

IBM Storage and SDI

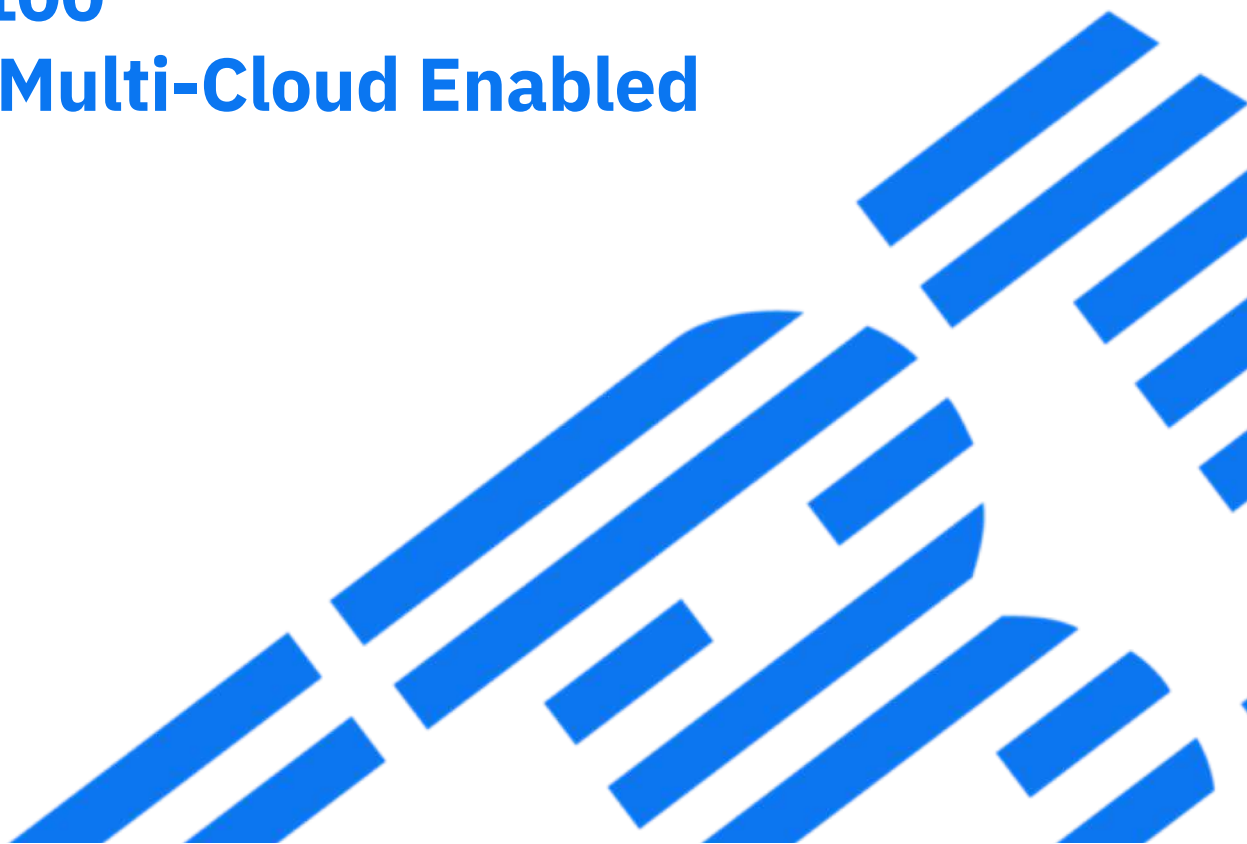
IBM FlashSystem 9100

NVMe-Accelerated, Multi-Cloud Enabled

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Storage CTS

September, 2018

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*“The world’s most valuable resource is no longer oil, but **data**.”*

The Economist

May, 2017



Today’s architecture starts with multi-cloud in mind

- Extend data across infrastructures
- Looking for choice, control and consistency
- Easy and agile data access

Broadest Storage and Software Defined Portfolio in the Industry



IBM Storage and SDI

Storage Systems

*Lowest Latency
Application
Acceleration*

FlashSystem 900



FlashSystem 9100

All Flash and Hybrid Storage Systems



FlashSystem
V9000

FlashSystem
A9000



FlashSystem
A9000R



XIV



DS8880



Storwize
V7000
V7000F



Storwize
V5000
V5000F

Tape and Virtual Tape Systems



TS7760



Tape Libraries



LTO8 and
enterprise tape
drives

Software Defined Storage

IBM Spectrum Storage

IBM Spectrum Storage Suite

- IBM Spectrum Virtualize
- IBM Spectrum Protect
- IBM Spectrum Control
- IBM Spectrum Accelerate
- IBM Spectrum Scale
- IBM Spectrum Archive
- IBM Spectrum Copy Data Management
- IBM Cloud Object Storage



Software Defined Computing

IBM Spectrum Computing

- IBM Spectrum Symphony
- IBM Spectrum LSF
- IBM Spectrum Conductor
- IBM Spectrum Cluster Foundation
- IBM Spectrum MPI

