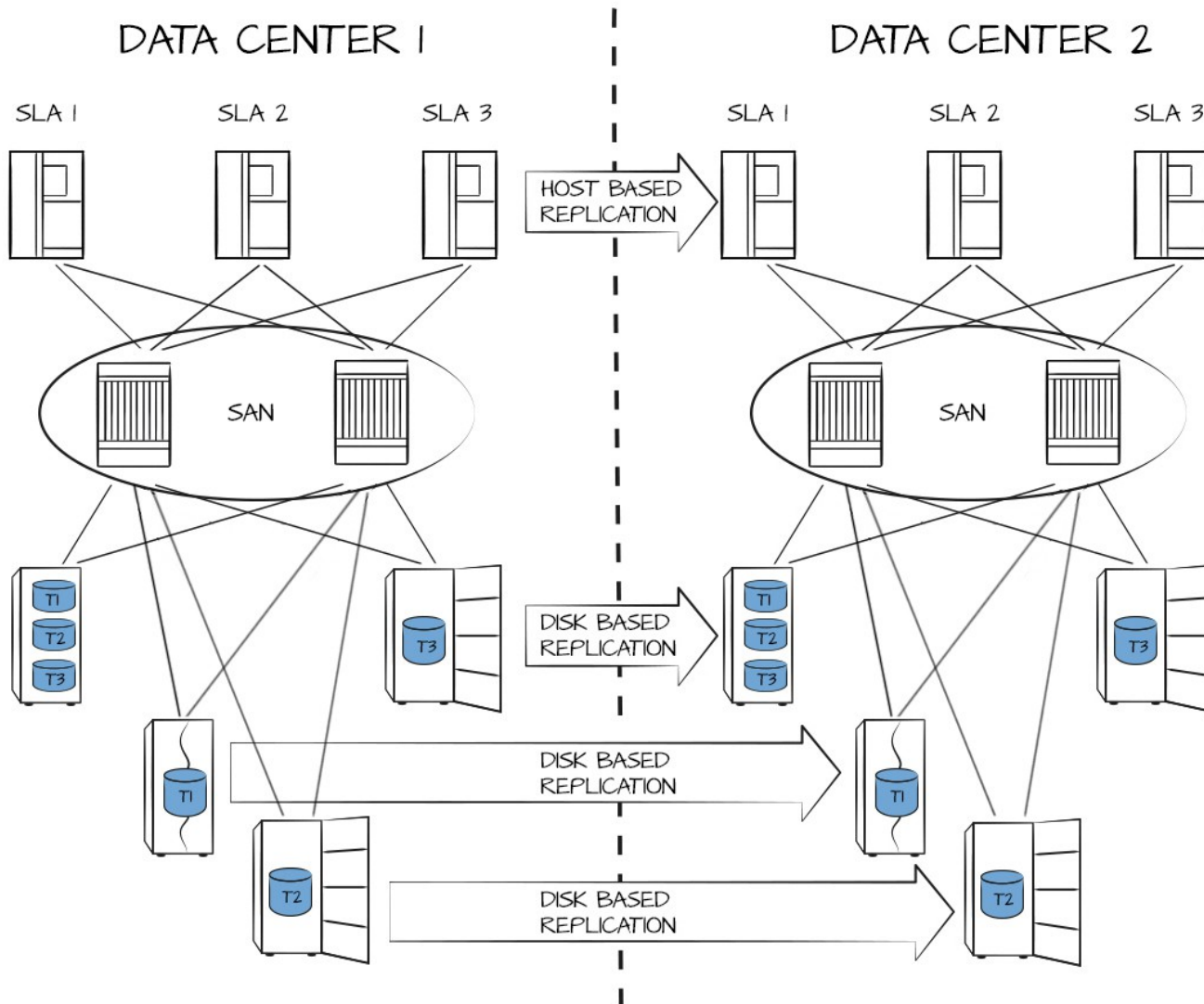


SOFTWARE- DEFINED-STORAGE

The future of cloud-
optimized Storage
Technical Presentation

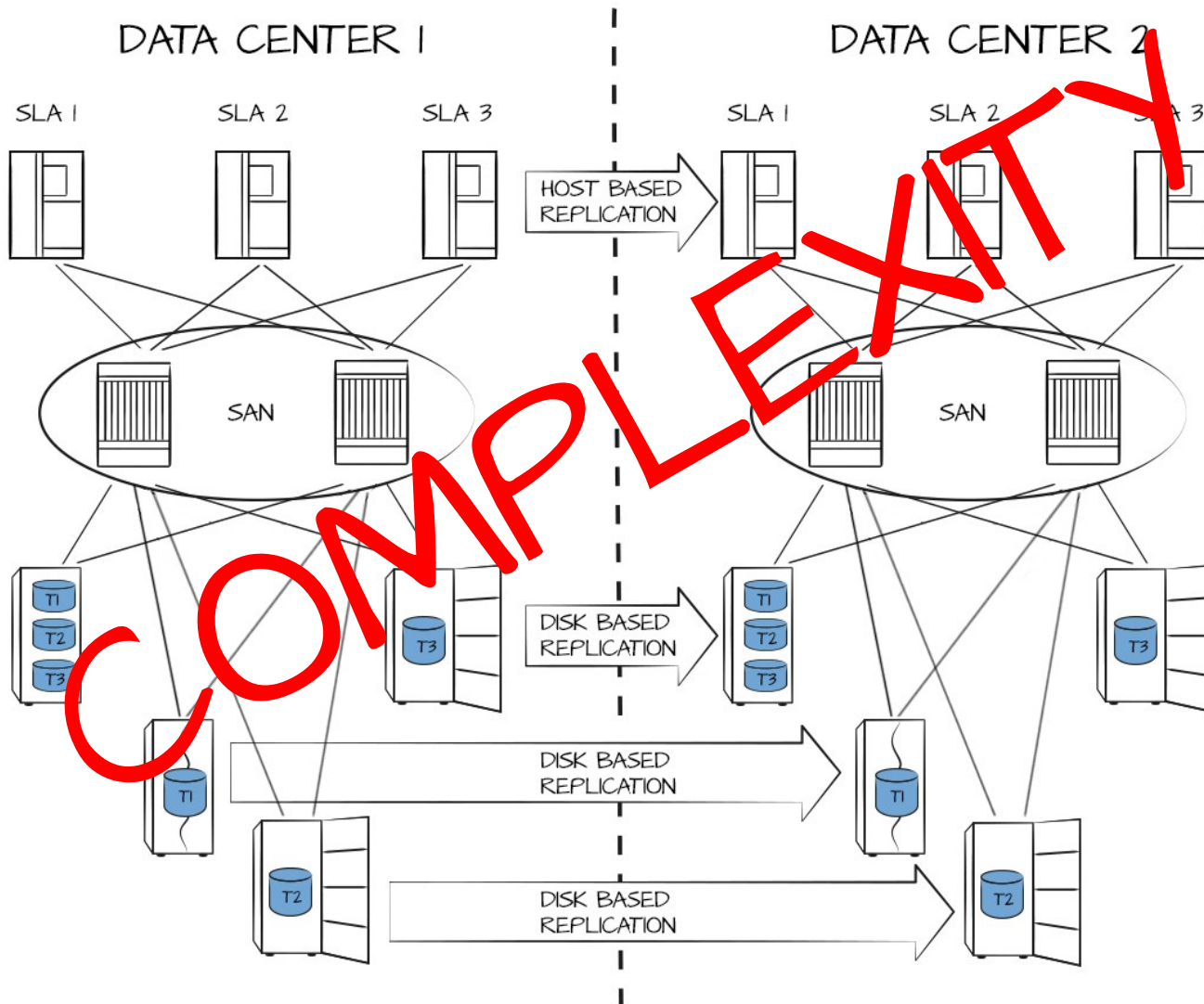


