NYRIAD™

we make every bit count
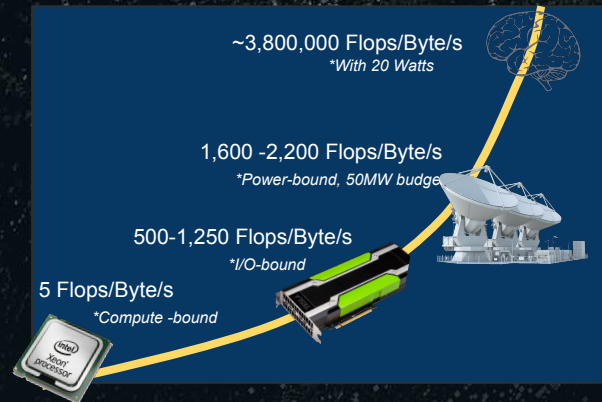
Nyriad is pioneering a revolutionary leap in computing density that enables us to address markets and opportunities that are presently impossible for existing IT solutions to achieve

The Problem: There is no path to the compute densities required to solve the most valuable modern scientific and business challenges with current IT solutions
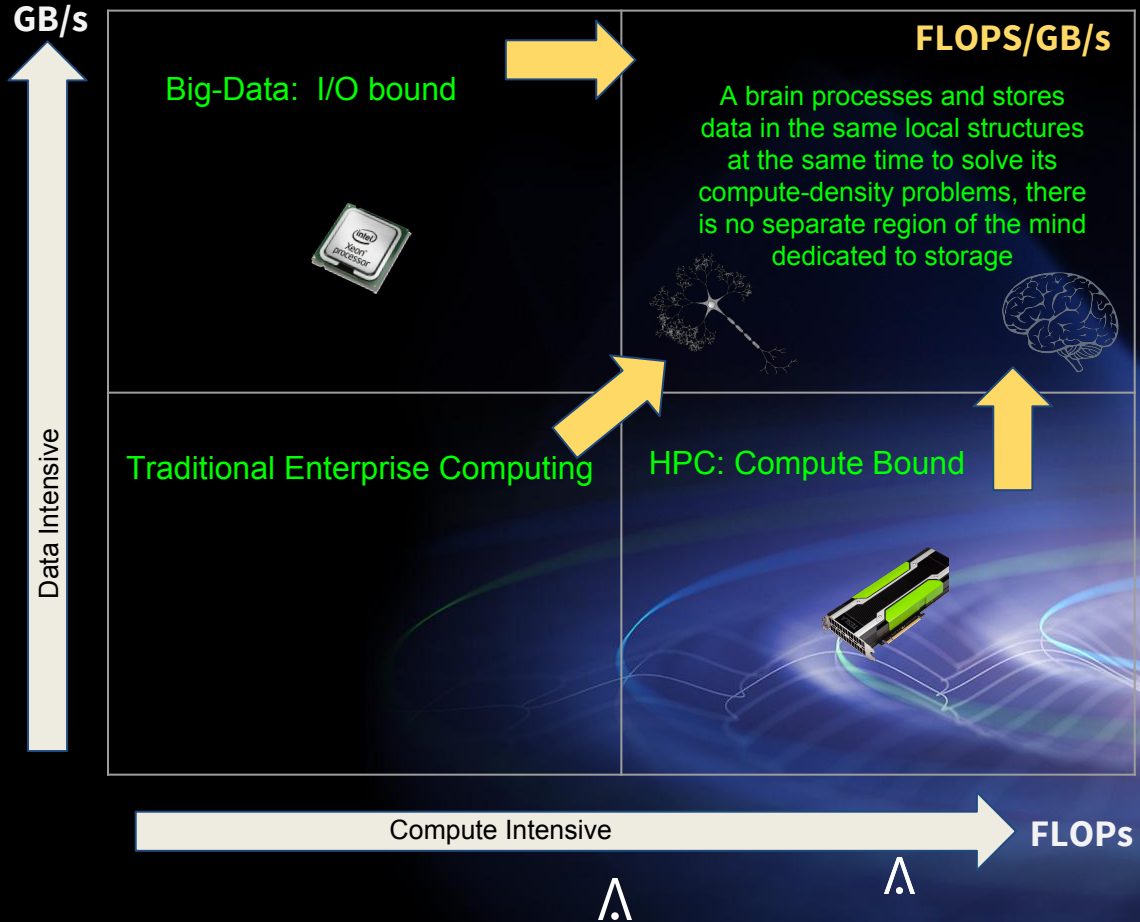
GB/s

FLOPS/GB/s

Big-Data: I/O bound
Networks and storage hardware can't move data faster than it can be processed.

