

CASE STUDY

Empowering COVID-19 Research with Cutting-Edge Tech

TGen leverages Intel and phoenixNAP technologies to distribute SARS-CoV-2 genome knowledge to the global biomedical community.



Challenges

- Lack of a shared data repository of SARS CoV-2 genome and related metadata
- Time-consuming data analysis processes
- Difficulties in sharing knowledge between researchers globally
- Limited infrastructure capabilities to execute diverse computational workflows

Solution

phoenixNAP's custom **Hardware-as-a-Service solutions** powered by Intel Xeon Dual Gold 6258R CPUs, Intel NVMe's (P4610) using Intel VROC, Intel NICs, and Intel Optane persistent memory, expanding memory capacity (128Gb DRAM + 1536GB Intel PMem); Intel® Tofino™ Programmable Ethernet Switch Products.

Results

- Fast data processing with Intel PMem compared to traditional RAM
- Centralized platform for global data access and analysis
- Integrated database for more efficient research on a global scale
- Optimized infrastructure for compute-heavy workloads

Contributing to the Global Biomedical Community

The 2020 outbreak of the COVID-19 (SARS-CoV-2) pandemic has united the world in a common fight, at the forefront of which are medical workers, researchers, and scientists. As an organization dedicated to “conducting groundbreaking research with life-changing results,” the Translational Genomics Research Institute (TGen), an affiliate of City of Hope, is a part of the global medical community that actively seeks ways to treat and eliminate COVID-19.

TGen is an Arizona-based research institute that has been conducting research on numerous human diseases and forms of cancer since 2002. To help the global fight against COVID-19, TGen is working to develop a centralized, aggregated dataset that can automatically pull COVID-19 sequenced genomes and other related data from multiple sources. This dataset can help improve research, data analysis, and increase understanding of the viral genome.

“Sifting through genetic data for useful information is crucial in helping bring treatments to patients faster, and we are thrilled to work with Intel utilizing technologies such as Persistent Memory to accelerate not just the pace of discovery, but our ability to find answers in the data. TGen is Looking forward to leveraging Intel Persistent Memory to accelerate genomics DB performance.”

*James Lowey,
CIO, TGen*

The Challenge of Aggregating and Analyzing Data

The identification of previously uncharacterized elements in the SARS-CoV-2 genome (i.e., genes, variable positions, regulatory or hidden functional elements) could lead to better diagnostics, vaccine constructs, and treatments for COVID-19. Most of the current genetic discovery strategies, however, rely on a particular technique that tends to disregard important correlations. For example, the focus on a single technique such as searching for regions of high sequence conservation or identifying polymorphisms that affect encoded protein/RNA structures might overlook co-evolved mutations, regulatory element/protein coding dependencies, and other interactions.

To overcome this gap, TGen proposed an integrated approach to the identification and characterization of the SARS-CoV-2 genome for clinically and therapeutically important genomic elements. This approach includes conservation, phylogenetic, systems biology, and comparative genomic analyses using both existing and novel analytic methods. The genomic data sets, protein structure, and expression data would be some of the elements utilized to model, analyze, and interpret the SARS-CoV-2 virus. Such data would be made available to the entire biomedical community to improve understanding of the virus.

However, due to the distributed nature of the COVID sequence data sets, the proposed analysis would be a very manual, time consuming process. TGen proposed a project that would construct resources such as integrated databases and computational environments that could be used for collaborative work between researchers from all over the world.

“We believe that by observing and analyzing interactions between different elements of the SARS-CoV-2 genome, we can identify biological patterns that can help in developing potential diagnostic, vaccine construct or therapeutic drug targets. We are talking about huge volumes of data that require advanced compute processing power. We turned to Intel and phoenixNAP for help on the technology side, and they readily joined the effort.”

*Nik Schork,
Deputy Director of Quantitative Science, TGen*

“Intel is committed to accelerating access to technology that can combat the current pandemic and enable scientific discovery that better prepares our world for future crises.”