Ivo Gomllšek - Senior Infrastructure Architect - CEE



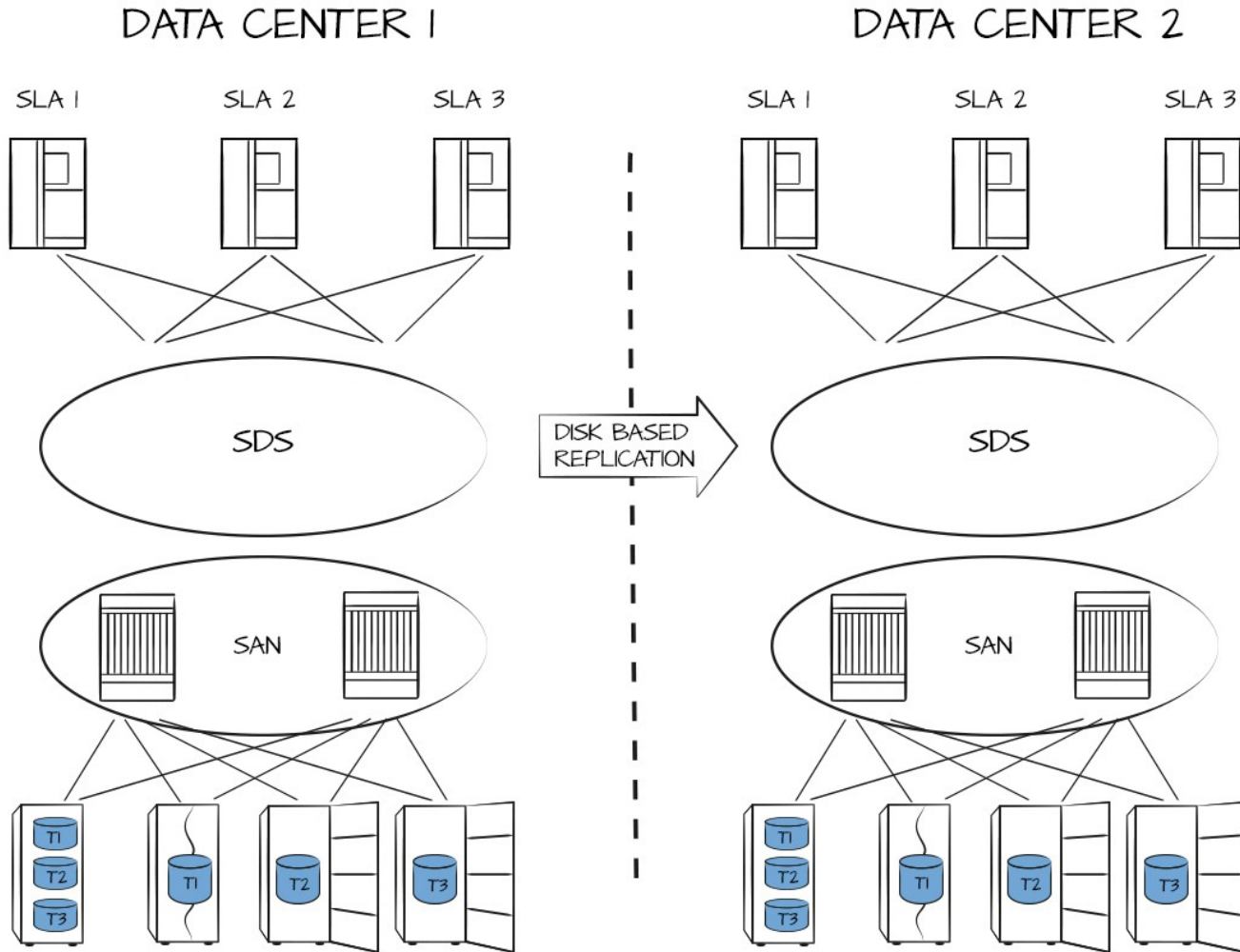
CLASSICAL DATACENTER WITH STORAGE IN SILOS...

