



IBM Elastic Storage Server Update

New York Spectrum Scale User Group
October 24, 2018



John Sing

WW Offering Evangelist

IBM Spectrum Scale, Elastic Storage Server

jmsing@us.ibm.com

Including Announcements of October 2018

Storage for the world's most powerful supercomputer



Summit System

- 4608 nodes, each with:
 - 2 IBM Power9 processors
 - 6 Nvidia Tesla V100 GPUs
 - 608 GB of fast memory
 - 1.6 TB of NVMe memory
- 200 petaflops peak performance for modeling and simulation
- 3.3 ExaOps peak performance for data analytics and AI
- **Spectrum Scale V5**
- **77 Elastic Storage Servers**

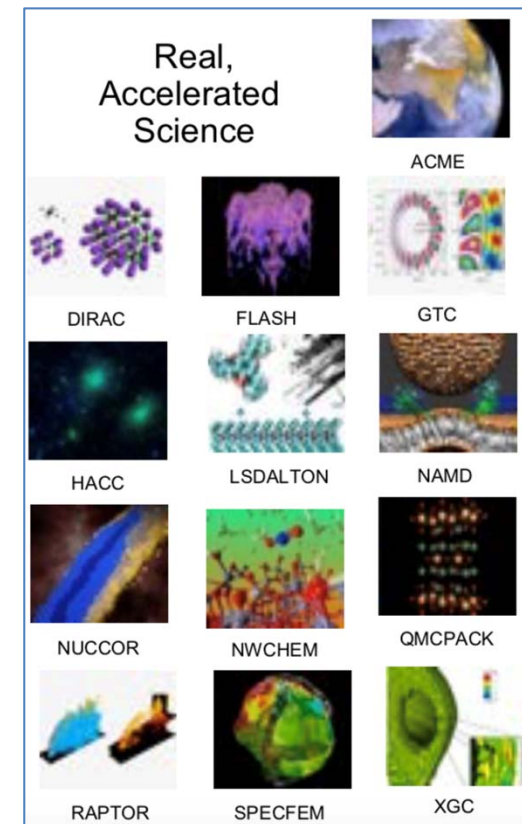


2.5 TB/sec

Throughput to storage architecture

250 PB

HDD storage capacity



Elastic Storage Server



Integrated Solution

IBM Elastic Storage Server (ESS)

Integrated scale-out data management for file and object data



Optimal building block for high-performance, scalable, reliable enterprise Spectrum Scale storage

- Faster data access with choice to scale-up or out
- Easy to deploy clusters with unified system GUI
- Simplified storage administration
- Current releases of **Spectrum Scale V5**

One solution for all your Spectrum Scale data needs

- Single repository of data with unified file and object support
- Anywhere access with multi-protocol support: NFS 4.0, SMB, OpenStack Swift, Cinder, and Manila
- Ideal for Big Data Analytics with full Hadoop transparency

Ready for business critical data

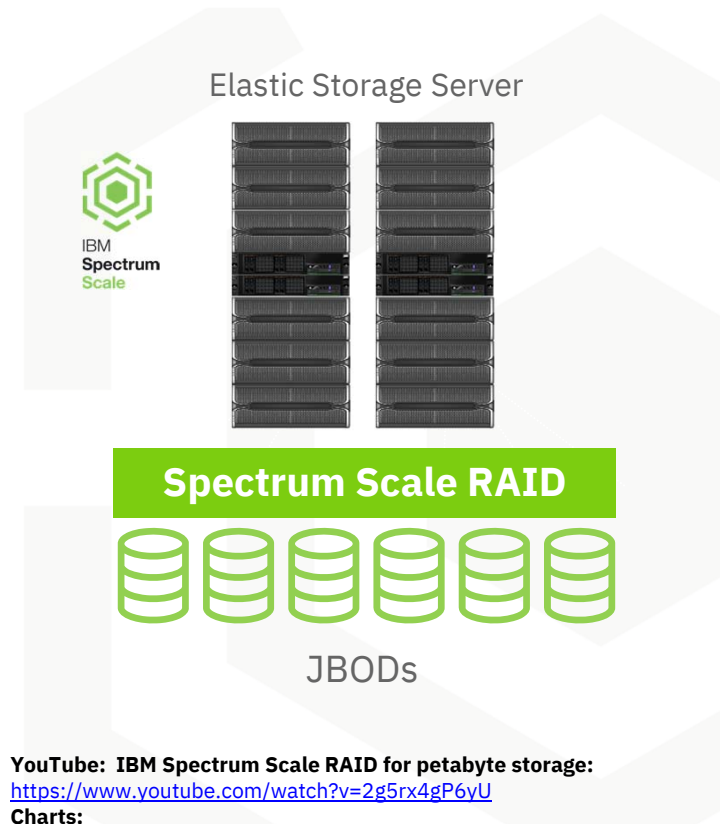
- Disaster recovery with synchronous or asynchronous replication
- Ensure reliability and fast rebuild times using Spectrum Scale RAID's dispersed data and erasure code
- Five 99999s of availability



ESS is IBM's delivery vehicle for Spectrum Scale RAID



- **Petabyte-scale: standard, inexpensive disk drives**
 - Erasure Code software implemented in Spectrum Scale
- **Petabyte-scale: faster rebuild times**
 - More disks are involved during rebuild
 - Approx. 3.5 times faster than RAID-5
- **Petabyte-scale: minimal impact of rebuild on system performance**
 - Rebuild is done by many disks
 - Rebuilds can be deferred with sufficient protection
- **Petabyte-scale: fault tolerance**
 - End to end checksum reduces / eliminates file system checks
 - Much longer mean-time-to-data-loss (MTTDL)



YouTube: IBM Spectrum Scale RAID for petabyte storage:
<https://www.youtube.com/watch?v=2g5rx4gP6yU>
Charts:
<https://www.usenix.org/legacy/events/lisa11/tech/slides/deenadhavalan.pdf>

