Université IBM i 2017

17 et 18 mai – IBM Client Center de Bois-Colombes

S5 – Les options de stockage sur IBM i.

Mercredi 17 mai – 14h00-15h30

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IBM CTS Power
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Préalables

- Présentation from :

  - Alison Pate
  - Executive IT Specialist
  - patea@us.ibm.com

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Agenda

- What's different about IBM i, and why should I care?
- Why move to external storage?
- Performance
- High Availability and Disaster Recovery
- Virtualization
- Systems Management
- Encryption
- IBM Disk Product Portfolio for IBM i
- Summary

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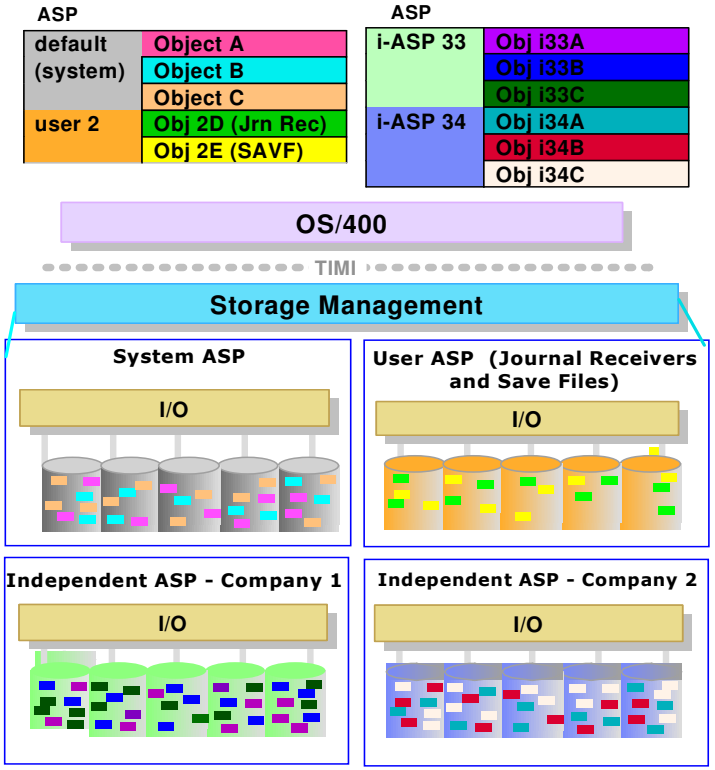
IBM i Storage Architecture

- Built on DB2 with heavy exploitation of Data in Memory
- Built on disk block size of 520 bytes
- Data is spread across all disks in disk pool
- Designed for ease of use and self-management
- Why does this matter when choosing a storage system?
  - Little skew
  - Random access patterns
  - Cache ‘unfriendly’
  - All-or-nothing copies (full system copy)



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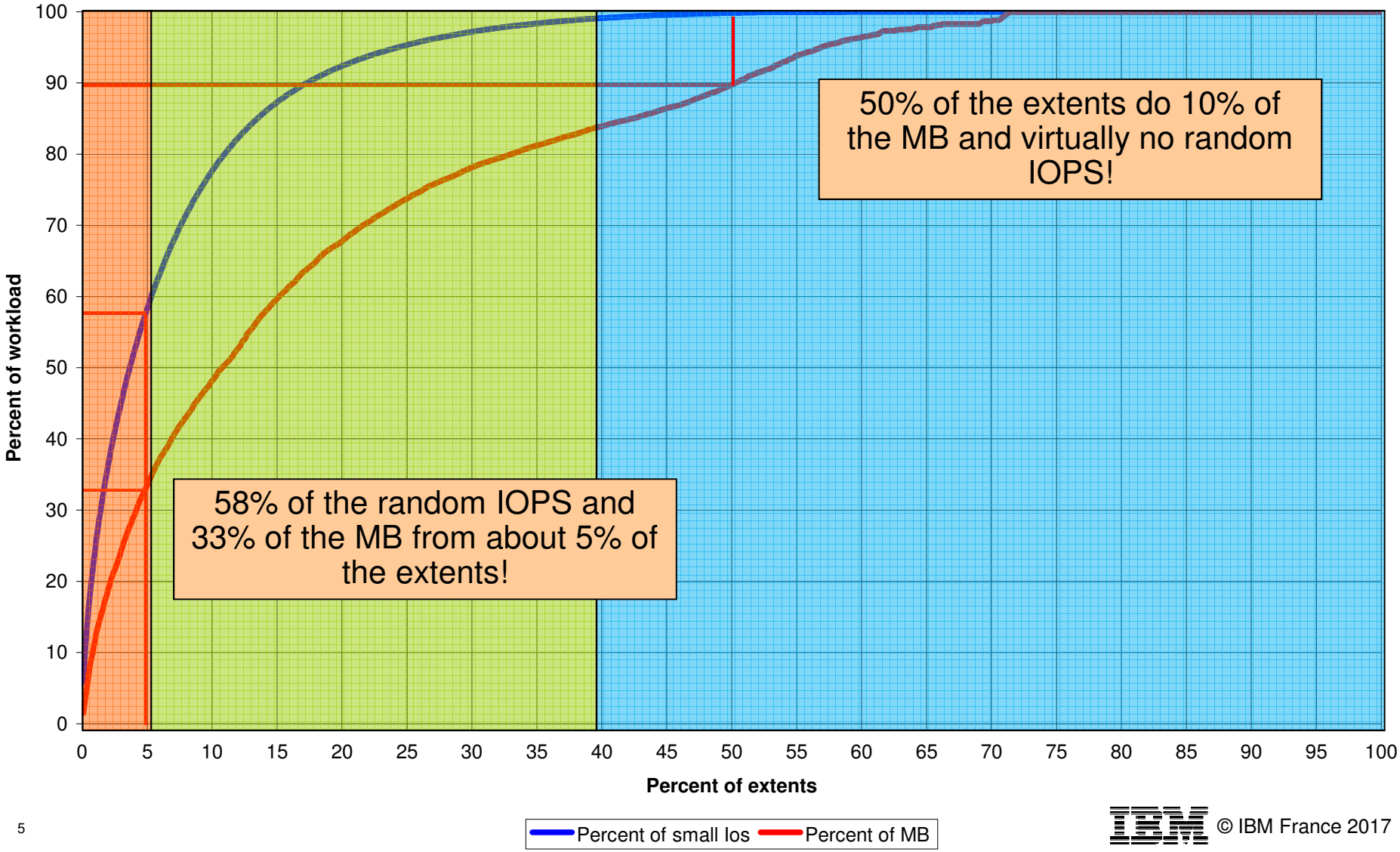
Typical workload skew – non IBM i



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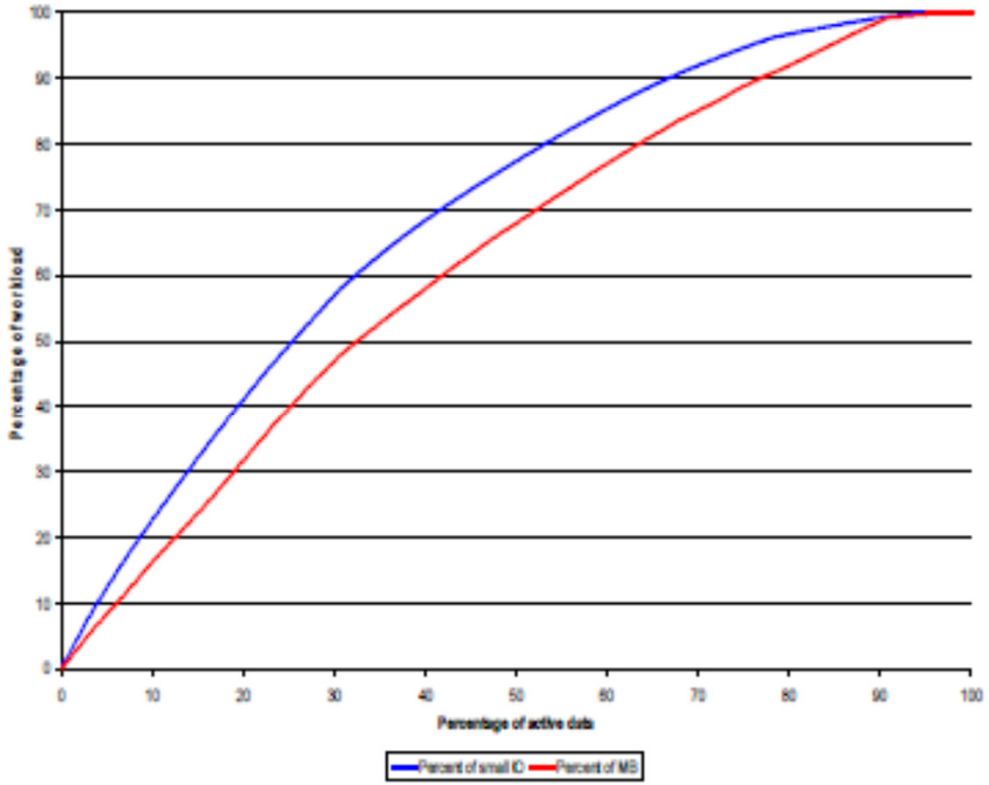
Example : skew on IBM i

Skew level:



Percent of small IO

Percent of MB

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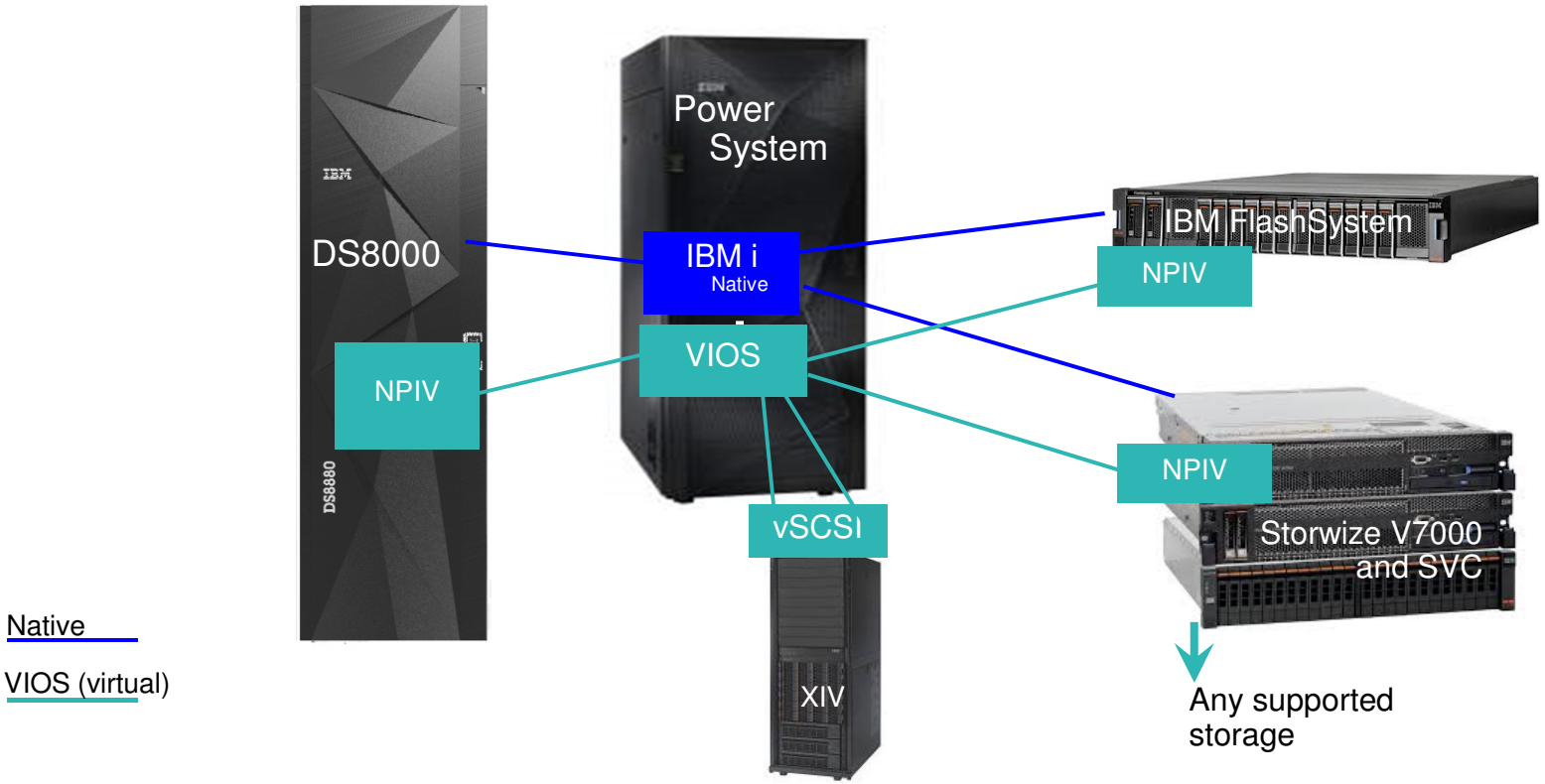
Storage Options