Hadoop, Large Databases, "big-data", Highly transactional websites like Google and Amazon, cloud computing

Dense Computing: Impossible
(exponential cost)
Real-time streaming data processing

- IOT Processing
- Security video analysis
- Weather forecasting
- Financial trading
- Machine Learning
- Radio astronomy

"Compute Density" is the number of computing operations/byte/s that can be applied to an infinite stream of data that must be transactionally processed and stored in real-time

Traditional Enterprise Computing: solved
Ordinary Enterprise and consumer computing. Entire solution and dataset can fit on a single node.

HPC: Compute Bound
Traditional HPC applications. The data is possible to store but can't be processed in real-time.

Scientific simulations, data analysis, climate modeling, seismic and astronomical imaging, movie rendering, etc.

Data Intensive

Compute Intensive

FLOP/s

~3,800,000 Flops/Byte/s
With 20 Watts

1,600 -2,200 Flops/Byte/s
Power-bound, 50MW budget

500-1,250 Flops/Byte/s
I/O-bound

5 Flops/Byte/s
Compute -bound

The Solution: Merge compute and distributed storage processing into the same architecture
Hyperconverged => **Hyper**merged

GB/s

FLOPS/GB/s

Big-Data: I/O bound

A brain processes and stores data in the same local structures at the same time to solve its compute-density problems, there is no separate region of the mind dedicated to storage

Nyriad software fuses I/O and compute into the same process and transaction at the Linux Kernel level, making processing and transactional I/O the same event.

Logically there is no difference between a computation addressing (persistent) RAM, a storage transaction and a network message. Unifying these paradigms results in a price/performance shift that disrupts all other IT markets

Data Intensive

Traditional Enterprise Computing

HPC: Compute Bound

Compute Intensive

FLOPs

In a "Hypermerged" architecture, data is never moved from storage for processing because it is always faster to analyse it in place. Derivative data is never stored because it's often faster/cheaper to recompute on demand
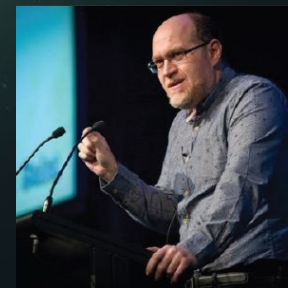
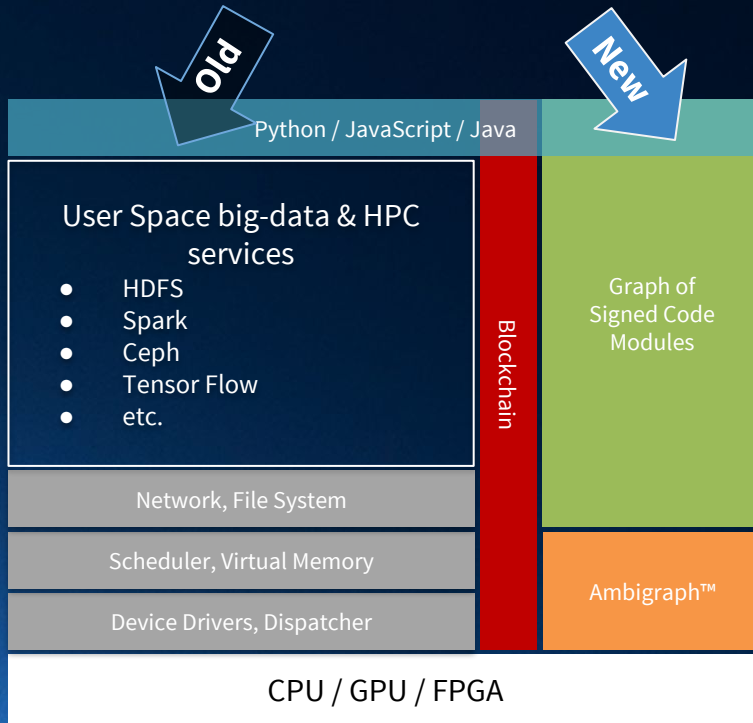# This is hard, but it has been done before