Coming Soon to the ESS - Spectrum Scale RAID FAQ

Table 4. ESS support matrix

ESS software level	Endian BE, LE	ESS hardware models	IBM Spectrum Scale software level	RHEL OS
5.3.1.1	BE, LE	5146, 5147, 5148	5.0.1	RHEL 7.4
5.3.1.0	BE, LE	5146, 5147, 5148	5.0.1	RHEL 7.4
5.3.0.1	BE, LE	5146, 5147, 5148	5.0.0	RHEL 7.3
5.2.2	BE, LE	5146, 5147, 5148	4.2.3	RHEL 7.3
5.2.1	BE, LE	5146, 5147, 5148	4.2.3	RHEL 7.3
5.2	BE, LE	5146, 5147, 5148	4.2.3	RHEL 7.3
5.1.1	BE, LE	5146, 5147, 5148	4.2.3	RHEL 7.2
5.1	BE, LE	5146, 5147, 5148	4.2.3	RHEL 7.2
5.0.2	BE	5146, 5147, 5148	4.2.2	RHEL 7.2
5.0.1	BE	5146, 5147, 5148	4.2.2	RHEL 7.2
5.0.0	BE	5146, 5147, 5148	4.2.2	RHEL 7.2
4.6.0	BE	5146	4.2.1	RHEL 7.2
4.5.2	BE	5146	4.2.1	RHEL 7.1
4.5.1	BE	5146	4.2.1	RHEL 7.1
4.5.0	BE	5146	4.2.1	RHEL 7.1
4.0.6	BE	5146	4.2.0	RHEL 7.1

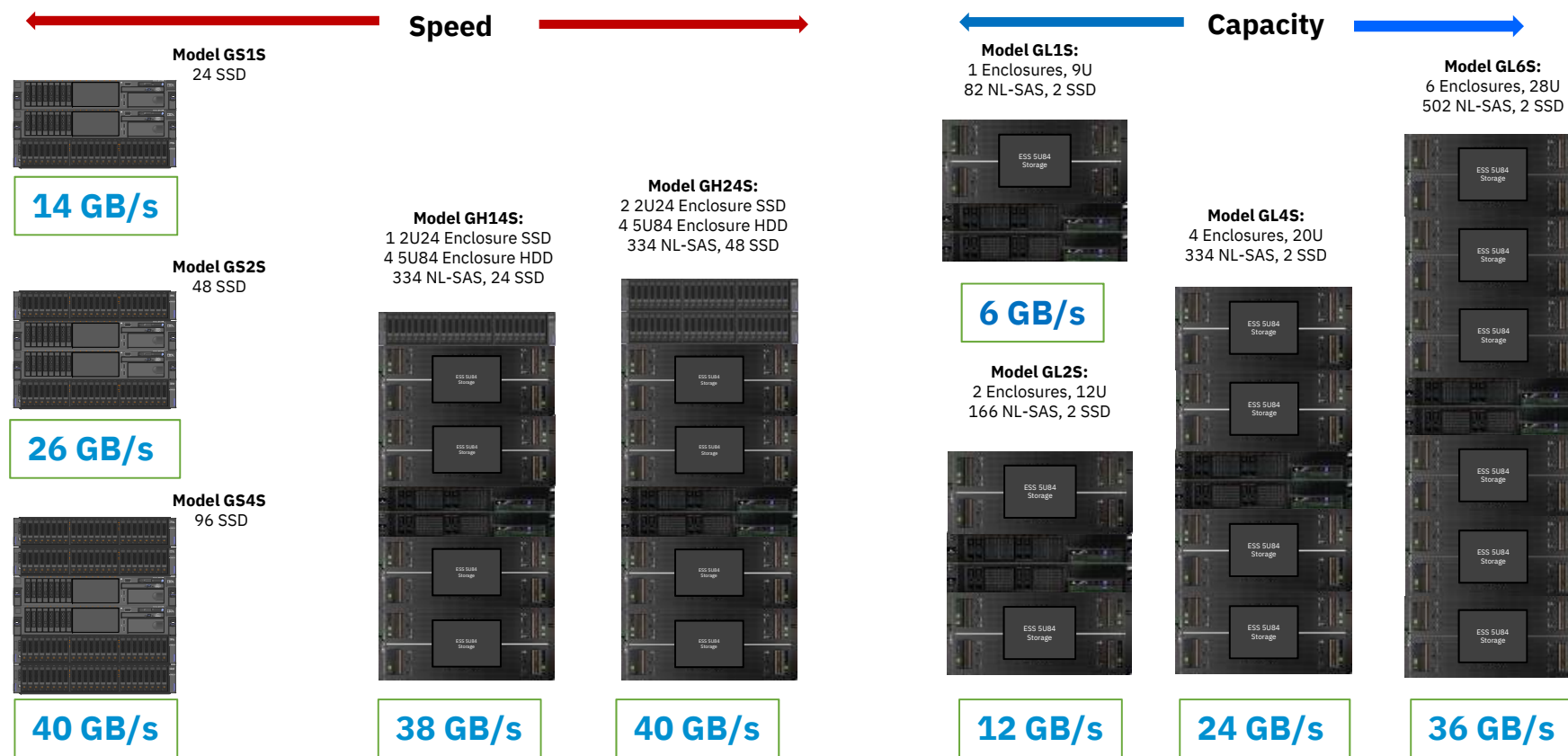
New ESS Solution *HW, SW Lifecycle / Support* info will be published soon

Table 5. ESS component levels

ESS	IBM Spectrum Scale	RHEL OS	Kernel update	OFED	Firmware	IPR	Systemd	Network manager
5.3.1.1 (PPCBE and PPCLE)	5.0.1-2	Red Hat Enterprise Linux 7.4	3.10.0-693.35.1	MLNX_OFED_LINUX-4.3-1.0.1.1 OFED2: (Packaged to support CX2): MLNX_OFED_LINUX-4.1-4.1.6.0	SV860_138 (FW860.42)	18518200	219-42.el7_4.11	1.8.0-12.el7_4
5.3.0.1 (PPCBE and PPCLE)	5.0.0-1 (GNR efix)	Red Hat Enterprise Linux 7.3	3.10.0-514.44.1	MLNX_OFED_LINUX-4.1-4.1.6.1	SV860_138 (FW860.42)	17518300	219-42.el7_4.10	1.8.0-11.el7_4
5.2.3 (PPCBE and PPCLE)	4.2.3-10	Red Hat Enterprise Linux 7.3	3.10.0-514.51.1	MLNX_OFED_LINUX-4.1-4.1.6.1	SV860_138 (FW860.42)	17518300	219-42.el7_4.11	1.8.0-12.el7_4
5.1.2 (PPCBE)	4.2.3-2	Red Hat Enterprise	3.10.0-327.55.3	MLNX_OFED_LINUX-4.0-2.0.0.3	SV860_103 (FW860.30)	15511800	219-30.el7_3.9	Not applicable