Integrated Infrastructure Solutions



Converged -
VersaStack



HyperConverged -
Supermicro +
Spectrum Accelerate



PurePower



IBM Elastic
Storage Server

Storage Networking



SAN768B & SAN384B
SAN64B-6, SAN256B-6, SAN512B-6



MDS 9148S



SAN42B-R



MDS 9718, 9710
& 9706

IBM Systems Flash Storage Offerings Portfolio

IBM Storage and SDI



IBM Spectrum **Virtualize**



IBM Spectrum **Accelerate**



IBM Spectrum **Scale**

**Storwize
V5030F / V7000F**



Entry / Mid-Range

New!
NVMe end-to-end
**FlashSystem 9100
Models 9110, 9150**



**Enterprise Class,
NVMe accelerated
Multi-Cloud Enabled**

**FlashSystem
A9000**



**Cloud Service
Providers**

**FlashSystem
A9000R**



**High End
Enterprise**

**IBM Elastic
Storage Server**



Big Data

Consolidate file &
object workloads
Faster data analysis
Global sharing

DS888x



Business Critical

z/OS / AIX
Power HA
Power i HA

Business critical,
deepest integration
with z Systems
Superior performance
and reliability
Three-site / Four-site
replication
DS8888F, DS8886F,
DS8884F

Scale-out clustering
Simplified management
Flexible consumption model
Virtualized, flash-optimized, modular storage
Enterprise heterogeneous data services and selectable data reduction

Simplified management
Flexible consumption model
Large Grid scale
Full time data reduction



IBM FlashCore™ Technology Optimized

SVC



Enhanced data storage functions,
economics and flexibility with
sophisticated virtualization

NVMe FlashCore Module

Superior endurance & better performance



- FIPS 140-2
- Hardware Compression

FlashSystem 900

Application acceleration



- Extreme performance
- Hardware Compression
- Targeting database acceleration

Data-Driven Multi-Cloud Storage Architecture

IBM Storage and SDI



Modern Infrastructure Support

Flexible

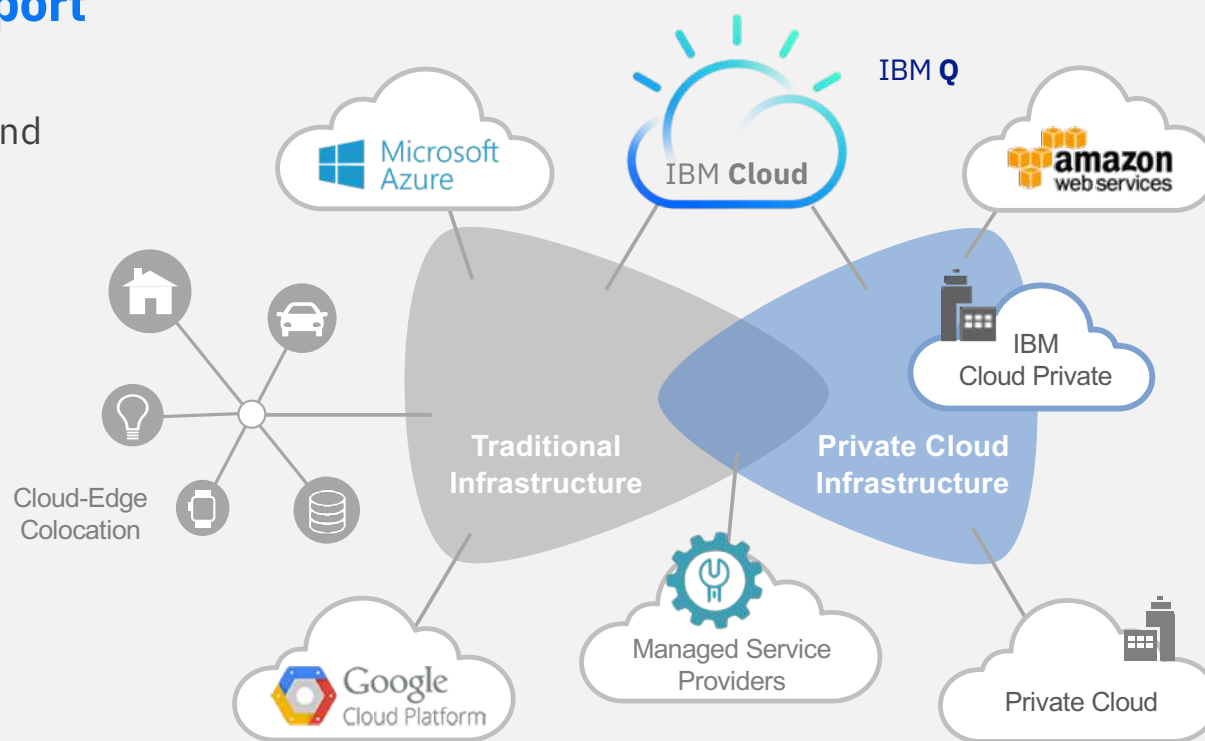
- Data Portability between Private and Public Clouds
- Secure and Compliant
- High ROI Use Cases

Modern

- API Automation
- Native DevOps Capable
- Self-Service

Agile

- Service Level Driven
- Software-Defined and Flash-Optimized
- Modern Backup and Replication



Client Multi-Cloud Patterns



IBM Storage and SDI

What you have ...



And you want to ...

Modernize traditional workloads

Private clouds for traditional application infrastructures as **agile, flexible** and **cost effective** as public clouds, and seamlessly extend to leverage public cloud infrastructure as business demands

IBM Storage delivers ...