Peak Double Precision FLOPS
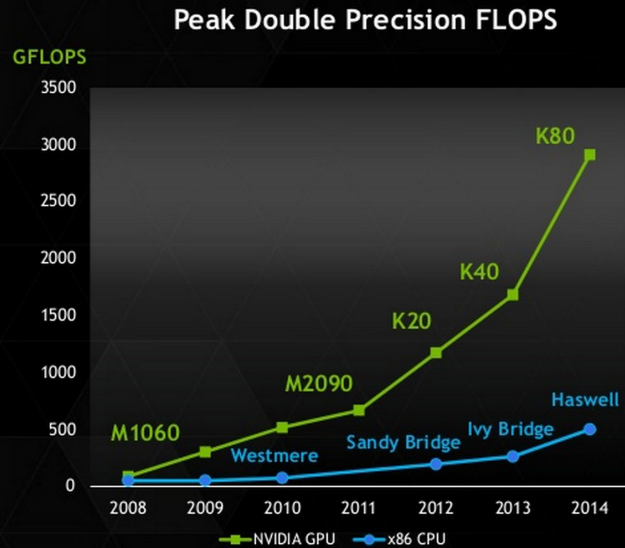
In 1995, Nyriad Co-founder and CTO Alex St. John, a lifetime physics and AI enthusiast, redesigned the Windows OS for real-time media. St. John created the Direct3D API and worked with ATI (now AMD) and startup Nvidia to create the first GPU's. St. John also created the teams that built the Windows 95 print architecture, the DirectXbox OS, the Windows media architecture, Windows update and later as founder of WildTangent Inc. the mapstream technology that later became Google Maps

His work on Direct3D enabled Nvidia to become the dominant machine learning platform and multibillion dollar competitor to Intel that it is today

The ability to utilize the incredible compute power of modern parallel processors is critically I/O bottlenecked by IT and OS paradigms from the 1990's. Today a re-architecture of the Linux Kernel driver model to utilize low-cost parallel computing power for storage and networking will unleash a massive drop in the cost of all computing and enable an exponential leap in practical computing density.

Two different OS architectures co-exist side-by-side

Old

New

Python / JavaScript / Java

User Space big-data & HPC services
- HDFS
- Spark
- Ceph
- Tensor Flow
- etc.

Network, File System

Scheduler, Virtual Memory

Device Drivers, Dispatcher

Blockchain

Graph of Signed Code Modules

Ambigraph™

CPU / GPU / FPGA

- Nyriad's "OS" runs in the graphics pipeline which bypasses other OS layers and virtualization, operating through the Linux video driver (CUDA)
- Nyriad threads a GPU accelerated graph processing architecture called "Ambigraph" from user space through to the kernel layer and REPLACES the Linux RAID and block storage interfaces with it
- The graph architecture is backed by a GPU accelerated blockchain that displaces hypervisor and sandbox style security paradigms
- In a distributed system, the transactional Linux block device interface now displaces all network and distributed storage services.   A massive HPC cluster just looks like a big consolidated GPU with non-volatile RAM to an Ambigraph application
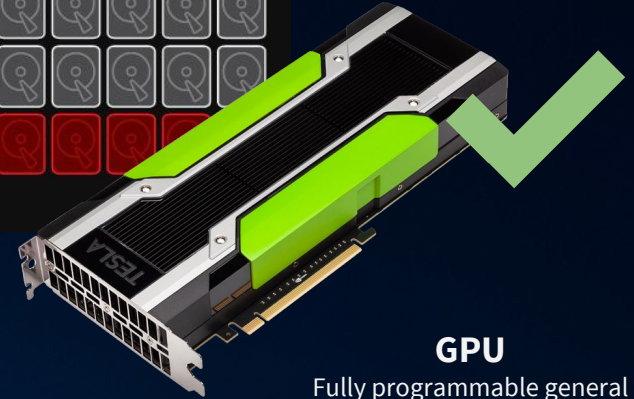- *This is a similar approach to how DirectX was injected into the Windows OS without breaking it

