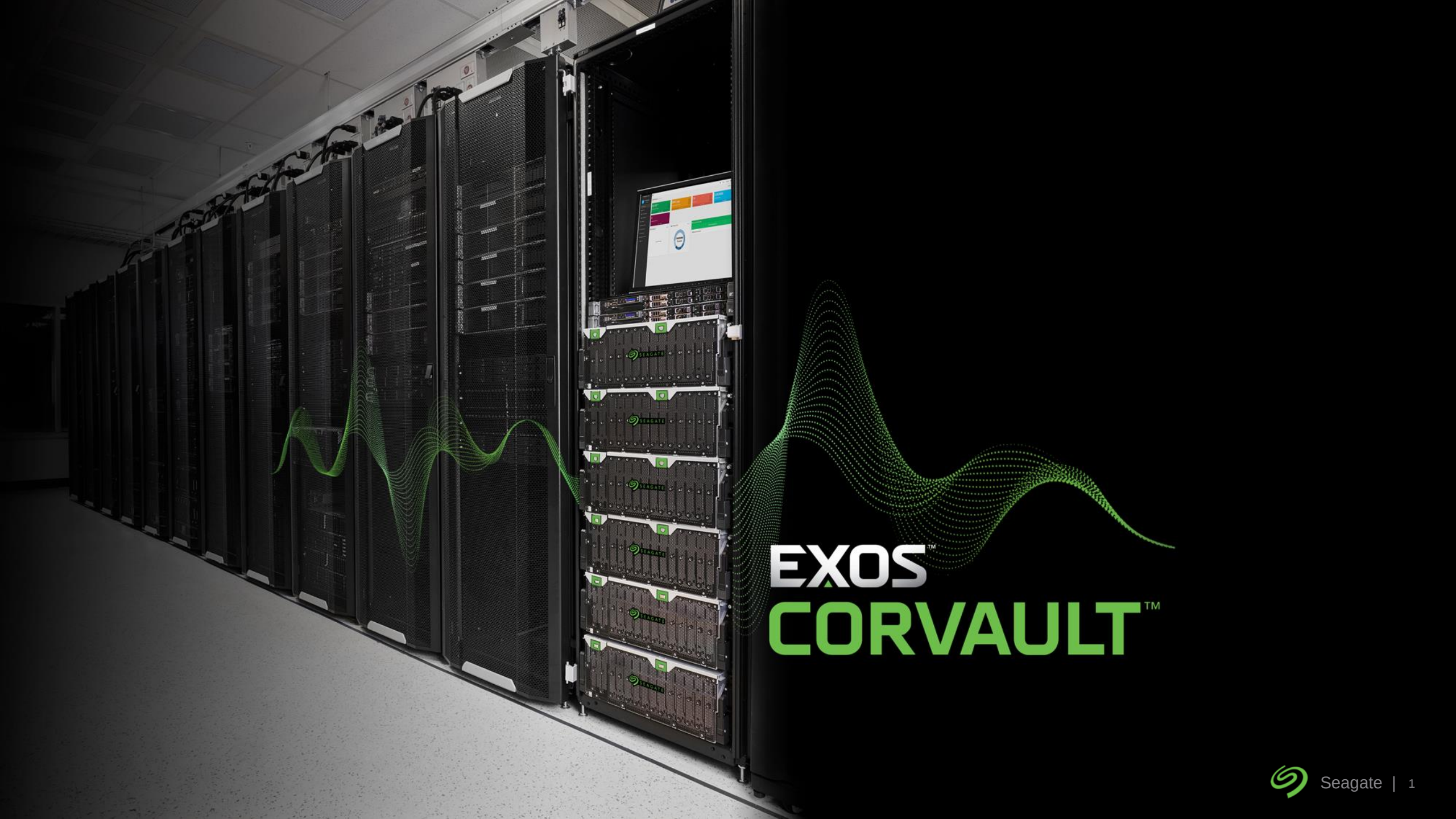

EXOS™
CORVAULT™

EXOS™ CORVAULT™

Transforming Data Center Storage

Enhance data availability, durability, and sustainability while reducing its carbon footprint, e-waste, and TCO.

Seagate Exos® CORVAULT™ is a high-performing, efficient, durable multi-petabyte capacity block storage system that is self-healing and brings five-nines availability to scale out storage for data center deployments.