<https://www.ibm.com/support/knowledgecenter/en/SSYSP8/gnrfaq.html>

IBM Elastic Storage Server



IBM Elastic Storage Server: Hybrid Models



Model GL1S:
1 Enclosures, 9U
82 NL-SAS, 2 SSD

ESS Hybrid Models: GH14 and GH24

- Provide combination of flash and HDD storage tiers in one ESS building block
- Combine All Flash performance with GL4S capacity
- Use cases:
 - Single system for both metadata services and high density
 - Use the Flash for Burst Buffer storage and have Spectrum Scale migrate data to high density spinning disk
 - Use Scale to automatically manage data location between flash and disk based upon heat maps and policy
 - Handle multiple kinds of workloads such as video and analytics in the same environment

Model GH14S:
1 2U24 Enclosure SSD
4 5U84 Enclosure HDD
334 NL-SAS, 24 SSD



38 GB/s*

Model GH24S:
2 2U24 Enclosure SSD
4 5U84 Enclosure HDD
334 NL-SAS, 48 SSD



40 GB/s*

*Estimated Performance

IBM Elastic Storage Server 5.3.2 – GA on Nov 9, 2018

Improved storage capacity and economy

- New ESS GLxC models use denser enclosures to deliver up to **26% more capacity in 17% less rack space***

Capacity upgrade without disrupting operations

- Capacity upgrades can be performed without application disruption
- Software automatically rebalances data across all drives

High performance connectivity

- Optional integrated 100Gb Mellanox Ethernet switch provides a lower cost high performance interconnect alternative to Infiniband

Leverage the latest IBM Spectrum Scale releases

- Data Management Edition, *new* Data Access Edition



Model	4U106 drawers	Drives	Raw capacity	Software licenses
GL1C	1	104	1.04 PB	104
GL2C	2	210	2.1 PB	210
GL4C	4	432	4.22 PB	432
GL6C	6	634	6.34 PB	634

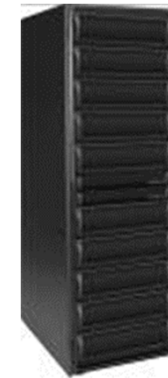
* Model GL6C compared to GL6S; varies by model

ESS GLxC: improved storage capacity and economy

- ESS GLxC models
 - The latest Seagate and helium drives
 - The highest storage density
 - Approximately 24% more per ESS
 - Faster drive access speeds*
 - More drive enclosure connections
 - Technical insights:
 - Uses **5** SAS cards per P8 Power data server
 - Thus max of 2 network interface cards (NIC)
- Leveraging the CORAL supercomputer modular design



In a single 42U Rack



>70GB/sec
>8PB of storage
>789TB per Rack Unit
Ultra-dense storage

* Benchmarks in process for publishing at SC18



Non-disruptive upgrades

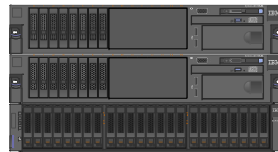
Simple expansion of Storage Capacity

- Spectrum Scale will automatically rebalance data in the background
- System automatically puts the new capacity to use
- No need to Archive & Restore data
- No System disruption*

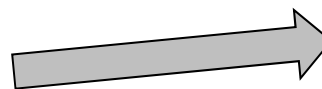
Non Disruptive Upgrades	
From	To
GS1S	GS2S
GS2S	GS4S
GL1S	GL2S
GL2S	GL4S
GL4S	GL6S

Example

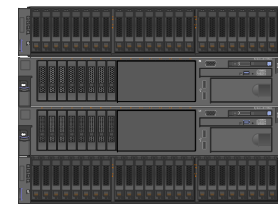
Model GS1S
With 24 SSDs



Install additional
drawer with 24 SSDs



Model GS2S
With 48 SSDs



*Requires space available in the rack

High performance connectivity

ESS networking options are now expanded:

- 100Gb Ethernet switch (Mellanox)
 - High performance industry standard interconnect as an alternative to Infiniband
 - Integrated, cabled and tested in the IBM racked ESS solution
 - Optional unracked delivery for customer provided rack.
 - Mellanox's multi-rate Open Ethernet products enable users to benefit from a far more scalable, lower latency, and virtualized fabric

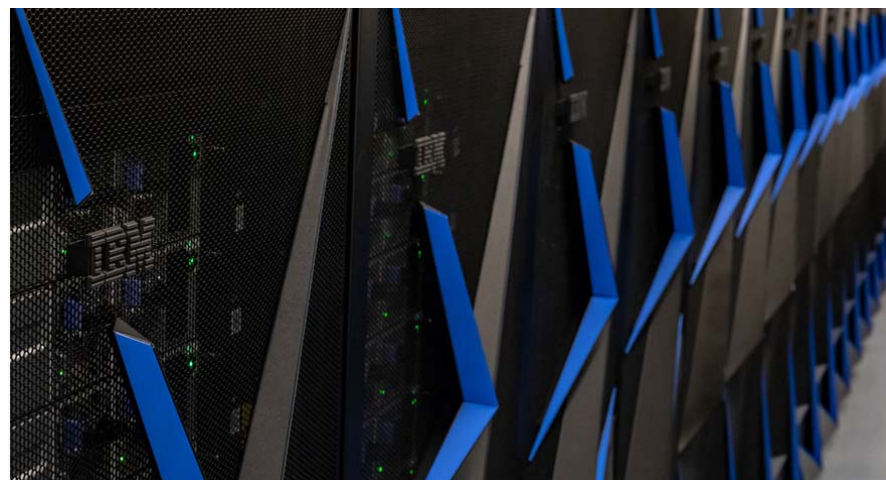


ESS is part of IBM Power Accelerated Computing Platform



Accelerated compute configurations for High Performance Computing (HPC and Artificial Intelligence (AI) / Deep Learning (DL)

- Provides ability to create you own installation based on the IBM CORAL installation – the world's most powerful and smartest supercomputer