Storage, computing and network messaging are now the SAME paradigm

LSI RAID card

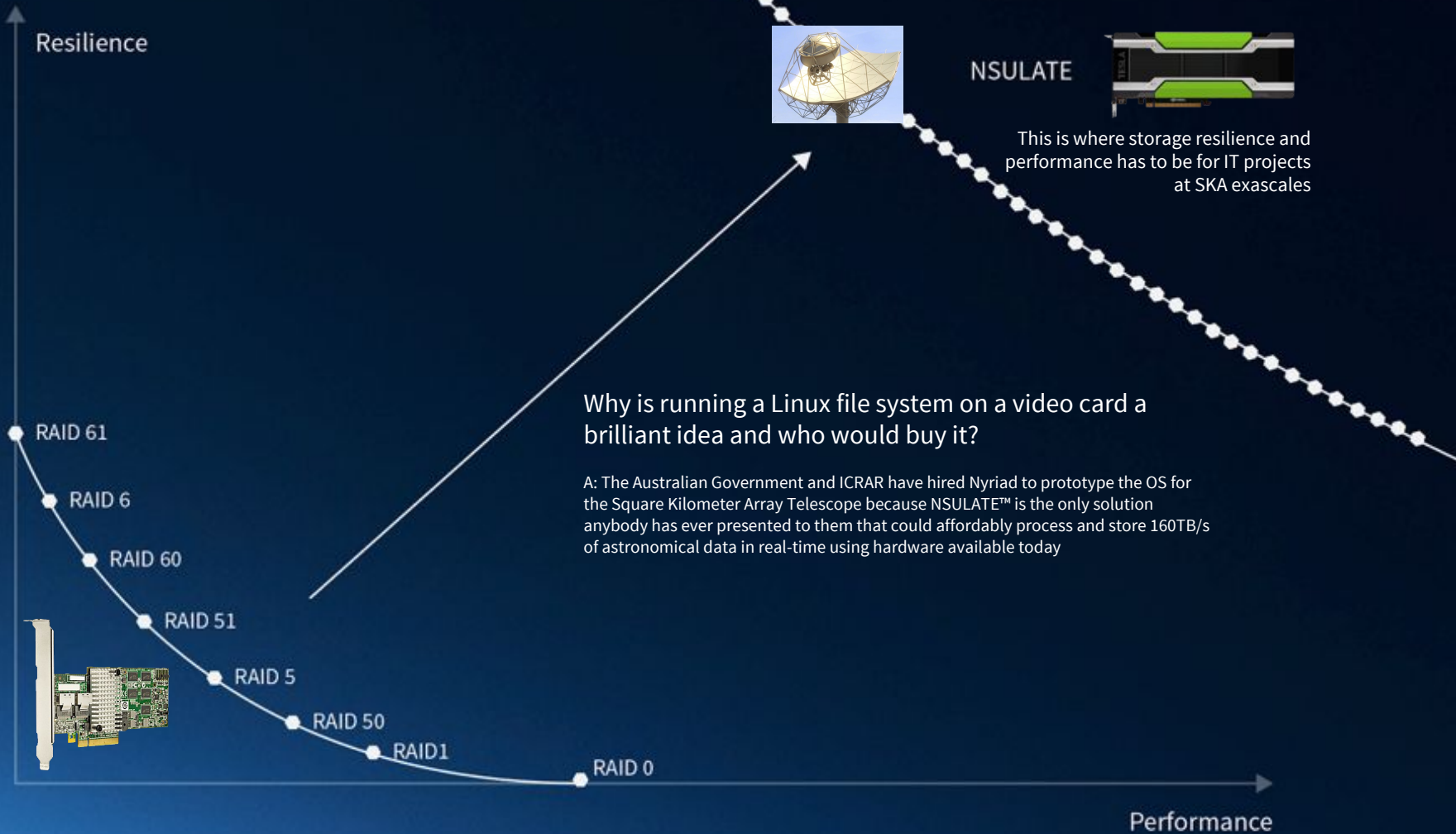Static hardware standardized in 1996, supports only 2 simultaneous device failures

RAID 6

2GB/s

NSULATE™   64GB/s

NSULATE™ replaces RAID and low-level storage services with GPUs enabling storage arrays to achieve tens of GB/s in storage throughput with higher resilience than any solution on the market.