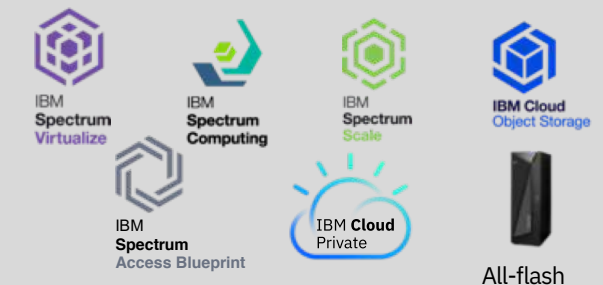
Transform with next-gen applications

AI and Big Data infrastructure to support High Performance Data Analytics and HPC leveraging the power of the Open Source community, supporting the very small to the largest clusters in the world



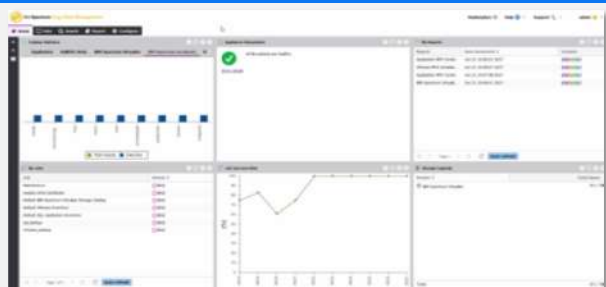
Refactor apps / containerize

Integrated Docker and Kubernetes
Private clouds for app modernization and agile development with full portability to leverage public cloud infrastructure



IBM FlashSystem 9100 – Enterprise NVMe Flash Array

NVMe-Accelerated and Multi-Cloud Enabled



NEW IBM FlashSystem 9100

- NVMe-Accelerated Enterprise Flash Array – 100% NVMe end-to-end
 - Industry Leading Performance and Scale - NVMe IBM FlashCore Modules and NVMe industry standard SSD
 - Flexible, Modern, Agile
 - Supports Physical, Virtual and Container Environments
- IBM Storage Insights: AI-empowered predictive analytics, storage resource management, and support platform delivered over the cloud
- Includes Spectrum Storage Software for array management, data reuse, modern data protection, disaster recovery, and containerization
 - IBM Spectrum Virtualize
 - IBM Spectrum Copy Data Management
 - IBM Spectrum Protect Plus
 - IBM Spectrum Virtualize for Public Cloud
 - IBM Spectrum Connect

NEW IBM FlashSystem 9100 Multi-Cloud Solutions

- Solution blueprints for Data Reuse, Protection and Efficiency
- Solution blueprints for Business Continuity and Data Reuse
- Solution blueprints for Private Cloud Flexibility and Data Protection



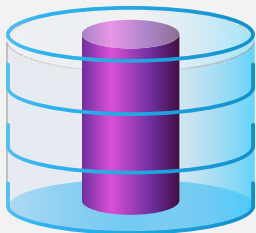
FlashSystem 9100



IBM Spectrum Virtualize for FS9100

Modernize Your Storage without Changing Your Storage

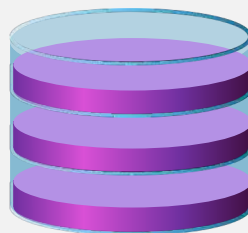
- Agility and efficiency of software-defined storage without replacing your existing storage
- Consistent storage services applies to all storage
- No need to redo automation / orchestration when new storage platforms come into play
- Higher level of simple and consistent data mobility supporting multi-cloud



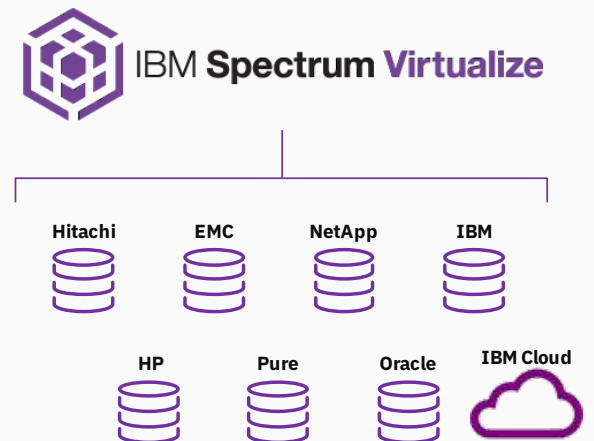
Compression and deduplication

store up to 5x as much data

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Thin provisioning can
double the amount of
data stored



“Spectrum Virtualize makes even highly complex physical landscapes easy to manage.”

Rick Harvey

*Director of IT Infrastructure
University of Rochester Medical Center*

FS9100 Features/Capabilities

IBM Storage and SDI

- Storage Virtualization
- Virtual Disk Mirroring
- HyperSwap
- Metro Mirror - synchronous remote replication
- Global Mirror - asynchronous remote replication
- Global Mirror over IP - remote replication over the Internet
- Importing and exporting existing LUNs via Image Mode
- Unmap
- Vvols
- Public Cloud offerings
- IBM Cloud Private
- Container support
- Thin Provisioning
- Fast-write cache
- Auto tiering (Easy Tier)
- Distributed RAID 5 & 6
- Transparent Cloud Tiering
- Cloud Snapshot
- Compression
- Deduplication
- FlashCopy (Snapshot)
- FlashCopy rollback
- Encryption of data at rest
- Data migration and pooling

IBM FlashSystem 9100

NVMe-Accelerated Enterprise Flash Array

IBM Storage and SDI

Future proof end-to-end NVMe

- Unmatched performance – NVMe & FlashCore
- Consistent low latency with Peak IOPS for transactional workloads and massive bandwidth for AI/ML workloads
- **5X** data reduction delivers 2PB in 2U and 32PB in a single rack dramatically reducing CAPEX and OPEX
- Built in encryption and FIPS 140-2 compliance
- Built for **100% data availability** for systems using HyperSwap



