



DUG's Massive HPC Cloud Service Powered by Mellanox Ethernet



DUG's 40k-Node HPC Cluster Utilizes Mellanox Ethernet End-to-End for Best-in-Class Efficiency, Scale & Performance

DUG is an innovative technology company providing high-performance compute and storage, technical services, geoscience expertise, and geophysical software to the global HPC and oil and gas industries.

DUG McCloud is a fully-integrated HPCaaS (High Performance Computing as a Service) offering which combines compute, storage, network, consulting and years of HPC expertise. This all runs on DUG's own huge machine, housed in a purpose-built exascale data center, located at Skybox Data Centers in Houston, Texas. The DUG McCloud data hall is one of the greenest computer rooms on earth with a Power Usage Effectiveness (PUE) of 1.04 and a power cost reduction of over 45%, thanks to DUG's patented cooling solution, DUG Cool. The initial DUG McCloud data hall has 15 MW of power to house over a 250 petaflop (single-precision) machine, once fully installed. Power, space, and plans are in hand to expand the facility beyond an exaflop. In recognition of the innovative design of the DUG McCloud data center, Data Centre Dynamics awarded DUG with the Enterprise Data Center Design Award in 2019.

Reaching for the Sky

With DUG McCloud, HPC and O&G customers can reach for the sky and expand computational capacity whenever needed. Data remains the customer's property and will never be held ransom with high retrieval charges. The unique benefit is the fully-integrated hardware/software/services stack of which DUG tells customers they can "McMix and McMatch according to their needs".

With over 40% of its staff with a Masters or PhD in mathematical or science fields, a huge compute engine, and a large software development team, DUG is uniquely positioned to solve the most challenging data and processing problems.

When planning the largest scale and greenest cloud service for HPC, DUG turned to Mellanox for an end-to-end Ethernet networking solution. DUG's requirements for the network included:

- Highest performance solution – enabling complex data processing and HPC modelling
- Scale-Out – supporting over 40,000 nodes in an efficient network design
- Small footprint – minimizing physical space and power requirements
- Cost optimization – maximizing investment spend in cloud infrastructure
- Consultative approach – joint design and deployment between customer and vendor

Key Benefits

- Accelerated HPC
- 50% fewer leaf switches
- 75% fewer cables to tanks
- Flatter network reduces latency and cost
- Boot Server on switch with containers
- Optimized supercomputer cost for As-a-Service operations

"The efficient fabric design of Mellanox's components complements DUG's drive to deliver the most cost-effective data centre ever created. We like to call DUG McCloud the greenest cloud service in the world"

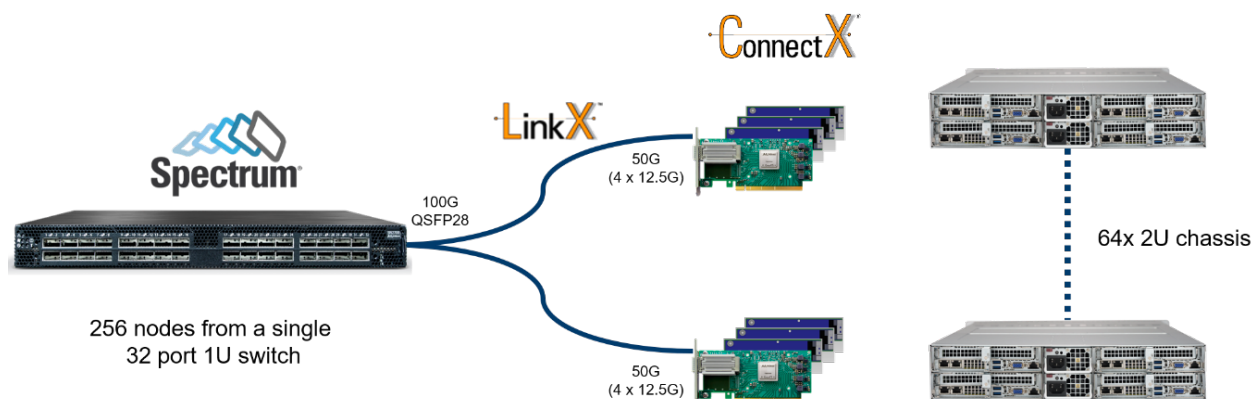
*Dr. Matthew Lamont
Managing Director, DUG*

Mellanox End-to-End Ethernet Solution

To meet the unique requirements of DUG's data center, Mellanox delivered a solution that included their ConnectX® adapter with Mellanox Multi-Host® technology, specifically developed for DUG, in addition to best-in-class Mellanox Spectrum® Ethernet switches and LinkX® cables.