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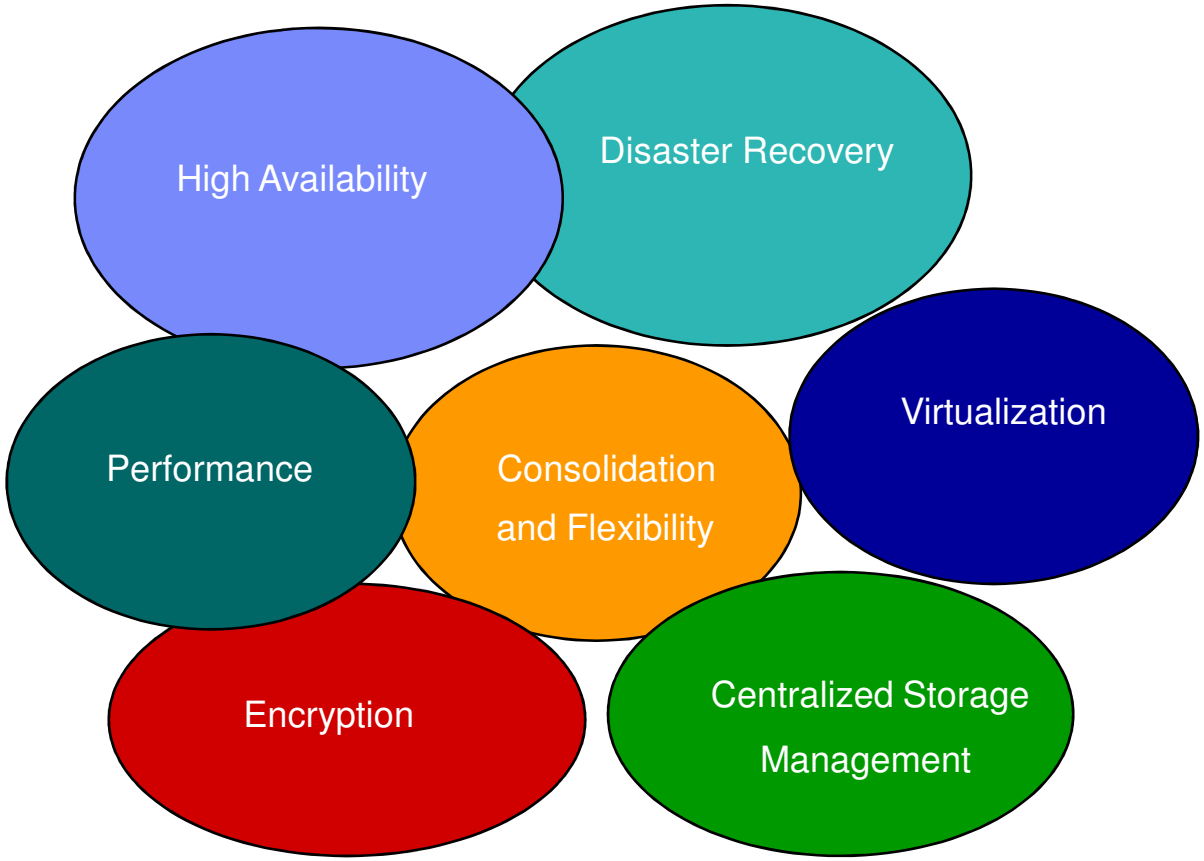
Why external disk?



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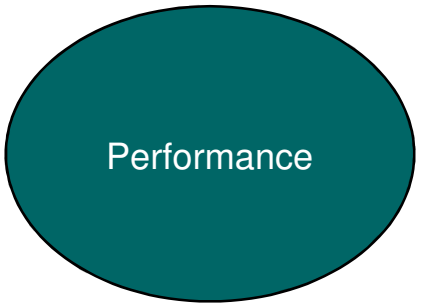
Performance



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Performance Objectives

- Provide predictable and consistent performance at the most cost effective point
- Easy performance management/minimize tuning
- Easy performance reporting

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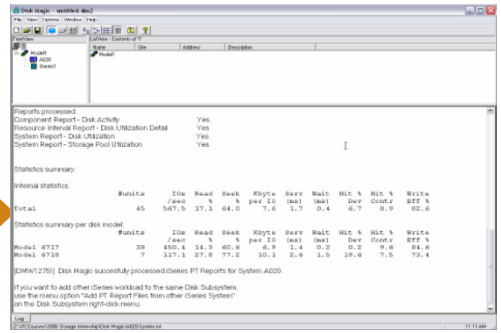
IBM Disk Magic - Performance planning Integration

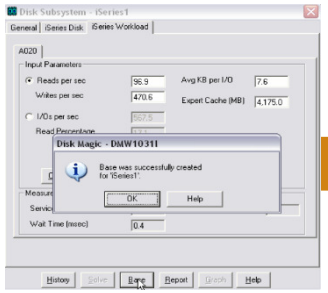
IBM/BP delivered custom performance and capacity sizing for your workloads

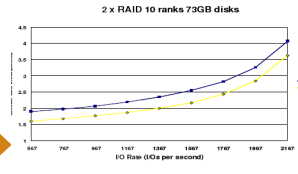
IBM i Performance Tools Report Data

POWER Workload Estimator

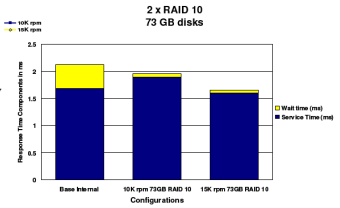
Manual Input







Modeled Workload Output



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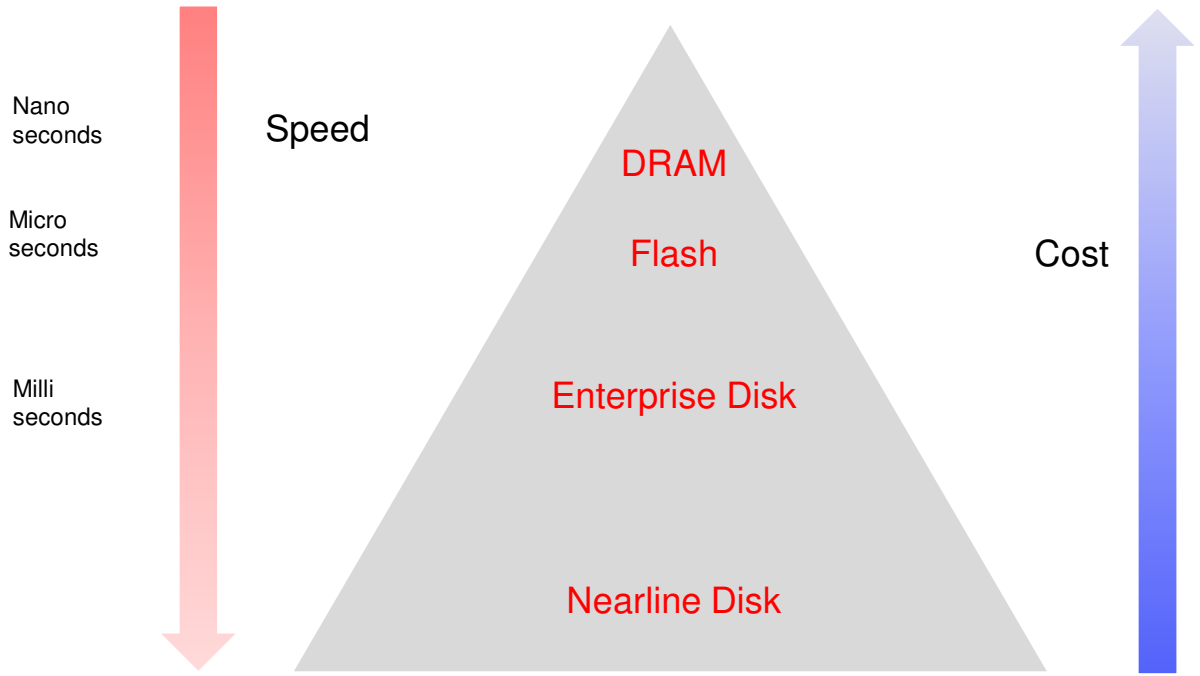
Memory and IO hierachy



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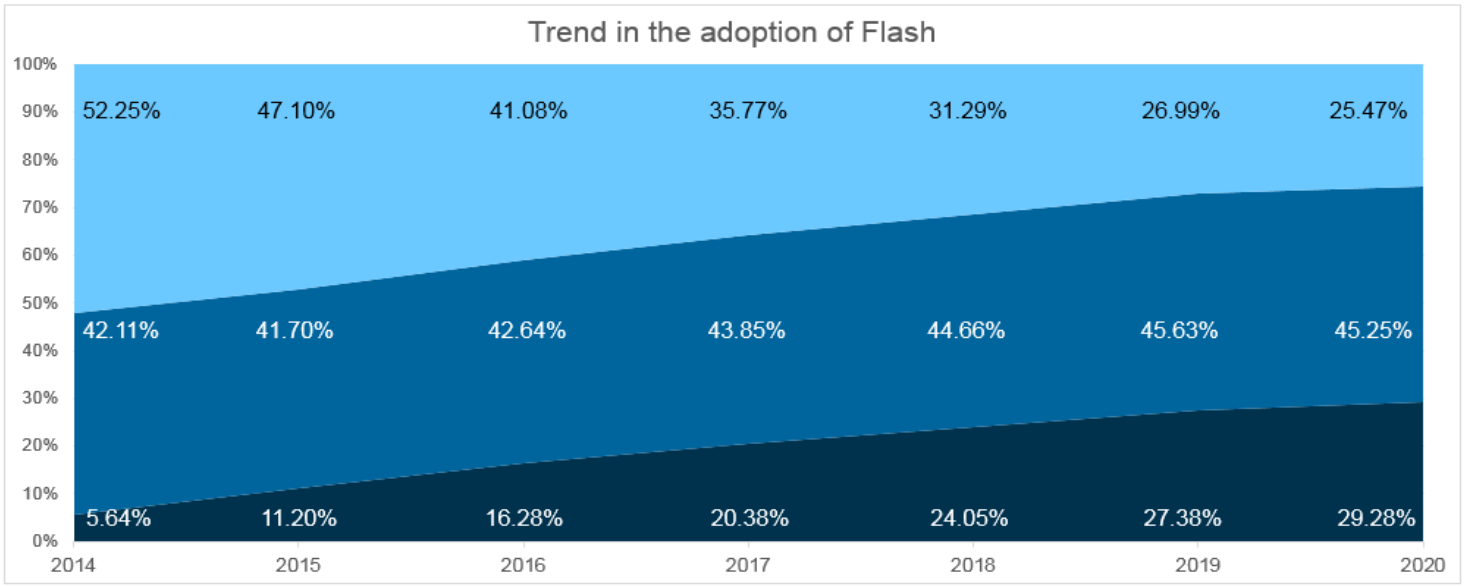
Future view of the All-flash and Hybrid-flash market …



Source: Worldwide External Enterprise Storage Systems Forecast, 2016–2020, Publication Date: IDC Jul , 2016

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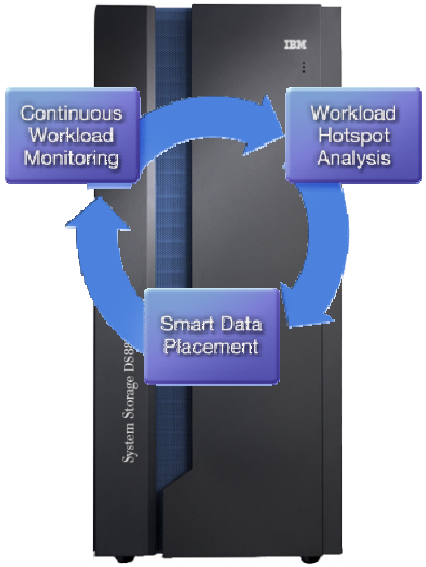
IBM System Storage Easy Tier

New generation of smart storage that intelligently adapts to application workloads

- Places data on the correct hardware tier
  - Optimize your hardware investment
  - Maximize application performance
- Automated and granular:
  - Automated movement of data based on actual workload performance
- Virtually no administrative effort:
  - Easy Tier optimizes storage tiering without laborious manual tuning
- Supported on DS8000, Spectrum Virtualize, and Storwize family
  - Slightly different implementations



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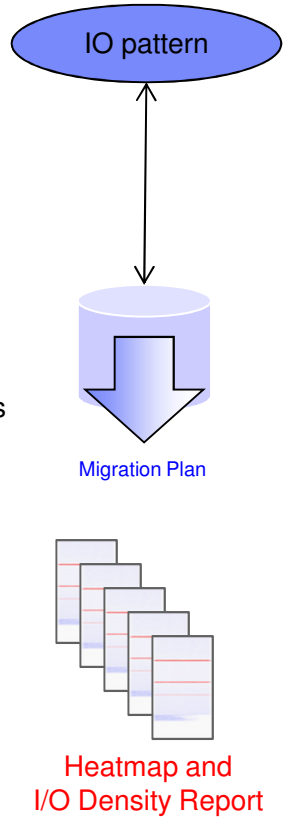
Easy Tier - Workload Learning

- Easy Tier learning of application IO patterns – Heat Map
- Migration plan
  - 24 hour cycle for inter-tier migration
  - 6 hour cycle for intra-tier migrations
- Extent migration – background task



