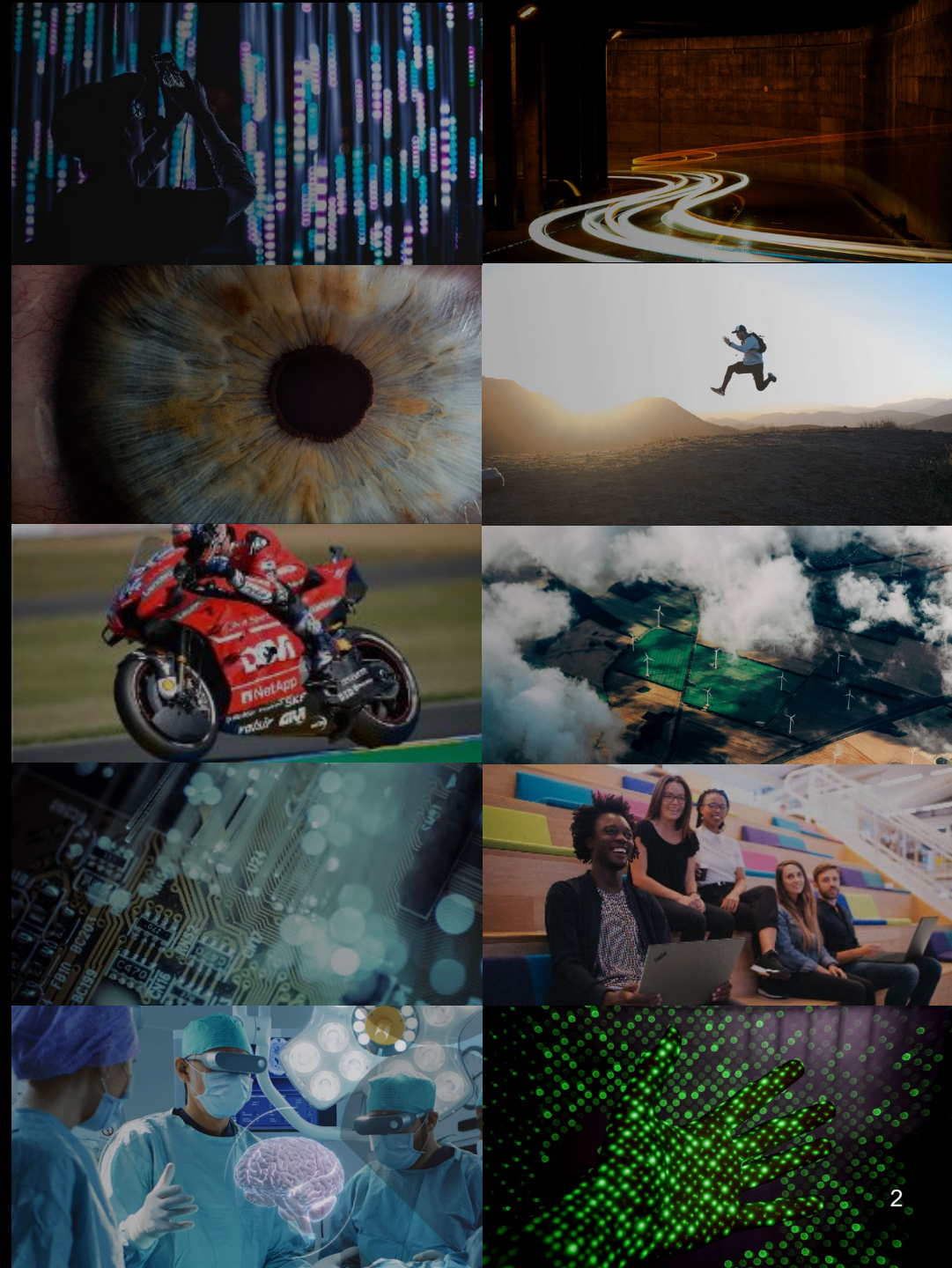
Lenovo Storage Portfolio

Mark Clayton – Principal Architect – Data Management Team
mclayton2@lenovo.com

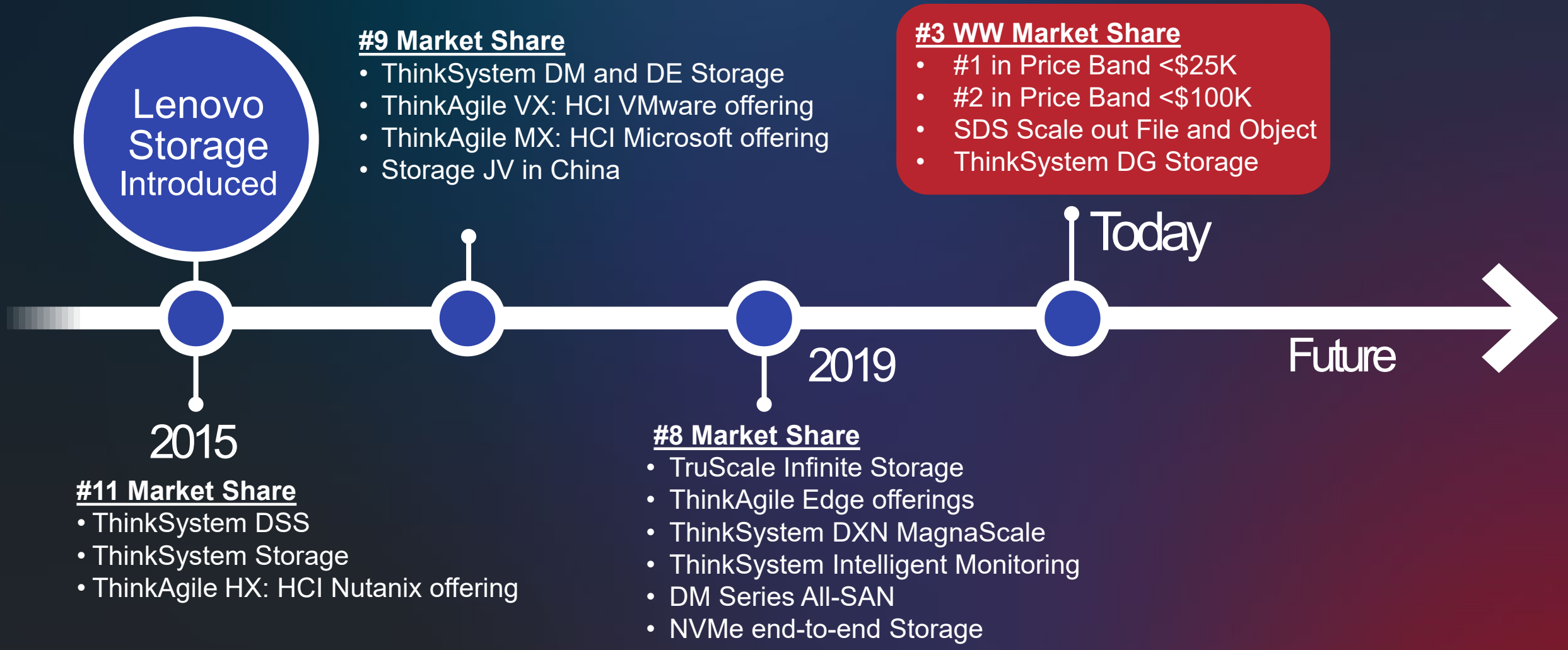
Lenovo Smarter technology for all

“We’re committed to delivering technology that improves human outcomes. We’re not developing tech for tech’s sake; we are purposeful in delivering human-centered innovation.”



The Lenovo Data Management and Storage History

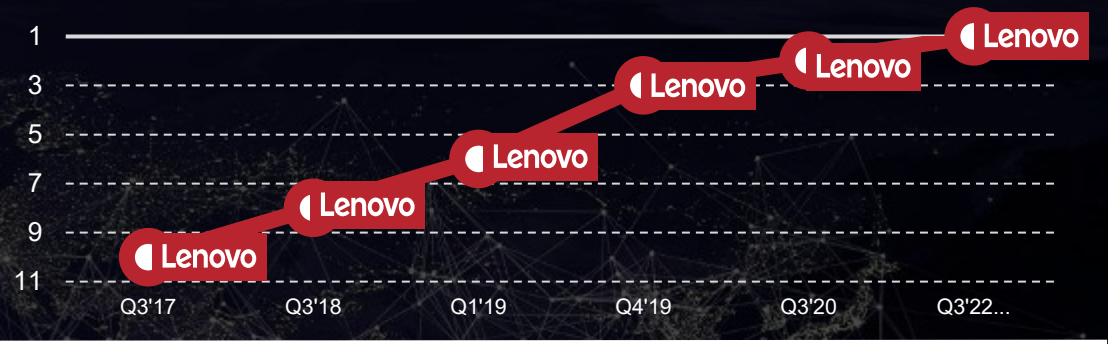
Building credibility and trust with our customers and partners