Power of Mellanox's ConnectX Adapter with Mellanox Multi-Host Technology

The solution comprised of ConnectX adapter and Mellanox Multi-Host technology is an innovative approach to minimizing networking infrastructure footprint while providing high throughput in a scale-out HPC environment.



The Mellanox Multi-Host solution provides the following advantages:

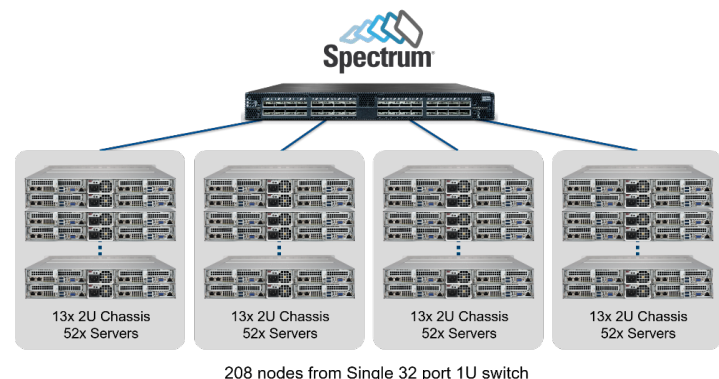
- 200+ servers connected to a single 1U Spectrum SN2700 switch
- 4 servers utilize a single 50GbE connection by sharing a ConnectX-5 100G Ethernet Multi-Host adapter
- Each server can burst up to 30 Gbps bandwidth
- Each server is guaranteed 12.5 Gbps bandwidth

Efficiency & Cost-Savings

Solution efficiency was one of the main attractions for DUG – 50% fewer switches and 75% fewer cables, which translates into cost-savings on the network. In fact, DUG was able to save an estimated \$1m in cable expenses alone. But, more importantly, it allows DUG to pack the most network and servers possible into their data center footprint. The Mellanox Multi-Host solution is generally available to any customer.

Mellanox Spectrum Switch

Network performance is critical for the DUG McCloud service at DUG. The Spectrum SN2700 provides performance that is not available in any other Ethernet switch. DUG is able to leverage the performance advantages by creating an HPC workload local to the 208 compute nodes connected to a single Spectrum switch.



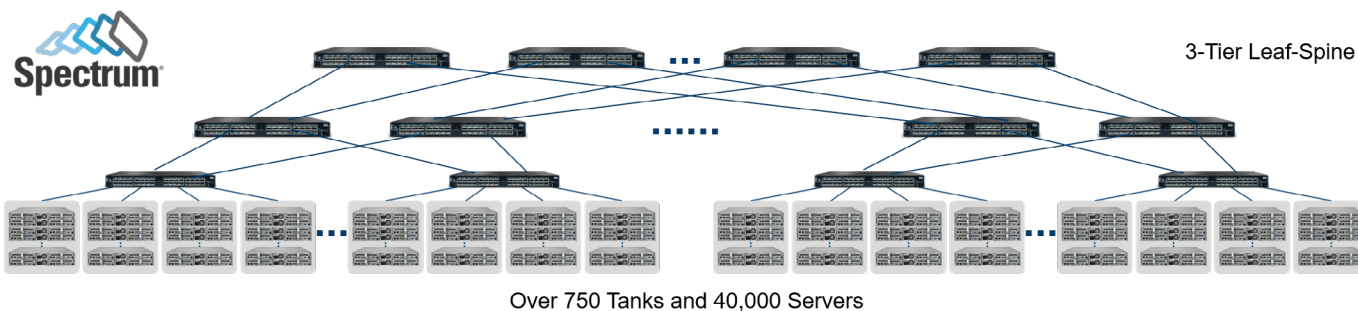
Advantages of the Mellanox Spectrum Ethernet switch include:

- Fair Traffic Distribution – all flows get fair bandwidth across the network
- Superior Microburst Absorption – especially critical for incast traffic to the storage nodes
- Lowest Latency – consistent 300ns latency, no matter the packet size
- Zero Packet Loss – full line-rate forwarding at all packet sizes
- Low Power Consumption – 150 watts per switch

The 208-server count to a single switch is unprecedented to a single network switch. 208 servers are just a single, 300ns hop away from each other. This allows DUG to create highly optimized, localized MPI processing groups, providing unmatched performance for HPC processing. Furthermore, the lower power requirements of the Spectrum SN2700 switch, less than half of standard switches, provides DUG with significant power and cooling savings. This is a critical element for DUG to build the greenest data center in the world.

