Hewlett Packard Enterprise

3D cardiac imaging: no longer a dream

A 3D image of a beating heart requires high performance computing to gather, store, and process massive amounts of data in the mere minutes the patient is on the table. GE Healthcare's Revolution CT scanner makes this state of the art capability a reality with a key imaging chain engine developed in partnership with HPE. The Revolution CT scanner is so fast and powerful that it can freeze-frame a stunningly detailed 3D image of a beating human heart—while lowering patients' radiation exposure by up to 82%. It's all part of GE's digital health transformation to improve patient care—and save lives—at an affordable cost.

AT A GLANCE   INDUSTRY CHALLENGE   IT CHALLENGE   SOLUTION   RESULT

GE Healthcare delivers advanced diagnostic imaging solutions

Healthcare Systems division provides diagnostic imaging solutions including low-dose computed tomography.

GE Healthcare provides transformational medical technologies and services to meet the worldwide demand for increased access, enhanced quality, and more affordable healthcare. A unit of General Electric Co., GE Healthcare operates three business divisions: Healthcare Systems, Life Sciences, and Healthcare Digital.

The GE Healthcare Systems division delivers a wide range of technologies and services, including diagnostic imaging systems such as X-ray, digital mammography, magnetic resonance, and low-dose computed tomography (CT). These allow clinicians to see inside the human body to detect abnormalities, diagnose disease, and plan treatment, including minimally invasive surgery.

> **"Healthcare providers are using data and analytics to improve clinical outcomes, operational performance, and financial results."**
>
> Dr. Jiang Hsieh, Chief Scientist, GE Healthcare

140+
Countries served worldwide

54K
Employees

$18.3B
2016 revenues

$7.2B

Projected global CT scan market by 2021

4.5%

Projected compound annual growth rate in global CT market from 2016 to 2021

16K

Scans every minute on GE Healthcare equipment

Pioneering advances in CT scanning

GE Healthcare responded to growing global needs with an initiative to introduce a new breed of low-dose, high-precision CT scanner.

To meet rising worldwide demand for more and better CT scanners, GE Healthcare aimed to advance the state of the art on several fronts.

To protect patients and address industry concerns about patient radiation exposure, GE Healthcare wanted to drastically reduce the scanner radiation dose. This is important for all patients, but particularly for infants and children, whose lifetime exposure to radiation must be minimized.

GE Healthcare also tackled the biggest challenge of cardiac CT: imaging the beating heart. Heart disease is a leading cause of death, and cardiac CT is an important tool for diagnosing heart abnormalities and diseases. However, imaging the anatomy and physiology of the heart demands greater temporal, spatial, and contrast resolution than other organ systems require. GE Healthcare set out to solve this decades-old problem.

Also recognizing that cost and efficiency are always top concerns, GE Healthcare wanted the solution to deliver high-performance computing speed, simplicity, and productivity.

> "GE Healthcare's Revolution portfolio of CT Scanners is built out of our passion to enable clinicians with extraordinary technologies to reach the right diagnosis, effortlessly."
>
> Dr. Jiang Hsieh, Chief Scientist, GE Healthcare

Imaging the beating human heart

Revolution CT scanner must quickly capture, store, transfer, and transform massive amounts of data into 3D images.

To enter a CT scanner, a patient lies on a CT table and is transported through a donut-shaped area, called the gantry, which houses an X-ray tube and detectors that rotate around the patient. Because its shutter remains open through an entire revolution, in order to take a clear picture, the gantry—which weighs more than a thousand pounds—has to move fast.

To improve patient outcomes, GE Healthcare wanted to do something that had never been done before: image the beating heart in only one heartbeat and in unprecedented 3D detail, while slashing patients' radiation exposure. Previous scanner generations all involved some kind of tradeoff. To deliver good image quality, the gantry would have to spin many times over multiple cardiac cycles—at the sacrifice of temporal resolution, or measurement precision in relation to time. Fewer spins would improve temporal resolution but reduce image quality or anatomy coverage.

GE Healthcare therefore faced formidable technical challenges. To freeze-frame the motion of a beating heart, the gantry must spin all the way around the patient in just 0.28 seconds. This feeds the system with scanning data that must be transferred and stored without dropping a single byte. Translating the data into 3D images would also take intensive mathematical calculations.