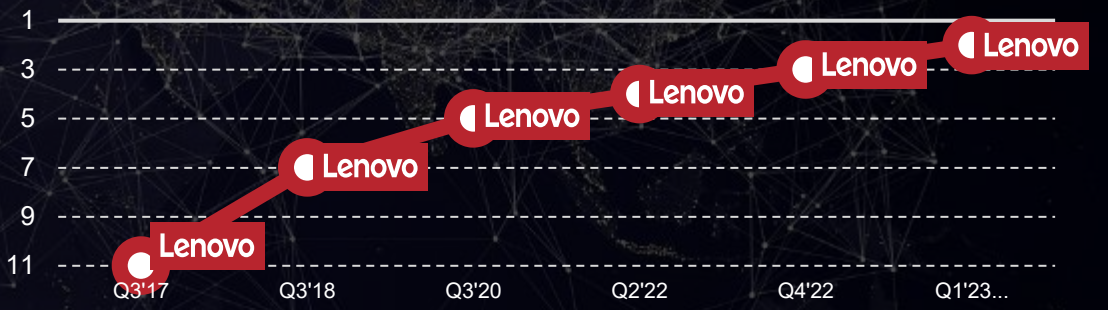
ISG's Storage Momentum

Market Share

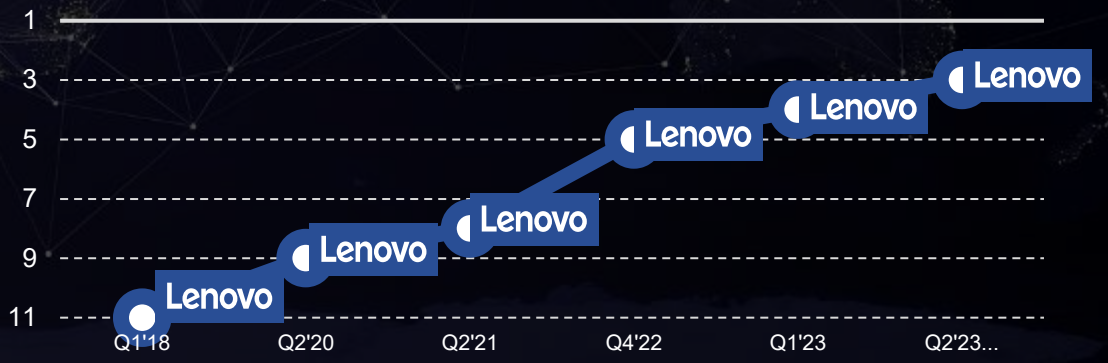
#1 <$25K Storage



#2 <$100K Storage



#3 Total Storage



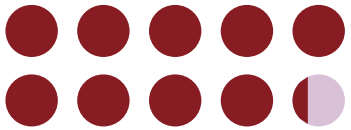
Source: IDC (December 2023), Market Share by Calendar Year

Global Footprint

View more customer stories

The value of data is critical to organizational success

Data is driving innovation



91.9%

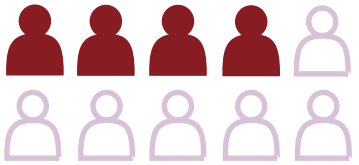
of companies report achieving measurable value from investments in data and analytics.[1]

59.5%

of business leaders say their companies are using data analytics to drive business innovation.[2]

The emergence of AI is enhancing data value even more

say generative AI use is on their board's agenda.[3]



40%

of organizations utilizing AI expect to invest more in it thanks to generative AI.[3]

Sources

1 HBR, "Why Chief Data and AI Officers Are Set Up to Fail?" June 2023
2 New Vantage Partners, "Data and Analytics Leadership Annual Executive Survey 2023," January 2023
3 McKinsey, "The state of AI in 2023: Generative AI's breakout year," August 2023

As data value grows, so do storage demands

1. Growing demands are impacting data and storage

Global data volume could reach **180 zettabytes** in 2025.[1]

2. Storage demands for new applications can be unpredictable

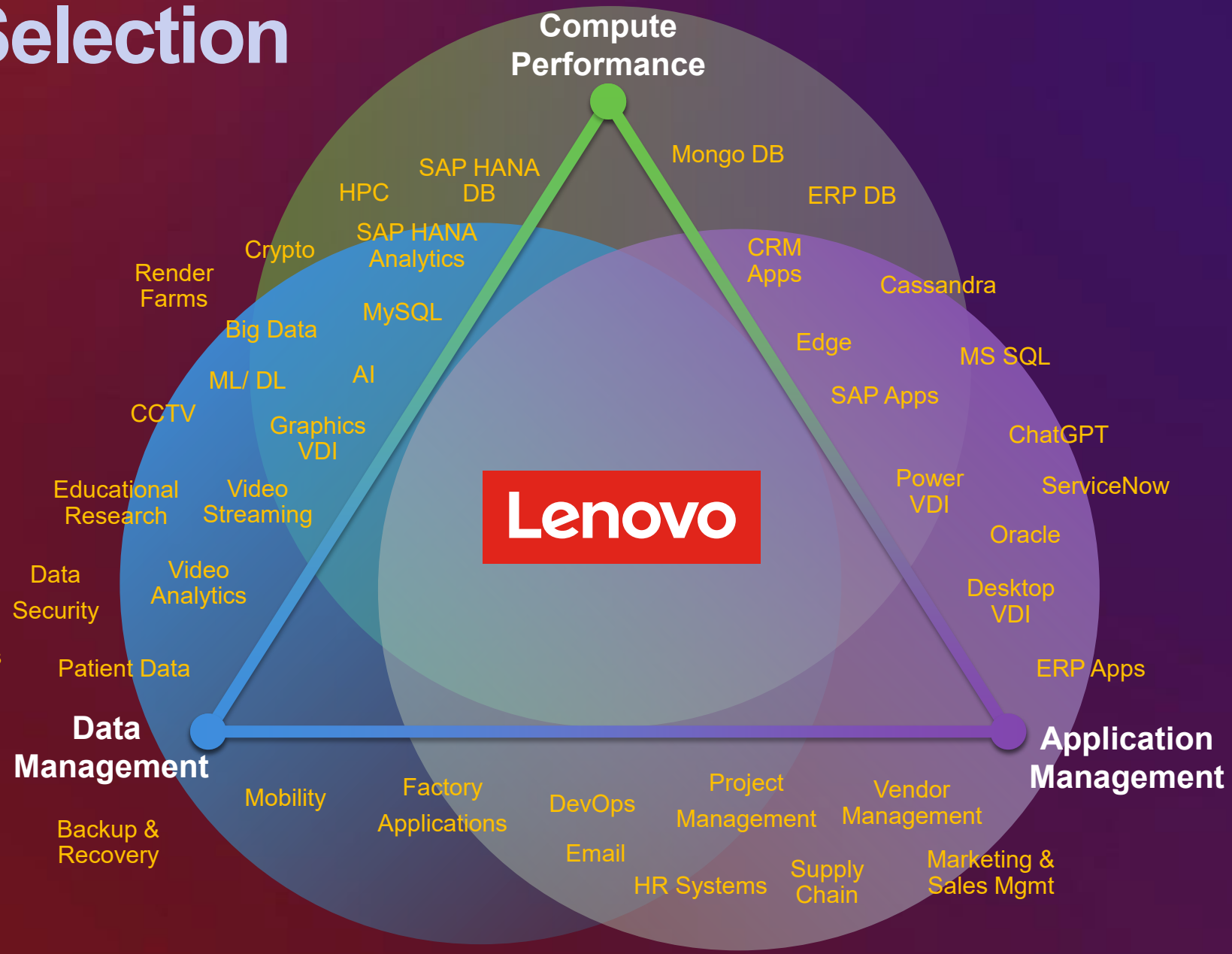
Amount of compute needed to train largest AI models **doubles every 3–10 months.**[2]

3. Not everything can be put in the cloud

Sources
1 Statista, “Volume of data/information created, captured, copied, and consumed worldwide from 2010 to 2020, with forecasts from 2021 to 2025,” November 2023
2 Accenture, “Technology Vision 2023,” March 2023

Data Storage Selection

- Location
  - Datacenter(s)?
  - Remote Locations?
- Performance
  - IOPS today
  - Throughput today
- Compliance Needs
- Application Requirements
- Security Requirements
- Amount of Data Needed
- Size of Access
- Data Access
  - NAS
  - Block
  - S3



Lenovo Data Management Portfolio

Lenovo TruScale

- Lenovo TruScale Infrastructure as a Service (IaaS)
- Lenovo TruScale Infinite Storage
- Lenovo TruScale Backup with Veeam

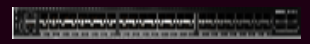
ThinkSystem Enterprise Storage


DE Series


DG Series


DM Series


D Series


Storage Networking


Tape Solutions

ThinkAgile HCI Hyperconverged Infrastructure

NUTANIX 
HX

Microsoft 
MX

vmware 
VX

SDS Software Defined Storage

CLOUDIAN

WEKA

ddn

ceph


Ready Node HS350X V3


MagnaScale (PRC Only)


Cloud Solutions


DSS

IBM

Solution Partners

Red Hat

NVIDIA

COMMVAULT

Microsoft Azure

SAP

openstack

intel

Mellanox TECHNOLOGIES

ProLion

veeAM

SUSE

aws

Google Cloud Platform

AMD

IBM Cloud

Services and Support Design | Implementation | Support

Lenovo Data Management

Multi-Workload Enterprise Storage

Performance Tuned Storage Single-Workload Exa-scale

Tier 1

RPO 0, RTO 0, Sync Replication
Low Latency
High IOPS
NVMe
Application Integration for Snapshots

Tier 2

Integrated Workflow Automation
Snapshots Thin provisioning
Data Efficiency (Compression, Compaction, Deduplication)
Adaptive Quality of Service
Application Based Balanced placement (Performance)
Local Storage Caching

Tier 3

Scale out Storage Clusters
High Throughput
Dynamic capacity expansion
Remote Storage Caching
Asynchronous replication
Backup Software Integration

Tier 4

S3 Object Storage Integration w/ Cloud
Encryption & Trusted Platform Module (TPM) support
WORM (Write Once Read Many) Data protection
AWS, Google, Azure Integration and other Cloud Providers
Dual Parity RAID Protection, Enhanced Parity (Erasure Coding, etc.)
Ransomware Protection