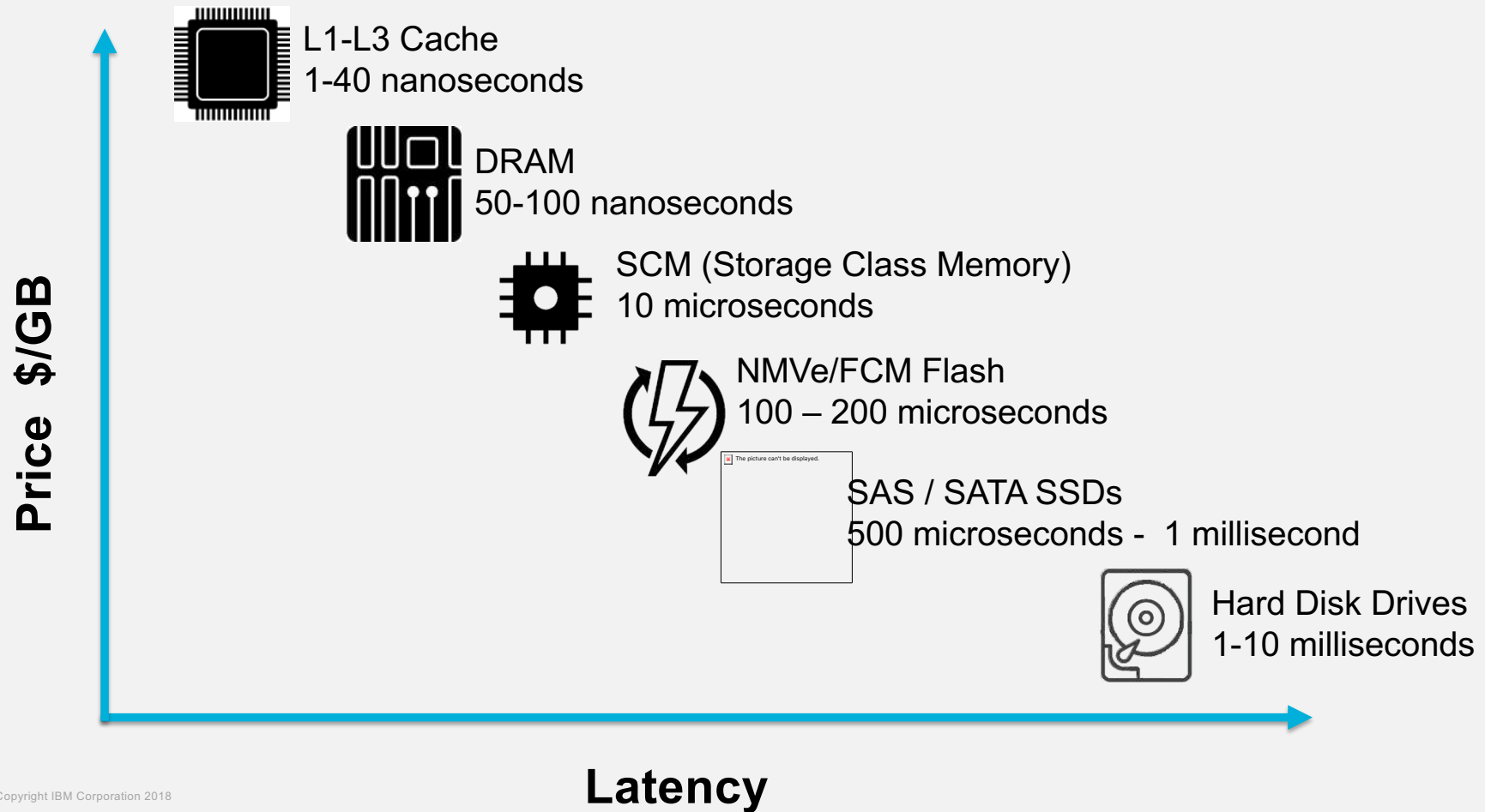
How is NVMe Different than SAS

IBM Storage and SDI

- NVMe is a new protocol designed for Flash Technologies
 - NVMe reduces latencies and increases bandwidth
 - NVMe initiator stack is performance optimized
 - Capable of future support of NVMe Storage Class Memory (SCM) media
- Supported NVMe drives are Self Encrypting
- Format behaviour more akin to FS900 than SAS
- FS9100 enclosure services are on a PCIe Switch rather than a SAS bus
 - Provides more bandwidth and lower latency to each drive

What does SCM capable mean?

IBM Storage and SDI



Accelerate business execution with IBM FlashCore NVMe Modules

IBM Storage and SDI

FlashCore technology differentiators:

- No performance impact due to hardware-based compression and encryption
- Outstanding data reliability
- Innovative ECC algorithm efficiently corrects high bit rate errors
- Endurance without latency penalty
- Optimal flash chip use through dynamic health checks
- Asymmetrical wear leveling
- FIPS 140-2 certification