This extreme parallel storage performance allows local storage arrays to process petabytes of data at nearly RAM speeds while eliminating network I/O bottlenecks to data processing performance. Each GPU adds 10X the processing power of an X86 server to the storage array resulting in a **100X-1000X gain in storage-processing efficiency per server.**

GPU

Fully programmable general purpose supercomputer, can recover from 255 simultaneous device failures in real-time

Resilience

NSULATE
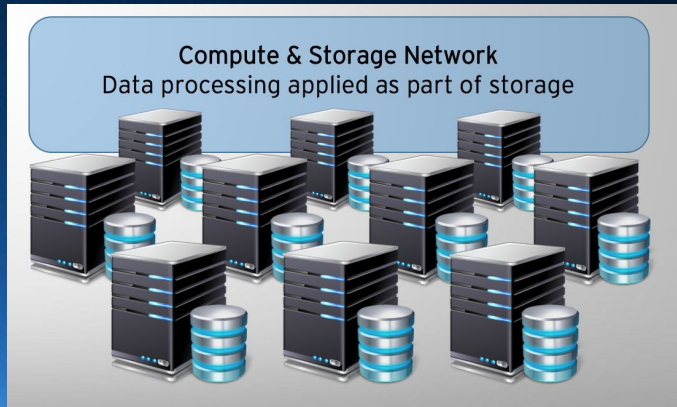
This is where storage resilience and
performance has to be for IT projects
at SKA exascales

RAID 61

RAID 6

RAID 60

Why is running a Linux file system on a video card a
brilliant idea and who would buy it?

A: The Australian Government and ICRAR have hired Nyriad to prototype the OS for
the Square Kilometer Array Telescope because NSULATE™ is the only solution
anybody has ever presented to them that could affordably process and store 160TB/s
of astronomical data in real-time using hardware available today

RAID 51

RAID 5

RAID 50

RAID1

RAID 0

Performance

You are going to want to rethink how you build hardware to really take advantage of this architecture but it works with existing components
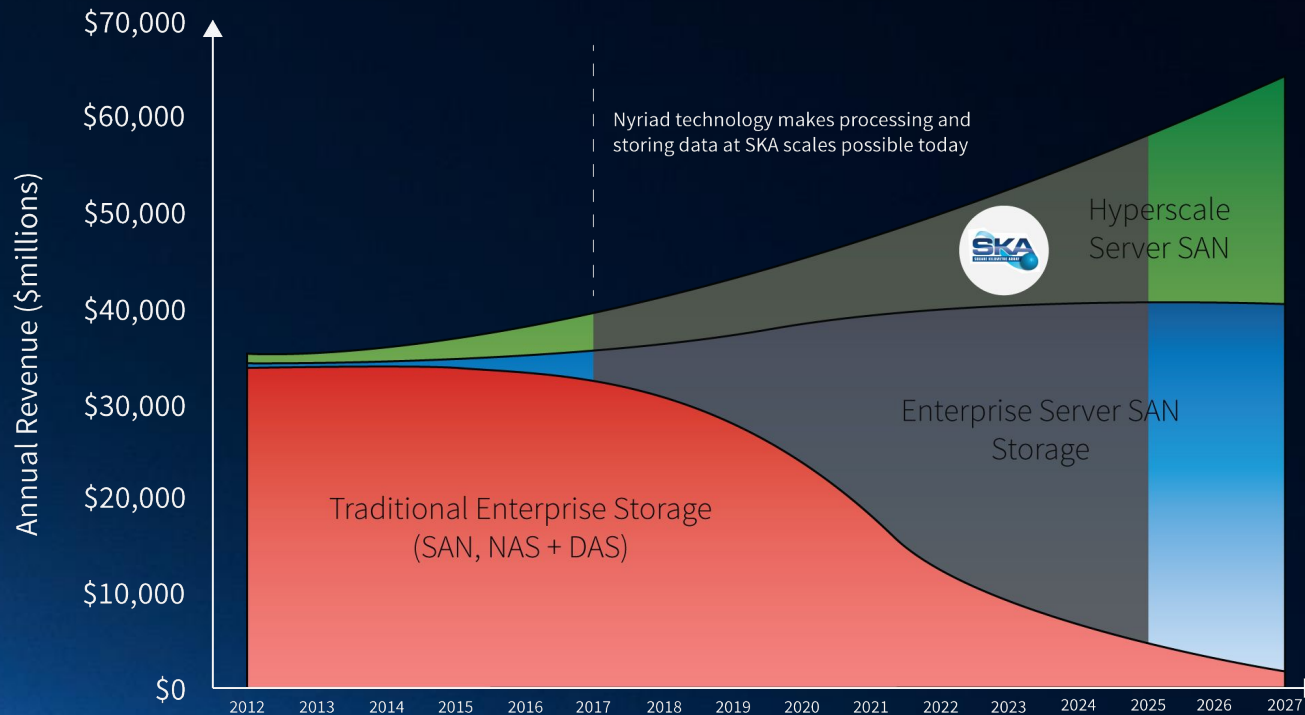
Traditional Compute/Storage Infrastructure