ThinkSystem DM\DG Series

ThinkSystem DE Series

ThinkAgile VX HX MX

ThinkSystem Tape

Lenovo DSS-G

ThinkSystem WEKA

Millions of IOPS
100's Gbps of throughput
nVidia GPU Direct
Snapshots & Cloning

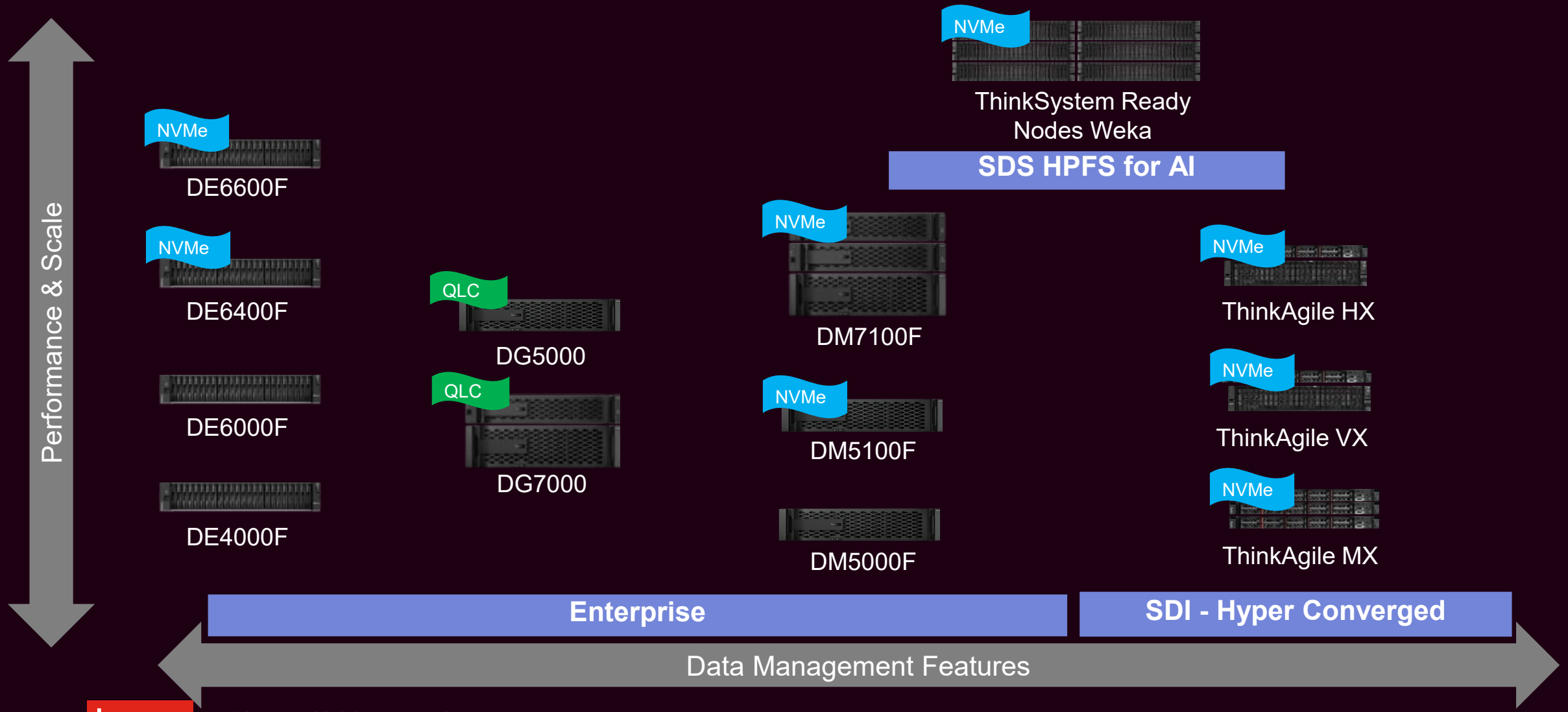
ThinkSystem CLOUDIAN

Cloud Bursting
Snap to S3
WORM protection
10's Gbps of throughput

Encryption
Data Immutability

Lenovo Data Management Flash Solution

Comprehensive Flash solutions for every workload and every scale!



ThinkSystem Enterprise Storage Array Portfolio

Efficient, secure solutions to maximize performance and value for AI and data intensive workloads

ThinkSystem DM Series

- Leadership flash performance
- Unified File/Block/Object
- Flash and hybrid models to optimize performance and scale
- Secure hybrid cloud management
- Integrated ransomware protection

ThinkSystem DG Series

- Efficient all flash data consolidation
- Unified File/Block/Object
- All-Flash at HDD economics
- Secure hybrid cloud management
- Integrated ransomware protection

ThinkSystem DE Series

- Simplified data management
- Entry to High performance block
- Flash and Hybrid models
- Easy to configure, manage, and scale.

Lenovo Scalable NAS/SAN/Object/Unified

ThinkSystem

DM / DG

- Unified Data Management OS
- Data Management
  - Multitenancy
  - Storage Efficiencies
  - Snapshots / Flexclones
- Data Protection
  - FIPS 140-2 Encryption
  - Anti-Ransomware
- Unified multi-protocol file and block
  - CIFS/SMB, NFS, S3
  - FC, FCoE, iSCSI, NVMe
- Cloud Tiering (Azure, Amazon, plus more)

- Transactional databases and analytics
- Virtualization and VDI
- Unstructured datasets
- Edge consolidation

Lenovo Storage Offerings

ThinkSystem DG Series: TCO & Sustainability

Reduce up to 80% of rack space with high-density capacity flash

Hybrid Flash Array

1224TB Effective Capacity in 2U

ThinkSystem DG5000

70% Reduction in power/cooling

80% Smaller footprint

*Based on internal testing results. Lenovo ThinkSystem DG5000 vs. previous generation hybrid array, August 2023

ThinkSystem DG Arrays

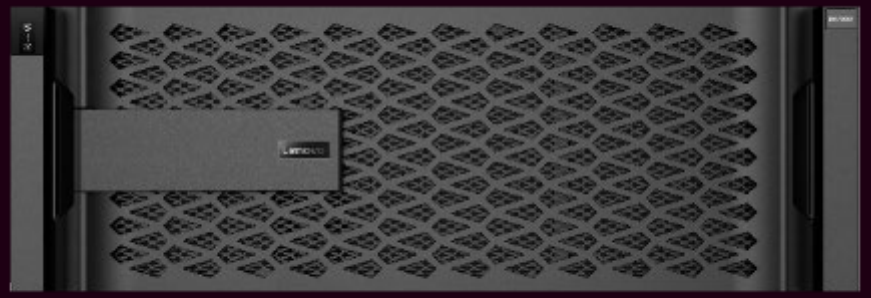
Workload Focus: AI/ML and analytics, data lakes, media/rendering, backup consolidation

Price/Performance

Up to 6x faster at 50% less cost* with budget-friendly high-capacity all-flash QLC storage

Scalability

Up to 17.6PB raw capacity in 24-node NAS cluster NAS and up to 8.8PB raw capacity in 12-node SAN cluster



Sustainability

Delivering substantial power savings versus hybrid arrays, enabling workload consolidation to reduce rack space and datacenter footprint

Security

Best-in-class data security and ransomware protection

**Internal calculations comparing Lenovo ThinkSystem DG Enterprise Storage Arrays to previous generation hybrid models (June 2023).*

ThinkSystem DG Series: Accelerate All-Flash Transformation

Transform from hybrid to all-flash

Hybrid Flash

DM7100H

DM5000H

DM3000H

Capacity Flash

DG7000

DG5000

Performance Flash

DM7100F

DM5100F

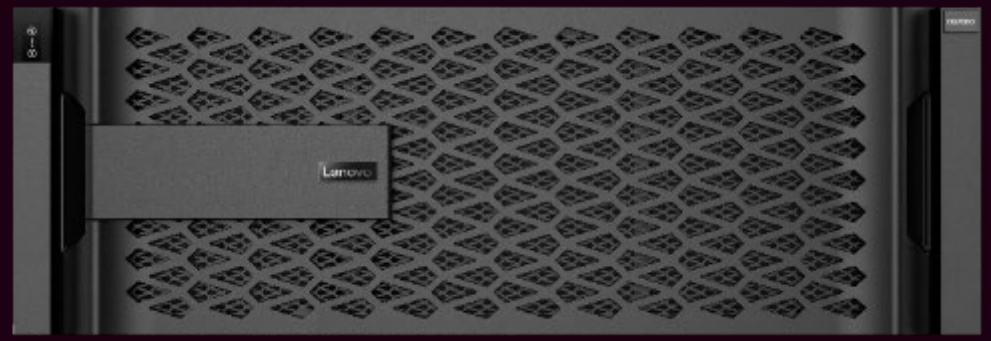
DM5000F

5–10ms latency

2–4ms latency

Sub-ms latency

ThinkSystem DG7000



Form factor	• 4U Controller Enclosure + 2U drive shelf (DG240N).
Controller memory	• 256GB RAM per system (128 GB per controller). 32 GB battery-backed NVRAM per system (16 GB per controller) mirrored between the controllers.
Raw Storage Capacity	• Up to 1.47PB (96x 15.36TB SSDs)
Storage Networking Supported	• NAS (File access): NFS, CIFS/SMB. • SAN (Block access): iSCSI, FC, NVMe/FC, NVMe/TCP • Object: S3
Expansion Support	• DG240N: 2U, 24 drives, NVMe QLC SSDs
Security Features	• Secure Socket Layer (SSL), Secure Shell (SSH), user level security, role-based access control (RBAC), LDAP authentication.
Category 1 Host Operating Systems	• Windows Server 2019, Windows Server 2022, RedHat, SuSE, VMware
Category 2 Host Operating Systems	• Citrix Hypervisor (CentOS, Ubuntu) *For version details, see the latest Category 2 Interoperability Matrix, available as a download from Lenovo Storage Interoperation Center (LSIC).*

https://lenovopress.lenovo.com/lp1755-thinksystem-dg7000

ThinkSystem DG5000

Leading the way to a cloud-connected, sustainable all-flash data center.

Efficiency & Performance

- High-capacity with flash performance characteristics.
- Aimed at workloads with performance needs while meeting budget requirements.

Scalable and Cloud-Ready

- Eliminate storage silos and scale capacity non-disruptively.
- Achieve greater savings by tiering cold data to the cloud.