IBM CEE STORAGE TEAM



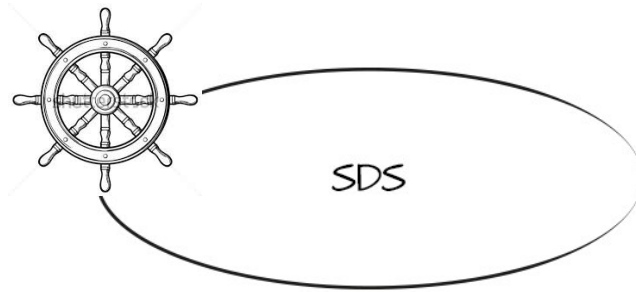
COMPLEX TO MANAGE...

IBM CEE STORAGE TEAM

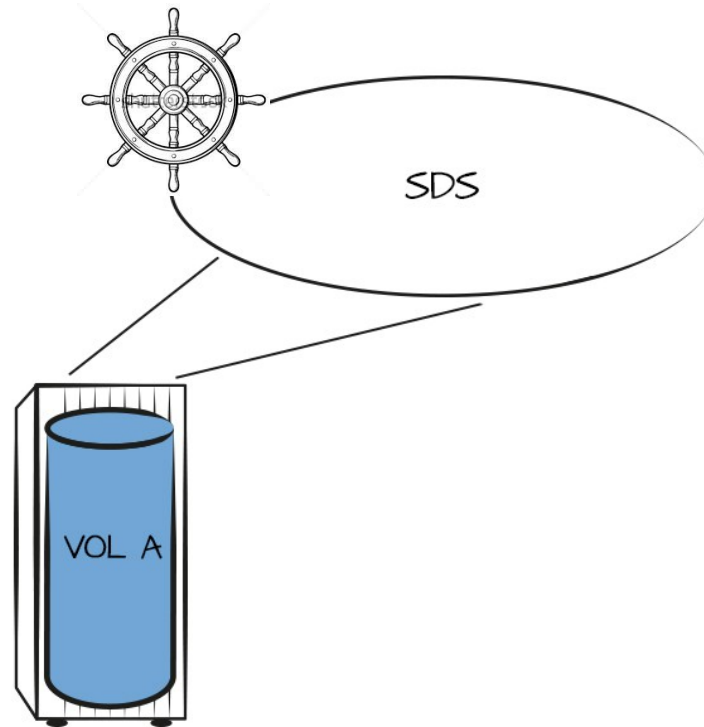


TO REMOVE THE COMPLEXITY, WE ADD SDS LAYER...