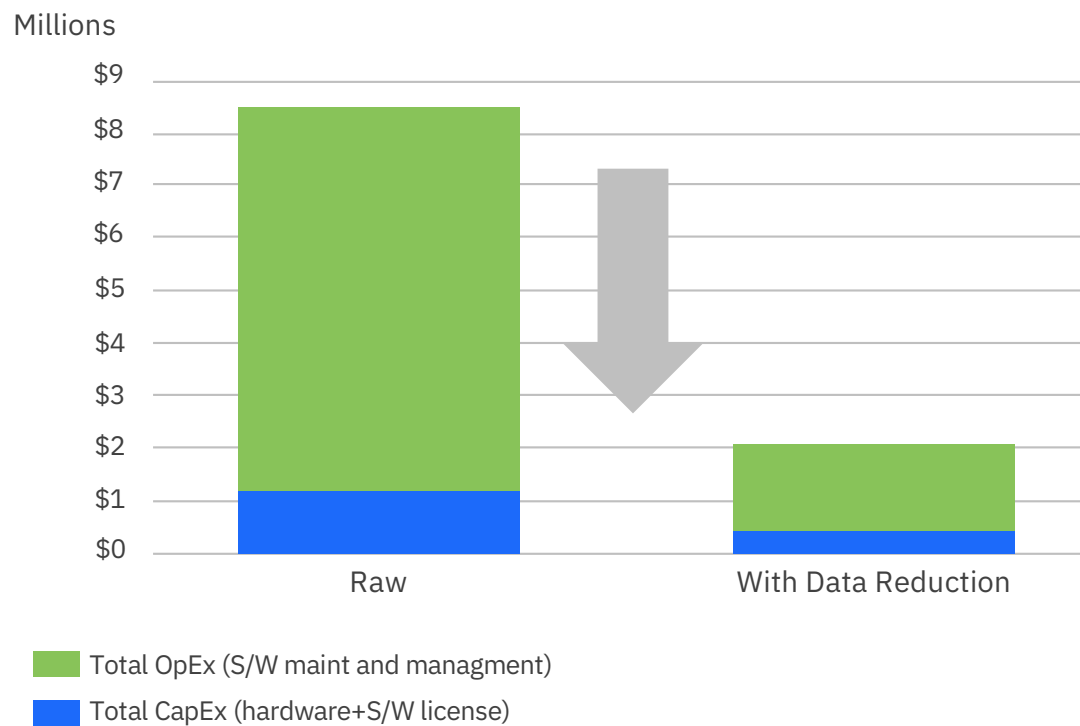


4.8TB, 9.6TB, 19.2TB
capacity options with
up to 5:1 compression

IBM FlashSystem 9100

Data Reduction 3 Year Financial Impact

IBM Storage and SDI



SAVINGS –
CAPEX: \$832,000
OPEX: \$5.6M

FlashSystem 9100

Approx. 968 TB usable configuration
5:1 data reduction
All software functions included
Typical street price

Transformation of Performance and Capacity

IBM Storage and SDI

↑ **Scale out**
10 million IOPS
136GB/sec in 8U

↓ **Zero Performance Impact**
Up to 3.6PB NVMe accelerated compressed data in 8U

↑ **Performance Density**
Up to 8PB of NVMe
Data storage in 8U with data reduction**

Performance and density to Modernize and Transform business efficiency

1.25M IOPS,
17GB/s per
rack unit

Up to 1PB
data storage
per rack unit

Up to 230TB
raw per rack
unit

IBM Storage Insights

AI-empowered Storage Analytics, Storage Resource Management, and Support Platform

IBM Storage and SDI

Knowledge Base

*Best practice +
Call Home Alerts +
Known issues +
Support feedback*



Analytics

*Identify impending issues or
configurations that do not
meet best practice*



Identify

AI finds matches!