Keep Data Secure, Protected, & Available

- Ransomware protection
- Business continuity, disaster recovery
- Application-integrated backup and recovery

THE CHANNEL CO. CRN Products of the YEAR 2023

Media/rendering, AI/ML and analytics, read-intensive workloads, data lakes, file storage, Home directories, non-mission-critical workloads

ThinkSystem DG5000

Form factor	• 2U with 24 SSD slots
Controller memory	• 128 GB RAM per system (64 GB per controller). 16 GB battery-backed NVRAM per system (8 GB per controller) mirrored between the controllers.
Raw Storage Capacity	• Up to 737TB (48x 15.36TB drives)
Performance	• Up to 440,000 random read IOPS (8 KB blocks) *Estimated performance based on internal measurements*
Storage Networking Supported	• NAS (File access): NFS, CIFS/SMB. • SAN (Block access): iSCSI, FC, NVMe/FC, NVMe/TCP • Object: S3
Expansion Support	• DG240N: 2U, 24 drives, NVMe QLC SSDs
Security Features	• Secure Socket Layer (SSL), Secure Shell (SSH), user level security, role-based access control (RBAC), LDAP authentication.
Category 1 Host Operating Systems	• Windows Server 2019, Windows Server 2022, RedHat, SuSE, VMware
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https://lenovopress.lenovo.com/lp1754-thinksystem-dg5000

ThinkSystem DM/DG Series Storage Array Portfolio

All-Flash


DG5000


DM5000F


DM5100F


DG7100


DM7100F

Hybrid


DM3010H


DM5000H

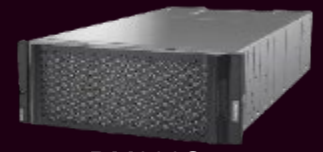

DM7100H

DM Series Expansions

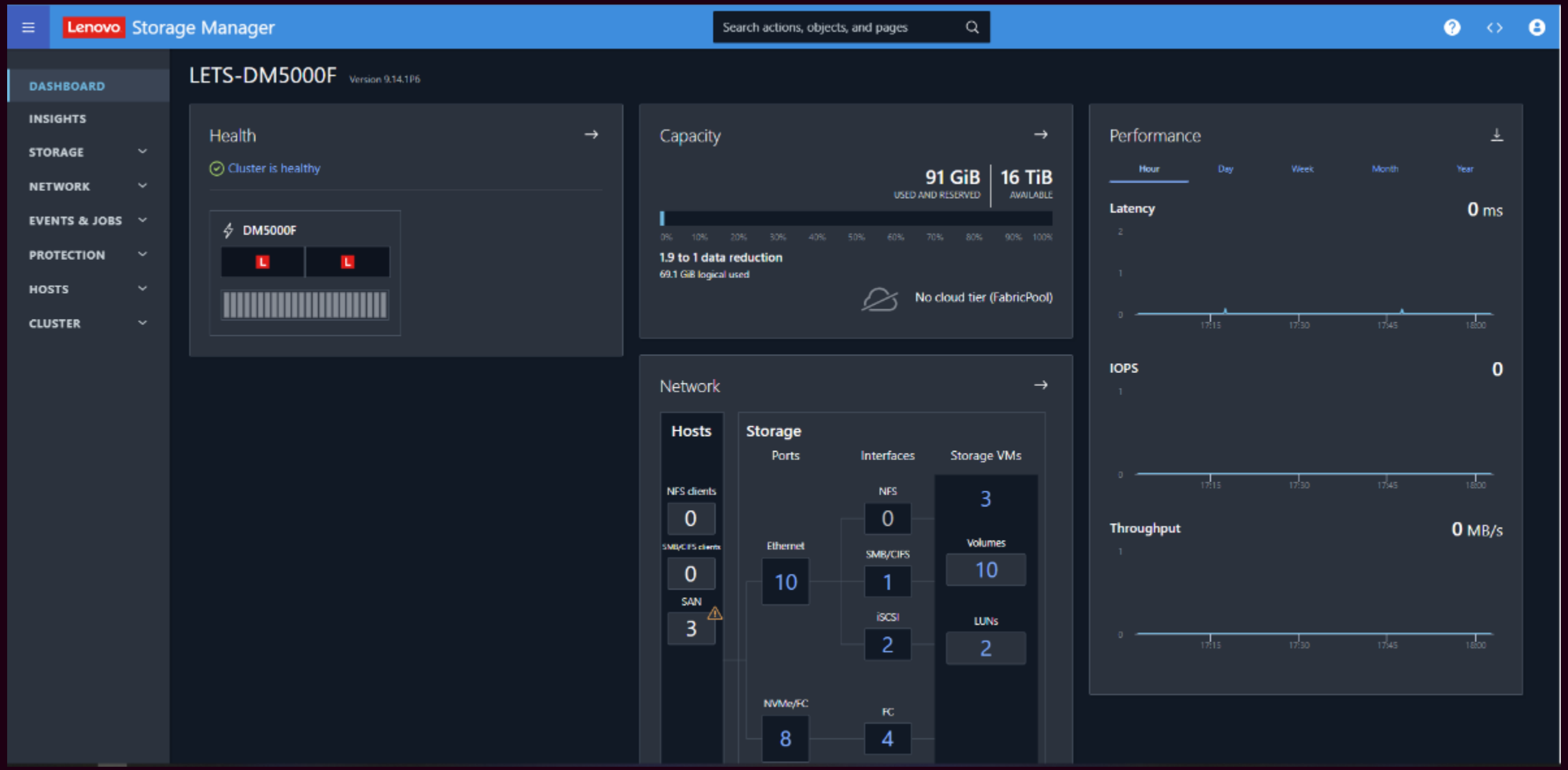

DM120S


DM240S (SAS)


DM240N (NVMe)


DM600S

Lenovo ONTAP GUI



Deploy any application at the edge, in the core, or in the cloud

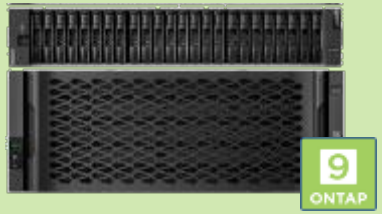
- Support new and traditional apps, block and file workloads

SAP ORACLE redhat vmware Microsoft CITRIX openstack mongoDB hadoop docker

ONTAP

Edge

Datacenter

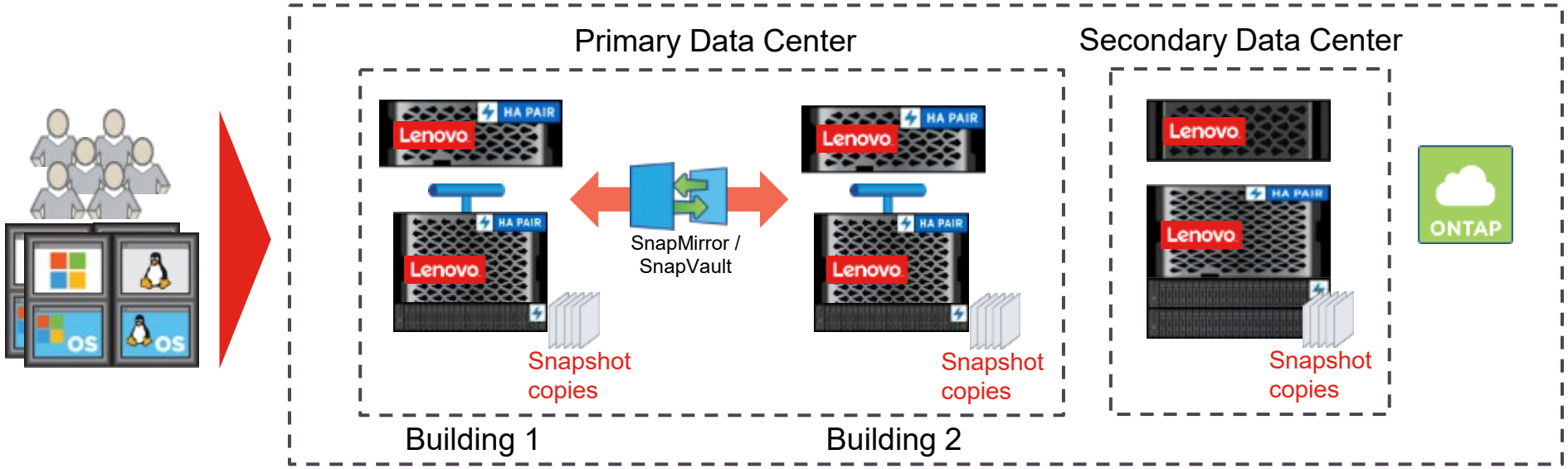


Cloud

Common data management and data services

SNAPCENTER SOFTWARE IS…

End-to-end protection and copy management for data anywhere in the Data Fabric



SnapCenter® Management

SnapCenter Plug-ins

Windows Server 2019 | ORACLE DATABASE | SAP HANA | Microsoft SQL Server | vmware | MySQL | IBM DB2 | mongoDB | Custom Applications | Exchange