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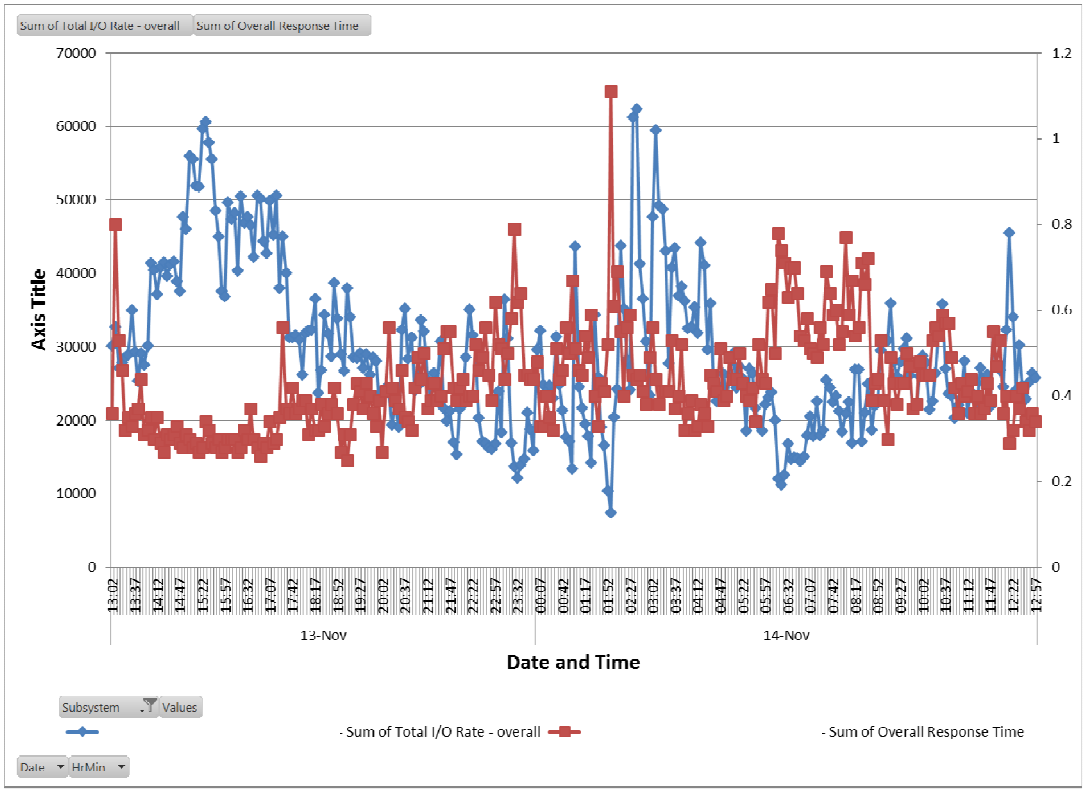
Easy Tier Performance with IBM i



DS8700 600GB 10K rpm disks plus SSD managed by Easy Tier

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IBM i Exploitation of SSD with DS8000

- IBM i can recognize SSD-backed LUNs on DS8000
  - Manually – ASP placement
  - DB2 Media Preference
  - ASP Balancer
  - BRMS Migration

Best option

- Easy Tier
  - Transparent to server
  - Minimal implementation effort

Best option

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Disk Performance on IBM i

- Understand your workload
- Use the sizing tools (Work with IBM or Business Partner)
  - Disk Magic
  - Sue Baker's IOA sizing spreadsheet
- Plan logical configuration as well as hardware configuration
- No measureable difference in performance between native, NPIV, and VIOS attachments
- Isolation or sharing?
  - Balance IO activity across all resources
    - Stripe and share everything
  - Isolate IBM i workloads for performance protection
- Easy Tier can work well with IBM i
  - Use *minimum* 20% Flash capacity guideline

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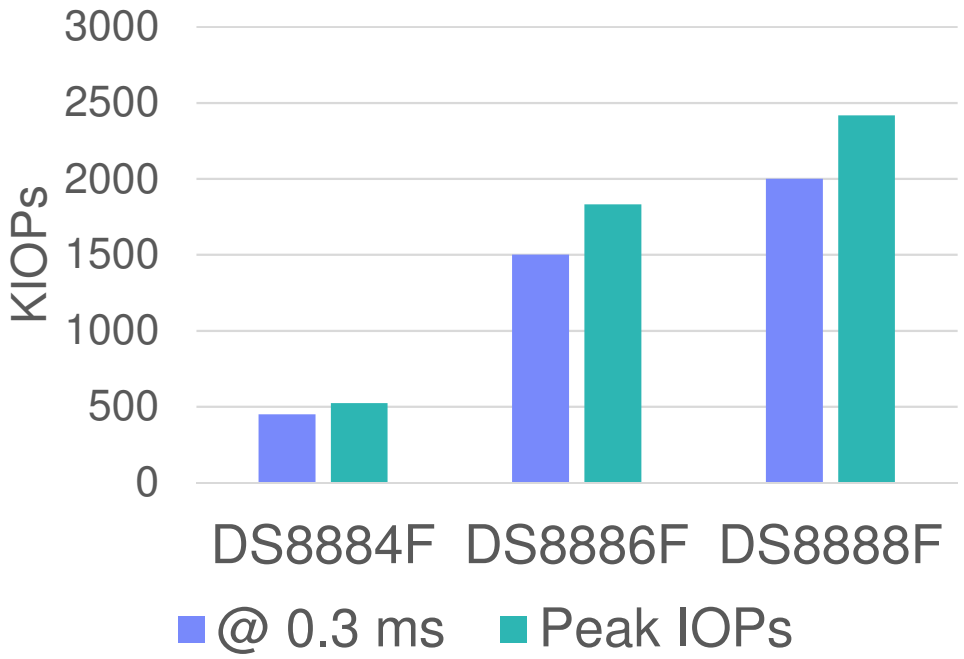
DS8880F All-Flash Database Open (DBO) Performance Summary

Values based on OLTP database simulation benchmarks:
70% read, 30% write, 4KB IOs and 50% read cache hit

	DS8884F	DS8886F	DS8888F
KIOPs @ 0.3 ms	450	1500	2000
KIOPS @ Peak	523	1832	2418



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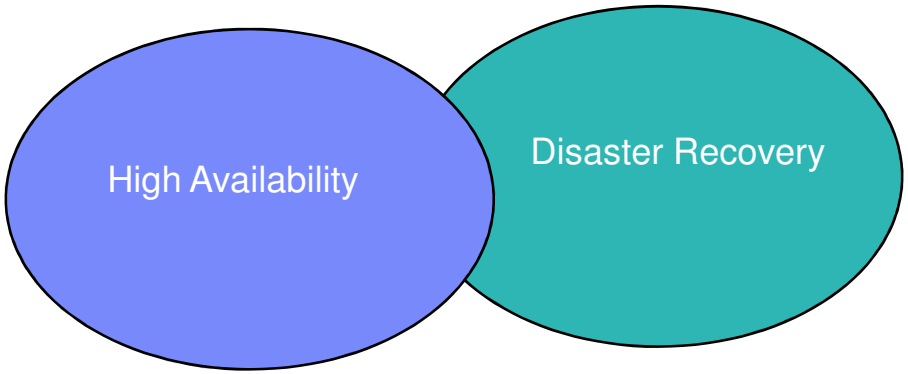
High Availability and Disaster Recovery



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High Availability and Disaster Recovery

- Increase system up-time
- Reduce backup times
- Reduce planned outages
  - Maintenance windows, Backup windows, Software upgrades
- Reduce time to recover in the event of a Disaster (RTO)
- Reduce RPO in the event of a disaster
- Increase backup frequency
- Automate Recovery
- Reduce overheads of Disaster Recovery provision
  - Combined HA/DR, Reduce costs, Reduce manpower

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Copy Services

- Point in Time copy – within the same storage system
  - FlashCopy
  - Snapshot
- Remote Replication – between storage systems
  - Synchronous (for campus/metro distances)
  - Asynchronous (for unlimited distance)
- Local Replication
  - Spectrum Virtualize Stretch Cluster
  - vDisk Mirroring
  - Hyperswap

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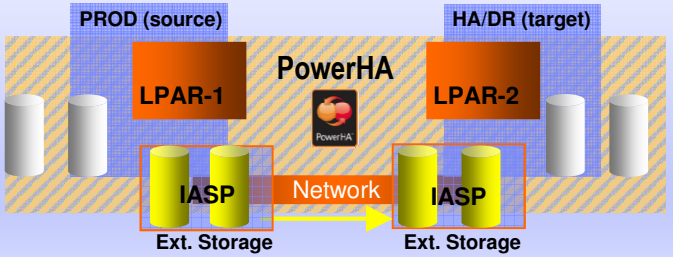
Copy Services Architectures for IBM i

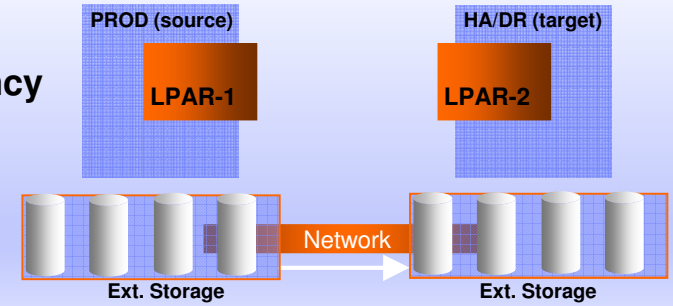
iASP based replication

- PowerHA and copy services
- PowerHA LUN Level Switching
- Clustering and E2E automation
- IASPs eliminate need for IPL
- HA, DR and Backups



Full Copy resiliency

- Full system copy
- Required IPL – 'crash' consistency
- Manual operation or toolkit management



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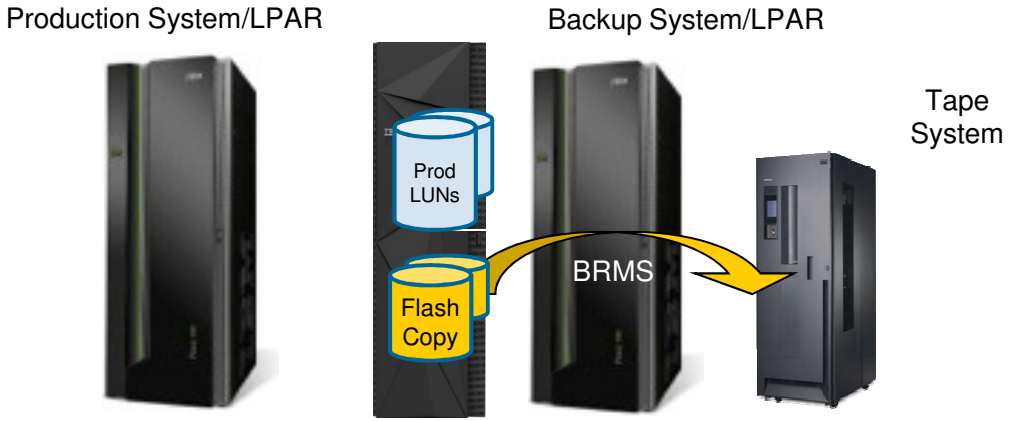
Point-in-Time Copy

Automation available from
IBM lab services for DS8000,
Spectrum Virtualize, and XIV



Thin provisioned copies, multiple targets, flash-back capability

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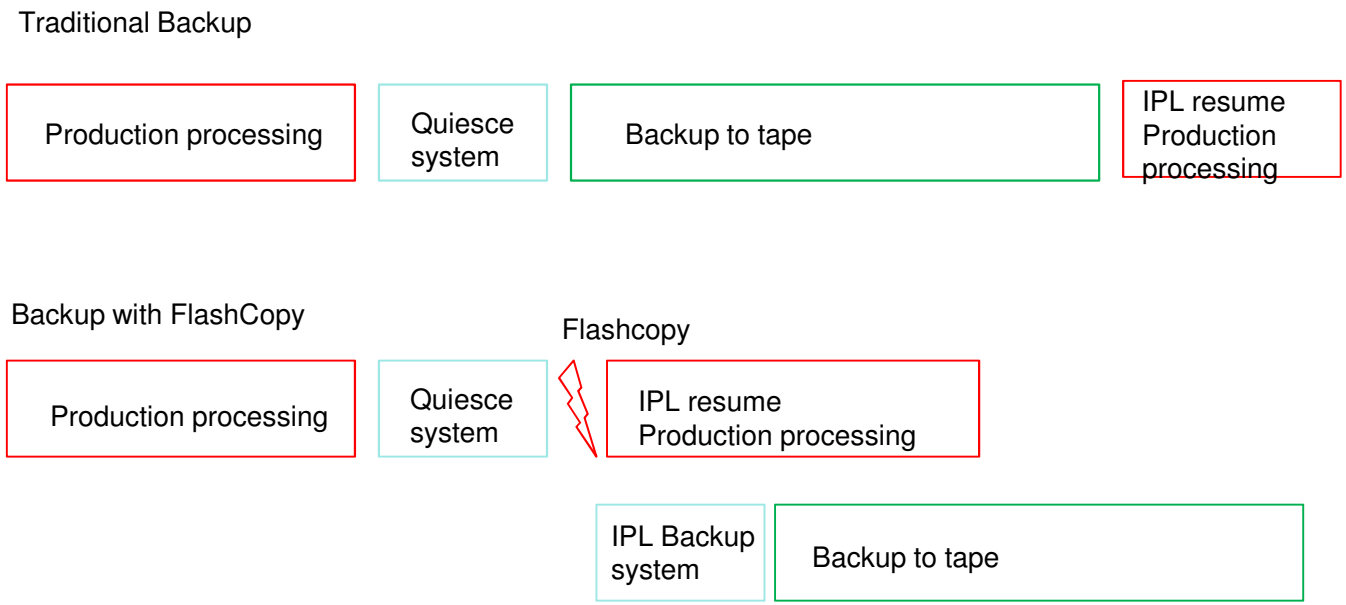
Flashcopy for backup timeline



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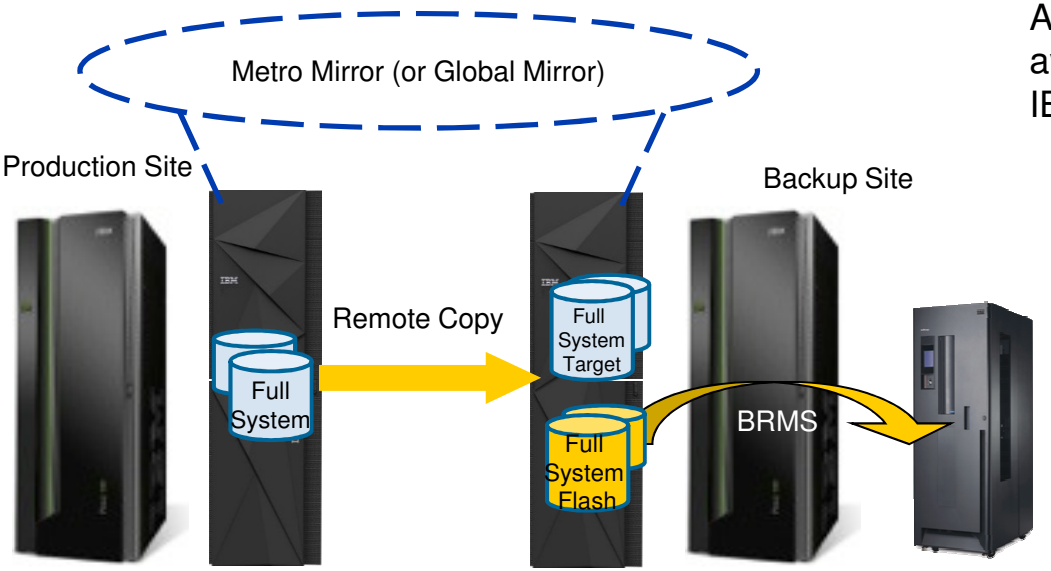
Full System Copy



Automation available from IBM lab services

Backup System i will require an *abnormal* IPL for unplanned outages.