Network-Scale

The DUG McCloud service is built for immense scale. By leveraging basic building blocks and a modern, leaf-spine network design, DUG was able to build a massive supercomputer consisting of 40,000 nodes.



DUG's 3-tier leaf-spine network leverages modern design techniques around a scale-out infrastructure. The same switch model, Mellanox Spectrum SN2700, is used at all tiers of the network. Industry-standard routing protocols are utilized to convey host reachability information and to handle failure scenarios – significantly simplifying the deployment and operation of the network. All nodes in the network are no more than 1.5 microseconds from each other, even when going across all 3 tiers, preserving high performance across the entire data center.

Containers and Boot Server

The Mellanox Onyx network operating system (NOS) is capable of running Docker containers, enabling DUG to leverage the Spectrum switches at boot servers.



DUG was able to deploy boot server services such as BOOTP/DHCP and NFS within containers on the switches. All of the compute nodes connect to the switch boot using the containerized boot services. By leveraging the container capabilities of Spectrum switches, rather than purchasing and deploying separate servers, DUG was able to realize additional infrastructure efficiencies and cost savings.

Consultative Approach

From the beginning, Mellanox worked hand-in-hand with DUG on the solution to design the ConnectX Adapter with Mellanox Multi-Host solution to meet DUG's needs for efficiency and performance. In addition, Mellanox consulted with DUG on the network architecture – both physical and logical, and supported DUG in the prototyping of the containers and boot server functionality.

When it came time to deploy the infrastructure, DUG and Mellanox continued the partnership. Mellanox's professional services worked closely with DUG on the installation, configuration, testing, and hand-over of the project. The close collocation ensured an on-time and top-quality deployment of the network.

Results & Benefits

DUG was able to realize significant infrastructure efficiencies by leveraging an end-to-end Mellanox Ethernet solution. These efficiencies and cost savings were critical in building a strong business model for their DUG McCloud HPC cloud service.

Standard Solution		Mellanox Solution	
Number of Switches	398	228	43% less switches
Number of Cables	10k	5.6k	45% less cables
Power Consumption	88k watts	34k watts	61% less power
Switch Latency (204 server groups)	6-60 microseconds	300ns	20x lower latency
Boot Servers	200	0	Containers on switch

By deploying the Mellanox Ethernet solution – including ConnectX Multi-Host Adapters, Spectrum switches, and LinkX cables, DUG was able to deploy a network supporting 40k nodes, providing the best performance and lowest network latency available, and with a very small footprint and power requirements.

Bottom line – DUG was able to deploy the world class, high performance DUG McCloud HPC and geoscience service that leverages the most efficient and cost-effective network infrastructure available today.

About DownUnder GeoSolutions

DUG is an innovative technology company providing high-performance compute and storage, technical services, geoscience expertise, and geophysical software. DUG has deep roots in the oil and gas industry. As one of the world's leading geoscience companies, DUG provides data processing, imaging services and seismic interpretation software. In the HPC industry, DUG offers compute, storage, software and services to accelerate research and production data processing and modelling. DUG's data centre cooling technologies allow up to 50% energy savings over traditional high-efficiency data centres. DUG has offices in Perth, London, Houston, and Kuala Lumpur. Connect with DUG on Twitter @DownUnderGeo or visit www.dug.com and www.dughpc.com.

About Mellanox

Mellanox Technologies (NASDAQ: MLNX) is a leading supplier of end-to-end Ethernet and InfiniBand intelligent interconnect solutions and services for servers, storage, and hyper-converged infrastructure. Mellanox intelligent interconnect solutions increase data center efficiency by providing the highest throughput and lowest latency, delivering data faster to applications and unlocking system performance. Mellanox offers a choice of high performance solutions: network and multi-core processors, network adapters, switches, cables, software and silicon, that accelerate application runtime and maximize business results for a wide range of markets including high performance computing, enterprise data centers, Web 2.0, cloud, storage, network security, telecom and financial services. More information is available at www.mellanox.com.



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