All of this must happen very fast, because the CT operator must ensure the scans are complete before the patient gets off the table.

> **"Cardiac imaging was a dream, because the heart is constantly moving. We wanted to make it a reality, but first we had to speed up the scanner rotation and increase scanner coverage, and overcome the challenge of making huge amounts of image data instantly accessible."**
>
> Dr. Jiang Hsieh, Chief Scientist, GE Healthcare

>1,000 lbs.
The weight of the spinning CT gantry

0.28 seconds
To spin gantry and capture a single human heartbeat

>2,500
High-definition patient pictures taken in each CT spin

Partnering with HPE to create a new generation of engines for imaging chain

Integrated data collection, storage, transfer, and processing enable very fast transformation into 3D images for faster and more accurate diagnosis and reduced patient radiation exposure.

GE Healthcare partnered with Hewlett Packard Enterprise to create the imaging chain engine for the Revolution CT, its flagship scanner that shows bones and organs in stunning 3D detail, while slashing patients' radiation exposure.

The faster a scanner spins, the more data it collects. The Revolution CT spins in 0.28 seconds, with 250,000 detector cells each sampling at seven kilohertz—fast enough to capture the motion of a beating heart. And its 16 cm detector can cover an entire organ at once, including capturing the whole heart in high definition, with motion-free coronary images at any heart rate. GE also developed powerful algorithms to process the raw data coming off of the scanner and generate human-readable 3D images.

GE paired the scanner with a customized IT solution architected by HPE. As an on-premise, high-performance computing (HPC) platform deployed at the edge, the HPE solution avoids latency issues that would arise if the data was transmitted over a network. And it has the horsepower and capacity to ingest, store, and process the large volume of data coming off the Revolution CT scanner without losing a single byte.

The system can scale up to 12 GPUs in concert to reconstruct 3D images for instant review. After the CT process is completed, the images are stored on the hospital's picture archiving and communications system (PACs) for future reference, completing the edge-to-core loop.

SOLUTION RECIPE

HPE ProLiant Servers deliver high-performance computing power

HPE ProLiant ML350 Servers pull data off the Revolution CT scanner and feed it to HPE ProLiant SL270 Servers, which provide the compute power to transform the data into 3D patient images. HPE customized the HPE SL270 servers with industry-leading Graphical Processing Units. The HPE ML350 solution is optimized with specialized disk drive firmware for performance and expandability.

HPE Hardware

HPE ProLiant Servers

HPE Partners

Intel

AMD

NVIDIA

HPE Transformation Solution

Infrastructure Consolidation and Virtualization

> **"The beauty of the HPE high-performance computing solution is that it's integrated for extremely fast transfer, computation, and storage of huge amounts of data, and it's fully expandable."**
>
> Dr. Jiang Hsieh, Chief Scientist, GE Healthcare

Digital health transformation saves lives

Clinical applications of Revolution CT span medical specialties to deliver high-value 3D imagery with much less patient radiation exposure.

A five-second total body scan with GE Healthcare's flagship Revolution CT helps save a car-accident victim's life. A 3D-printed replica from scanning data helps doctors plan surgery on a tiny infant heart. Scans of a cancer patient's liver yield vital information for treatment planning.

The integrated solution provides uncompromised image quality and clinical capabilities through the convergence of coverage, spatial and temporal resolution, and spectral imaging all in one system. And the Revolution CT reduces patient radiation exposure up to 82%.

The clinical applications for Revolution CT reach across medical specialties, increasing clinicians' diagnostic confidence, and helping improve patient care. Its intelligent design also improves hospitals' financial performance through enhanced efficiency.

GE Healthcare sees Revolution CT as part of healthcare's digital transformation. The company is partnering with HPE also to create patient monitoring devices and networks, mobile diagnostics technologies, and turnkey PACs solutions, including installation and maintenance services—all in the interest of better patient care at affordable costs.

1 heartbeat
Time it takes to scan the entire heart in high definition

Up to 82%
Reduction in patient radiation exposure

Lower
Total cost of care in emergency chest pain patients

> **"Digital has the potential to revolutionize the healthcare industry. We're looking at cloud computing, big data, artificial intelligence, deep learning—and HPE is right there with us exploring this exciting future."**
>
> Dr. Jiang Hsieh, Chief Scientist, GE Healthcare

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