Planned outages require an IPL of the Backup LPAR

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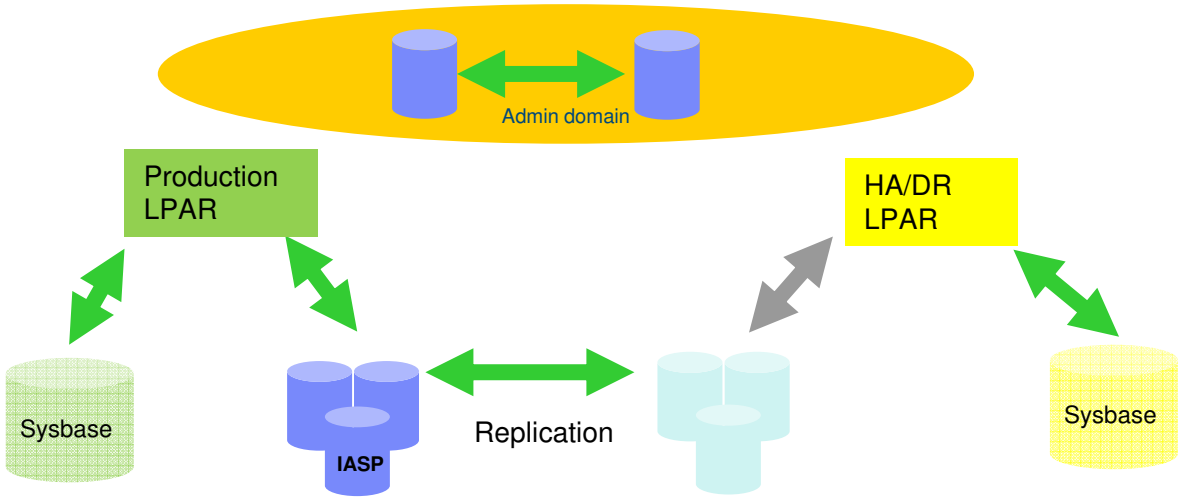
Power HA with Storage Replication



- Only the IASP is replicated/switchable
- Replication target is offline until failover when it is varied online to the HA/DR system
- Each IBM i LPAR is running it's own version of the System (SYSBAS)

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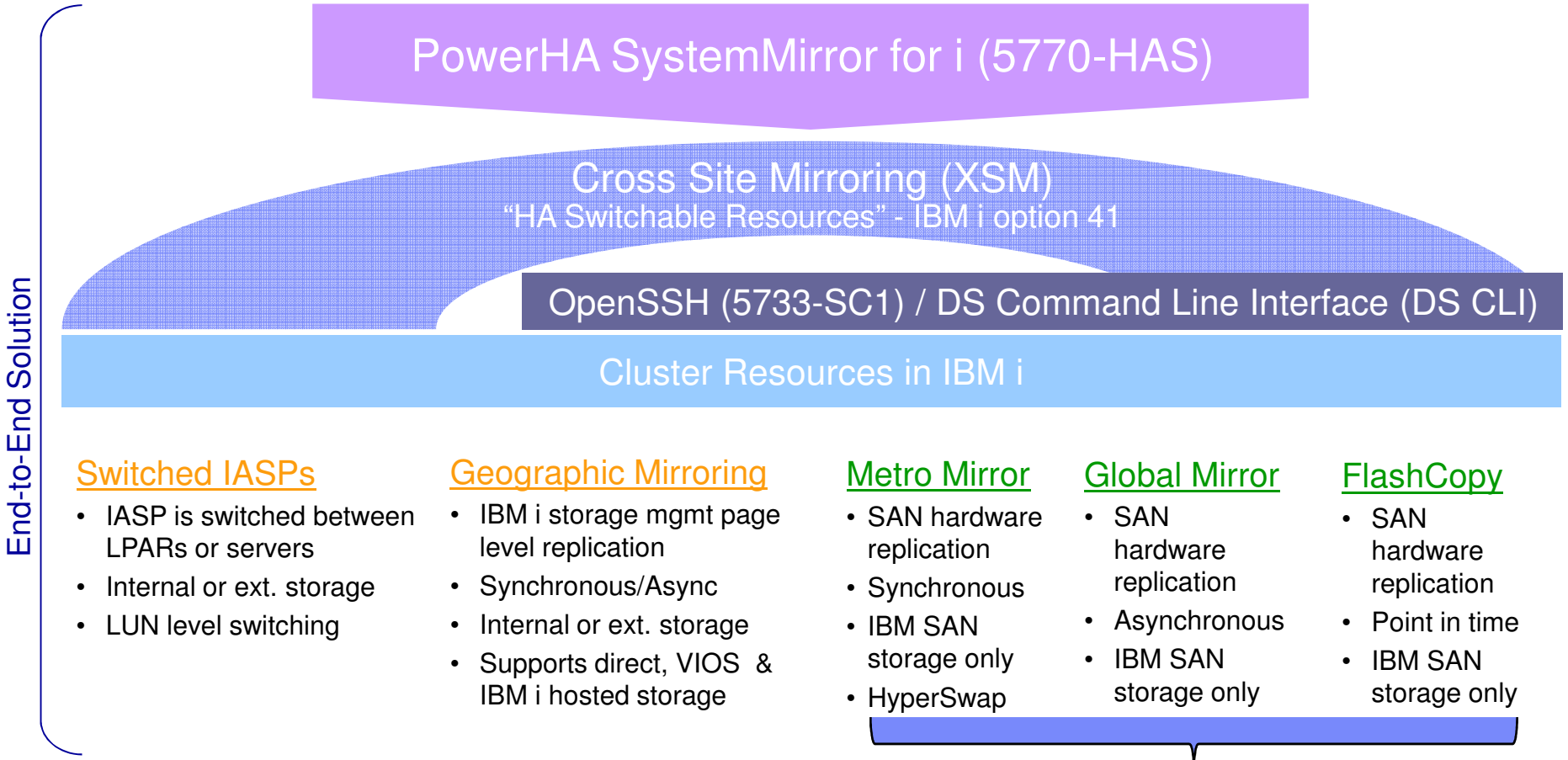
IBM PowerHA SystemMirror for i

Provides an end-to-end solution for management of IBM i IASP and DS8000, SVC / Storwize family resiliency and replication technologies for HA and DR



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PowerHA for IBM i

- ✓ Comprehensive HA/DR solutions for multi-site or data center
- ✓ Shared storage clustering technology
- ✓ Provides automation for ease of use
- ✓ Implemented in IBM i, SLIC, and storage management
- ✓ Data replication is provided by IBM storage
- ✓ FlashCopy enables off line tape backup
- ✓ Designed for regular role swap operations and automated failovers
- ✓ Developed and supported by IBM

PowerHA™

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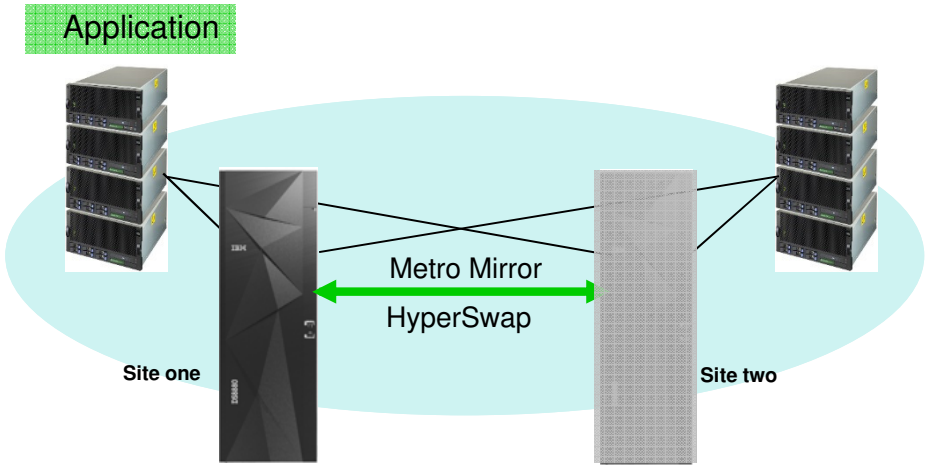
PowerHA Enterprise Edition HyperSwap solution for High Availability

- Two-site DS8K HyperSwap PowerHA Enterprise Edition cluster configuration
- Combine with Live Partition Mobility for Server and Storage HA
  - Server outage management via a PowerHA cluster operation
  - Storage outage management via a HyperSwap switch
- Full System or IASP implementation



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Replication Options

	DS8000	Storwize family	XIV
Point in time copy	Yes	Yes	Yes
Async Remote Copy	Yes	Yes	Yes
Metro Mirroring	Yes	Yes	Yes
Power HA Support	Yes	Yes	No
Full System Toolkit	Yes	Yes	Yes
Hyper-Swap	Yes	Yes	No
RPO less than 3-5 seconds	Yes	No	No
RPO Less than 1 minute	Yes	'Classic' GM with unconstrained bandwidth only	Yes
RPO Less than 10 minutes	Yes	Yes (GM with Change Vols)	Yes
3 site Replication	Yes	No	Yes
Multi-target PPRC	Yes	No	Yes

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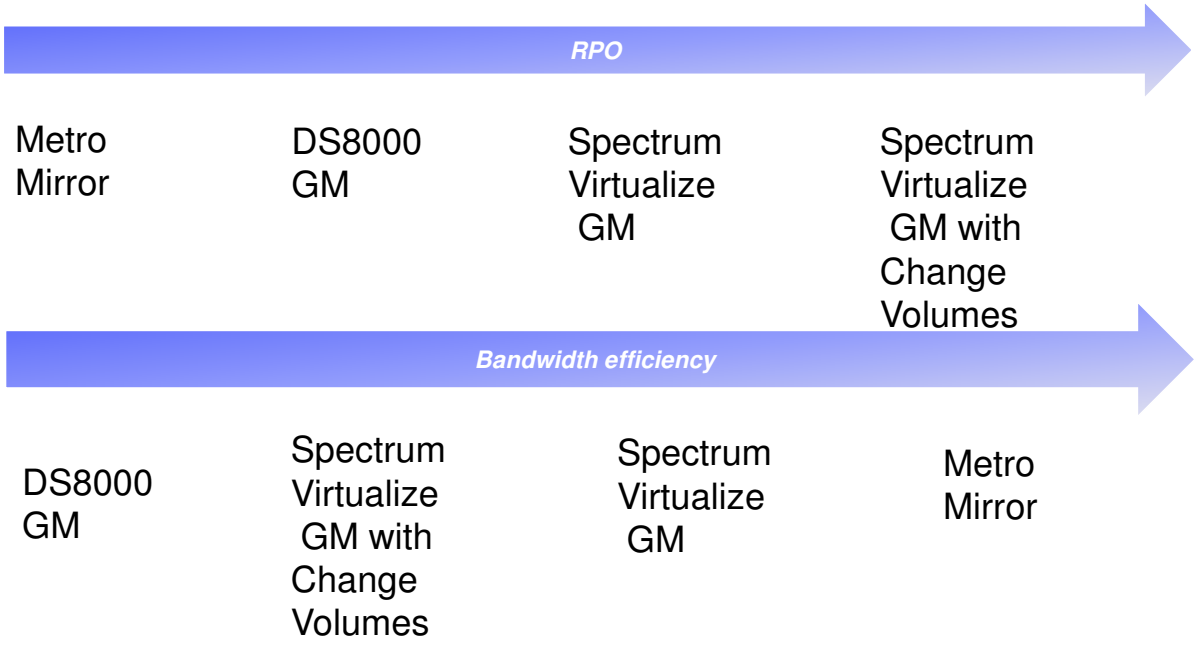
Copy services selection