*Rachel Mushahwar,
VP and GM, Intel US Sales, Enterprise, Government and Cloud Server Providers*

Funding for this solution was provided in part by Intel's **Pandemic Response Technology Initiative**.

For more information about healthcare solutions from Intel, visit [intel.com/healthcare](https://www.intel.com/healthcare).

For more information about Intel's COVID-19 response, visit [intel.com/COVID-19](https://www.intel.com/COVID-19).

Deploying Cutting-Edge Platform to Enable Biomedical Computation

“We needed a robust computational environment for large data volumes and sophisticated analytical tools. We have maintained compute infrastructure with phoenixNAP for years, but we needed to expand and customize it to support this project. We got a more streamlined, powerful infrastructure that will give us enough power and memory, while at the same time providing us with a great degree of flexibility as our research expands. Intel Optane PMem emerged as a logical solution to support large data sets.”

*Glen Otero,
VP Scientific Computing, TGen*

Due to the volumes and complexity of available data on SARS-CoV-2 genome, the TGen research project needed a robust compute platform that would allow for fast processing and global distribution of data. phoenixNAP's HaaS solution powered by Intel technologies emerged as a logical option for this need. With the ability to deploy custom technologies, phoenixNAP's HaaS would provide critical capabilities for realizing TGen's project.

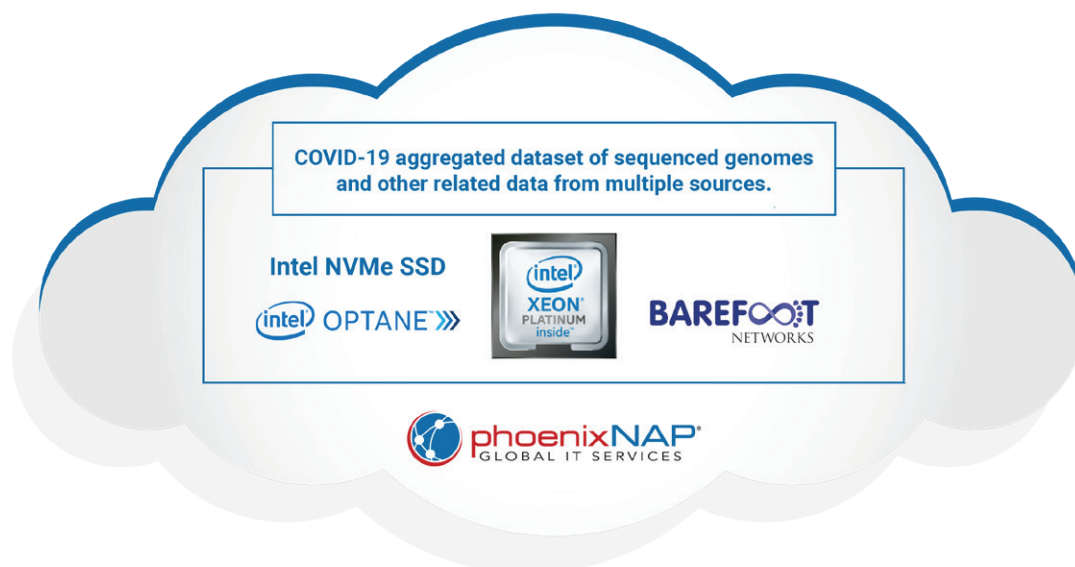
Leveraging Intel Xeon Dual Gold 6258R CPUs, Intel NVMe, and Intel Optane persistent Memory, the platform ensured speed and availability. TGen could centralize all the needed data for faster in-house analysis and share resources with other researchers and contributors by leveraging phoenixNAP's global data center network. The result is a streamlined, automated process for aggregating COVID-19 genomic data and related metadata, which is intended to accelerate viral research and analytics on a global scale.

“TGen is doing an amazing job every day and this project is one of the examples of how they are actively working to make life-changing results. We discussed their project and knew that Intel will be open to collaborating with us on building a proper platform for it. We are excited for having the opportunity to work with both Intel and TGen on something this relevant to the entire world.”