Notification

Client Admin



IBM Support



*Proactive Insights
and Notifications*

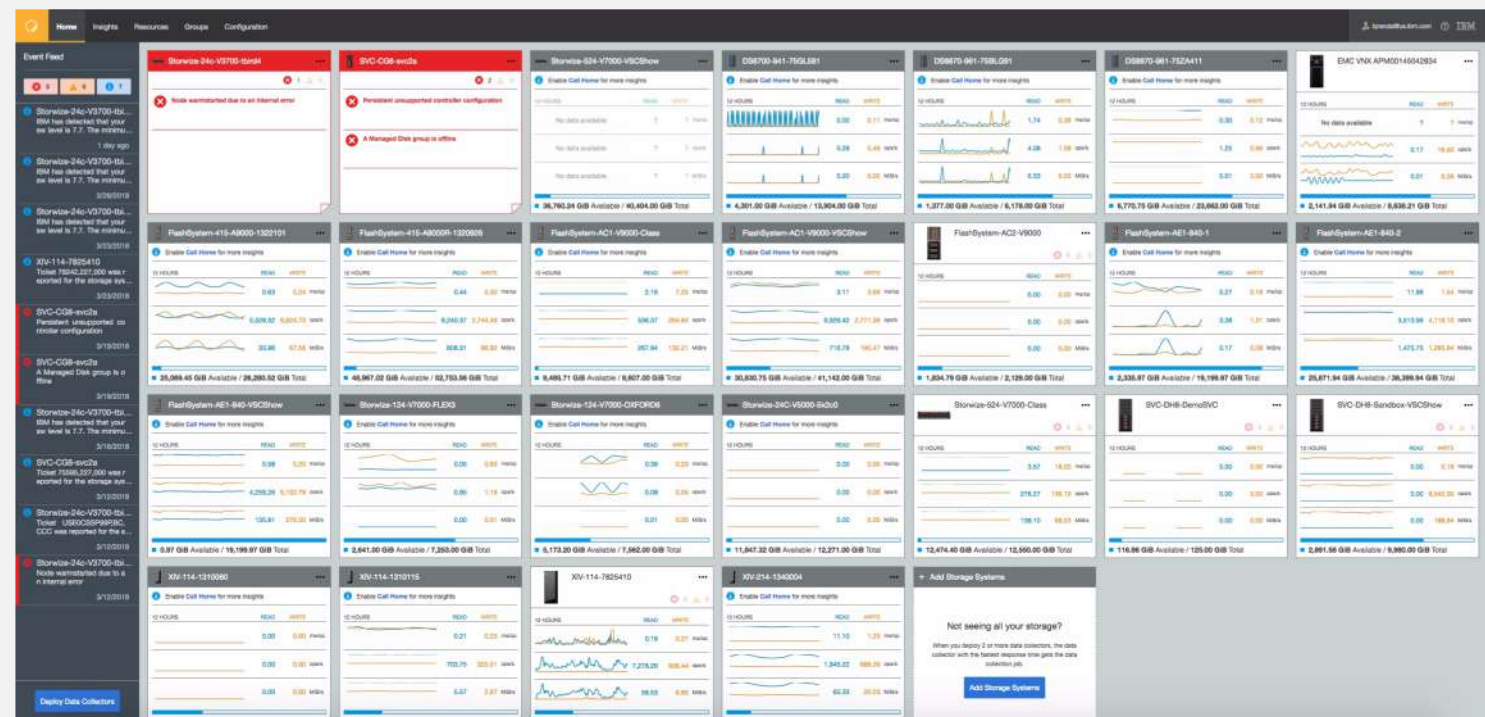
IBM Storage Insights

Unified dashboard of the storage environment

IBM Storage and SDI

One place to look

- Inventory at a glance
- Call home events
- Capacity
- Key performance metrics
- Validate call home is on and working



Complete Peace of Mind with IBM FlashSystem 9100

IBM Storage and SDI

- **IBM data reduction guarantee**

Flexible guarantee: up to 5:1 data reduction
Express guarantee: 2:1 data reduction

- **IBM availability guarantee**

IBM guarantees 100% data availability for systems using HyperSwap and deployed by IBM Lab Services

- **IBM controller upgrade program**

No up-front charges, no contractual commitment to buy

- **7 year 24x7 Support**

Up to 7 years support available with flash media retention offerings

- **Endurance**

IBM FlashCore Modules will be covered for read/write endurance while you are under warranty or maintenance

- **Migration**

Up to 45 days to migrate data at no extra charge



*Peace of
Mind Guarantee*

*Eligible storage systems vary by program terms and
conditions specified in guarantee contracts apply*

IBM FlashSystem 9100 Multi-Cloud Solutions

IBM Storage and SDI

Proven solutions to transform infrastructure efficiency

- Select from 3 new IBM FlashSystem 9100 Multi-Cloud Software Solutions
- Deploy rapidly and with confidence based on IBM validated blueprints
- Easily purchased together with FlashSystem 9100

Data Reuse,
Protection
and
Efficiency

Business
Continuity
and Data
Reuse

Private Cloud
Flexibility
and Data
Protection



Flexible, Modern, Agile and Blazing Fast

Data Reuse

IBM Storage and SDI



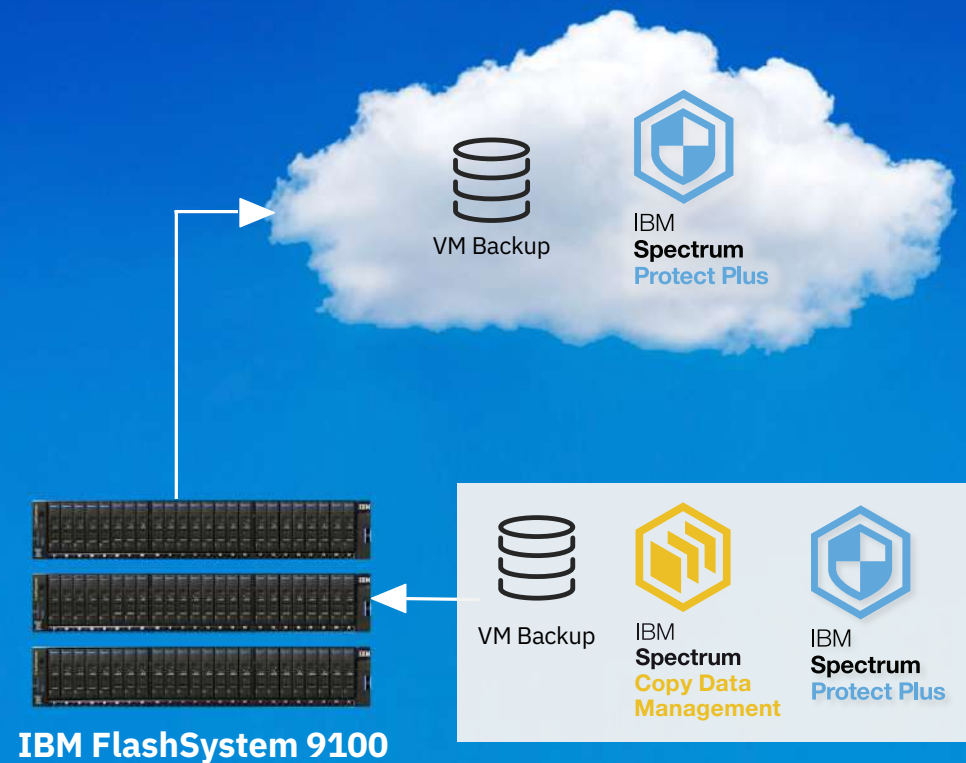
Flexible, Modern, Agile and Blazing Fast