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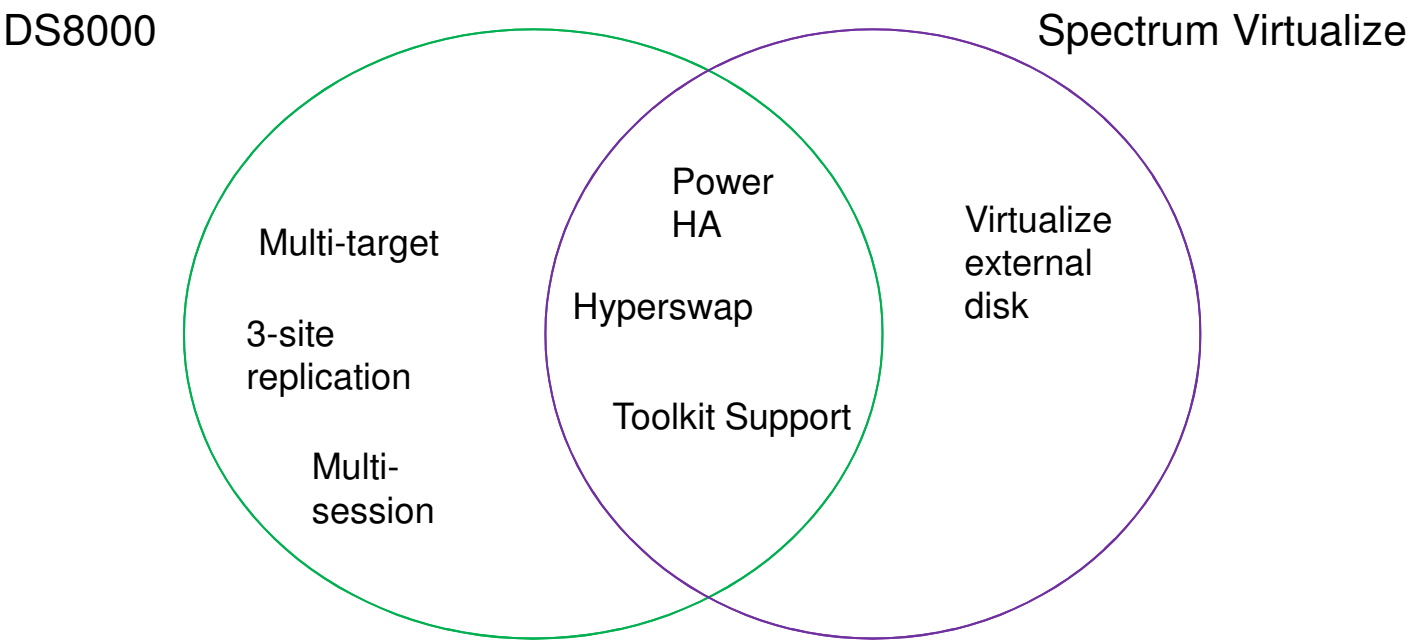
Copy services selection



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PowerHA Tools for IBM i

- Complement and extend PowerHA and IBM Storage capabilities for HA/DR
- Helps reduce business risk and improve resiliency for critical applications
- Simplifies set up and automation of HA/DR and backup solutions
- Reduces cost of maintaining and regular testing of an HA/DR environment
- Facilitates flexible deployment options for single or multi-site protection
- Assures consistent deployment using best practices and experienced consultants

PowerHA Tools for IBM i is a service offering from IBM Systems Lab Services

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PowerHA Tools for IBM i

PowerHA Tools for IBM i	Capability	Benefit	DS8000	Storwize	Internal
Smart Assist for PowerHA on IBM i	Provides operator commands and scripts to supplement PowerHA installation and ongoing operations for IASP enabled applications.	Simplifies deployment and ongoing management of high availability for critical IBM i applications.	**Yes**	**Yes**	**Yes**
IASP Manager (Automated recovery with faster IASP-level vary on, no system IPL)					
Flashcopy	Automates Flashcopy of IASP for daily off-line backup with seamless BRMS integration.	Increases application availability by reducing or eliminating backup window for routine daily backups.	**Yes**	**Yes**	
LUN-level Switching	Simplifies deployment and automates switching of an IASP between IBM i cluster nodes in one data center.	Enables a business continuity manager to provide a simple, single site HA solution.	**Yes***		
Remote Copy	Simplifies initial deployment and automates ongoing server and storage management of two-site Metro Mirror or Global Mirror HA or DR solutions. Requires IASP enabled applications..	Enables a business continuity manager to provide seamless operation of integrated server and storage operations for two-site high availability or disaster recovery.	**Yes**		
Metro Global Mirror (MGM)	Extends PowerHA functionality to provide three-site server/storage replication solution combining Metro Mirror for HA with cascading Global Mirror for DR. Requires IASP enabled applications and IBM Tivoli Productivity Center for Replication (TPC-R).	Enables a business continuity manager to further lower business risk and maximize business resilience for highly critical business applications that require three-site HA/DR protection.	**Yes**		
Multi-Target Copy (MTC)	Extends PowerHA functionality to provide three-site server/storage replication solution for HA/DR broadcast topologies including two Metro Mirror relationships or a Metro Mirror and Global Mirror relationship. Requires IASP enabled applications and IBM Copy Services Manager (CSM).	Enables a business continuity manager to further lower business risk and maximize business resilience for highly critical business applications that require three-site HA/DR protection.	**Yes**		
Full System Manager (Automated recovery, requires full system IPL on target LPAR)					**XIV**
Flashcopy	Automates full system Flashcopy for daily off-line backup with integrated support for BRMS without IASP-enabled applications.	Increases application availability by reducing or eliminating backup window for routine daily backups. Enables an entry solution while planning IASP enablement.	**Yes**	**Yes**	**Yes**
Remote Copy	Simplifies initial deployment and automates ongoing server and storage management of two-site Metro Mirror or Global Mirror HA or DR solutions. without IASP-enabled applications.	Enables a business continuity manager to provide seamless operation of integrated server and storage operations for HA or DR. Enables an entry solution while planning IASP enablement.	**Yes**	**Yes**	

*DS8000 support available with PowerHA Tools for IBM i 6.1 or earlier, included in PowerHA SystemMirror 7.1

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IBM Lab Services Offerings for PowerHA for IBM i

PowerHA Service Offering	Description
IBM i High Availability Architecture and Design Workshop	An experienced IBM i consultant will conduct a planning and design workshop to review solutions and alternatives to meet HA/DR and backup/recovery requirements. The consultant will provide an architecture and implementation plan to meet these requirements.
PowerHA for IBM i Bandwidth Analysis	An experienced IBM i consultant will review network bandwidth requirements for implementing storage data replication. IBM will review I/O data patterns and provide a bandwidth estimate to build into the business and project plan for clients deploying PowerHA for IBM i.
IBM i Independent Auxiliary Storage Pool (IASP) Workshop	An experienced IBM i consultant will provide jumpstart services for migrating applications into an IASP. Training includes enabling applications for IASPs, clustering techniques, plus managing PowerHA and HA/DR solution options with IASPs.
PowerHA for IBM i Implementation Services	An experienced IBM consultant will provide services to implement an HA/DR solution for IBM Power Systems servers with IBM Storage. Depending on specific business requirements, the end-to-end solution implementation may include a combination of PowerHA for IBM i and/or PowerHA Tools for IBM i, plus appropriate storage software such as Metro Mirror, Global Mirror and/or Flashcopy.

For more information on PowerHA Tools for IBM i offerings and services, contact: Mike Gordon mgorgo@us.ibm.com **507-253-3477**

www.ibm.com/systems/services/labservices **stgls@us.ibm.com**

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for Business

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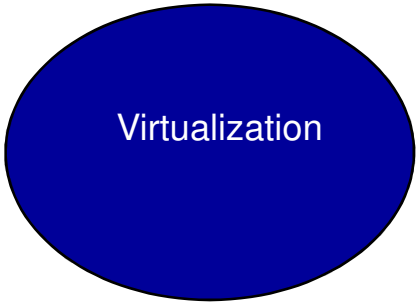
Virtualization



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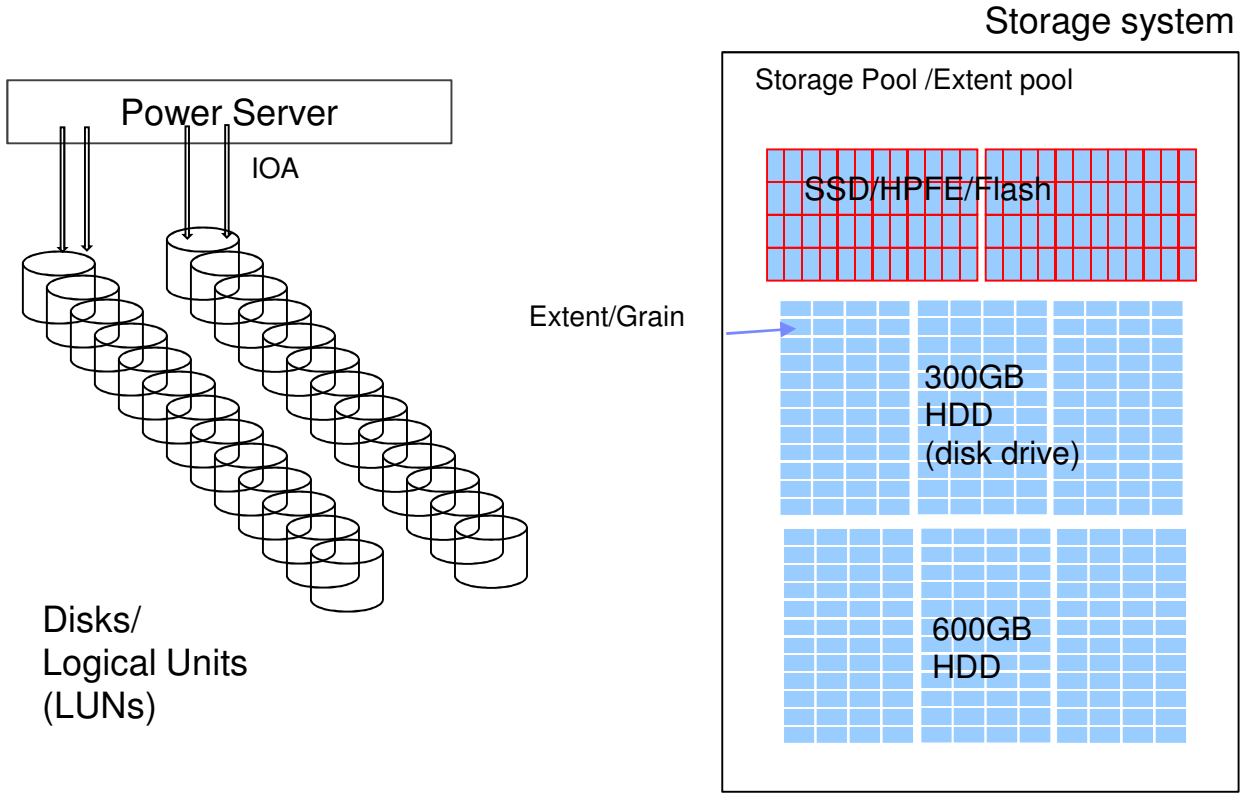
Virtualized architecture



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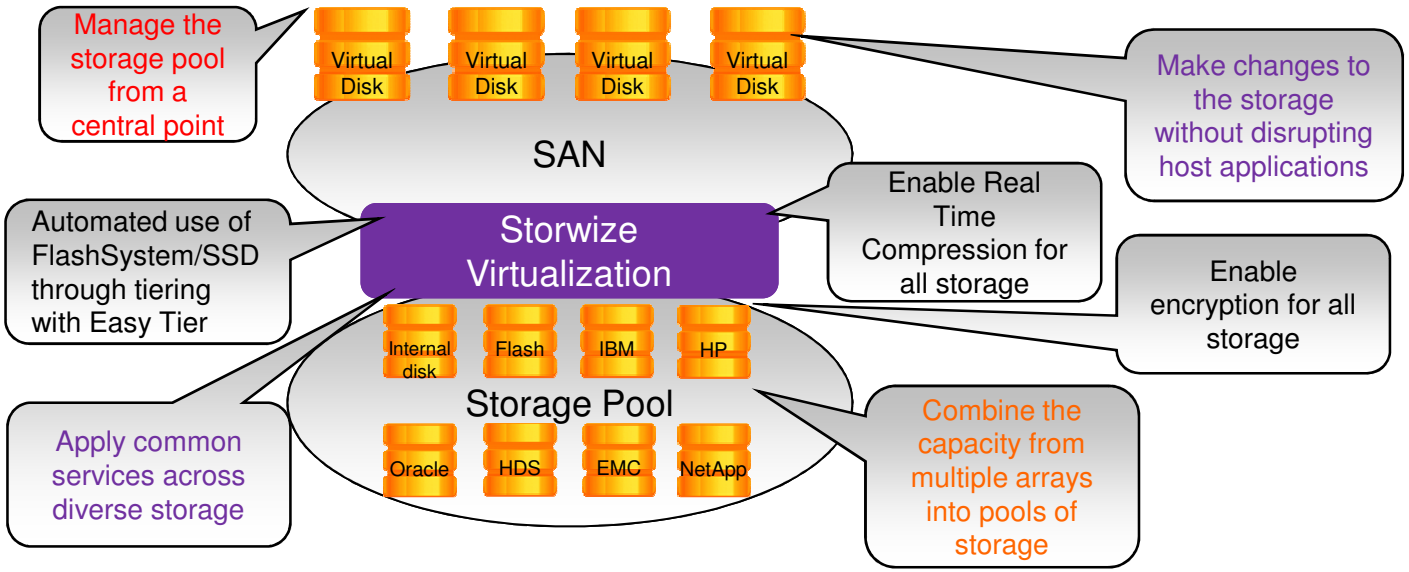
Spectrum Virtualize