IBM CEE STORAGE TEAM

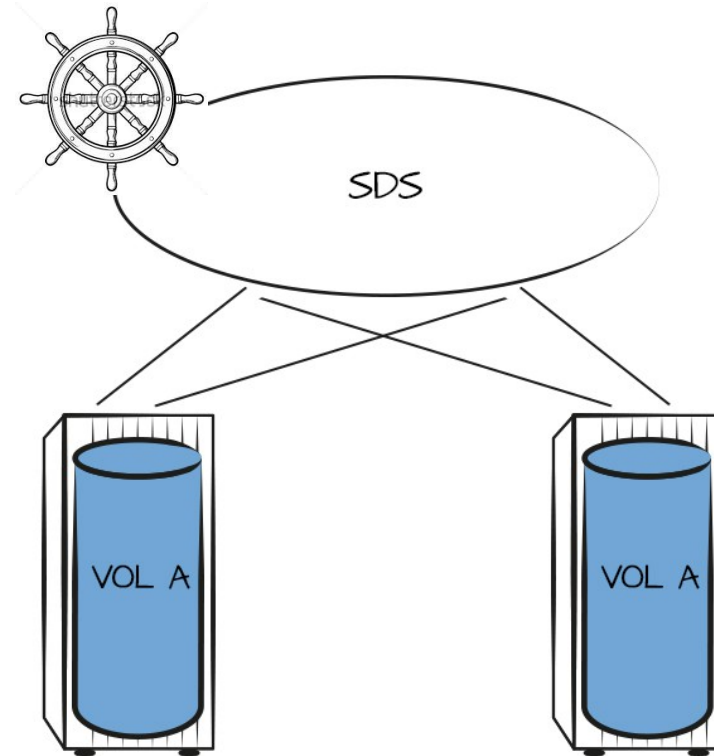


IN A SDS ENVIRONMENT, YOU CAN MANAGE EVERYTHING FROM A SINGLE LAYER



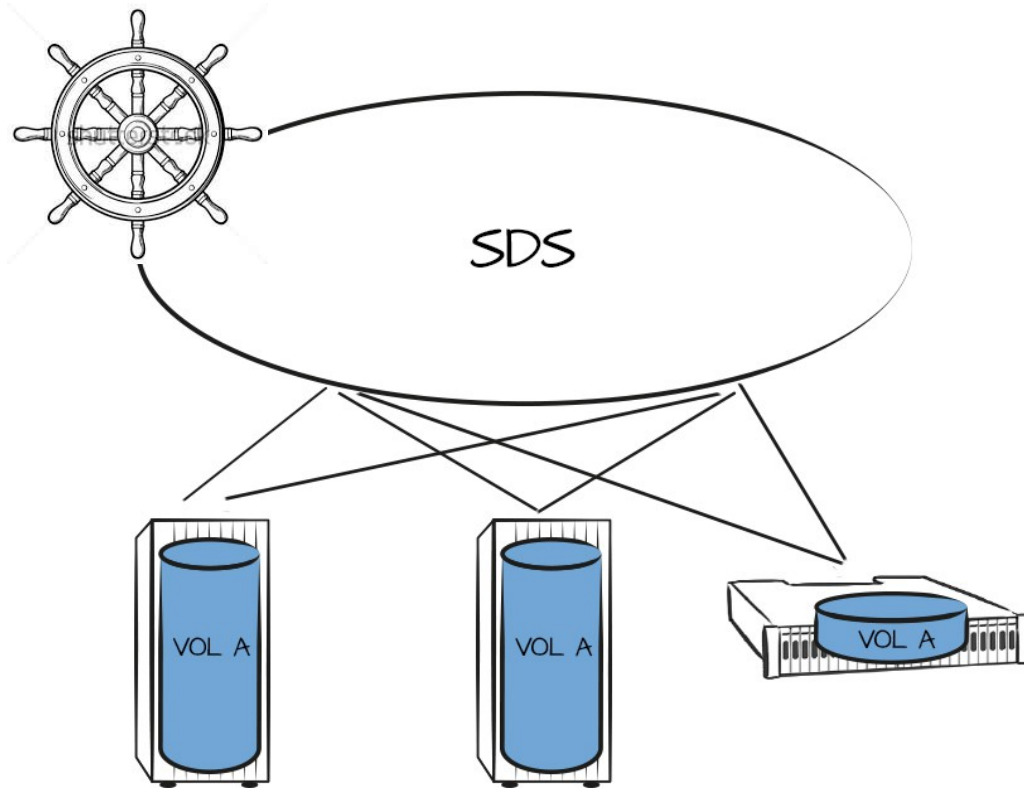
YOU CAN USE ANY STORAGE SYSTEMS...

