



Groundbreaking research with life-changing results

With the power of high performance computing, TGen unravels the genetic components of deadly diseases, from cancer to COVID-19.



Genomics Research | United States

Business needs

TGen needs leading-edge high performance computing systems to accelerate genomic sequencing and the development of new, personalized therapies for patients.

Solutions at a glance

- Dell EMC Ready Solutions for HPC Genomics
- Dell EMC PowerEdge servers
- Intel® Xeon® processors
- Dell EMC PowerSwitch Networking
- Dell EMC Isilon network-attached storage

Business results

- Accelerating lifesaving genomic sequencing
- Offering new hope to patients and their families
- Identifying drugs to target infectious diseases
- Working to bring about a better future

TGen cut genomic sequencing times from two weeks to just

7 to 8 hours



TGen's largest supercomputer from Dell Technologies performs

12 trillion operations/sec



Turning lab discoveries in patient treatments

TGen, the Translational Genomics Research Institute, an affiliate of City of Hope, is a nonprofit medical research institute dedicated to conducting groundbreaking research with life-changing results. The Arizona-based institute works to unravel the genetic components of common and complex diseases, including COVID, cancer, neurological disorders, infectious disease and rare childhood disorders. By identifying treatment options, TGen helps make medicine more rational, more precise and more personal.

TGen's precision medicine explorations bring better treatments to more patients. The institute takes discoveries in the lab and translates them into treatments quickly and effectively. This work requires the ability to manipulate massive quantities of data — moving it to where it needs to be, managing it securely, and processing it quickly and intelligently on high performance computing systems.

This is all part of a day's work for James Lowey, TGen's chief information officer.

Accelerating time to clinically relevant results

When Lowey joined TGen in 2003, the institute used a DNA sequencing instrument called a microarray, which captures a portion of a person's genetic data. To process the data generated by microarrays, Lowey and his colleagues built a supercomputer with a terabyte file system — a very large storage system by the standards of the early 2000s.

“And then we started seeing an evolution of DNA sequencing toward what is now called next-generation sequencing, which is different from microarrays,” Lowey says. “While microarrays might capture a few thousand genes, next-generation sequencing can capture your entire genome. You're talking about 18,000 unique genes and 3 billion base pairs. And that data volume moved us from gigascale to terascale computing.”

With next-generation sequencing, or NGS, up to a terabyte or more of data is captured each time a sequencer runs. And at TGen, multiple sequencers run around the clock.

Leveraging systems from Dell Technologies

In addition to its supercomputer focused on next-generation sequencing, TGen operates various other HPC resources based on systems from Dell Technologies. These include a cluster at the TGen North facility in Flagstaff that is used primarily for pathogen genomics. TGen is the process of building a new system there, based on Dell EMC PowerEdge R640 servers, Dell EMC Isilon storage and Dell EMC PowerSwitch networking.

TGen also operates a GPU-centric system that it built with its affiliate City of Hope, a world-renowned independent research and treatment center for cancer, diabetes and other life-threatening diseases. This system, which is used primarily for molecular dynamics simulations, is based on Dell EMC PowerEdge C4140 and R640 servers with NVIDIA® Tesla® V100 GPUs, Dell EMC PowerSwitch networking and Dell EMC Isilon network attached storage.

“That created a huge challenge in storing and accessing data generated by these instruments,” Lowey says. “It’s a lot of data being generated. That creates a lot of pressure on IT systems. You have to have a place to store the data, and you have to be able to compute against it.”

Extremely fast data processing is also important here. Without the right high performance computing and storage systems, sequencing an entire genome could take weeks to complete. And that’s a problem, because in clinical applications, fast time to results can be critical — even lifesaving.

“You want clinical results back as fast as possible, so physicians can make decisions in a more timely manner,” Lowey says. “You don’t want to wait two to three weeks to do this. You want to do it in a much faster time period.”

The rise of a new machine

When TGen first began working with next-generation sequencing in 2008, it took approximately two weeks for the institute’s supercomputer to process an entire genome — and that’s an eternity when it comes to using data in a clinical setting to identify personalized treatment options for patients.

The time-to-result prompted discussions among TGen, Dell Technologies and Intel, which led to an ambitious HPC project in 2012. In this project, Intel and Dell contributed in-kind donations, and engineers from both companies volunteered their time to help create an optimized HPC platform at TGen, purpose built to rapidly process NGS samples.