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IBM i File System

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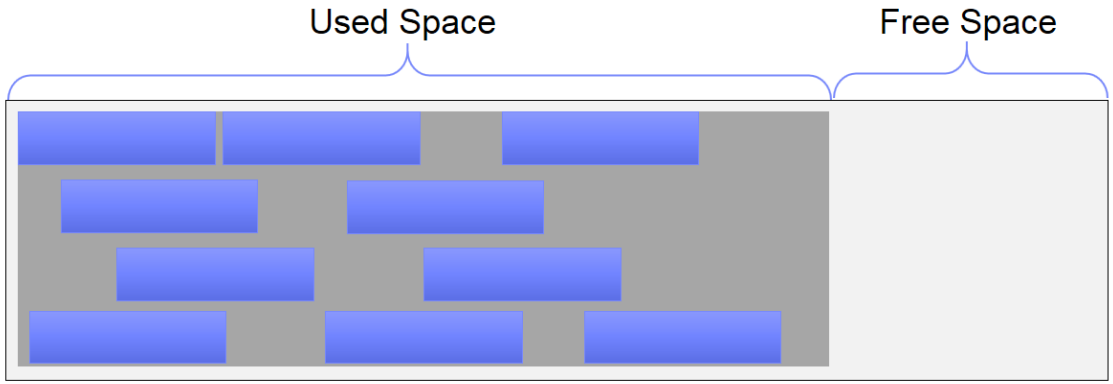
IBM i File System



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IBM i File System

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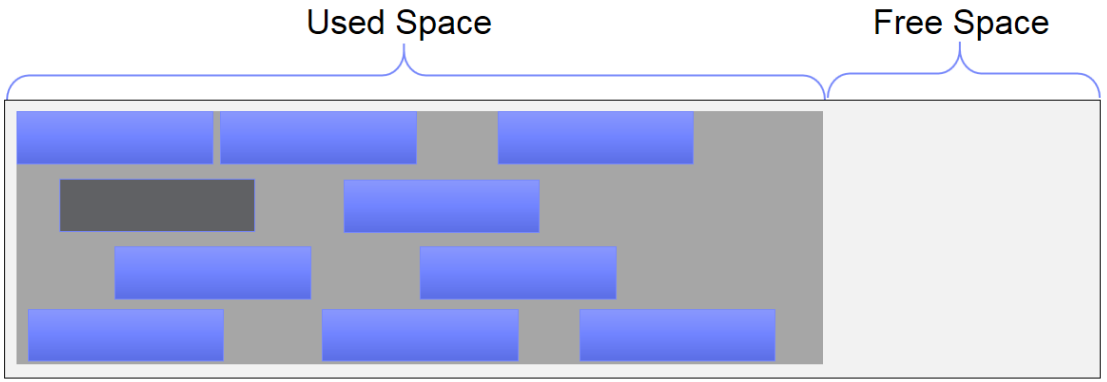
IBM i File System



1. Object deleted
2. Space released to ASP pool (only the first 4KB page zeroed out)

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IBM i File System

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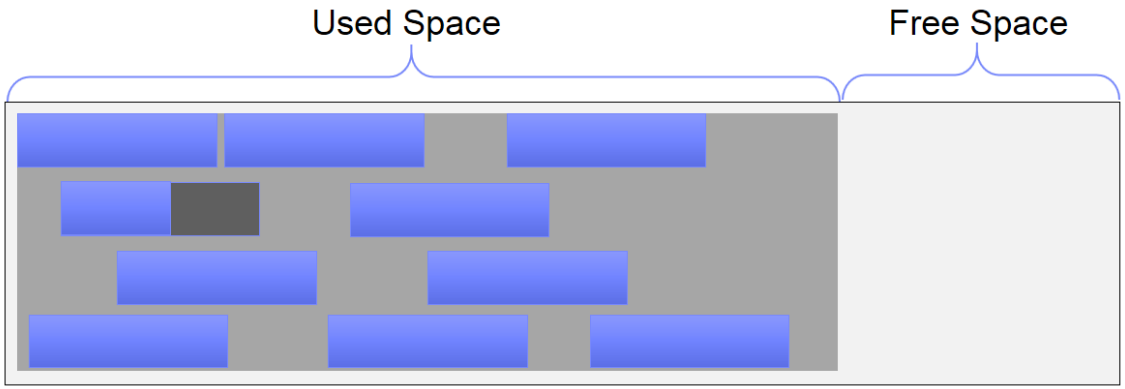
IBM i File System



1. Object deleted
2. Space released to ASP pool (only the first 4KB page zeroed out)
3. A new object is created
4. Space utilization reported by DS8000 remains the same
5. Space utilization reported by IBM i is reduced

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IBM i File System

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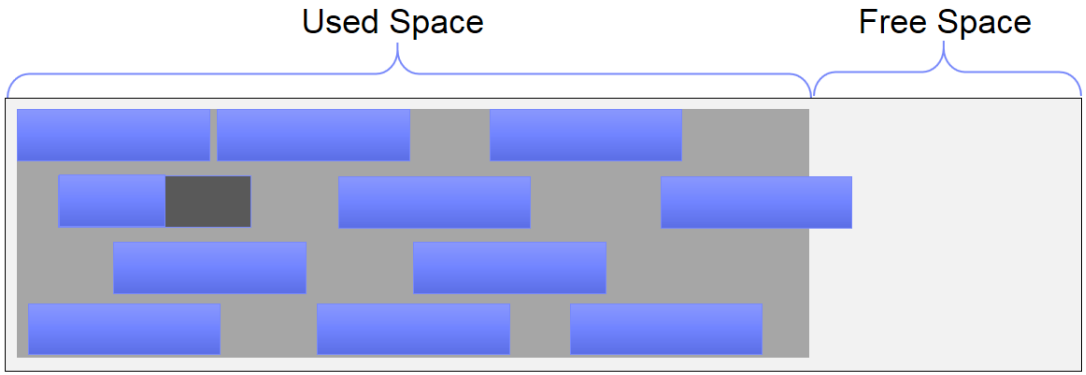
IBM i File System



6. Another object is created

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IBM i File System

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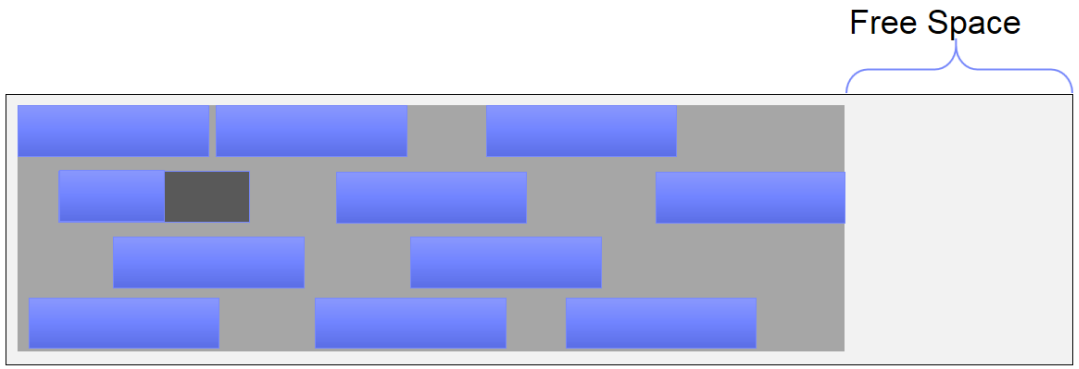
IBM i File System



6. Another object is created
7. Space utilization reported by the DS8000 increases as new extent added to thin provisioned volume

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IBM i File System

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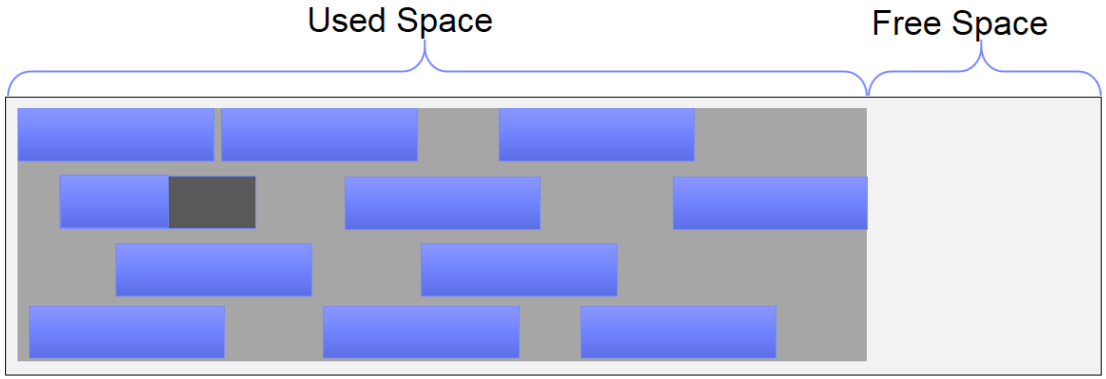
IBM i File System



6. Another object is created
7. Space utilization reported by the DS8000 increases as new extent added to thin provisioned volume
8. Space utilization in ASP as reported by IBM i increases

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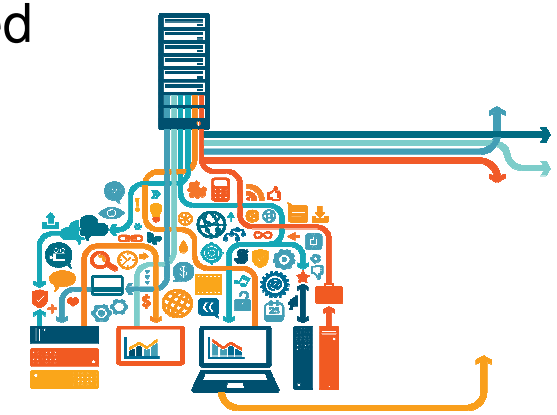
IBM i Exploitation of Thin Provisioning

- IBM i supports thin provisioning on all IBM storage platforms
- The IBM i Single Level Storage architecture spreads I/O across the entire storage pool (ASP)
- When space is released within the IBM i storage pool the space is not released to the storage system
- Released space from deleted objects is not zeroes, only the first 4 KB page is zeroed
- Space released from delete luns only once they have been reinitialized from the storage system and the IBM i system IPLed



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Thin Provisioning Guidelines for IBM i

- Thin provisioning (ESE) is not typically recommended for production volumes due to the requirement for continual monitoring of real capacity utilization
- Thin provisioning is a reasonable option for FlashCopy targets, especially where these are retained for a short duration and can be an excellent replacement for Track Space Efficient FlashCopy
  - Small extents are recommended
  - Recommendation for thin provisioned FlashCopy targets is 50%
  - Global Mirror journal volumes can also be used to exploit thin provisioning and recommended to be sized at 50%
- When FlashCopy targets are thin provisioned ensure that there are adequate hardware resources to sustain the performance requirements of the application
  - Ideally the target luns should be in the same extent pool as the source luns

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Real-time Compression – What is it?

- A compressed Volume is a third type of Volume
  - Regular (fully allocated)
  - Thin Provisioned
  - Compressed
- A compressed Volume is “a kind of” Thin-Provisioning
  - Only allocates and uses physical storage to store the compressed data for the Volume
- Supported on Storwize and XIV
- Compression has a latency and throughput impact

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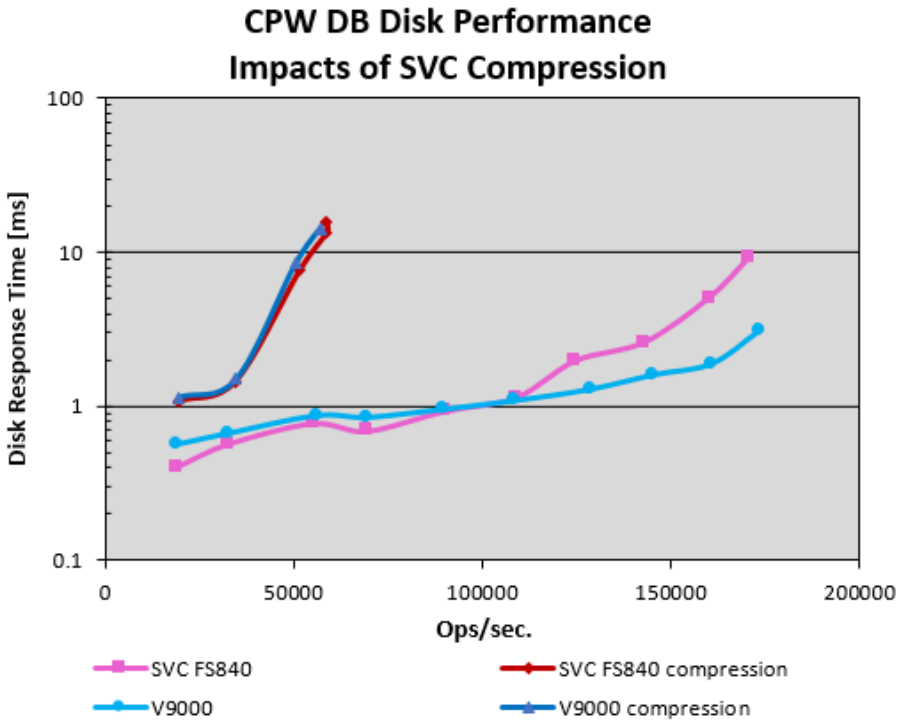
Impacts of Compression



Note : « S48 - IBM i et stockage SSD/Flash: retour d'expérience » pour un complément d'informations relatifs à d'autres tests très récents.