IBM CEE STORAGE TEAM

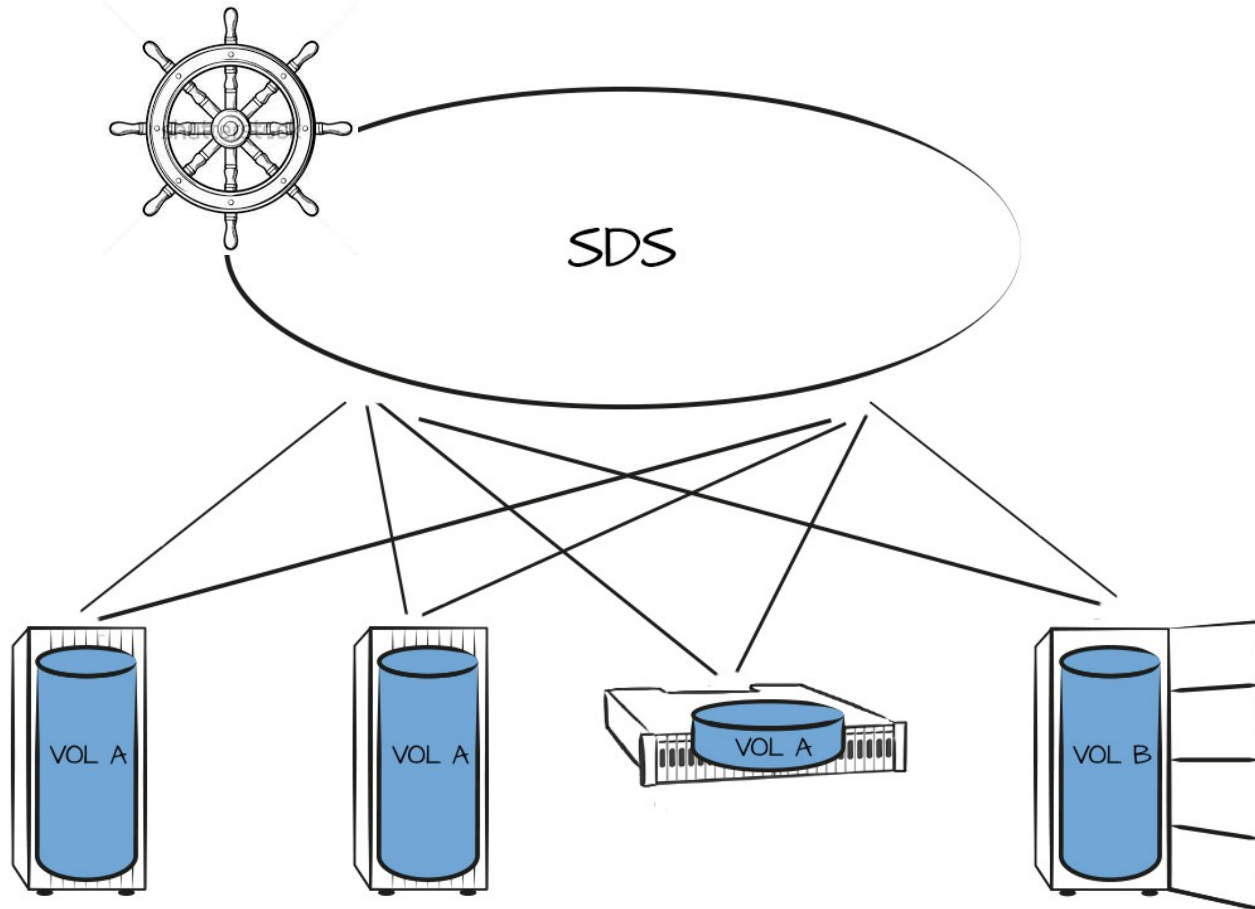


AND YOU CAN GROW VERTICALLY & HORIZONTALLY

IBM CEE STORAGE TEAM

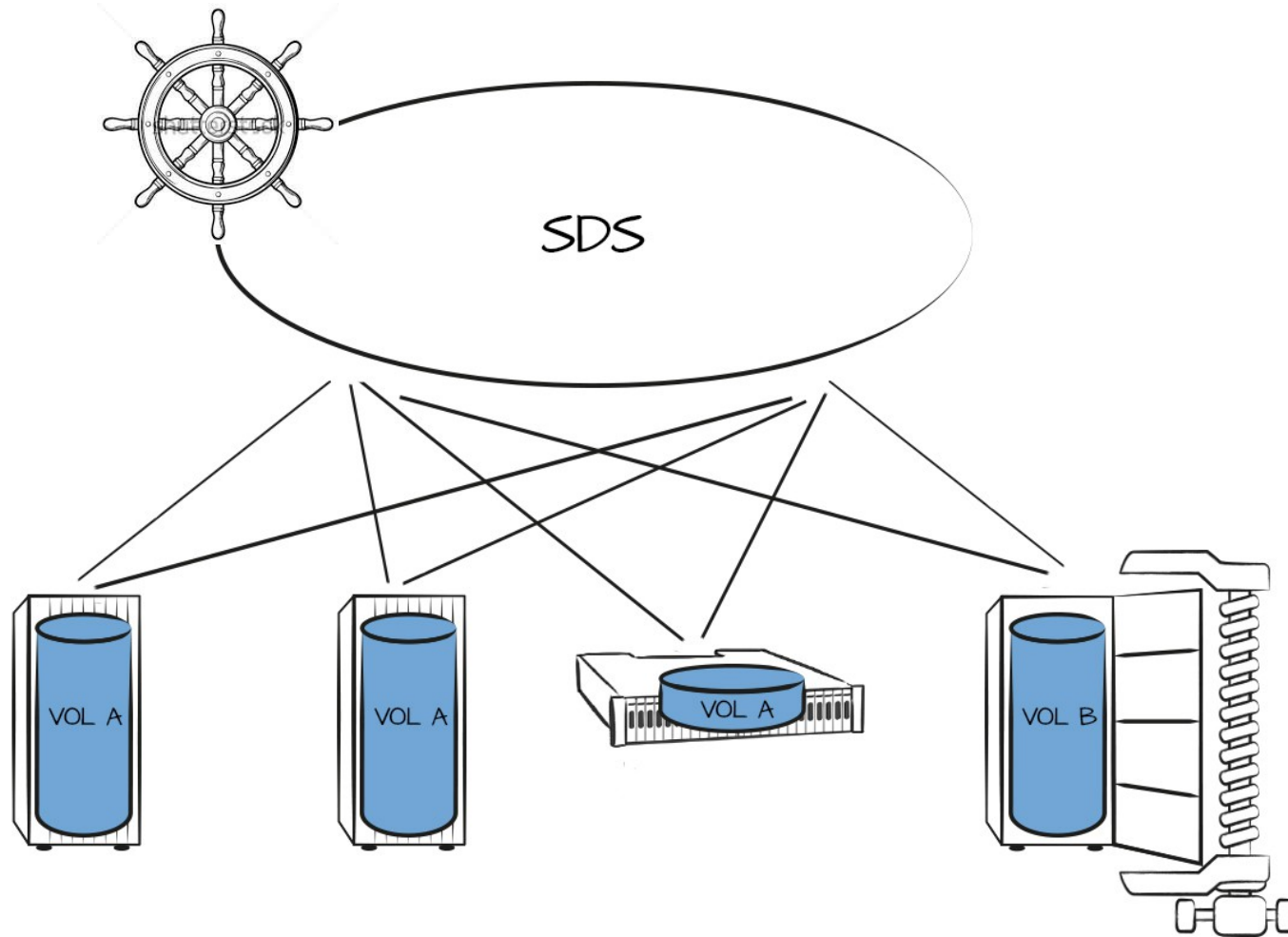