IBM FlashSystem 9100 Solution for Data Reuse, Protection and Efficiency

IBM Storage and SDI

Protect and reuse data for maximum business agility

- Comprehensive backup in virtual or physical environments
- Quickly spin-up and spin-down real world environments using CDM's API integration and templating
- Reuse backup and other data copies for:
 - DevOps
 - Analytics
 - Reporting
 - DR
- Orchestrate copies to maximize use of snapshots
- Leverage flash speed to enable multiple use cases to meet all your SLAs



Flexible, Modern, Agile and Blazing Fast

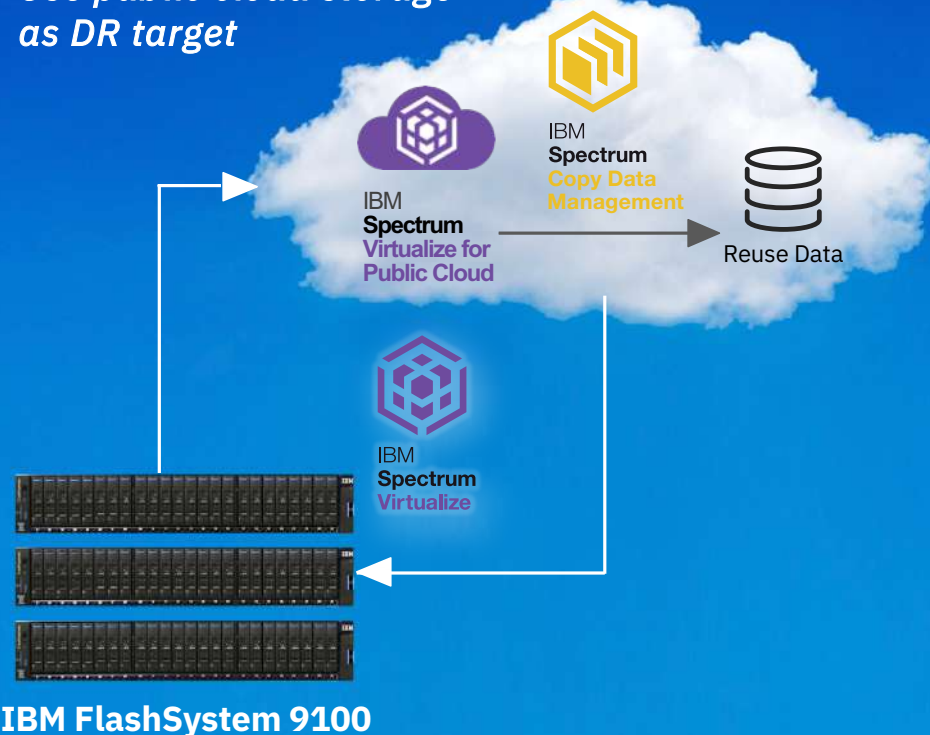
IBM FlashSystem 9100 Solution for Business Continuity and Data Reuse

IBM Storage and SDI

Deploy multi-cloud environments for business continuity and data reuse to reduce cost and improve agility

- Reduce OPEX/CAPEX for business continuity by replicating to IBM Cloud
- Leverage cloud DR copies for
 - DevOps
 - Analytics
 - Reporting
- Recover applications in VMware Environments in IBM Cloud with near zero RTO/RPO
- Easily migrate workloads between on-prem, private and IBM Cloud

Use public cloud storage as DR target



Flexible, Modern, Agile and Blazing Fast

IBM FlashSystem 9100 Solution for Private Cloud Flexibility and Data Protection

IBM Storage and SDI

Transform on-premises storage with cloud efficiency and flexibility for Docker and Kubernetes environments

- Maximize agility when deploying new-generation applications in on-prem environments or private clouds
- Automate storage provisioning and data protection
- Reuse backup and other data copies for DevOps, analytics and reporting with virtualized and Linux on bare metal environments
- Simplify deployment with pre-tested IBM Cloud Private and IBM Spectrum Access Blueprint



IBM Cloud Private



IBM
Spectrum
Copy Data
Management



IBM
Spectrum
Connect



IBM
Spectrum
Access
Blueprint



IBM FlashSystem 9100

Flexible, Modern, Agile and Blazing Fast

Multi Cloud Solutions - Offering Components

IBM Storage and SDI

Ordering	BASE	OPTIONAL	OPTIONAL	OPTIONAL
Software Offerings Orderable with FlashSystem 9100	Multi-Cloud Enabled Base Software for FlashSystem 9100	IBM FlashSystem 9100 Solution for Data Reuse, Protection and Efficiency (per TB)	IBM FlashSystem 9100 Solution for Business Continuity and Data Reuse (per TB)	IBM FlashSystem 9100 Solution for Private Cloud Flexibility, and Data Protection (per TB)
Products				
Spectrum Storage Insights	✓			
Spectrum Connect	✓			
Spectrum Virtualize	✓			
Spectrum Protect Plus	✓ (5TB Starter Kit)	✓		
Spectrum CDM	✓ (5TB Starter Kit)	✓	✓	✓
Spectrum Virtualize for Public Cloud	✓ (5TB Starter Kit)		✓	
Blueprint	✓	✓	✓	Spectrum Access
Lab Services (Post GA)		✓ (optional)	✓ (optional)	✓ (optional)