CORVAULT breakthrough technologies provide hyperscale efficiencies, rapid deployment, and automatic hard drive renewal for less e-waste and operational costs.

EXOS™ CORVAULT™ Benefits

Enhance data availability, durability, and sustainability while reducing its carbon footprint, e-waste, and TCO.

Hyperscale Efficiency

- Lower TCO with hyperscale capacity, maximum space utilization, extended lifecycles, and less power per petabytes.
- Reduce Host CPU Cores & Memory by 50% vs. JBOD deployments and improve Rack Power Efficiency by 30%

High Capacity

- Features the latest, most efficient petabyte capacity block storage —with maximum data density— for optimal data center usage.

Sustainability and Cost Savings

- Reduces the carbon footprint of data centers with architectures requiring less compute and networking resources, slashing TCO and e-waste.

Superior Data Availability

- Provides five-nines data availability, durability, and performance needed to promote reliable data storage.

EXOS™ CORVAULT™

Enhance data availability, durability, and sustainability while reducing its carbon footprint, e-waste, and TCO.

System Data Protection and Self-Healing Hard Drives

- Protects data via Seagate Advance Distributed Automation Protection Technology (ADAPT) for rapid rebuilds, storage efficiency, improved sustainability, and reduced downtime.
- Minimizes e-waste, downtime, maintenance, and human intervention by renewing errant drives on demand with ADAPT and autonomous drive regeneration (ADR).

Simplicity and High Disk System Performance

- Allows simple installation, configuration, and management with enterprise storage that's like a single hard drive with petabytes capacity, continuous data access and responsive low latency performance.

Maximum Security

- Self-encrypt data via Seagate Secure™ for maximum protection, reduced privacy concerns, and secure cryptographical erase.

Dependable Technology

- Provides a well-designed, reliable data storage solution backed by Seagate's 40+ years of demonstrated data storage innovation, expertise, and supply chain.

EXOS CORVAULT™

Designed for Maximum System Uptime

CORVAULT Dual Controller Architecture

Designed to withstand controller failovers

12 GB/s **Read Throughput**

10 GB/s **Write Throughput**

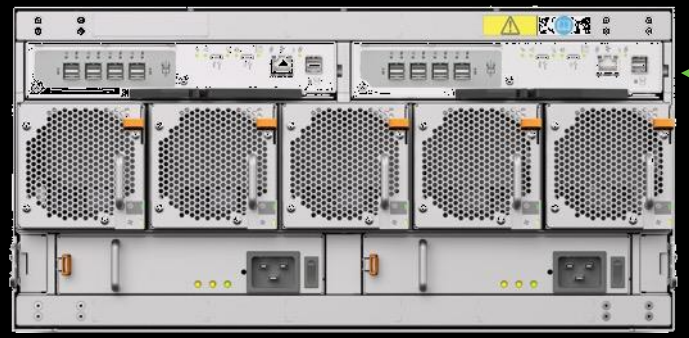
High Performance
Low Cost
In-chip Hardware Acceleration

Performance Highlights

- 6th generation VelosCT ASIC for in-box data protection
- Active / Active HA Controllers with super-cap protected, mirrored cache
- Optimized data-path for multi-stream workloads