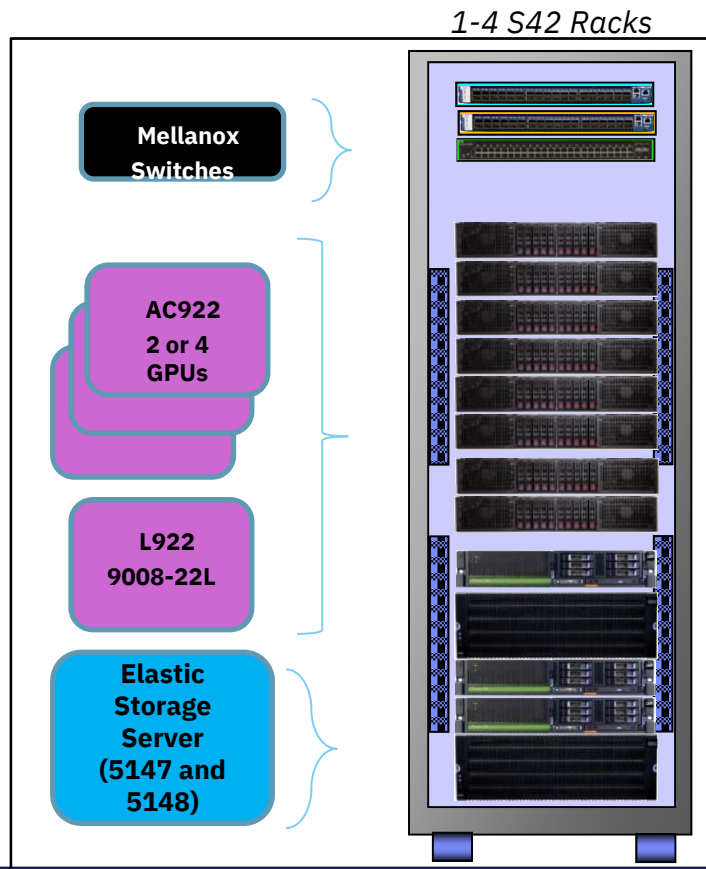
CORAL-based Power/ESS Configuration example

- Simplified configuration of scale-out infrastructure
- Support for HPC and AI workloads
- Software preloaded and fully rack integrated in IBM manufacturing

Storage	Compute	Management	Switches	Rack
Elastic Storage Server	AC922 (2 or 4 GPU) 8335-GTG	L922+ Management Server	Mellanox	One to four 42U Racks (S42)
Optional	Air Cooled Only Same Processors as in CORAL Servers		100Gb InfiniBand 40Gb Ethernet 10Gb Ethernet 1Gb Ethernet	If you really need more, let us know!

Power Accelerated Computing Platform

Sample Building Block View



Configurable with **Elastic Storage Server**
and Network Switches

Includes Login and Management Servers

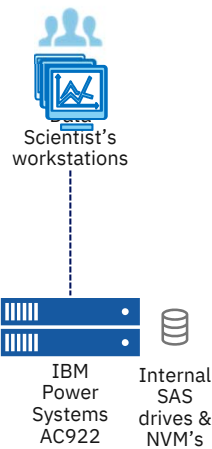
Assembled in IBM factory for each client

Delivered ready to “plug in” to power

IBM AI Architecture from Experimentation to Expansion

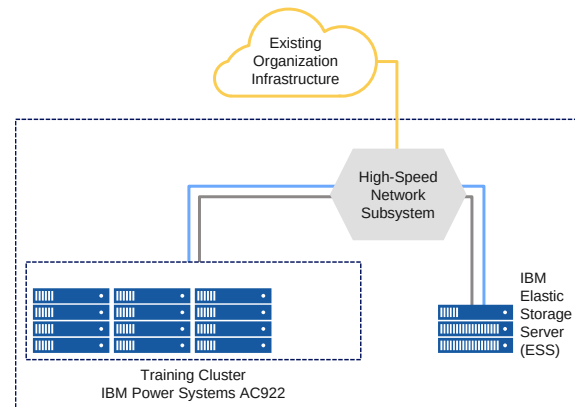
Experimentation

Single Tenant



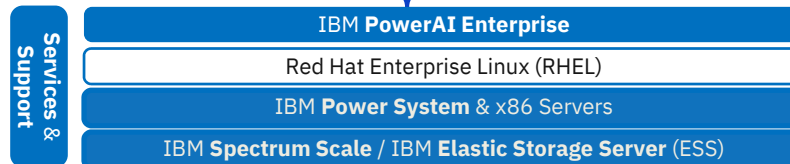
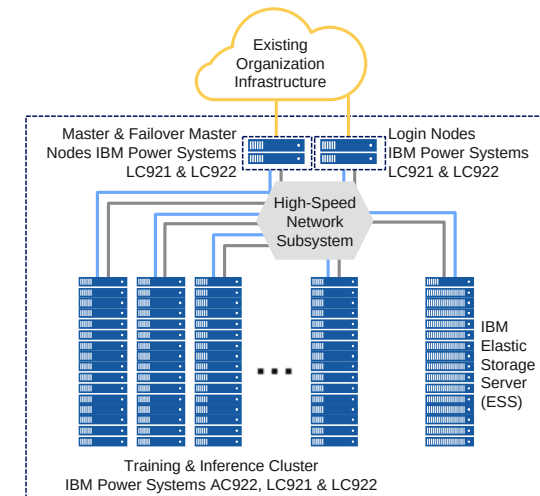
Stabilization & Production