OR, YOU CAN ADD FLASH SYSTEMS TO INCREASE OVERALL PERFORMANCE..



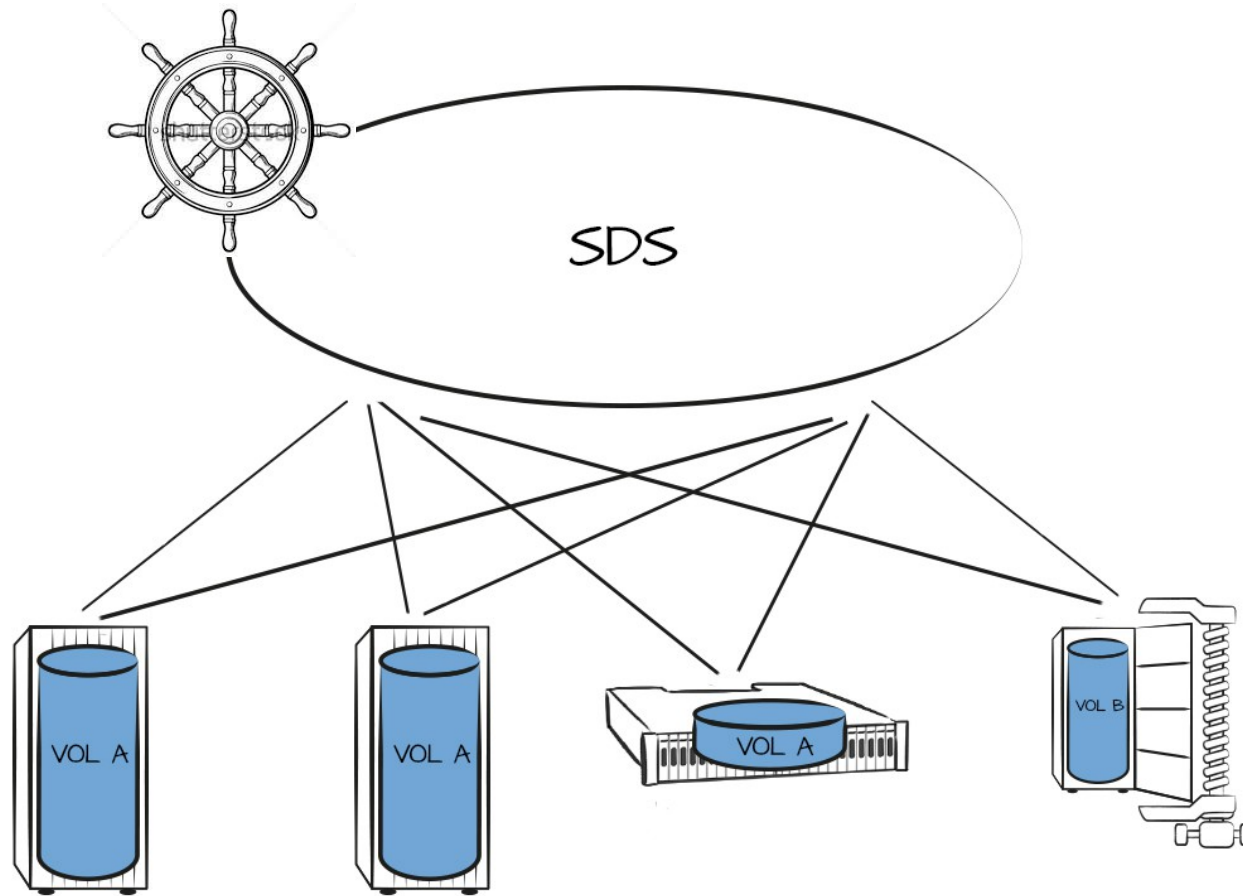
OR, YOU CAN CREATE TOTALLY DIFFERENT ENVIRONMENTS