DevOps Orchestration

Running workloads anywhere

TRIDENT

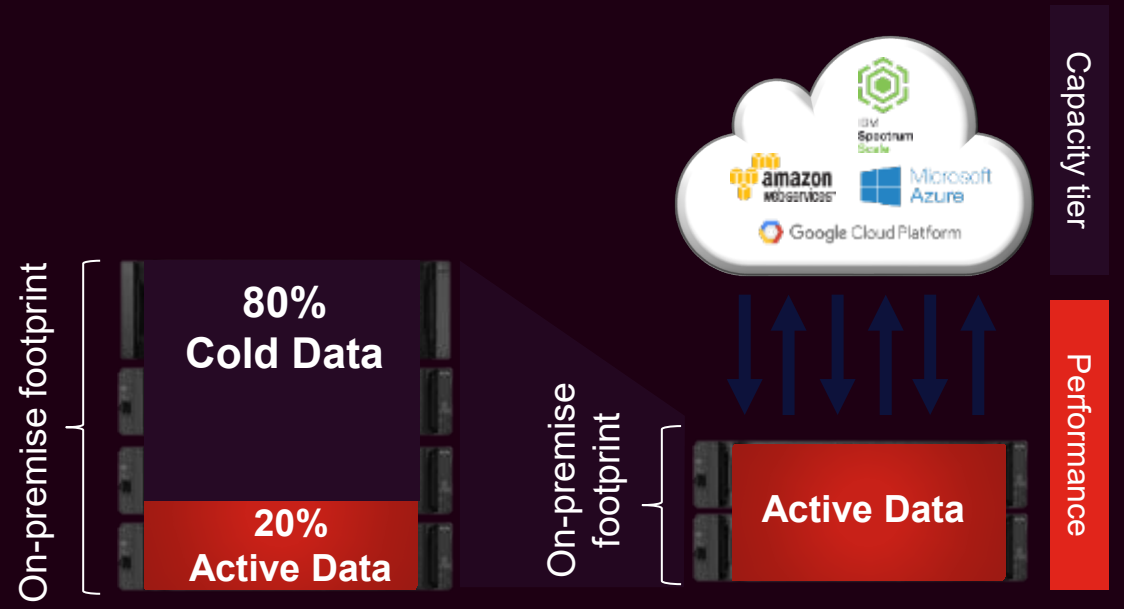
thePub netapp.io

Cloud mobility for data agility

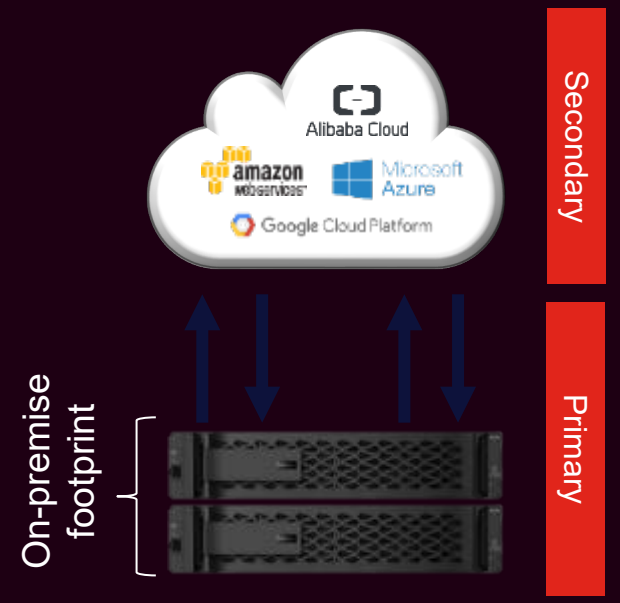
Leverage cloud storage to optimize on-premise footprint

Easily move, manage, optimize, and secure data; **utilize cloud as a new transparent volume** and shift to an OPEX consumption model

ThinkSystem Fabric Pool S3 Tiering



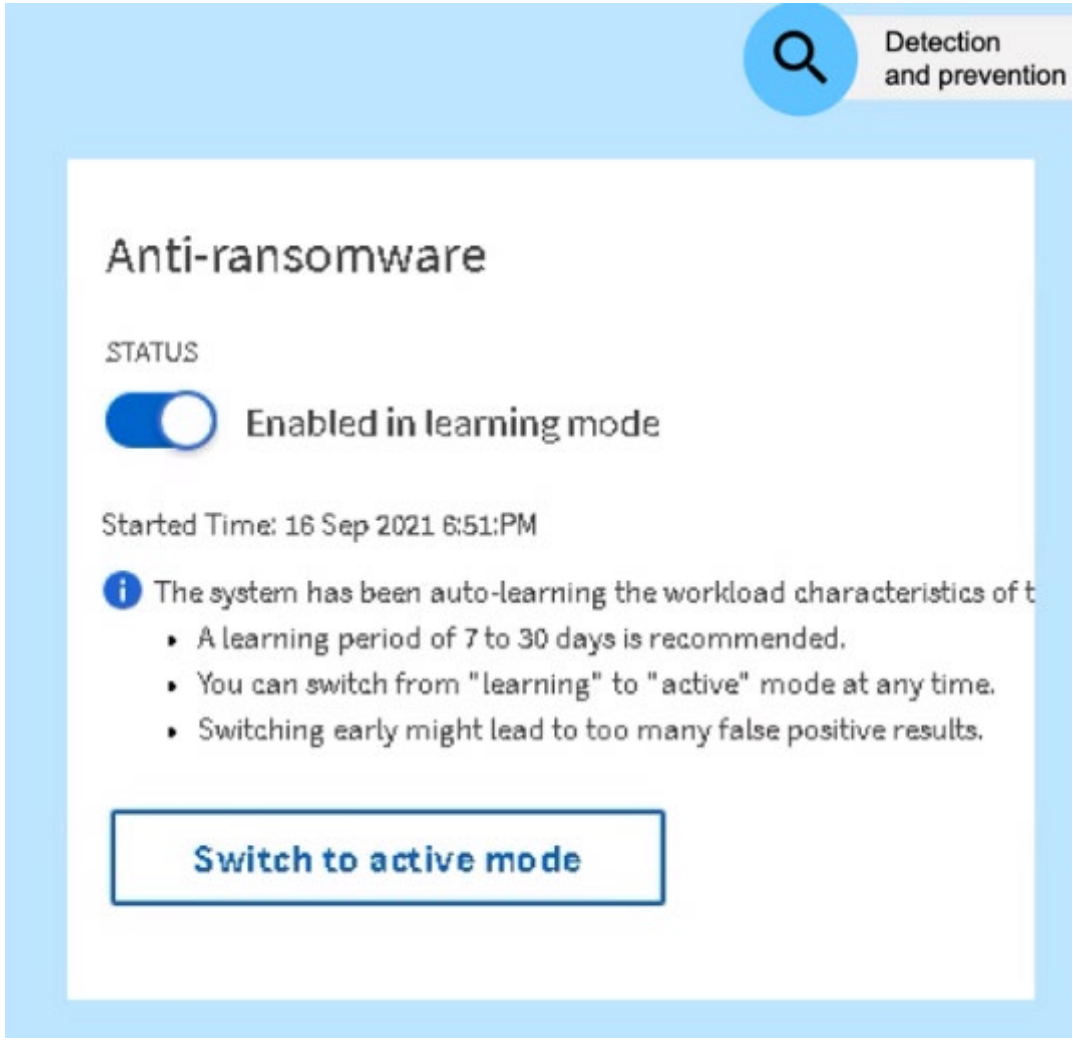
Cloud Volumes / Cloud Manager



ONTAP Anti-ransomware

On-box automatic ransomware detection

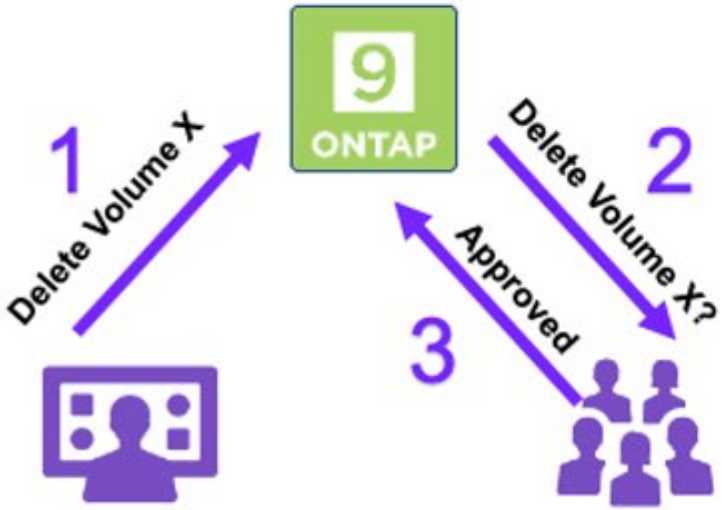
- Available in ONTAP 9.10.1 for NAS (Feb ‘22)
- On-box ML analytics engine leverages volume file activity and data entropy
- Learning mode (min. 7 days, recommended 30 days)
- Alerts admin via EMS, System Manager, Unified Manager, CLI
  - Does not disrupt I/O; only alerts on suspected activity
- Automatically takes a Snapshot
  - Admin can determine if it is a false positive
- Additional layer of detection and ransomware protection



Multi-Admin Verification

Enhanced dual-admin control

- Defend against a single compromised administrator account or a rogue administrator by requiring multiple approvals for commands that could result in data loss
- Approval groups where one or more additional approvals are required for a command to be executed



Industry's first enterprise-grade storage validated by the NSA

ONTAP storage platform receives NSA CSfC validation for security and encryption

ONTAP supports the commercial cybersecurity strategy of the National Security Agency (NSA)

- NSA Commercial Solutions for Classified (CSfC) validation for data-at-rest collaborative protection using full drive encryption
- ONTAP protects data at rest at both the hardware layer with NSE and the software layer with NVE/NAE

With ONTAP, organizations can expect to:

- Natively store top secret data, confidently and reliably
- Save time by making it easier to buy pre-approved solutions
- Limit the processes required to move or store data securely
- Offer cost savings via reduced monitoring and audits

Lenovo

- System Capacity – Up to 480 SSD/HDD
- Up to 2M/390K IOPS – 21/7 GBps (Reads / Write)
- Fault Tolerant (HA Controllers / Power Supplies / Fans)
- Utilizing 3 different types of shelves (12/24/60)
- RAID
  - Traditional RAID 0, 5, 6, or 10
  - Distributed RAID (Dynamic Disk Pools)
- Easy Expansion
  - Dynamically grow volumes
  - Dynamically redistributes data
- Automated deployment (scripted)

https://lenovopress.lenovo.com/lp0882-lenovo-thinksystem-de4000h-hybrid-storage-array