IBM FlashSystem 9100

FlashSystem 9110 and FlashSystem 9150

IBM Storage and SDI

Dual Active-Active Array Controllers w/NVMe to Flash Media
Dual-ported 2.5" NVMe Flash bays (24)

Flash Core Modules redesigned to 2.5" industry standard form factor
(Includes: HW Compression, HW Encryption and 64 Layer 3DTLC)

FS9110

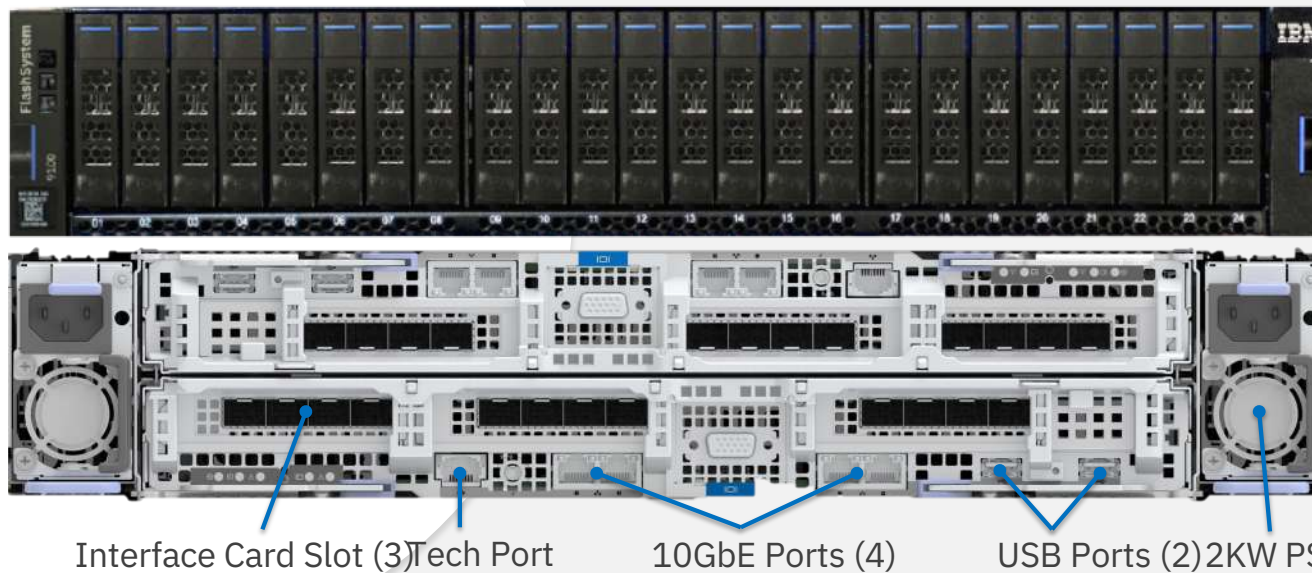
Dual 8-core processors per controller

Up to 1.5TB Cache per controller enclosure

FS9150

Dual 14-core processors per controller

Up to 3 host adapters per controller



Interface Card Slot (3) Tech Port

10GbE Ports (4)

USB Ports (2) 2KW PSU (2)

Supported Flash Modules

IBM Storage and SDI

New Flash Core Modules (FCM)

Size	Compression Capable	Encryption Capable
4.8 TB	Yes	Yes
9.6 TB	Yes	Yes
19.2 TB	Yes	Yes

Industry Standard NVMe Drives

Size	Compression Capable	Encryption Capable
1.92 TB	No	Yes
3.84 TB	No	Yes
7.68 TB	No	Yes
15.36 TB	No	Yes

Valid Supported Memory Configurations

Cache

IBM Storage and SDI

Canister	Control Enclosure	DDR4 DIMM Use/Canister
64GB	128GB	4 x 16GB
128GB	256GB	8 x 16GB
192GB	384GB	12 x 16GB
384GB	768GB	12 x 32GB
576GB	1152GB	12 x 16GB 12 x 32GB
768GB	1536GB	24 x 32GB

Supported Host connections

IBM Storage and SDI

Supported Adapters

Number of Cards	Ports	Protocol	Possible Slots
0-3	4	16Gb Fibre Channel	1, 2, 3
0-3	2	25Gb Ethernet (iWarp)	1, 2, 3
0-3	2	25Gb Ethernet (ROCE)	1, 2, 3
0-1	2	12Gb SAS Expansion	3

On Board Ethernet Ports

Port	Speed	Function
1	10 GbE	Management IP, Service IP, Host/Storage IO, IP Replication
2	10 GbE	Secondary Management IP, Host/Storage IO, IP Replication
3	10 GbE	Host/Storage IO, IP Replication
4	10 GbE	Host/Storage IO, IP Replication
T	1 GbE	Technician Port – DHCP/DNS for direct attach service management

Capacity Can Be Added At Any Point In Time

IBM Storage and SDI



- If expansion beyond twenty-four drives is required, it is easily accomplished
- Capacity can be added with up to twenty 12Gb/s SAS 24F expansion enclosures
- Capacity can also be added with up to eight 12Gb/s SAS 92F expansion enclosures



FlashSystem 9100 will be trust based and all-inclusive

- Features are all included as part of the base license
- Internal Storage will be licensed on a per enclosure basis
- Encryption which will use key based activation for regional controls
- Externally Virtualized storage will be SCU licensed (same as with the SVC)

IBM Storage and SDI

Thank you