IBM CEE STORAGE TEAM



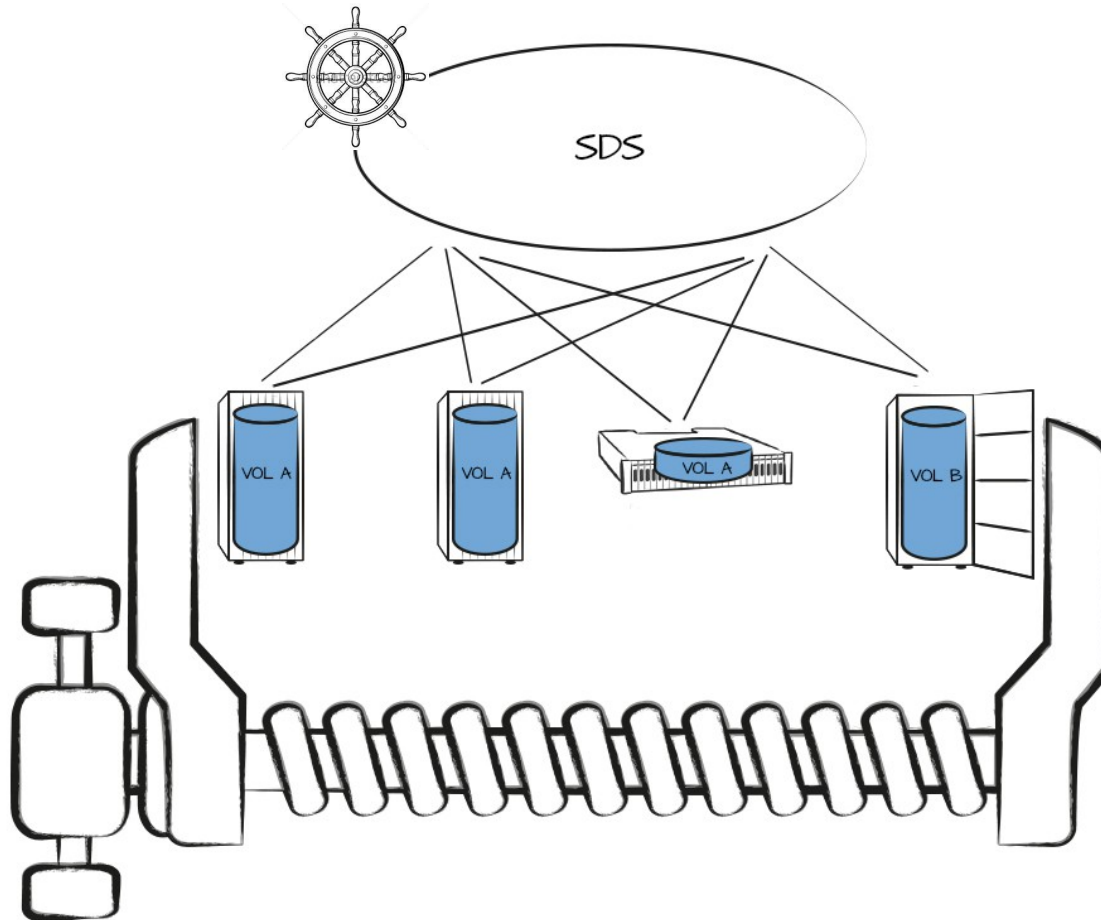
YOU CAN COMPRESS DATA ON ONE BOX/VOLUME...

IBM CEE STORAGE TEAM



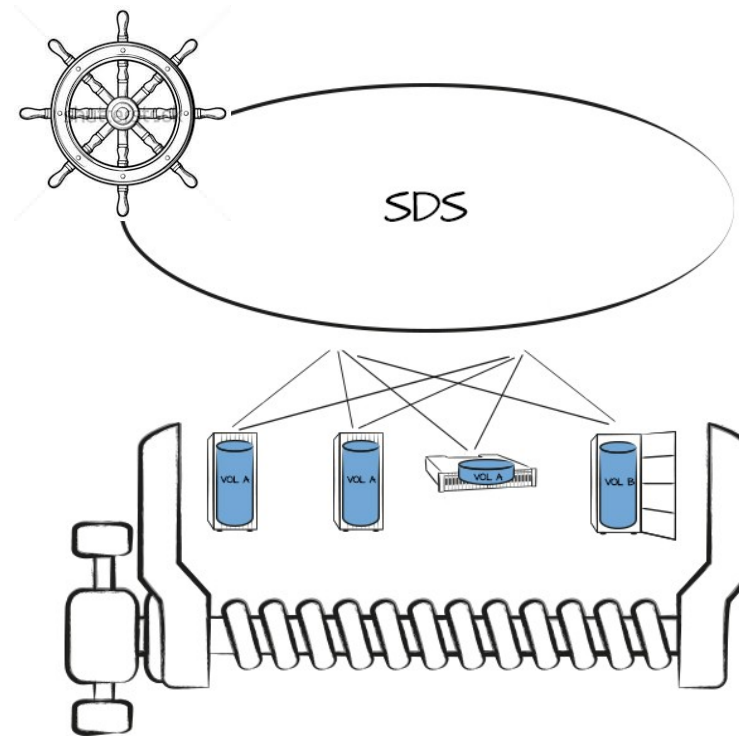
WITHOUT PERFORMANCE DEGRADATION...