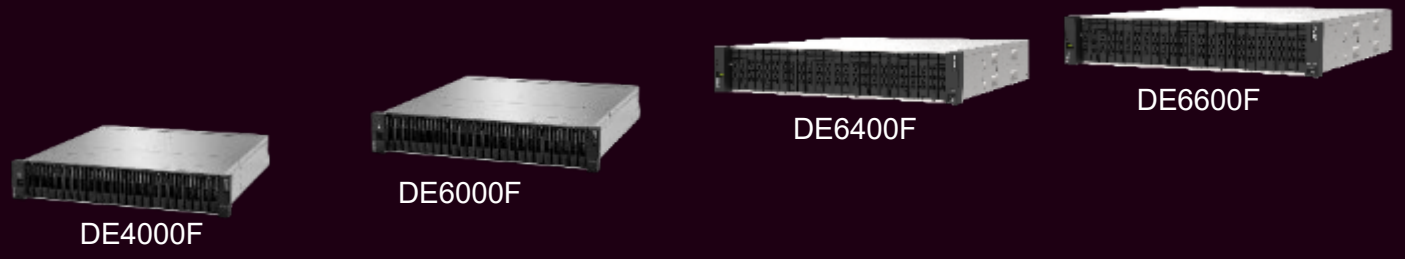
ThinkSystem

DE Product

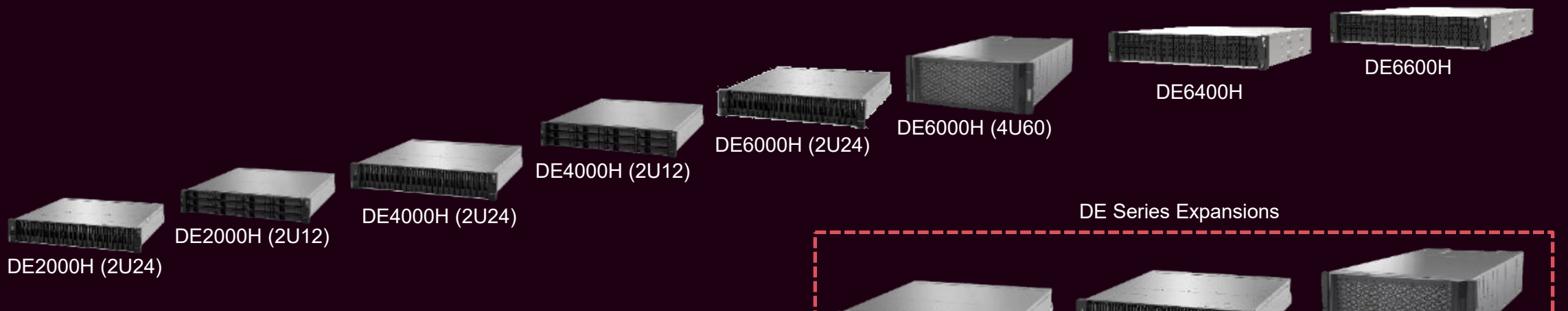
- Video Surveillance
- Backup & Recovery
- Technical Computing
- Big Data Analytics
- HPC Workloads

ThinkSystem DE Series Storage Array Portfolio

All-Flash



Hybrid



DE Series Expansions

Lenovo DG Series SAN Storage Solutions

ThinkSystem DG Series

- Efficient all flash data consolidation
- Unified File/Block/Object
- All-Flash at HDD economics
- Secure hybrid cloud management
- Integrated ransomware protection

ThinkSystem Fibre Channel HBA and SAN support 32 Gb/s, NVMe, and now Autonomous.

Lenovo Servers & Emulex FC HBAs

Brocade GEN6 FIBRE CHANNEL

DB610S

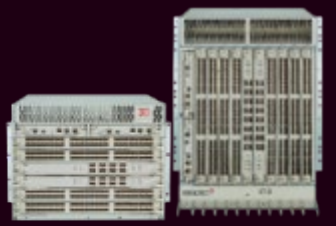
DB620S

DB630S

Brocade GEN7 FIBRE CHANNEL

DB720S

DB730S



Directors

Lenovo Software Defined Storage (SDS) Portfolio

High Performance File Solution (HPFS) powered by WEKA

- High-performance, large-scale workloads
- AI/Analytics, Finance High-frequency Training, Genomics/Life Science, Media & Entertainment

Increase productivity up to **90%**
Improvement in deep learning time

Improve resource ROI **75%**
Reduction in workload wall clock time

Lower storage costs **65%**
Savings over traditional high-performance computing

Object Storage Solution powered by Cloudian

- Capacity-intensive enterprise workloads
- Backup/Archive, Video/Images, Healthcare/Life Sciences, Research, IoT, Video Surveillance, Data Lakes

Lower Storage costs **70%**
Compared to traditional storage systems

Reduce primary backup tier cost up to **40%**
Superior RTO/RPO for fast restore times

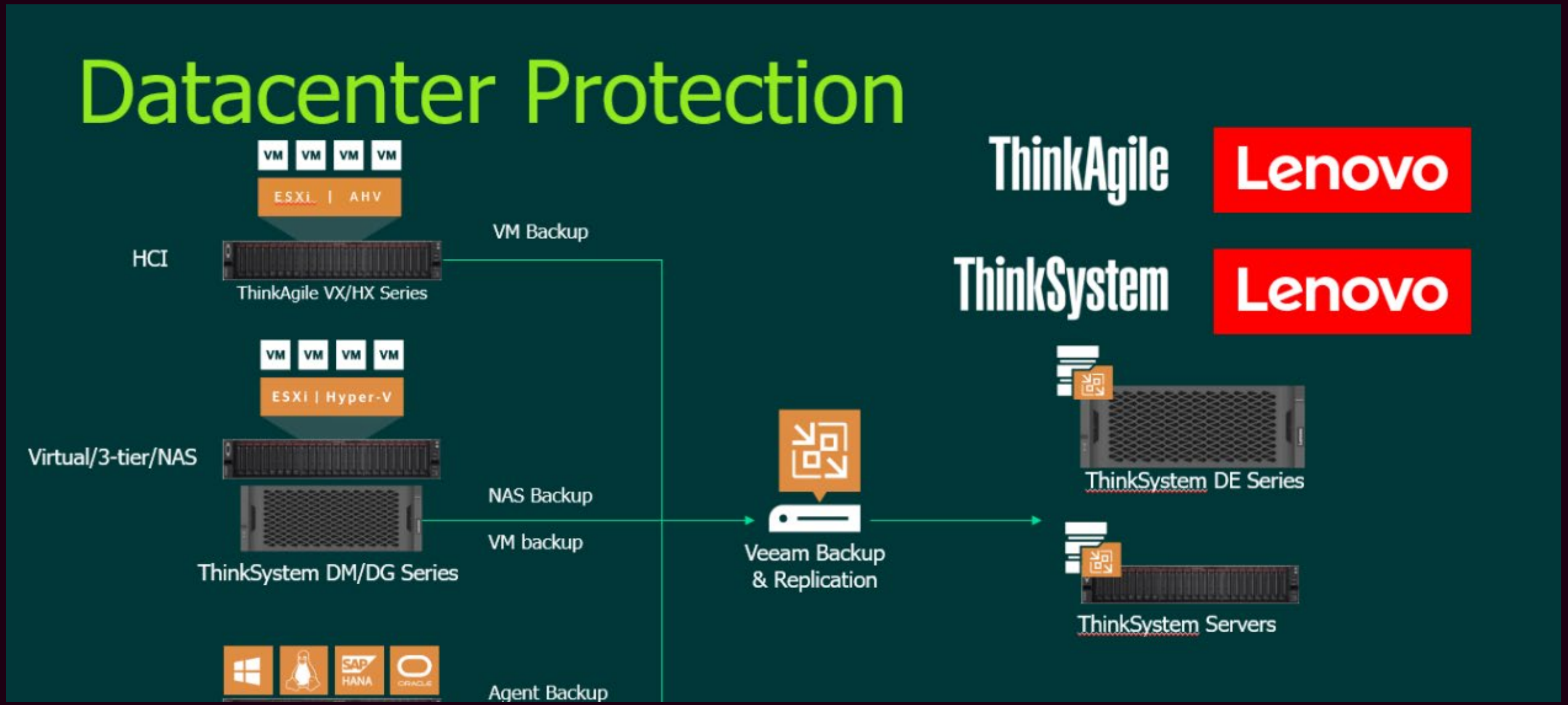
Reduce TCO by **33%**
Compared to legacy storage systems