Secure Multitenant



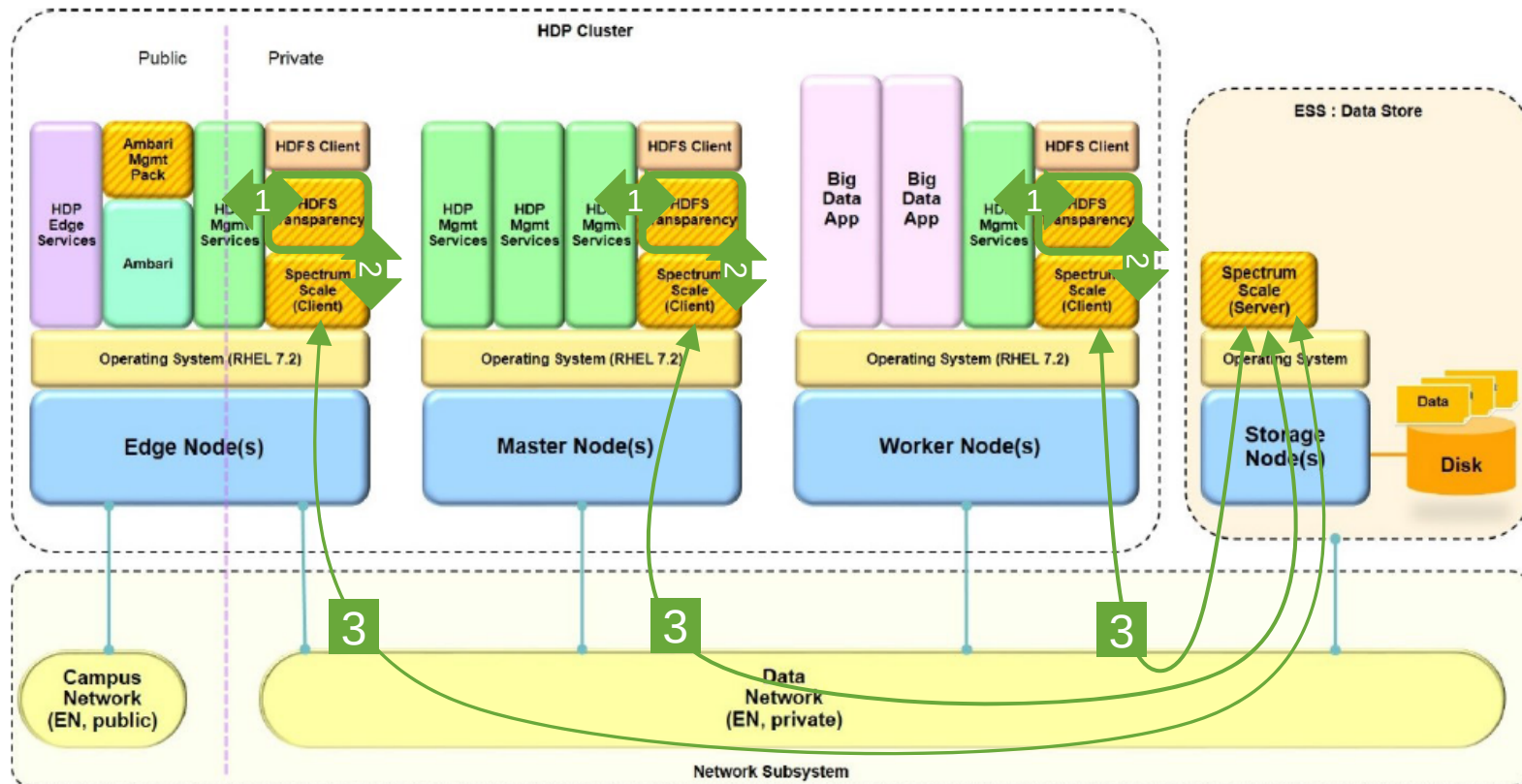
Expansion

Enterprise Scale / Multiple Lines of Business



One software stack from experimentation to expansion

Often Asked: Hadoop Transparency Connector diagram



Spectrum Scale, ESS Use Cases and References



Chip Design – Cypress Semiconductor:
<https://www.youtube.com/watch?v=Kn90TkMvkfw>
<https://www.youtube.com/watch?v=TfYDeP1F-CY>



Finance - Viewpoint:
<https://www.youtube.com/watch?v=SgJc0fjnOsg&t=52s>



<https://www.youtube.com/watch?v=ID8CIPQYRTI>



Real time analytics – Red Bull Racing:
https://www.youtube.com/watch?v=r_DD65KnYO8



SuperComputing 2017:
<https://www.youtube.com/watch?v=xVzPkUIVDh4>



Healthcare - SIDRA: <https://www.youtube.com/watch?v=BdoU5naRiyo>
<https://www.youtube.com/watch?v=BdoU5naRiyo&t=8s>



Speech and Imaging - Nuance Communications:
<https://www.youtube.com/watch?v=Cq7daARviak>



Media/Entertainment – new Atlanta stadium:
<https://www.youtube.com/watch?v=GMarZjIviYs>
<https://www.youtube.com/watch?v=n3sdQypcxok>
https://www.youtube.com/results?search_query=ibm+atlanta+falcons+stadium
<https://www.ibm.com/events/think/watch/replay/114049526/>

- **Banking and Financial Services** – fraud prevention, check truncation, regulatory compliance
- **Insurance** – Policies & underwriting
- **Media and Entertainment** – radio and television, Remote DVR
- **Petroleum** – Seismic data ingest and analytics
- **Smarter cities** – Video surveillance
- **Automotive** – Crash test recording, autonomous driving, etc.

- **Smarter cities** – Video surveillance
- **Defense / Military** – flight recording, threat assessment
- **Public / Government** – Law enforcement, recording of events, personnel cameras, satellite Image archival
- **Telecom** – Call Detail Records
- **Life Sciences and Pharmaceuticals** – Genomics
- **Hospitals** – Medical images
- ...



Oh!



Just one more thing....

ESS Roadmap Outlook for 2019

- 1Q19
 - 14TB HDD
- After That
 - Faster Infiniband (HDR and NDR)
 - Newer levels of Spectrum Scale, RHEL
 - “Capacity model” enhancements
 - Partial population of enclosures
 - "Performance model" enhancements (NVMe)

Getting started



Next steps you can do today!

- **Schedule remote Proof of Technology Lab**
 - Three global IBM labs with deep expertise
- **Try Spectrum Scale on Amazon Web Services Quickstart**
- **Experience Spectrum Scale virtual machine demonstration**
 - Download & run on your system for PoC
- **Free Introductory IBM Education course on ESS and Spectrum Scale RAID (30 minutes):**
<https://www.onlinedigitallearning.com/course/view.php?id=2173>
(Log on with your IBM ID)



ibm.com/systems/storage/spectrum/scale/

Store **Everywhere.** Run **Anywhere.**

Thank You



John Sing

WW Offering Evangelist

IBM Spectrum Scale, Elastic Storage Server

jmsing@us.ibm.com

Supplement

IBM Spectrum Scale on AWS

Bring Your Own License



Easily deploy a high availability scalable cluster filesystem on AWS infrastructure

- For Scale customers: exploit AWS elasticity for your workload
- For AWS customers: an HPC-capable file system

Purchase and deployment

- Deploy through AWS Marketplace (same experience as any other AWS offering)
- IBM-provided Cloud Formation script
 - deploys a cluster of EC2 instances (Amazon virtual servers),
 - deploys Spectrum Scale across the cluster
 - mounts the Scale filesystem across the instances
- IBM Spectrum Scale Support from IBM through normal channels
 - AWS infrastructure support from Amazon. If in doubt, call IBM first.