*Ian McClarty,
President of phoenixNAP*

Technical Components of the Solution

TGen's platform leverages advanced technology by Intel and phoenixNAP to ensure cutting-edge performance. phoenixNAP's HaaS and Intel components were provided as a donation to ensure TGen has all technical resources to focus on its primary task. Powered by 2nd Gen Intel Xeon Scalable processors, housed at phoenixNAP's secure data center, and globally connected through phoenixNAP's 15+ strategic locations worldwide, TGen's new platform provided compute power and reliability needed for this project. In addition to this, Intel® Tofino™ Programmable Ethernet Switch Products, which Intel® has offered since the acquisition of Barefoot Networks in June 2019, were used to create an ultrafast network that is fully customized to meet the unique needs of the project.



Platform Specs

Power – 208V 30A Primary/Redundant

2 x 10 Gbps (active/passive) of IP Transit / 28 CIDR block

10 x Intel Xeon Gold 6258R 28C 205W 2.7GHz Processor

60 x 32GB DDR4-3200 2Rx4 ECC REG DIMM

10 x Intel DC P4610 1.6TB NVMe

10 x Intel DC P4510 1TB NVMe

5 x Intel VROC HW Key

5 x Intel 25G Dual Port NIC

phoenixNAP HaaS Features

Highly configurable hardware

Systems supporting large DDR4 RAM capacity

Industry-leading DDoS mitigation and protection

Hardware and software-level security

Premium carrier blend

Network

Intel® Tofino™ Programmable Ethernet Switch Products

Intel Optane Features

Intel Optane persistent memory is a critical component enabling TGen's database server to store large volumes of unstructured data while delivering consistent performance. The ability to affordably expand memory capacity to 128Gb DRAM + 1536GB Intel Optane PMem helps in faster data processing compared to traditional RAM, which is essential for TGen's project.

Intel Optane persistent memory is a high-density, byte-addressable, 3D memory technology that gives organizations the ability to extract more from larger datasets by combining more capacity and native persistence in a DIMM form factor. Intel Optane PMem lets you keep more data in memory to avoid input/output (I/O) bottlenecks, so that you can drive faster analytics and simulations on those datasets.

Organizations can significantly lower TCO by expanding the available memory pool to increase the utility of each server, and PMem integrates strong, industry-standard hardware security encryption measures for data at rest.

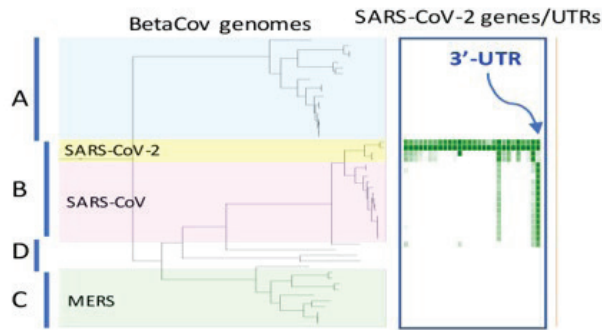
Results

By gaining access to the necessary compute resources and global network, TGen started an important project that will enable the world to make and share important discoveries related to COVID-19. phoenixNAP's infrastructure provides tools and resources to sequence multiple COVID-19 genomes and compare its research against numerous COVID-19 genomic sequences from around the world. The advanced hardware resources allow for fast and secure data processing and analysis on a global scale.

To date, TGen has identified a number of novel features in the SARS-CoV-2 genome (the themes of 2 provisional patents) that they have shared with laboratory and translational researchers, as well as commercial groups, for further development. Further work on the platform will enable it to contribute even more to this global effort.