WEKA

ThinkSystem

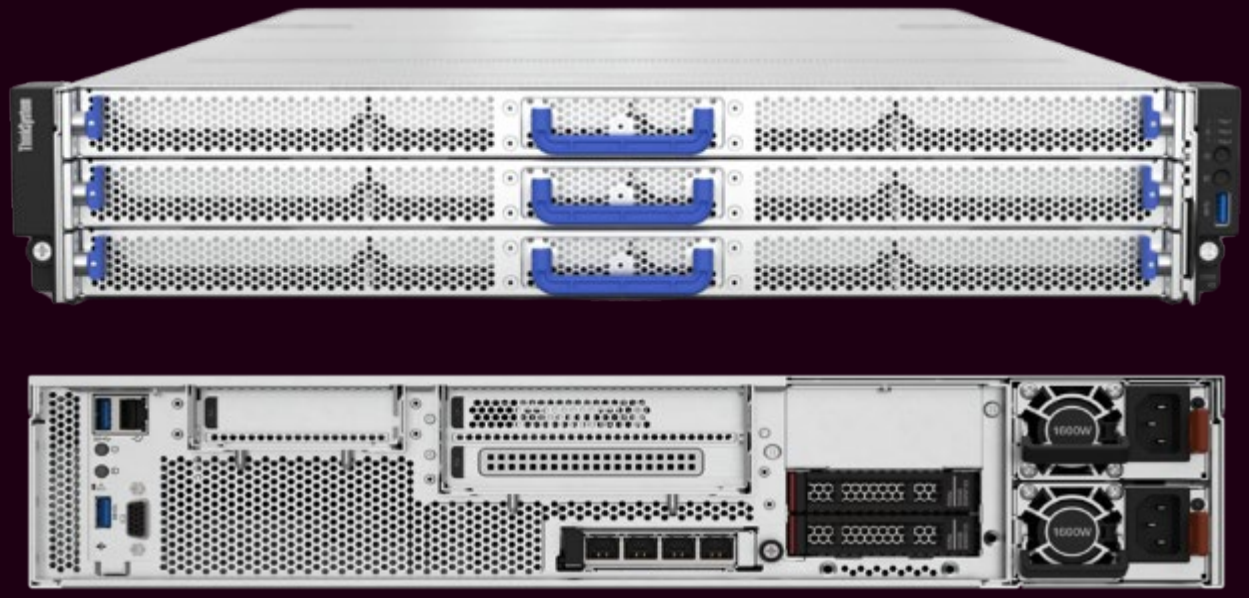
CLOUDIAN

Veeam can protect Lenovo's entire Data Management portfolio



Lenovo ThinkSystem HS350X V3 Storage Server

System Specifications



Feature	HS350X V3
Form Factor	• 2U Rack Server
Processor	• 1x 4th generation or 5th generation Intel Xeon Scalable processor family. Supports processors up to 64 cores, core speeds of up to 2.2 GHz, and TDP ratings of up to 350 W.
GPU Support	• No support
Memory	• 16 DIMM slots with one processor. Processor has 8 memory channels, with 2 DIMMs per channel (DPC)

Disk Drive Bays	• Up to 24x 3.5-inch and 2x 2.5-inch hot-swap drive bays:
	  • Front bays can be 3.5-inch (24 bays)
	  • Rear bays can be U.2 NVMe 2.5-inch (2 bays)

Boot	• 2x M.2 NVMe SSD as boot drives (Via CPU PCIe Lanes), supports Intel VROC
Storage Controller	• HBA: Broadcom 9600-24i SATA/SAS HBA Card (non-RAID) • RAID: Broadcom 9670-24i SATA/SAS RAID Card
Cooling	• 6x single-rotor hot swap 60 mm fans, configuration dependent. Fans are N+1 redundant.
Network Interfaces	• Dedicated OCP 3.0 SFF slot with PCIe 5.0 x16 host interface. Supports a variety of 2-port and 4-port adapters with 1, 10, 25 or 100 GbE network connectivity.
Systems Management	• No support for XClarity, BMC, UEFI, operator panel with status LEDs. AMI based.
Ports	• Front: 1x USB 3.2 G1 (5 Gb/s) port, 1x USB 2.0 port, External diagnostics port, optional VGA port. • Rear: 3x USB 3.2 G1 (5 Gb/s) ports, 1x VGA video port, 1x RJ-45 1GbE. Optional DB-9 COM serial port (installs in slot 3). • Internal: 1x USB 3.2 G1 (5 Gb/s) connector for operating system or license key purposes
PCIe	• Rear: Up to 3x PCIe slots, 1x slot dedicated to an OCP 3.0 adapter and NVMe backplane to support 2x 2.5-inch drive configurations also support an additional internal bay for a cabled RAID adapter or HBA.
Power Supply	• Up to two hot-swap redundant AC power supplies, 80 PLUS Platinum certification. 1300W, 1600W AC options, supporting 220 V AC.
Warranty	• Three-year (model dependent) customer-replaceable unit and onsite limited warranty with 9x5 next business day (NBD).

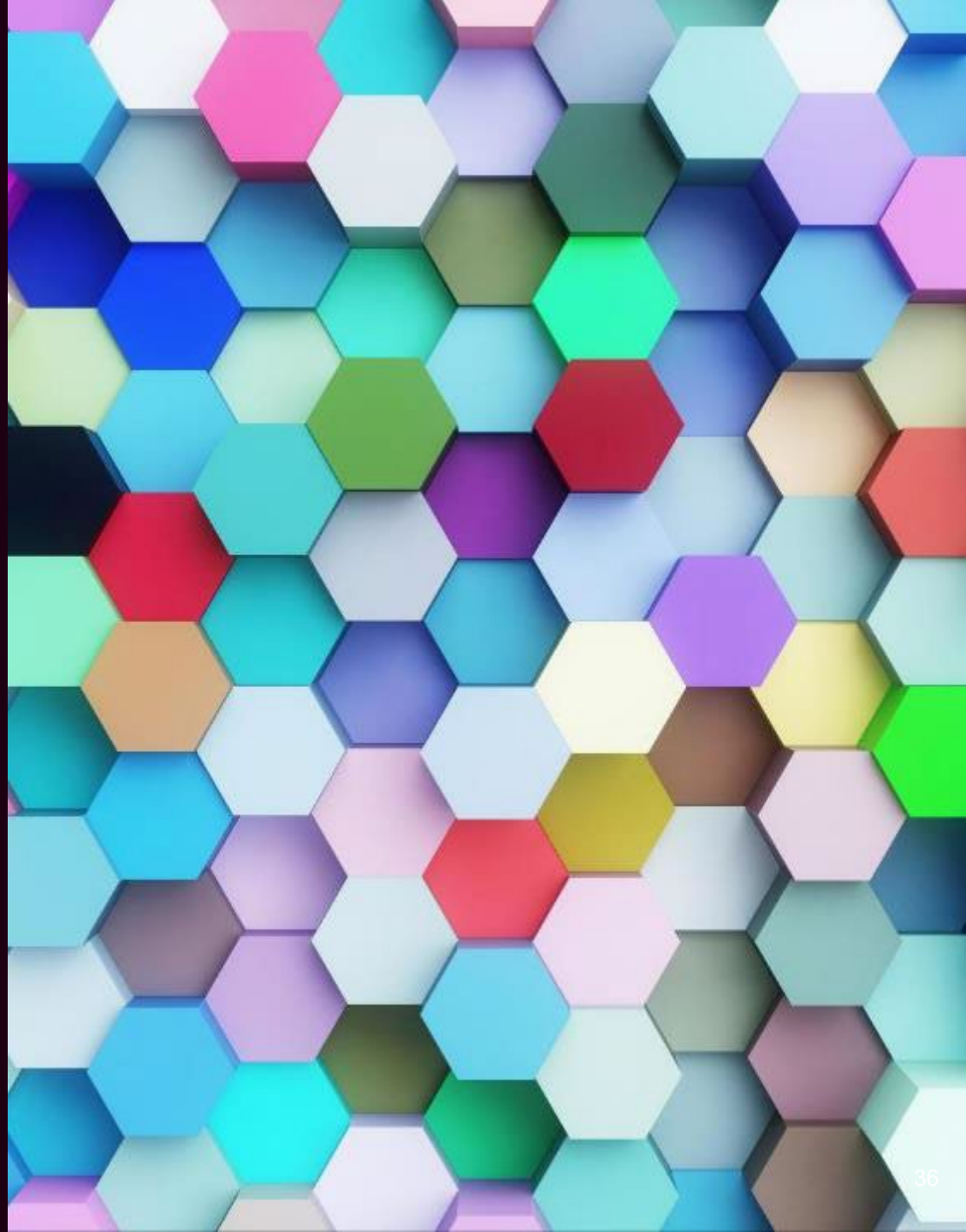
HS350X V3 Tech Sheet

https://lenovopress.lenovo.com/datasheet/ds0173-lenovo-thinksystem-hs350x-v3

Software-Defined Storage Market Trends

“By 2028, 70% of file & object data will be deployed on a consolidated unstructured data storage platform, up from 35% in early 2024.”

-Gartner Enterprise Storage Trends, 2024



Lenovo ThinkSystem Ready Nodes for HS350X V3

Workload focus: Object and scale-out file, backup and recovery, Big data analytics, multimedia streaming, surveillance, AI/data lakes, data observability

Optimized Infrastructure

Single-socket storage server built for maximum capacity.

Powerful Efficiency

Supports the latest Intel Xeon Scalable processor family for maximum efficiency and peak computational resources.

Maximum Density

Supports 24 3.5” hard drives in a 2U form factor (8 drives per tray).

Hybrid Cloud-ready

Scalable, efficient, and cost-effective infrastructure for your on-premises or cloud workloads.