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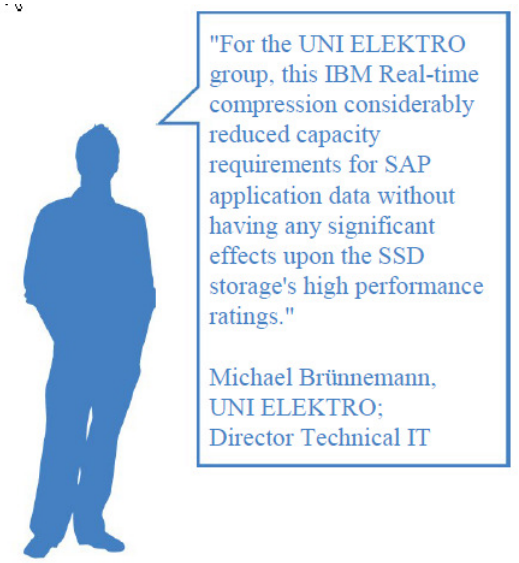
Real time Compression IBM i customer experience

- SVC Response time 2-3msec @ 18K writes plus 7K reads
- DB2 Compression ratio at 79.5%
- SAP Dialog response time reduced from 270 msec to 150 msec



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Thin Provisioning and Compression

	Thin Provisoning	Compression
DS8000	Yes	No
FS900	No	No
Spectrum Virtualize V7000 V9000	Yes	Yes
XIV	Yes	Yes

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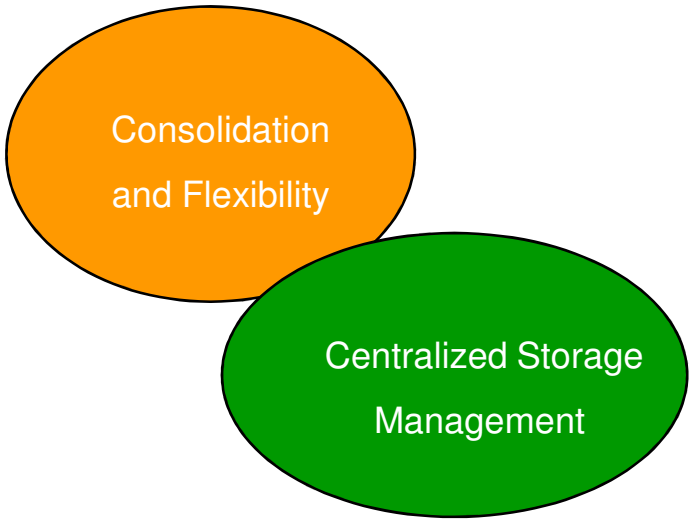
Systems management



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Systems Management

- Consolidation and Flexibility
  - Can move disk between servers and between platforms
  - Non-disruptive re-provisioning
  - Non-disruptive capacity addition
- Centralized storage management
  - Command line interface hosted on IBM i
    - DS8000
    - Spectrum Virtualize Software
- Intuitive easy-to-use GUI across all IBM storage systems

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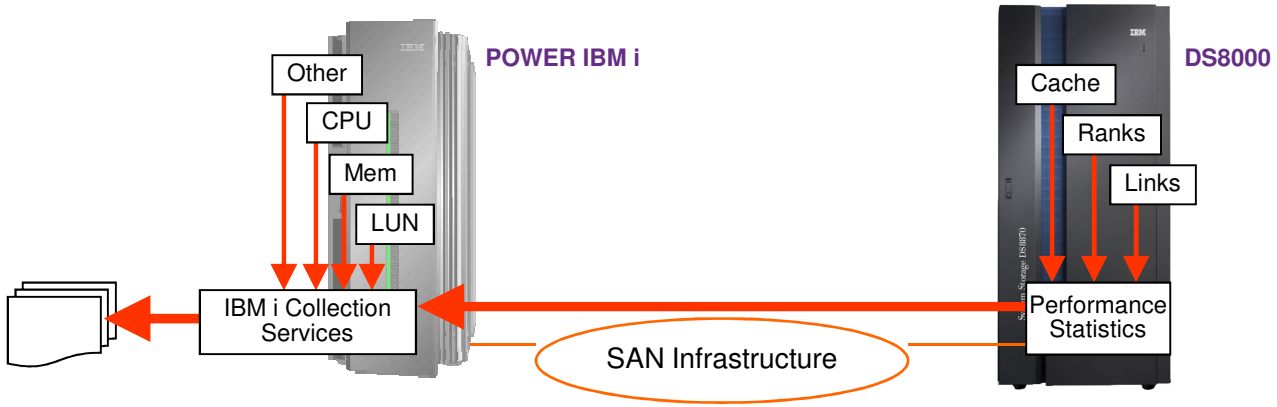
Performance Monitoring Integration



- Focus on end-to-end performance monitoring and investigation for an IBM i and DS8000 environment
- IBM i 7.1 adds a new category to IBM i Collection Services
  - *EXTSTG – new collection performance metrics from DS8000
    - Requires DS8000 R4 or later firmware
  - Data can be presented in graphs using iDoctor

Performance monitoring integration and ease of use

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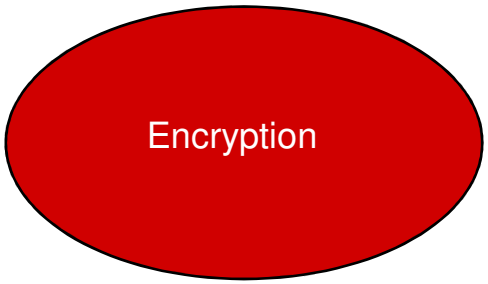
Encryption



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Encryption Options

	Encryption	Performance Impact	Key Management	Encrypt external storage
DS8000	AES 256	None	TLKM/SKLM	No
FS900	AES-XTS 256	None	USB Key	Yes
Spectrum Virtualize V7000 V9000	AES 256-XTS	None	USB Key or SKLM	Yes
XIV	AES 256	None	TLKM/SKLM KMIP	No

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for Business

IBM Storage Product Portfolio for IBM i

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IBM Systems Flash Storage Offerings Portfolio

IBM Spectrum Virtualize | IBM Spectrum Accelerate | IBM Spectrum Scale | IBM Power Systems | IBM z Systems | Heterogenous flash storage

Storwize V5030F

Entry / Mid-Range

Storwize V7000F

Mid-Range

FlashSystem V9000

Virtualizing the DC

FlashSystem A9000

Cloud service providers

- Full time data reduction
- Workloads: Cloud, VDI, VMware

FlashSystem A9000R

Large deployments

- Full time data reduction
- Workloads: Mixed and cloud

Simplified management
Flexible consumption model
Virtualized, enterprise-class, flash-optimized, modular storage
Enterprise class heterogeneous data services and selectable data reduction

DeepFlash 150

Big Data

- High capacity
- High density

DS8884F

Business class

DS8886F

Enterprise class

DS8888F

Analytic class with superior performance

Business critical, deepest integration with z Systems, superior performance, highest availability, Three-site/Four-site replication and industry-leading reliability

SVC

Enhanced data storage functions, economics and flexibility with sophisticated virtualization

FlashSystem 900
Application acceleration

IBM FlashCore™ Technology Optimized

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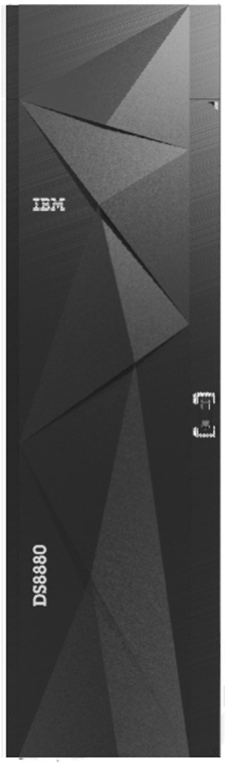
DS8880 Family Highlights

- **Performance**
  - Built on Power 8
  - High-Performance Flash Enclosure
  - Five generations of Easy Tier® and automated QoS management
- **Storage synergy**
  - Integration with IBM i for an infrastructure optimized for critical workloads and high performance
- **Reliability and availability**
  - Designed for 99.9999% availability to keep critical applications “online all the time”
  - The gold standard in business continuity solutions with deep integration with high-end server HA/clustering
- **Economic Impact**
  - Self-optimization and QoS management
  - Efficient architecture keeps hardware resources balanced and capacity utilization high
- **Data Protection and Security**
  - Flexible replication services to address backup and business-continuity needs.
  - Government-grade security with stronger encryption, advanced access control, and self-encrypting drives
- **Ease of Use**
  - Self optimization features to redirect IT staff to more important initiatives
  - Advanced GUI keeps administrators productive and happy



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DS8880F all-flash family

Efficiently designed to meet a wide range of business needs, from midrange to large enterprises

DS8884F
Business class

- Lowest entry cost for midrange enterprises
- Built with IBM Power Systems S822
- 6-core POWER8 processor per S822
- Up to 256 GB Cache (DRAM)
- Up to 32 Fibre channel/FICON ports
- From 6.4TB to 154 TB of flash capacity

DS8886F
Enterprise class

- High performance for large enterprises
- Built with IBM Power Systems S824
- From 8 to 24-core POWER8 processor per S824
- Up to 2 TB Cache (DRAM)
- Up to 128 Fibre channel/FICON ports
- From 6.4TB to 614.4 TB of flash capacity

DS8888F
Analytics class

- Highest performance for faster insights
- Built with IBM Power Systems E850
- From 24 to 48-core POWER8 processor per E850
- Up to 2 TB Cache (DRAM)
- Up to 128 Fibre channel/FICON ports
- From 6.4TB to 1.22 PB of flash capacity

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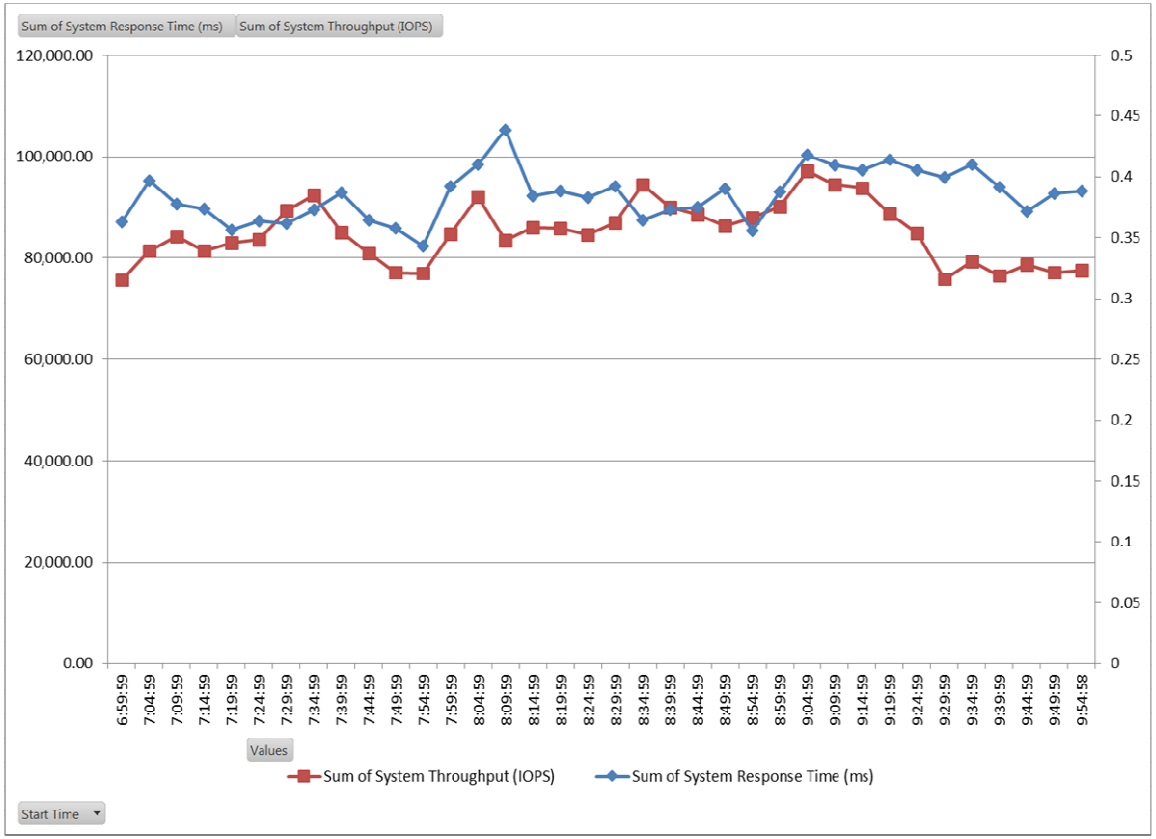
DS8886 Performance – IBM i Client Data



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IBM FlashSystem family

IBM FlashSystem V9000

Scalable Performance: Grow capacity and performance with up to 2.2 PB scaling capability

Enduring Economics: Next generation flash media for less than the cost of HDD

Agile Integration: Fully integrated system management to simplify management and improve workforce productivity under a single name space

IBM FlashSystem 900

Extreme Performance with IBM MicroLatency™: Delivers 100 microsecond response times

Macro Efficiency: Lowest latency offering with >40% greater capacity

Enterprise Reliability: IBM enhanced Micron flash technology which contains MLC offering with Flash Wear Guarantee