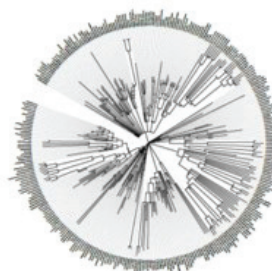
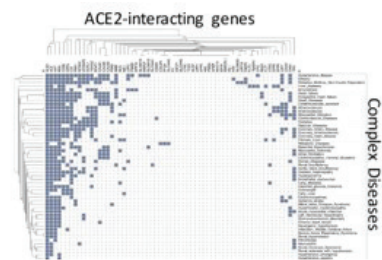
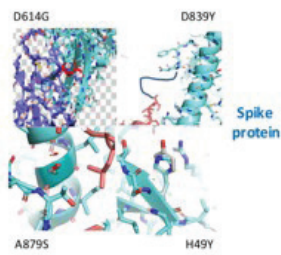
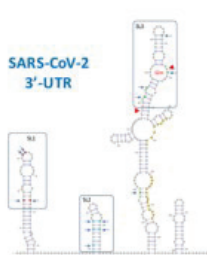
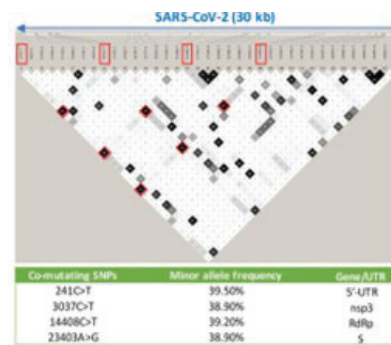
“Healthcare is becoming more intelligent, distributed, and personalized. Intel technologies are helping to enable a new era of smart, connected, value-based patient care, remote medicine and monitoring, individually tailored treatment plans, and more-efficient clinical operations. Intel-enabled technologies help optimize workflow to lower research and development costs, improve operational efficiency, speed time to market, and improve patient health.”

*Rachel Mushahwar,
VP and GM, Intel US Sales, Enterprise, Government and Cloud Server Providers*



3'-UTR (~300 bp)

Type	Representative isolate	3'UTR.R1	3'UTR.R2	Genomes
G1	Human SARS-CoV-2 Wuhan-Hu-1	A,T,T,T,A,C,T,A,G,G	C,T,C	370
	Human SARS-CoV-2 Hu/DP/Kng/19-027	A,T,T,T,A,T,T,A,G,G	C,T,C	3
	BatCoV-Ra RaTG13	A,T,T,T,A,C,T,A,G,G	C,G,T	1
	BatCoV-Rs ZC45	A,T,T,T,A,C,T,A,G,A	C,G,T	1
	BatCoV-Rs ZXC21	A,T,T,T,A,C,T,A,G,A	C,G,T	1
G2	Human SARS-CoV Tor2	G,A,A,C,A,A,C,G,T,A	T,G,T	196
	BatCoV-Rf Jiyuan-84	G,A,A,C,A,A,C,G,T,A	C,G,T	11
	BatCoV-Rs HKU3-1	G,A,A,C,G,A,C,G,T,A	C,G,T	39
G3	PangolinCoV GX-PIE	G,T,T,C,G,T,C,G,A,G	C,G,T	4



Location effects: Age - 1

	post.mean	l-95% CI	u-95% CI	eff_samp	pMCMC
(Intercept)	38.76	35.30	41.79	1000	-0.001 ***

Intel is committed to accelerating access to technology that can combat the current pandemic and enable scientific discovery that better prepares our world for future crises. Funding for this solution was funded in part by Intel's **[Pandemic Response Technology Initiative](#)**.

For more information about healthcare solutions from Intel, visit **[intel.com/healthcare](https://www.intel.com/healthcare)**. For more information about Intel's COVID-19 response, visit **[intel.com/COVID-19](https://www.intel.com/COVID-19)**.



ABOUT phoenixNAP

phoenixNAP is a global IT services provider offering progressive Infrastructure-as-a-Service solutions from locations worldwide. Our bare metal server, cloud, hardware leasing and colocation options are built to meet the evolving technology demands businesses require without sacrificing performance. Scalable OpEx solutions to support with the systems and staff to assist; phoenixNAP global IT services.



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