Reliable

Lenovo continues to lead the industry in best uptime among all x86 platforms.*

Innovative Design

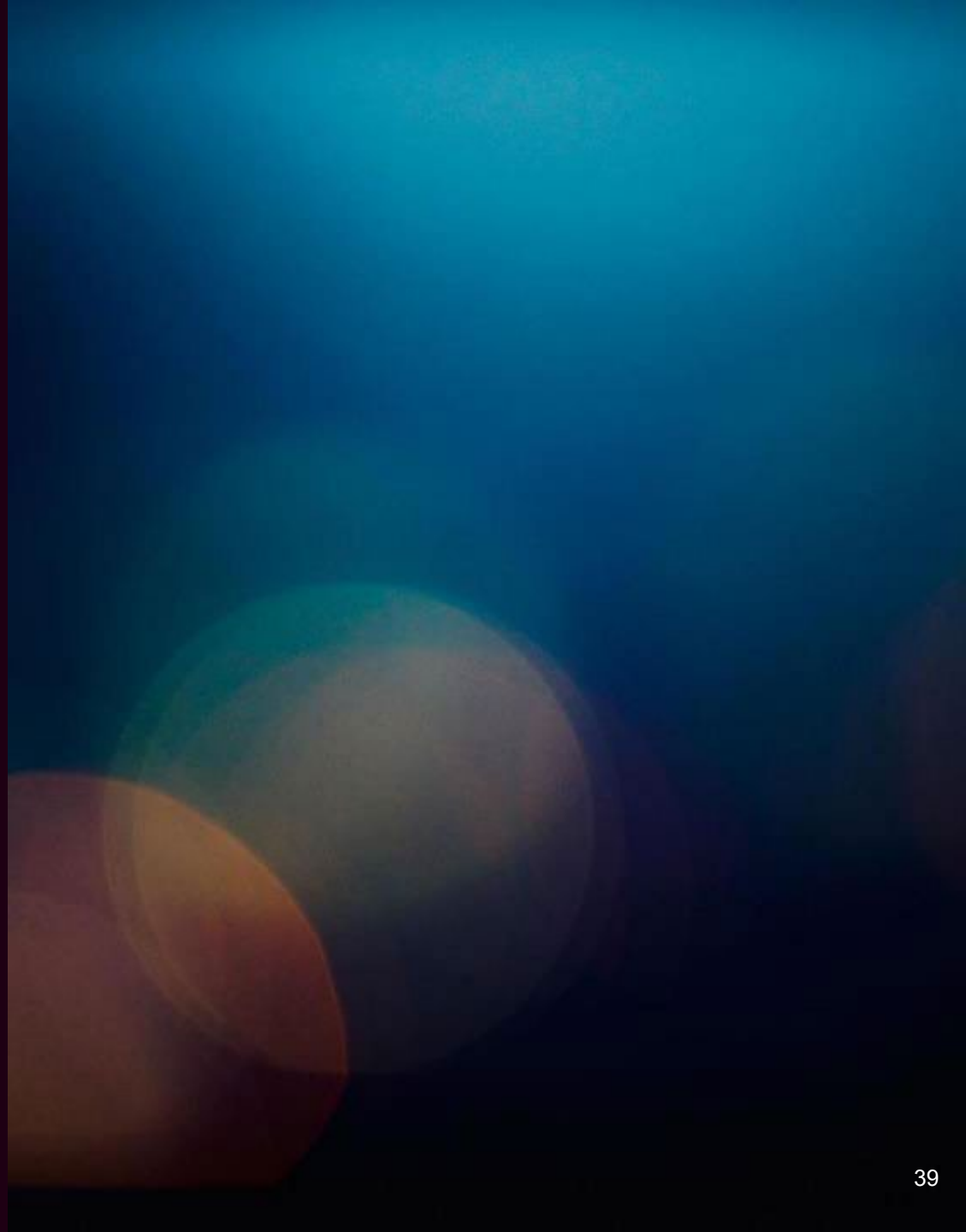
The three-tray design allows users to access the hot-swap drives without powering off the system.

**ITIC Reliability Study, February 2023*

Common Use Cases: Object & Scale-out File

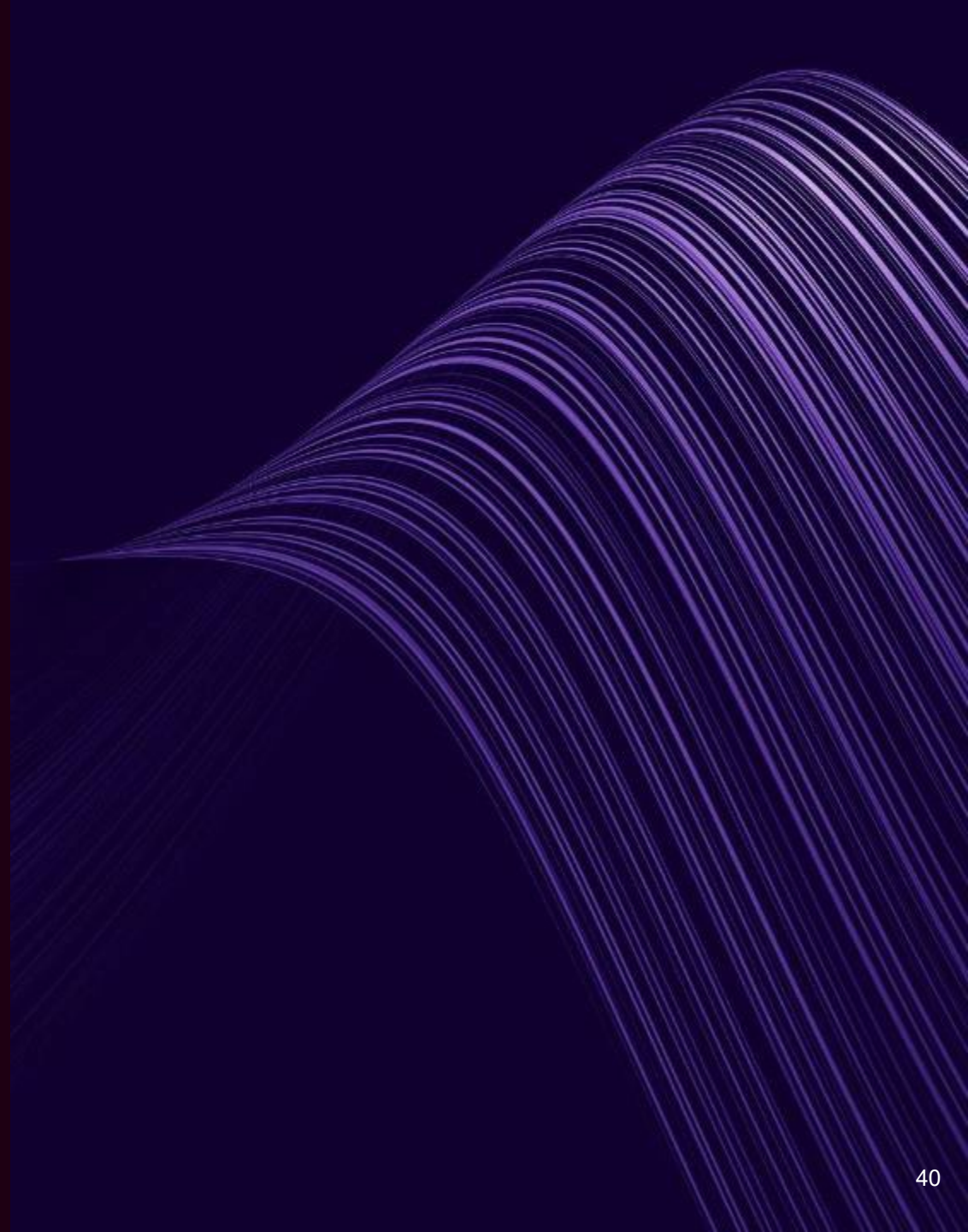
Commvault

- Centralized Data Management
  - Centralized platform for managing diverse data types across various environments, including on-premises, cloud, and hybrid setups.
- Data Protection/Security
  - Robust data protection mechanisms, such as encryption, access controls, and compliance safeguards.
- Scalability and Flexibility
  - Commvault’s scalability allows you to expand storage and backup capabilities seamlessly.
- Operational Efficiency
  - Features like automation, policy-based management, and analytics-driven insights streamline data operations.
- Business Continuity and Disaster Recovery
  - Commvault facilitates quick data restoration, reducing downtime in case of system failures, natural disasters, or cyberattacks.



Cloudian

- Scalability
  - Massive scalability and streamlined data management result in less overhead.
- Cost Efficiency
  - HyperStore’s efficient architecture running on the ThinkSystem HS350X V3 frees up CAPEX dollars.
- Data Security and Compliance
  - Hyperstore has robust security features and data encryption capabilities.
- High Availability and Reliability
  - Hyperstore provides high availability through features like data replication and erasure coding, ensuring data redundancy and resilience.
- Versatile File Services
  - HyperStore’s File Services offer seamless integration with existing file-based applications, simplifying data management and accessibility.



Ceph

- Scalability
  - Ceph utilizes a distributed architecture allowing users to add or remove nodes as needed.
- Cost-effective
  - Being open-source, Ceph eliminates the costs associated with proprietary offerings.
- Data Redundancy and Reliability
  - Ceph employs data redundancy mechanisms, such as replication and erasure coding, as well as replicating data across multiple nodes in a fault-tolerant manner.
- Unified Solution
  - Ceph offers unified storage capabilities, providing object, block, and file storage within a single system.
- Open-source Community
  - Ceph benefits from a vibrant open-source community, which contributes to its ongoing development and improvement.

Lenovo Services

Support Services

Warranty Upgrades/ Extended Warranty
- On-site 9x5x5
- On-site 24x7x365
- **Foundation** NBD response
- **Essential** 4hr response or 24hr CSR
- **Advanced** 2hr response or 6hr CSR

Technical Account Management
- Trusted advisor
- Service planning
- Account reporting

Premier Support
- Remote 24x7x365 support
- Direct technician access
- Single point of contact
- E2E case management
- 3rd party collaborative SW support
- Comprehensive HW + SW troubleshooting
- Response time options for onsite parts and labor

Sustainability
- ARS
- Carbon offset

Smarter technology for all

Lenovo

thanks.

Product Mapping

H = Hybrid
F = Flash

Lenovo Model DM	NetApp Model	Form Factor
DM3000H	FAS2720	2U12
DM3010H	FAS2820	2U12
DM5000H	FAS2750	2U24
DM5000F	AFF A150	2U24
DM5100F	AFF A250	2U24
DM7100H	FAS8300	4U
DM7100F	AFF A400	4U
DG5000	AFF C250	2U24
DG7000	AFF C400	4U
Lenovo Expansion Model DM	**NetApp Expansion Model**	**FF**
DM120S	DS212C	2U12
DM240S	DS224C	2U24
DM600S	DS460C	4U60
DM240N	NS224	2U24
Lenovo Model DE	**NetApp Model**	**FF**
DE2000H	E2812	2U12
DE2000H	E2824	2U24
DE4000H	E2812	2U12
DE4000H	E2824	2U24
DE4000H	E2860	4U60
DE4000F	EF280	2U24F
DE6000H	E5700	2U24
DE6000H	E5760	4U60
DE6000F	EF570	2U24F
DE6400F	EF300	2U24F
DE6600F	EF600	2U24F
Lenovo Expansion Model DE	**NetApp Expansion Model**	
DE212S	DE212C	2U12
DE224S	DE224C	2U24
DE600S	DE460C	4U60

ONTAP

SANTricity E-Series