Powered by
IBM FlashCore™ technology

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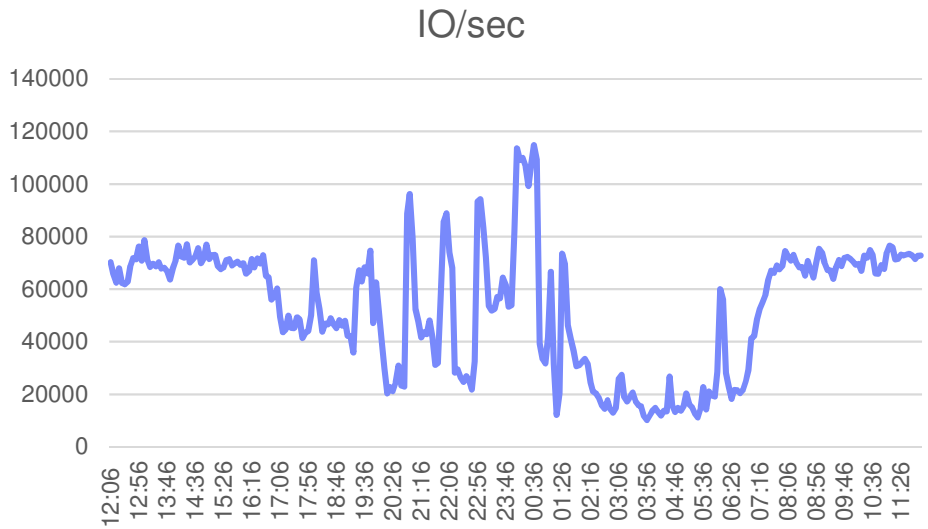
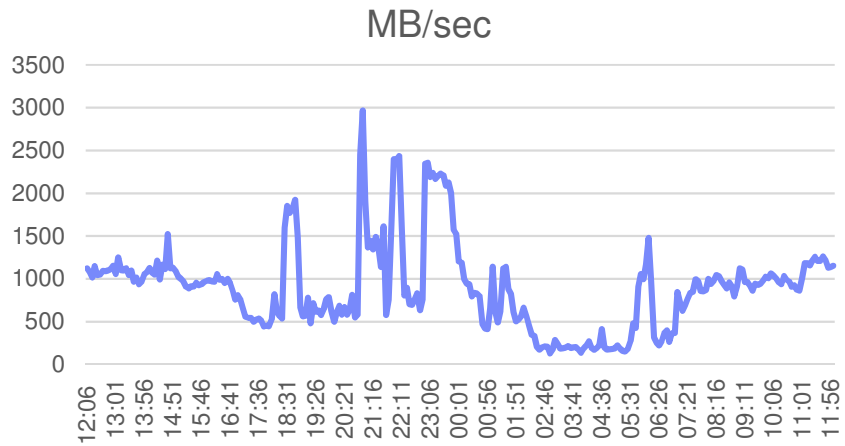
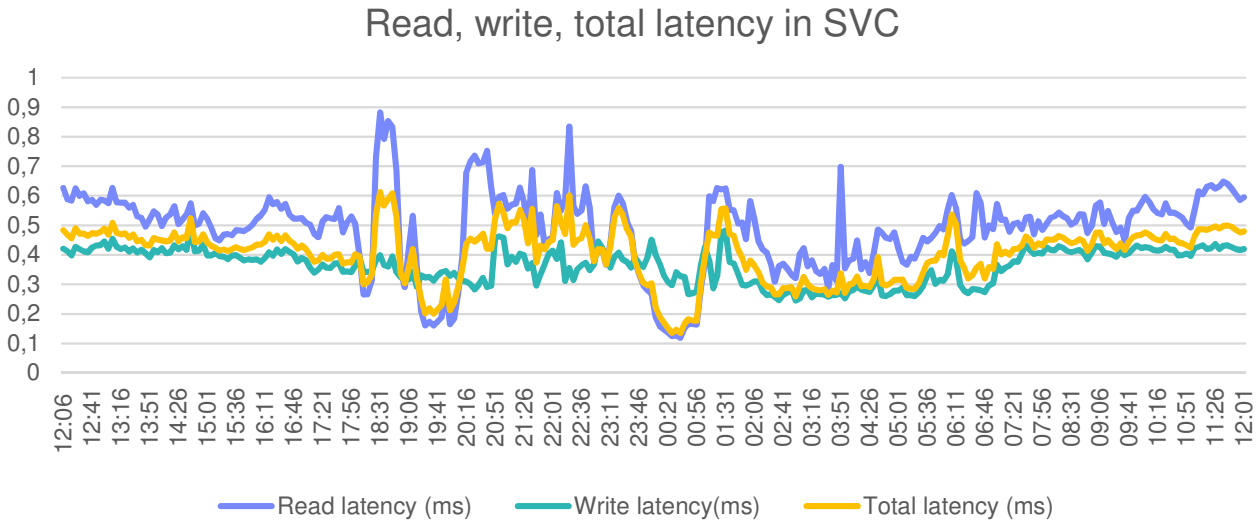
IBM i client Performance SVC/FlashSystem







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Systems Built With IBM Spectrum Virtualize

- IBM Spectrum Virtualize software has been available only pre-installed in IBM storage systems
  - IBM SAN Volume Controller
  - IBM Storwize family
  - IBM FlashSystem V9000
- Fully integrated solutions designed, tested, and supported by IBM
- Great choice for clients who prefer the simplicity of preconfigured storage appliances from midrange to enterprise

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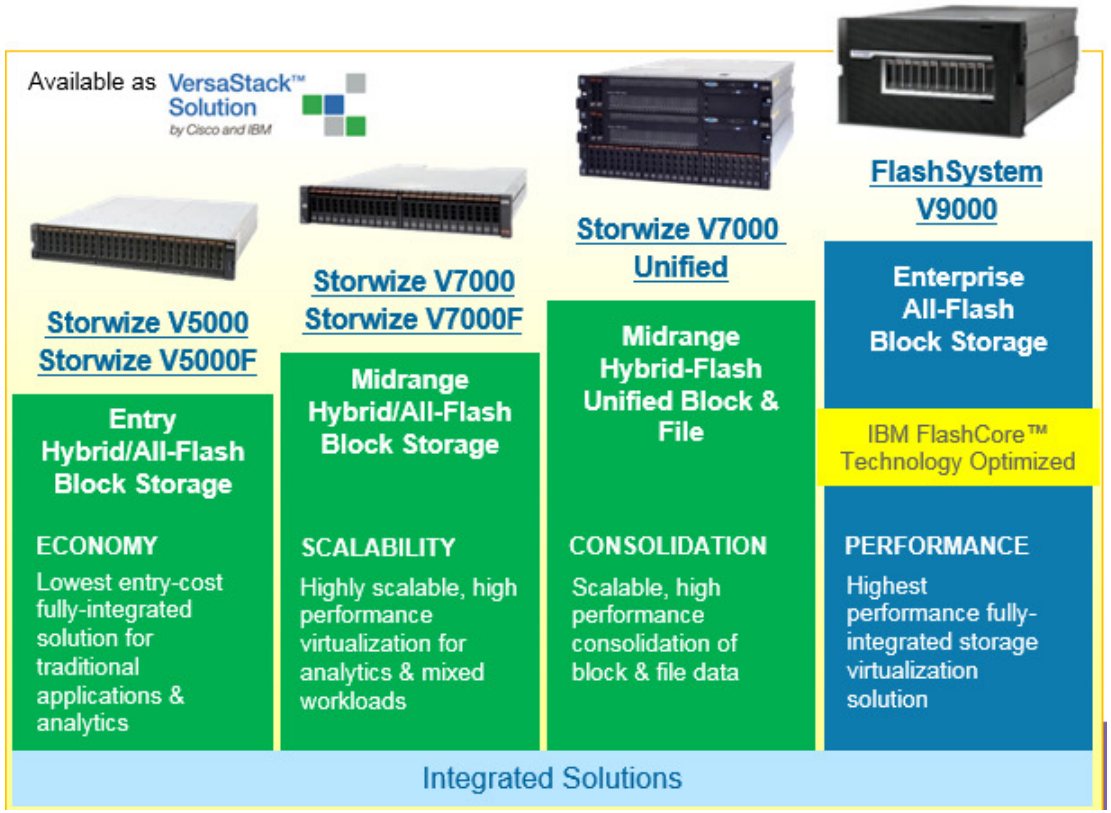
IBM All-Flash Solutions Built with IBM Spectrum Virtualize Software



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Storwize Hardware Platform

	Storwize V5010	Storwize V5020	Storwize V5030	Storwize V7000
Scale-out	Yes, upgradable	Yes, upgradable	2-node to 4-node Clustering Plus External Storage	2-node to 8-node Clustering Plus External Storage
Data Reduction	Compression	Compression	Compression	Compression
Drives			504 Clustering – 1,008	504 Clustering – 1,056
Memory	16GB	32GB	Base - 64GB Clustering - 128GB	Base - 64GB Clustering - 256GB
CPU/Cores	Broadwell 2 x 6-core, 2 thread	Broadwell 2 x 6-core, 4 thread	Broadwell 4 x 6-core, 4 thread	Broadwell 8 x 8-core PLUS Compression HW
FE Ports	iSCSI, FCP, SAS	iSCSI, FCP, SAS	iSCSI, FCP, SAS	iSCSI, FCP
BE Ports	12Gb/s	12Gb/s	12Gb/s	12Gb/s
RAID Options	0,1,5,6,DRAID	0,1,5,6,DRAID	0,1,5,6,DRAID	0,1,5,6,DRAID

IBM Storwize Offers Superior Upgradability and Flexibility!

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Storage System Comparisons

	DS8000	Storwize family	XIV	FlashSystem 900
Native device support	Yes	Yes	No	Yes
NPIV support	Yes	Yes	No	Yes
Power HA Support	Yes	Yes	No	No
Full System Toolkit	Yes	Yes	Yes	No
Hyper-Swap	Yes	Yes	No	No
IBM i hosted CLI	Yes	Yes	Yes (Service Offering)	No
RAID Options	5, 6, &10	0, 1, 5, 6, & 10 (DRAID 5 & 6)	Grid	5
Automatic load balancing	3-tier Easy Tier	3-tier Easy Tier	Yes	No
Flash/SSD Exploitation	Automatic and IBM i managed	Automatic	Automatic	All-Flash
Thin provisioning	Yes	Yes	Automatic	No
Compression	No	Yes	Yes	No
Point in time copy	Yes	Yes	Yes	No
Async remote copy	Yes	Yes	Yes	No
Encryption	Yes	Yes	Yes	Yes

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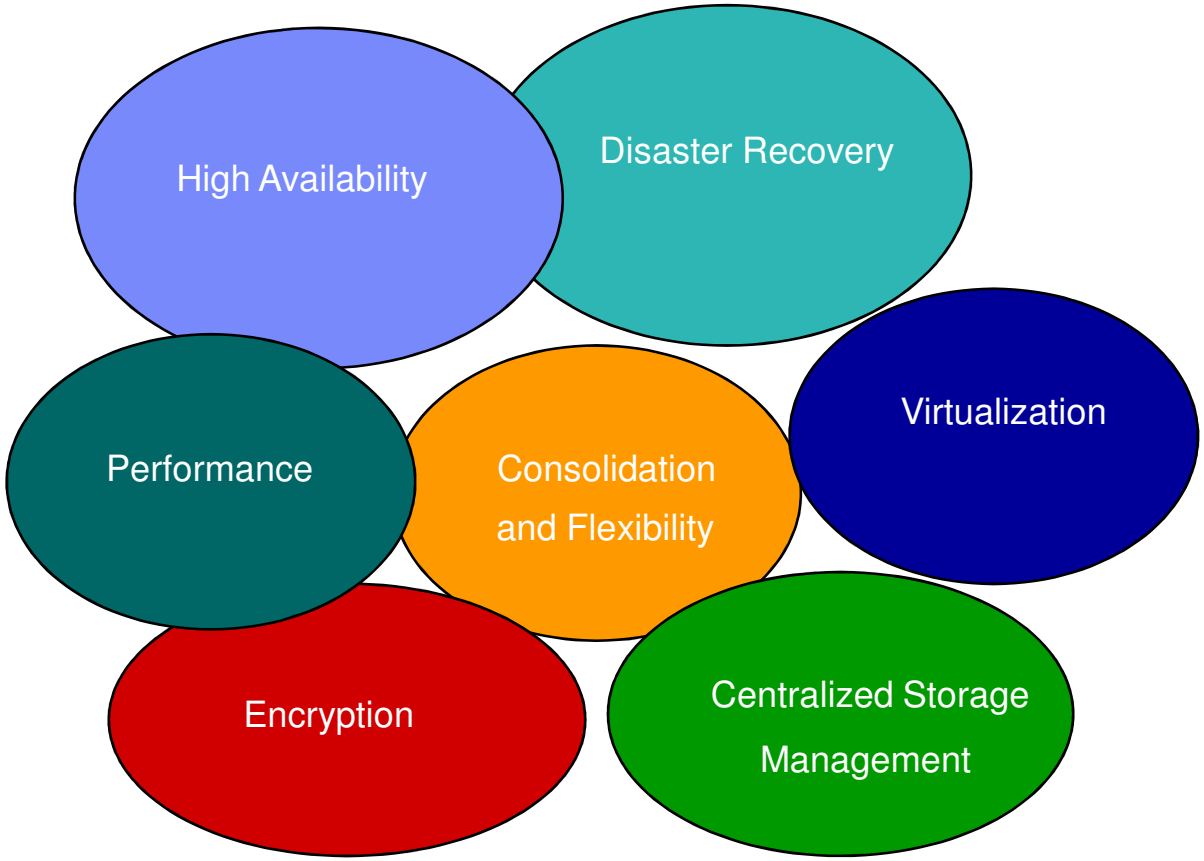
Why external disk?



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Session summary

- One size does not fit all
- Flash exploitation across the board
- Integration with IBM i and Power HA is key
- IBM storage meets the requirements of IBM i customers better than other vendors

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