Native AWS cloud experience

- Cluster expansion and limited contraction
- Shutdown and restart of cluster without removing any Amazon storage volume resource
- Collection of AWS cluster management debug info

IBM Spectrum Scale Data Access Edition

- Simpler and more predictable cost structure preferred by most clients
 - Per-terabyte pricing replaces existing per-socket pricing
 - Much simpler to understand and plan
- Replaces IBM Spectrum Scale Standard Edition
 - Same functionality as Standard Edition
 - Existing Standard Edition customers may continue to use current per-socket pricing



Licensing Options Summary



Spectrum Scale	Standard Edition	Data Access Edition	Data Management Edition
Pricing metric	Per socket Server, client, FPO	Per “usable” TB Per Disk Option with ESS	Per “usable” TB Per Disk Option with ESS
Multi protocol scalable file service with simultaneous access to a common set of data	●	●	
Facilitate data access with a global namespace, massively scalable file system, quotas and snapshots, data integrity & availability and filesets	●	●	
Simplify management with GUI	●	●	
Improved efficiency with QoS and Compression	●	●	
Create optimized tiered storage pools based on performance, locality, or cost	●	●	
Simplify data management with Information Lifecycle Management (ILM) tools that include policy based data placement and migration	●	●	
Enable worldwide data access using AFM asynchronous replication	●	●	
Asynchronous multi site Disaster Recovery		●	
Hybrid cloud (TCT)		●	
Protect data with native encryption and secure erase, NIST compliant and FIPS certified.		●	
File Audit Logging		●	
Watch Folder (iNotify)		●	

Free! Introduction to IBM Elastic Storage Server and Spectrum Scale RAID



<https://www.onlinedigitallearning.com/course/view.php?id=2173> (Log on with your IBM ID)

The screenshot shows the IBM online learning interface. At the top, there are navigation links for "My Enrollments" and "My courses". Below this, the course ID "DL08003G" is displayed. The main content area is titled "Introducing the Elastic Storage Server". It includes a description of the IBM Elastic Storage Server, which is a big data storage system combining Power servers, storage enclosures, and disks with IBM Spectrum Scale and IBM Spectrum Scale RAID technology. The course is labeled as "Basic", "30 Minutes", and "Self-paced". A "Launch" button is visible. On the left side, there is a sidebar with navigation options: "Navigation", "My Enrollments", "My courses" (with a dropdown arrow), "DL08003G" (with a dropdown arrow), and "Support". Below this, there is a section for "Self Completion" stating "You have already completed this course". At the bottom of the sidebar, there is a section for "Course Completion Status".

IBM ESS Entry Model GL1S



An entry ESS:

2U for ESS 5148-21L ESS Mgmt Server

9U for the ESS GL1S



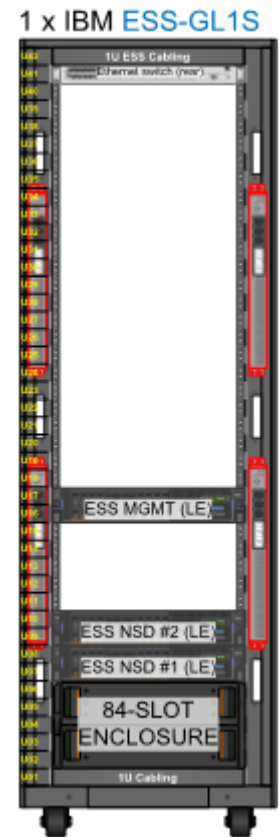
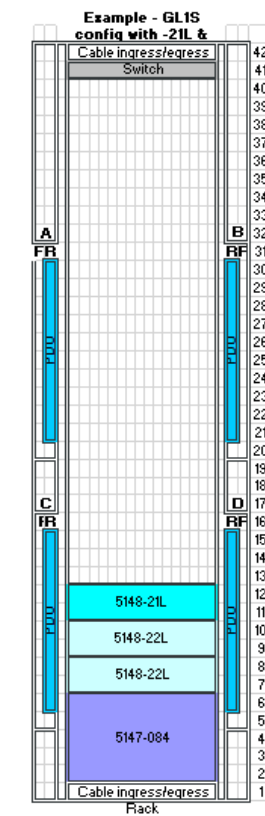
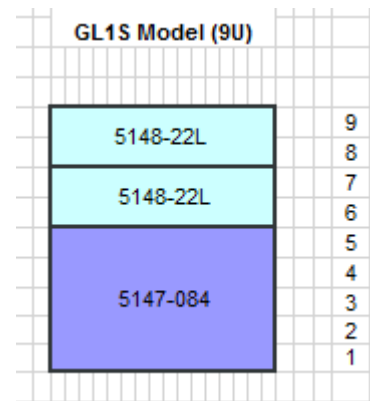
5148-21L – 2U ESS Mgmt Server



5148-2L – 2U ESS Data Server #1

5148-2L – 2U ESS Data Server #1

5147-084 – 5U84 ESS Storage



IBM ESS Hybrid Models GH14 and GH24



Hybrid ESS:

2U24 for All Flash SSD drawer

5U84 for HDD drawers

Model GH14S:

1 2U24 Enclosure SSD
4 5U84 Enclosure HDD
334 NL-SAS, 24 SSD



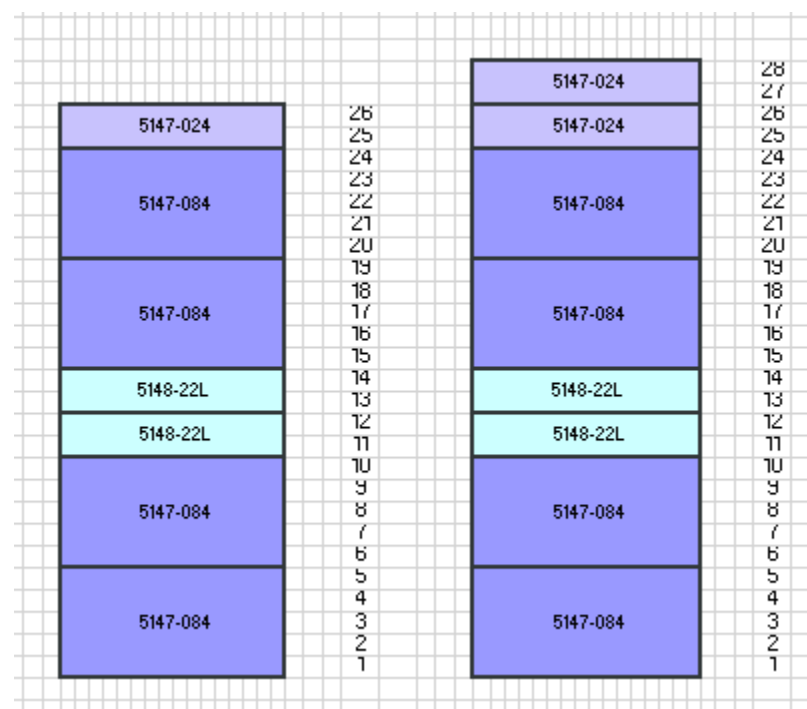
38 GB/s*

Model GH24S:

