented a machine learning algorithm developed by NEC and has commenced R&D to provide doctors with intelligent suggestions generated by the system on the spot.

"Of course, all final judgments on issues such as treatment will be decided through communication between doctor and patient, but we hope that the path to that can be enhanced and made more clinically accurate through the use of machine-based intelligence," said Torikai. "As we look to the future, I believe that our mission as a core hospital is look at how we can refine systems to streamline and automate operations to cope with growing medical demands and accelerated population aging."

Cat.No. E11-15120001E