Compute ⇔ Storage Network

intel
Xeon
processor

Compute & Storage Network
Data processing applied as part of storage

Gateways

PE R730xd

PE R730xd

10Gb/s
Copper

2x Xeon E5-2637
Chassis for 24, 2.5" HDD
8x 64GB LRDIMM, 2400MT/s
PERC H730 RAID Controller
2x 400GB SSD SATA, 6Gbps 2.5in, S3610
PCIe Risers 4x8 + 2x16 PCIe
2x NVIDIA Tesla P100 GPU PCIe
4x Intel X710 Quad Port 10Gb DA/SFP+ Ethernet,
Network Daughter Card

Data Pool Node (x12)

Theoretical Throughput per Node	
Element	GB/s
GPUs	31.5
Network	2
Storage	26.5

PE R730xd

PERC
H830

2x MD1420 DAS

2x Xeon E5-2637
Chassis for 24, 2.5" HDD
8x 64GB LRDIMM, 2400MT/s
PERC H730 RAID Controller Mini Mono
2x PERC H830 for external JBOD
24x 400GB SSD SATA, 6Gbps 2.5in, S3610
PCIe Risers 4x8 + 2x16 PCIe
2x NVIDIA Tesla P100 GPU PCIe
Dell NIC 2x 10Gb daughter card
Intel X710 DP 10Gb DA/SFP+, + I350 DP 1Gb
Ethernet, Network Daughter Card

JBOD
24x 400GB SSD SATA, 6Gbps 2.5in, S3610
2x 12Gb HD-Mini to HD-Mini SAS cable

MATTHEW SIMMONS *Co-Founder & CEO*

- Founder of Arvus Group International Ltd.
- Inventor of dozens of signal processing technologies used by Dolby, Sony, Microsoft, Samsung, Pixar, Park Road Post and Disney
- CEO of the NZ Clean Energy Center, New Zealand's Extreme Materials initiative for Molten Salt Nuclear Reactors, High Temp Solid State heat-transfer systems for Molten Salt Reactors, Solid State power generation from Geothermal sources

ALEX ST. JOHN *Co-Founder & CTO*

- CEO-Founder of WildTangent Inc.
- President & CTO of Hi5.com,
- Creator of the Microsoft DirectX OS used by the DirectXbox
- Creator of the Direct3D API, Pioneered GPU computing
- Led development of the Windows 95 and Windows NT print, video, audio, 2D & 3D graphics, color management, font system, multiplayer and input architectures
- Inventor of the streaming mapping technology used for Google Maps
- 23+ patents in compression, Digital Rights Management, machine learning, streaming media, e-commerce, virtual currencies and online advertising

DR. STUART INGLIS *CIO*

- PhD in Computer Science and Machine Learning
- Decades of experience in storage, data compression, Bioinformatics, big-data analytics and machine learning.
- Founder of Real-Time Genomics
- Founder of NetValue
- Previously CTO of Mega, the world's largest secure storage service