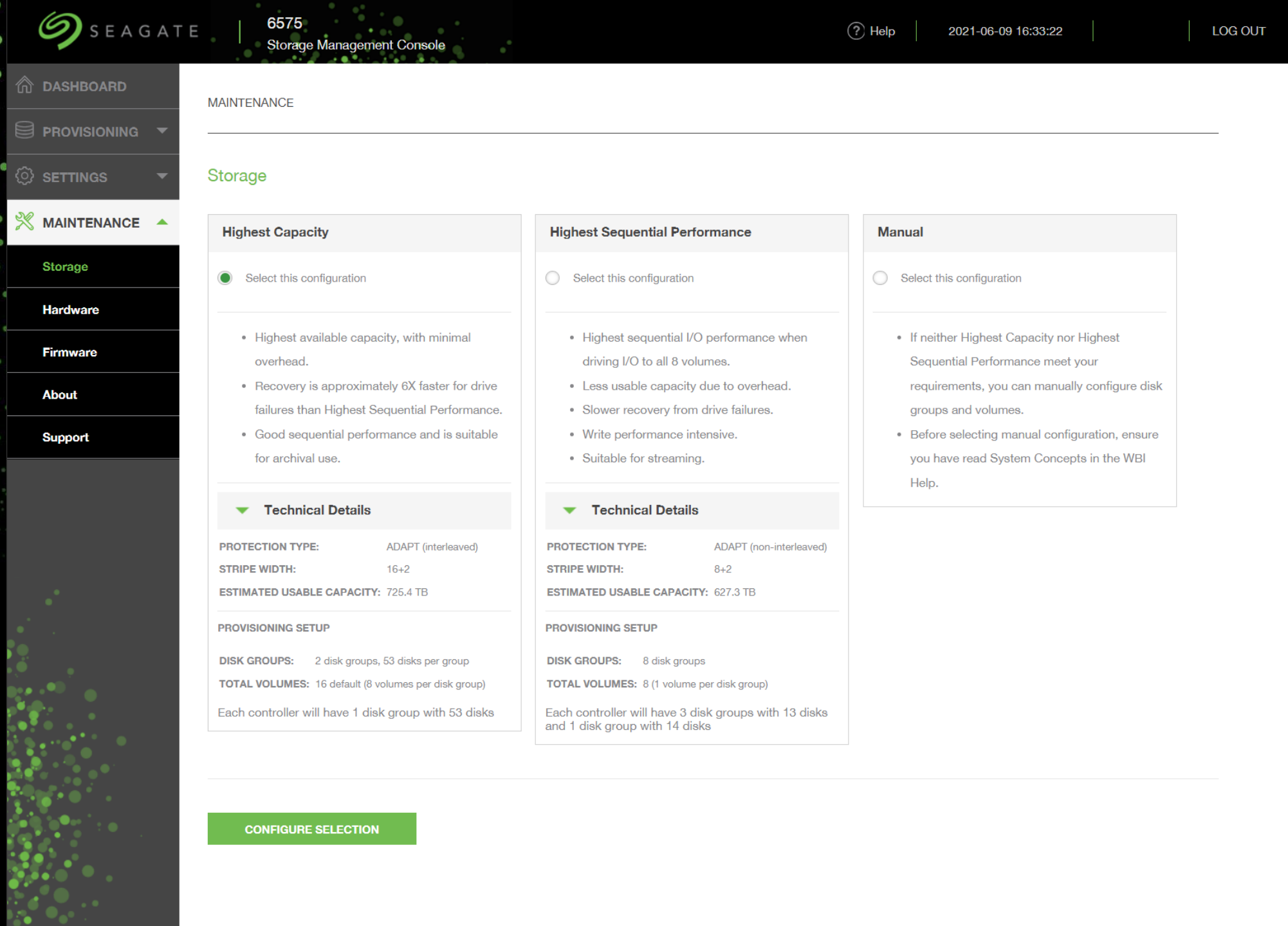
5x Nines of Data Availability

- Dual CORVAULT Controllers
- Redundant Power Supplies
- Hot-Swappable Fan Modules
- Dual ADAPT Pools