2 2U24 Enclosure SSD
4 5U84 Enclosure HDD
334 NL-SAS, 24 SSD



40 GB/s*



Spectrum Scale User Group



- The Spectrum Scale User Group is free to join and open to all using, interested in using or integrating Spectrum Scale. Check out the links below for upcoming meetings.
 - In addition to the User Group hosting their own meetings, IBM will host Spectrum Scale User Group meetings at most IBM Systems Technical Universities in 2018.
 - Join the User Group activities to meet your peers and get access to experts from partners and IBM. Check out the Presentations link, free download of excellent material.
- **Web page:** <http://www.spectrumscale.org/>
 - **Presentations:** <http://www.spectrumscale.org/presentations/>
 - **Mailing list:** <http://www.spectrumscale.org/join/>
 - **Contact:** <http://www.spectrumscale.org/committee/>



YouTube channel for Spectrum Scale User Group:

https://www.youtube.com/watch?v=iX440e_VHE&list=PLrdepxEIEyCp1TqZ2z3WfG0gqO9oY01xY

<http://www.spectrumscaleug.org/category/posts-meetings/>

Big Data and Analytics Enhancements



- **Spectrum Scale Certification with HortonWorks Data Platform 2.6**

- Certified on both Power8 and x86 platforms
- Certified with Ambari 2.5 for rapid deployment
- Hortonworks names IBM “Global Partner of the Year 2017”

- **Integration with Spectrum Conductor for Spark**

- **Much more information:**

- **YouTube: Hadoop / Hortonworks on Spectrum Scale:**
<https://www.youtube.com/watch?v=8pZuiNvgfWk>
- **Evaluator Group Analyst report:**
<https://www.youtube.com/watch?v=Yp8m4A6IpgA>
- **Redpaper:** Hortonworks Data Platform with IBM Spectrum Scale: Reference Guide for Building an Integrated Solution
<https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/redp5448.html?Open>
- **Hortonworks Data Platform (HDP) Solution Brief:** Hortonworks Data Platform on IBM Power Systems for Financial Service
<https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=POS03163USEN>
- **Newest deliverable, published November 22, 2017:** Reference Architecture for HortonWorks / Hadoop Data Platform on Power, ESS and Spectrum Scale
• <https://www.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=POL03281USEN&>



Hadoop / Hortonworks on Spectrum Scale / ESS
<https://hortonworks.com/partner/ibm/>



Hadoop and Hortonworks Data Platform on Power / Spectrum Scale / ESS Information



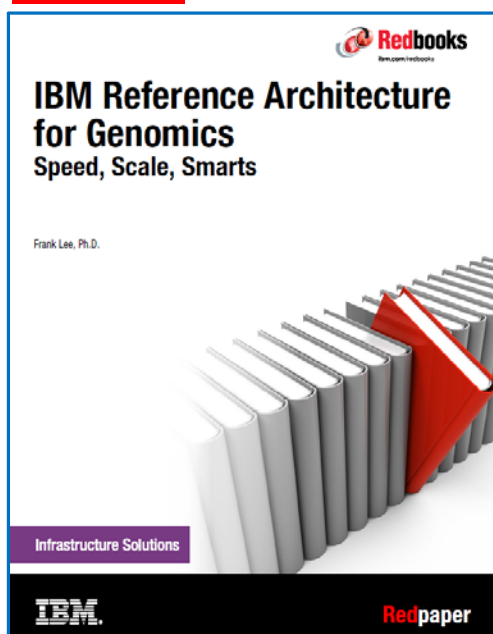
- **Hortonworks Data Platform on Power – Solution Brief**
 - <https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=POS03160USEN&>
- **Reference Architecture:**
 - <https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=POL03270USEN&>
- **Redpaper:** IBM Spectrum Scale Big Data and Analytics Solution: <http://www.redbooks.ibm.com/redpapers/pdfs/redp5397.pdf>
- **Redpaper:** Hortonworks Data Platform with Spectrum Scale - Reference Guide for Building an Integrated Solution (July 2017):
 - <http://www.redbooks.ibm.com/abstracts/redp5448.html?Open> and <http://www.redbooks.ibm.com/redpapers/pdfs/redp5448.pdf>
 - Spectrum Scale 4.2.3 Big Data and Analytics manual: https://www.ibm.com/support/knowledgecenter/en/STXKQY_4.2.3/com.ibm.spectrum.scale.v4r23.doc/bl1xx_library_prodoc.htm
 - Certification testing complete Hortonworks Data Platform on Power / Spectrum Scale / ESS
- **IBM Developerworks** information about HDFS transparency:
 - <https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/General%20Parallel%20File%20System%20%28GPFS%29/page/2nd%20generation%20HDFS%20Transparency%20Protocol>
- **Deploying Spectrum Scale Hadoop using Ambari:**
 - <https://developer.ibm.com/storage/2017/06/27/deploying-ibm-spectrum-scale-file-system-using-apache-ambari-framework-hadoop-clusters/>
- **Reference Architecture for HortonWorks / Hadoop Data Platform on Power, ESS and Spectrum Scale**
 - <https://www.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=POL03281USEN&>

