TGen helps bring breakthroughs to the bedside faster with an integrated clinical genomic solution.

Overview

- ***Challenge***
  With a mission to translate genomic discoveries into new treatments, TGen needed powerful computing capabilities to handle the enormous processing demands of advanced genomic analysis.
- ***Why Become an On Demand Business?***
  TGen needed the flexibility to grow its processing capacity to keep ahead of the explosive growth in genomic and clinical data. To keep its resources focused on research—not on assembling a solution from piece parts—TGen sought a partner whose vision and technology roadmap matched its own.
- ***Solution***
  TGen and partner Arizona State University engaged IBM Healthcare Life Sciences Information-Based Medicine to create a powerful platform to advance the translation of genomic discoveries into new treatments and diagnostic tools. The new system combines scalable, world-class computing horsepower with highly advanced data mining capabilities.
- ***Key Benefits***
  - *2 trillion calculation per second processing capacity reduces cycle time by 99%*
  - *A horizontally scalable architecture enables TGen and ASU to grow computing capacity as needed, saving $300,000 in associated costs*

Phoenix-based TGen works closely allied with the academic, government and private research sectors in searching for faster ways to translate genomic discoveries into practical treatments that save lives. TGen also established a for-profit company—the Molecular Profiling Institute—which applies genomic technologies to patient specimens on a realtime basis. TGen employs approximately 200 scientists, clinicians and bioinformatics experts.

When the first full mapping of the human genome was completed in April 2003, the world got a glimpse of the root-level molecular data or "instructions" that guide the way humans develop and function. This singular achievement illustrated the importance of information technology in bringing mankind's scientific understanding to a new level and unleashed a tide of optimism about the gene-based medical breakthroughs that it would enable. The crux of this vision—known as personalized medicine—is to integrate, mine and leverage genomic information and clinical information to develop highly targeted

"For all the value IBM's on demand technology has provided, the heart and soul of our relationship is the shared vision that sits in front of that technology. There is a shared sense of excitement and commitment that comes from doing good and doing well."

– *Dr. Jeffrey Trent, President and Scientific Director, Translational Genomics Research Institute*

ON DEMAND BUSINESS™

On Demand Business Benefits

- 2 trillion calculations per second processing capacity reduces the cycle by 99% (from years to days) speeding the development of new treatments.
- A horizontally scalable architecture enables TGen and ASU to grow computing capacity as needed, saving $300,000 in associated costs.
- IBM's ability to provide an entire end-to-end solution enabled a faster deployment and more seamless integration.
- Advanced data management tools broaden the range of information that can feed into TGen's analytical processes.
- Resilient platform ensures high levels of performance and availability.

"Biology and medicine are becoming more information based sciences. It's not just observing, but understanding the underlying mechanisms of complex diseases. Both ASU and TGen are intimately engaged in and collaborating in the identification of biological signatures that make this understanding possible."

– *Dr. George Poste, Director of the Biodesign Institute, Arizona State University*

treatment regimens. In contrast to traditional clinical practices that apply standard treatments based on observable symptoms, personalized medicine takes aim at the deep, molecular foundations of diseases, in order to improve effectiveness while minimizing debilitating side effects.

While the success of the Human Genome Project clearly brought science across an important threshold of knowledge, scientists were quick to label it a starting point for the broader and deeper inquiry that would be required to make personalized medicine a reality. In understanding the genomic and molecular mechanisms behind complex diseases such as cancer, knowing the elements of the genome map is akin to having all the pieces of a large and complex puzzle. For researchers, the new—and in many ways even more complex—challenge is to gain a deeper understanding of the various ways these pieces fit together. Only by bridging this knowledge gap can researchers begin to answer the most crucial clinical questions, most notably: how an individual's genomic makeup impacts susceptibility to certain diseases, the rate at which those diseases progress and their resistance to standard approaches to therapy. The drive to understand these relationships—and to translate this understanding into practical treatments that save lives—represents the new frontier of genomics. To meet this goal, a new field known as translational genomic research has emerged, with organizations like the Translational Genomics Research Institute (TGen) at the forefront.

Power for progress

A non-profit biomedical research institute based in Phoenix, TGen (www.tgen.org) was founded in July 2002 by a group of academic and private sector luminaries in the fields of genomic analysis, bioinformatics, and cancer drug development, many of whom were key players in the Human Genome Project. Reflecting the dynamics and economics of biomedical research, TGen has established close affiliations within government, academia and industry to collaborate in research and to access and share resources. Of the resources required to fulfill TGen's mission, powerful computing capability is high on the list. The main driver of this need, and a pillar of translational genomics, is the importance of understanding how certain genes interact, a goal only achievable through intense testing involving enormous volumes of genomic data. Managing and analyzing the enormous amount of data generated by genotypic analysis—such as genetic markers for disease, evidence of responsiveness and resistance to treatments or other key correlations—is also crucial to getting research results from "benchside to bedside" as quickly and efficiently as possible. TGen also established

a for-profit company—the Molecular Profiling Institute—which applies genomic technologies to patient specimens on a realtime basis.