Host Connector
SAS Only

Easy Button Setup



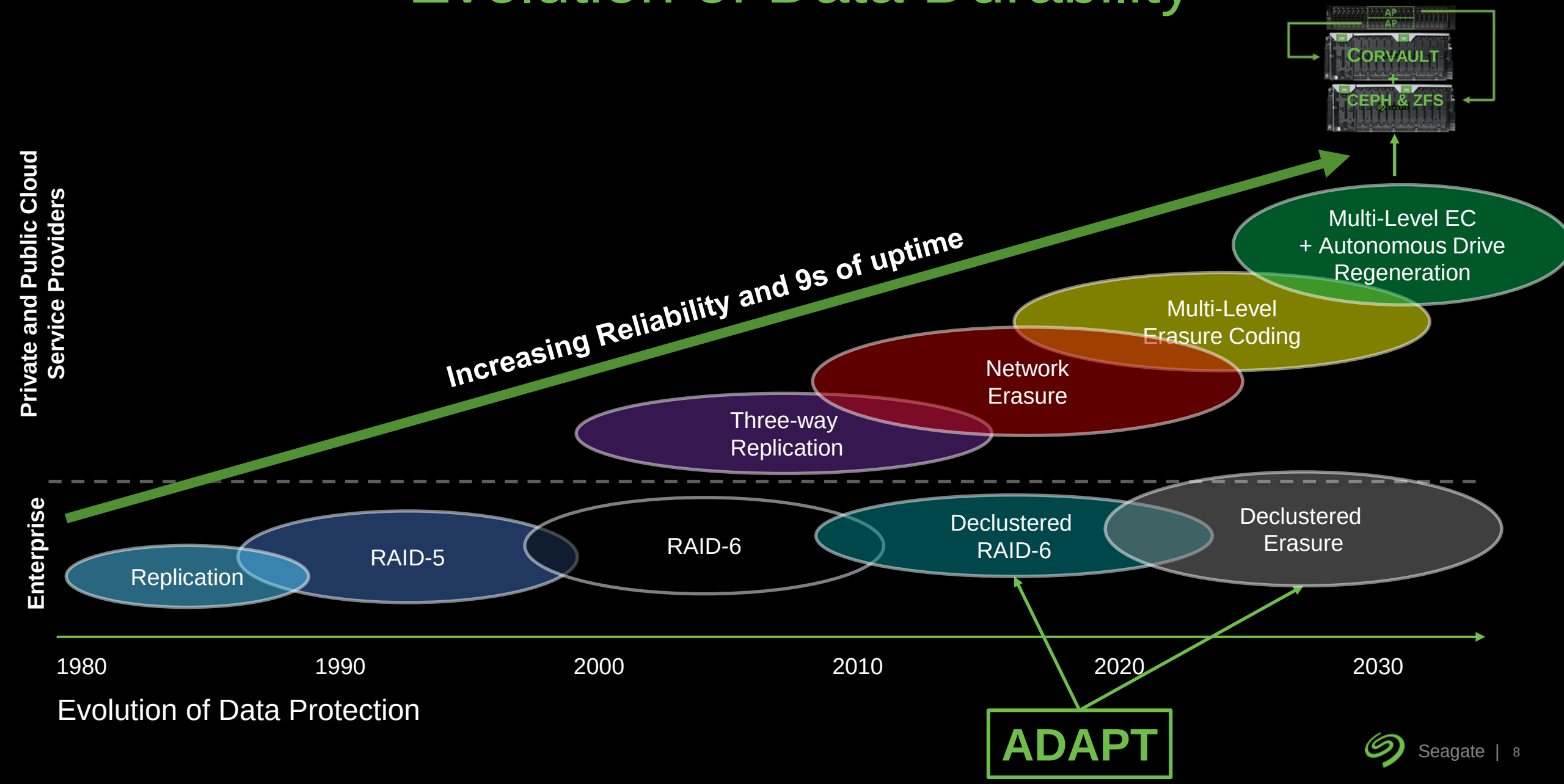
ADAPT Erasure Coding
Enabling five-nines reliability

CORVAULT is built on Seagate's erasure encoding solution - Autonomic Distributed Allocation Protection Technology (ADAPT). It replaces traditional RAID types with a protection scheme that distributes the parity across a larger set of HDDs or SSDs. The upshot is Data protection is now available at a capacity higher than ever before—with rebuilds that are up to 95% faster than with traditional solutions. With ADAPT, system administrators will find scalability, flexibility, and infrastructure that is easier to maintain and expand.

Metric	Traditional RAID 8+2	24 Drive ADAPT	56 Drive ADAPT	106 Drive ADAPT
Perf impact*, 1 drive down	-41%	-23%	-11%	-6%
Perf impact*, 2 drive down	-62%	-37%	-20%	-12%
Rebuild 1 drive	55.5 hours	24 hours	10 hours	5.3 hours
Fault Tolerance: 3rd drive failure	55.5 hours	9 hours	1.5 hours	25 minutes

Feature	Benefit
Parallel architecture	Reduces rebuild time by up to 95%, providing data protection, especially with large devices
Self-healing system	Automatically allocates spare capacity to recover common device failures
Mixed drive capacities	Maximizes usable capacity, reduces $/TB
Universally compatible geometry	Simplified user configurations
Unique two-device fault tolerance	Increased data protection, even in the event more than one device fails
Expandable support pools, even while online	Excellent performance and capacity scaling from 12 to 128 devices
Sequential I/O performance	Supports multi-input HDD streaming applications