Spectrum Scale Genomics and Healthcare Reference Architectures and Blueprints



Spectrum Scale
ESS

REDP5210



<http://www.redbooks.ibm.com/Redbooks.nsf/RedpieceAbstracts/redp5479.html>

<https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=TSW03536U>

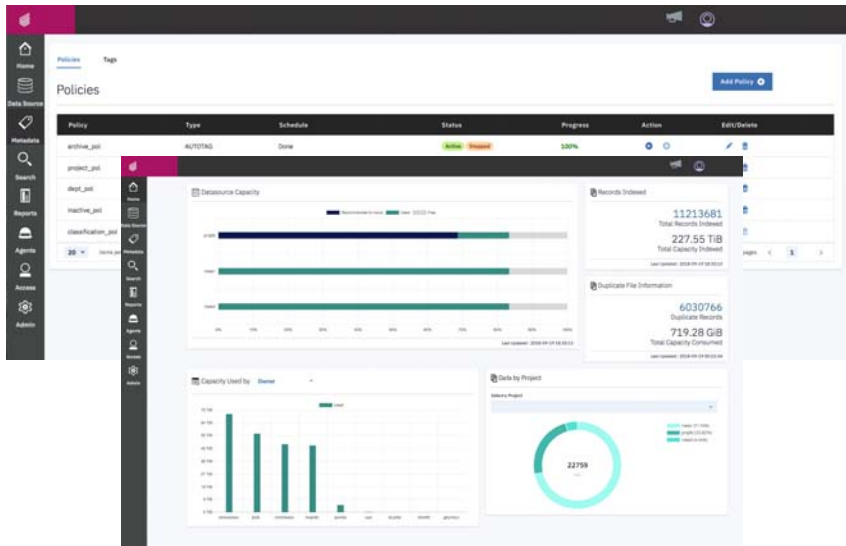
REDP5479



IBM **Spectrum Discover**



IBM Spectrum Discover



Data Insight for Analytics, Governance, & Optimization

- **Automate** cataloging of unstructured data by capturing metadata as it is created
- **Enable comprehensive insight** by combining system metadata with custom tags to increase storage admin & data consumer productivity
- **Leverage extensibility** using the API, custom tags, and policy-based workflows to orchestrate content inspection & activate data in AI, ML, & analytics workflows

Metadata is the Key to Data Organization and Insight

Three Types of Metadata

```
<!DOCTYPE html PUBLIC "-//W3C/  
<html xmlns="http://www.w3.org  
  <head>  
    <meta http-equiv="Content-  
    <meta http-equiv="Content-  
    <meta http-equiv="Content-
```

1

Metadata can come
from a system
(owner, last modified,
size, type, etc.)

2

Metadata can be custom
(map to various business and
scientific aspects)

3

Metadata can be
derived from
analytics
(percent confident)

IBM Spectrum Discover Accelerates Customer Value

Analytics

- Accelerate data identification for large-scale analytics
- Operationalize tasks to reduce the burden of data preparation
- Orchestrate ML/DL & MapReduce processes

*Reduce time
to accuracy
and results*

Governance

- Ensure data is consistent with governance policies
- Reduce risk buried in unstructured data stores
- Speed investigations for legal discovery & regulatory audits

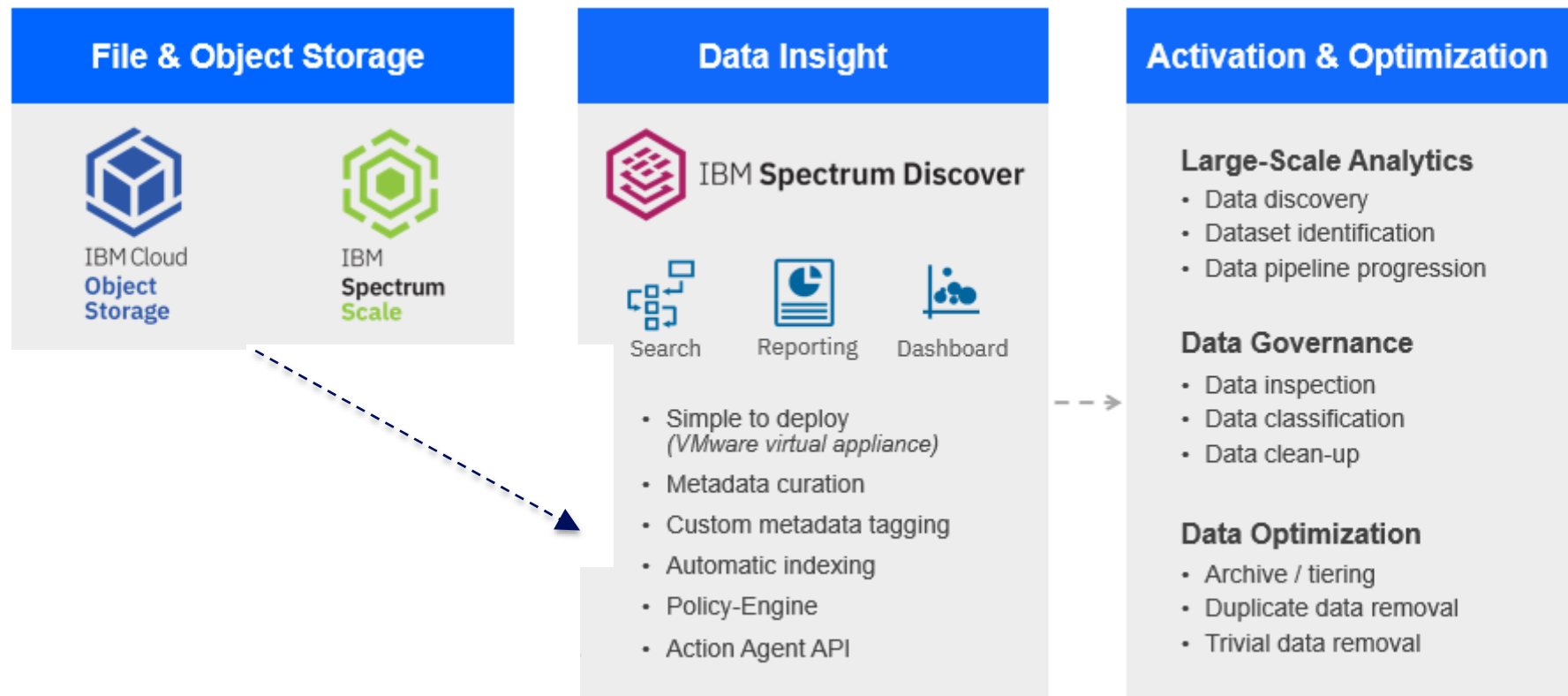
*Mitigate risk
and improve
data quality*

Optimization

- Decrease storage CAPEX by facilitating data movement to colder, cheaper storage
- Increase storage efficiency by eliminating redundant data
- Reduce storage OPEX by improving storage administrator productivity

*Improve
storage
Utilization*

IBM Spectrum Discover Overview



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