Another key part of TGen's vision was the collection and integration of a wide variety of existing data sources into a virtual "dictionary" that would catalog correlations between particular genetic signatures and their responses to various therapeutic agents. This inclusive knowledge base—comprised of everything from Web pages to medical journals—would then be integrated with TGen's core genomic data and run through another round of statistical tests, resulting in a set of clinical recommendations. For TGen to fulfill its mission, having the robust, scalable and intelligent systems required to perform these functions was essential. What's more, with world-class research talent a key part of TGen's plan, putting in place a powerful, state-of-the-art infrastructure would vastly improve its ability to attract, retain and fully leverage that talent.

Sharing a vision and sharing success

As Dr. Jeffrey M. Trent, TGen's president and scientific director explains, TGen knew it needed more than just a technology provider to translate its vision into reality. "We knew that individual companies could provide the various pieces of what we needed, but we saw the real key to success was working with a partner that was in lockstep with our vision of where information-based medicine was going," says Dr. Trent. "IBM not only shared our vision, but was able to provide the entire solution using established tools that worked seamlessly together. And the fact that we were committed to a common vision of information-based medicine also gave us the confidence that IBM's development efforts in this area would be in synch with our needs as they evolved."

Staff from TGen and Arizona State University, a close collaborator and a leader in genomics research (www.biodesign.org), met with a team from the IBM Healthcare Life Sciences Information-Based Medicine organization to design a business model built around tight collaboration with IBM. The teams also worked closely to design a solution that mapped to TGen's needs. The solution they created is anchored by a high-performance computing infrastructure whose capacity of 2 trillion calculations per second enables it to perform tests and analysis that previously took years in a matter of days. Deployed using an IBM eServer Cluster 1350 with 512 eServer xSeries 335 servers, the platform runs on Linux, making it not only highly cost effective but also horizontally scaleable—a crucial trait given the skyrocketing volume of biomedical data created and consumed by genomic research. The infrastructure was deployed on the Arizona State University campus by a team from IBM Global Services - Integrated Technology Services.

The platform's raw muscle is complimented by an equally powerful data management capability, the core of which is provided by IBM DB2 Universal Database. In addition to maintaining the massive volume of genomic data derived from profiling and testing, the system also stores both structured and unstructured information drawn from an

Key Components

Software

- IBM Cluster Systems Management for Linux™
- IBM DB2 ® Universal Database™
- IBM DB2 Intelligent Miner™ for Data
- IBM WebSphere® Application Server
- IBM Tivoli ® Storage Manager
- Red Hat Linux

Servers

- IBM eServer™ Cluster 1350
- IBM eServer xSeries®
- IBM eServer pSeries®
- IBM TotalStorage® FAStT700 Storage Server
- IBM 3584 LTO Tape Library

Services

- IBM Healthcare Life Sciences Information-Based Medicine EBO
- IBM Global Services - Integrated Technology Services
- Computational Biology Center at the IBM TJ Watson Research Center

> *"To collaborate in the area of information-based medicine, the need for a shared vision is fundamental. Having such a shared vision has made our collaboration with TGen and IBM so successful and productive."*
>
> – *Dr. George Poste*

enormously diverse array of sources, including clinical trial data, biomedical images, chemical compound libraries, environmental records and family histories. One of the project's biggest challenges—and biggest potential payoffs—was in finding a way to harvest the valuable data embedded in these sources, and then use this data to supplement and enrich TGen's own genomic research. To achieve this, TGen and IBM used DB2 Data Miner software to create an intelligent knowledge management tool that extracts relevant data and then applies advanced analytical and visualization tools to unlock valuable data and speed the development of more effective treatment options. Running on a pair of IBM eServer pSeries 690 servers configured for maximum resiliency, these tools are accessed by clinicians and researchers through IBM WebSphere Application Server running on two pSeries 650 servers at the front end of the solution. For fast and reliable storage, the solution uses three IBM TotalStorage FAStT 700 Storage Servers, SAN switches and an IBM 3584 LTO Tape Library. IBM Tivoli Storage Manager provides automated backup.

In a project replete with benefits, the biggest is the prospect of bringing new hope to patients by getting discoveries out of the laboratory and into the hands of doctors in the near term—not years down the road. This accelerated ability to translate discoveries to real treatments derives not only from the power of TGen's Linux cluster, but also from its vastly improved ability to share data and resources with other key players in the information-based medicine arena, its close collaboration with the Mayo Clinic and the Biodesign Institute at Arizona State University being prime examples. To further strengthen its analytical capabilities, TGen is also working with the Computational Biology Center at the IBM TJ Watson Research Center to put its algorithms to work gleaning data from patient records to further advance the state of personalized medicine. Dr. Trent sees TGen's partnership with IBM as a critical catalyst to the development of translational genomics and a key to its success going forward. "For all the value IBM's on demand technology has provided, the heart and soul of our relationship is the shared vision that sits in front of that technology," says Dr. Trent. "There is a shared sense of excitement and commitment that comes from doing good and doing well. IBM is a key part of this equation."

For more information

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