Evolution of Data Durability



Higher Durability and Lower Cost with CORVAULT

Scaling out with CORVAULT reduces CPU resources by 60% and reduces RAM by 40%

Build with Simple JBOD

20PB Solution	720 CPU Cores	7,680 GB RAM

Scale-Out CEPH w/ WD JBOD and External Compute

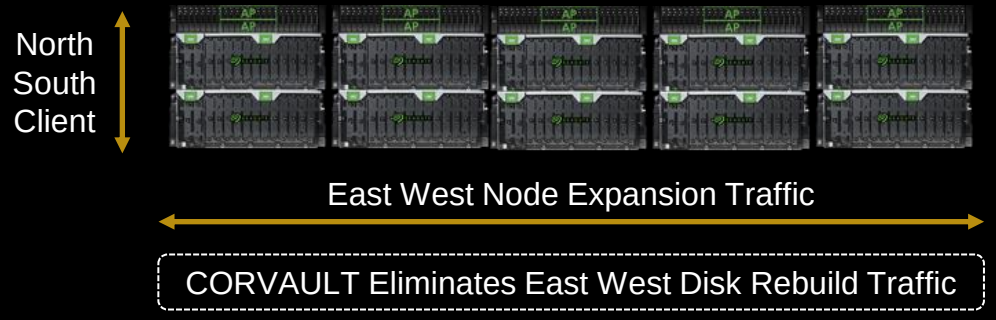
Single-Layer EC

- Disk failures will cause east west network traffic
- 10 nines data durability
- 16+4 EC

Build with CORVAULT

20PB Solution	256 CPU Cores	4,096 GB RAM
	↓ 60% Less CPU	↓ 40% Less RAM

Scale-Out CEPH w/ Seagate AP and CORVAULT



Multi-Layer EC

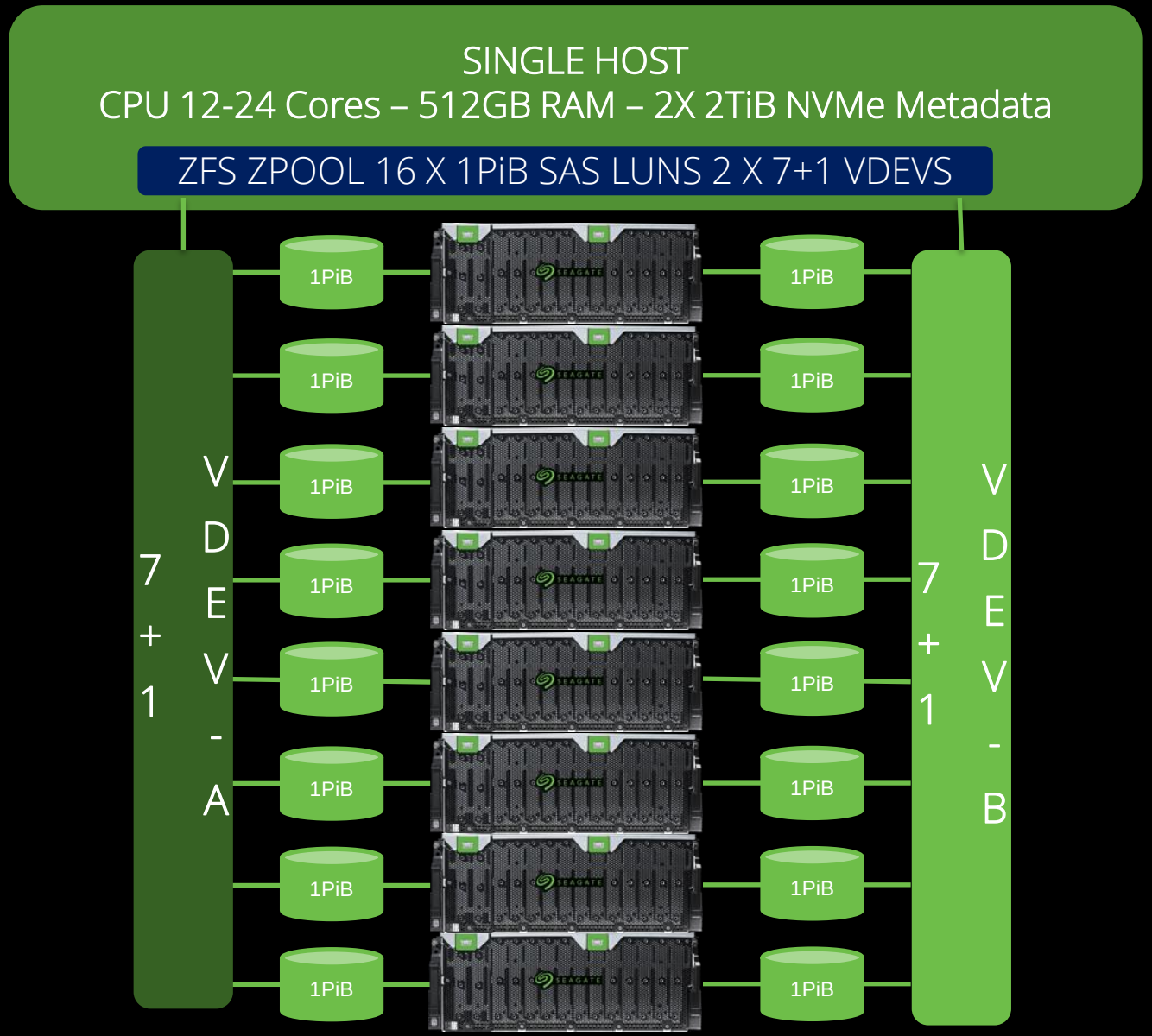
- Disk rebuild traffic is localized to each CORVAULT
- Rebuild Traffic is eliminated
- 14 nine's data durability
- [16+2] + ADAPT