With its most recent upgrade, this supercomputer, based on Dell EMC PowerEdge servers, offers the processing power of 3,000 Intel® Xeon® compute cores. The cluster delivers 1 million CPU hours per month and performs 50 trillion operations per second, according to TGen. The genomics sequencing system also offers more than 3 petabytes of Dell EMC Isilon scale-out network-attached storage.

This supercomputer greatly accelerates the speed of genomic sequencing. It cuts the data processing time from two weeks with the earlier-generation system to just seven to eight hours. This dramatic improvement in performance allows TGen’s scientists and physicians to accelerate data analysis and offer personalized treatments in a more timely manner.

“We were able to take something that, I would argue, was barely at a clinically relevant time period and take it to something more clinically relevant,” Lowey says. “You can have results back the same day, which is huge for patients and their families.”

While that was all a big step forward, TGen isn’t stopping there. Today, the institute is working with Dell Technologies and other partners to build a system that can do the same amount of processing on genomic sequencing datasets in just one to two hours. Lowey notes that this speed is extremely important as sequencing technology moves from the laboratory into the mainstream of clinical care.

Joining the fight against COVID-19

As part of its humanitarian mission, TGen works to unravel the secrets of infectious diseases. That’s the case today as the institute participates actively in the global fight against the deadly COVID-19 disease.

“When we talk about genome sequencing, we’re talking about sequencing any living organism,” Lowey explains. “This planet uses DNA to encode how life exists. Viruses are no different in that respect. Although they can be much simpler from a genetic standpoint than a human, they still require DNA as the code that makes them tick. It’s important to understand how that works in order to fight the disease.”

To that end, the TGen North facility has developed an RNA test for COVID-19 and has been testing people in Arizona since early March. As part of this process, researchers are sequencing all of the positive test results and building a biobank of genetic signatures.

Enabling workload migration between clouds

VMware virtualization software is a foundational aspect for the next generation of high performance computing at TGen. The institute is now using VMware software to build infrastructure that will support seamless workload migration between public and private clouds. This will enable TGen to move computational workflows to where data resides, instead of trying to move enormous datasets to the computational systems.

“This helps us understand how the disease first appeared in Arizona and where it came from, and understand the mechanisms behind the disease more clearly,” Lowey says. “And this continues to this day, not just with TGen but across a wide variety of institutions and organizations. Understanding that genetic component has led to an understanding of the different substrains of SARS-CoV-2, which impact the infectiousness of the virus and influence how the virus spreads through the population.”

As part of this initiative, researchers at TGen are using insights gained from genetic sequencing to search for drugs that might target the SARS-CoV-2 virus. As part of this scientific exploration, TGen worked with the Dell Technologies HPC & AI Innovation Lab in Austin, Texas, to analyze data on the lab’s Zenith supercomputer.

“We took a pretty good subset of all the known sequences of COVID, loaded it into the supercomputer, and ran some very complex analysis of that,” Lowey says. “This work helped us come up with a possible drug-able target that was reflected in the genome of the virus.”

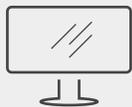
Working with Dell Technologies

TGen and Dell Technologies have enjoyed a long and productive relationship, one that extends far beyond technology. While technology and innovative solutions are obviously extremely important to TGen, the institute also needs partners who help solve problems — like the need to greatly accelerate sequencing processing timelines.

“That requires a company who has both the products and the brains to work with us to come up with a solution to a very hard problem — to cut sequencing times from weeks to hour. That’s huge,” Lowey says. “Technology is important. You have to have that. You have to have great tools to do the job. But you also have some alignment on what you’re trying to accomplish.”

At a higher level, Lowey sees Dell Technologies as a partner who shares TGen’s vision of a better future — and is working to make that happen.

“Over a number of years, I’ve had the opportunity to work with many people at Dell who are really passionate about what they do, and believe in the mission,” Lowey says. “I think Michael Dell (founder and CEO of Dell Technologies) puts it best when he says it’s not just about building technology for technology’s sake. It’s about building technology to solve problems, to work in the real world and to make a difference. That philosophy aligns very closely with what we are trying to do here at TGen. Having a partner who is truly invested in trying to change things for the better is absolutely critical. That’s something we value immensely.”



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