ADAPT is a Compute Reduction Engine for ZFS

The advantages of ADAPT with ZFS are Complimentary in every way!

ZFS Shortcomings	ADAPTS Solves this
ZFS disk are aggregated into VDEVs. It takes X computation power to compute 40 x 20TB drives. 1 Compute = 40 x 20TiB Drives	The same amount of "compute" required to operate a zpool. 1 Compute = 40 x 20TiB Drives **1 Compute = 40 x 800TiB ADAPT Volume** **40x reduction in compute requirements per TiB**
VDEVs cannot be "stacked", they can only be mirrored or striped.	ADAPT brings "stacked" VDEVs to ZFS, single "LUNs" can be in excess of 800TiB!
All disk must be homogenous (the same size/capacity).	ADAPT enables the use of a heterogenous mix of disk drives – no two need be the same size.
The bigger the VDEV, the slower the performance.	Erasure coding between ADAPT and ZFS are multiplicative in protecting data and ensuring end-to-end data integrity.
ZFS dRAID solves some problems, but not the scaling problem of ZFS, nor does it allow for stacking of VDEVs.	ADAPT brings self healing with ADR (autonomous drive regeneration) to ZFS and enables stacked erasure coding, doubling the nines of data durability.

15 PiB+ Storage Node with CORVAULT and ZFS



- 8 CORVAULT's with a single host
- 16 SAS Ports (4 x 4port SAS HBA's)
- One SAS Port per CV controller
- Each CORVAULT presents 2 x 1PiB volumes over 2 controllers
- Each zpool is comprised of 2 x 7+1 protected Vdevs
- Can provide over 10 GiB / sec write throughput
- Provides high durability with ADAPT + ADR (self-healing storage) with over 12 x 9's durability
- Can tolerate multiple simultaneous individual drive failures
- Offloads disk aggregation from host CPU to dedicated hardware ASIC

EXOS™
CORVAULT™

	Exos™ CORVAULT 5U84	Exos™ CORVAULT
System Capacity	1.5PB	2.0PB / 2.5PB
Form Factor	5U, 1-meter	4U, 1.2-meter
Host Interface	12Gb SAS3	12Gb SAS3
Features	Seagate ADAPT 16+2 Autonomous Drive Regeneration Linear Storage Targets	Seagate ADAPT 16+3 Autonomous Drive Regeneration Linear Storage Targets
Availability **Data Durability**	99.999 % 99.9997 %	99.999 % 99.999999 % (8-nines)
Performance	12GB/s Read Throughput 10GB/s Write Throughput	12GB/s Read Throughput 10GB/s Write Throughput