IBM CEE STORAGE TEAM



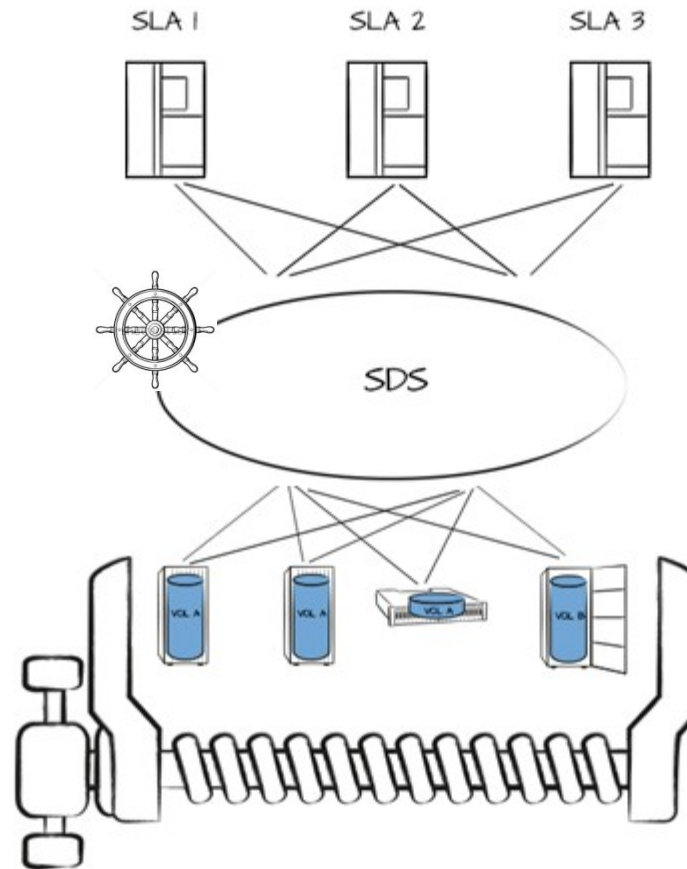
OR, YOU CAN ENABLE IT FOR WHOLE ENVIRONMENT

IBM CEE STORAGE TEAM



WITHOUT ANY DOWNTIME...

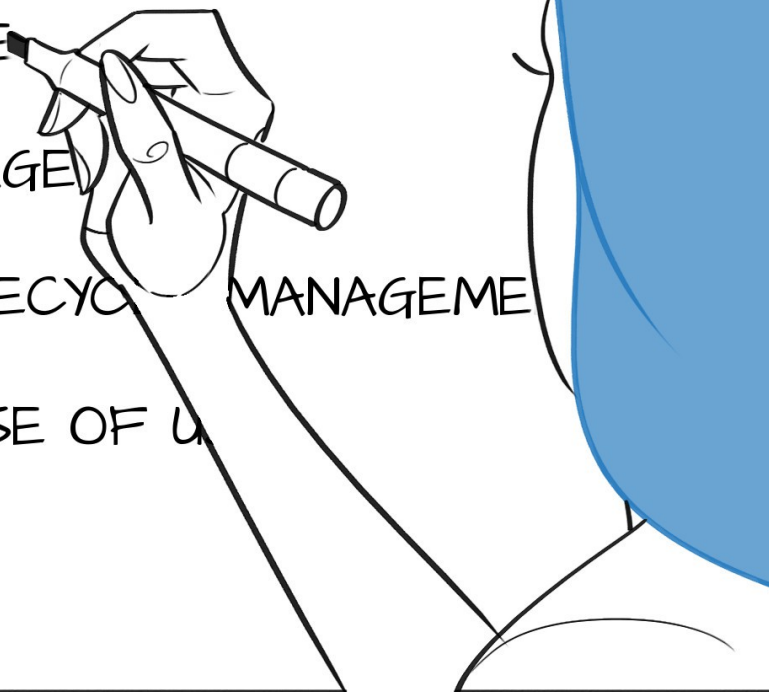
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WITHOUT TOUCHING OR CHANGING OS OR APPLICATION LAYER...

IBM CEE STORAGE TEAM

We use these functionalities ,
to eliminate the following challenges...

- 
- AVAILABILITY (HA/DR)
 - GROWTH / SCALABILITY
(CAPACITY MANAGEMEN
 - PERFORMANCE MANAGE
 - INFRASTRUCTURE LIFECYC MANAGEMEN
 - MANAGEABILITY / EASE OF U
 - BACKUP

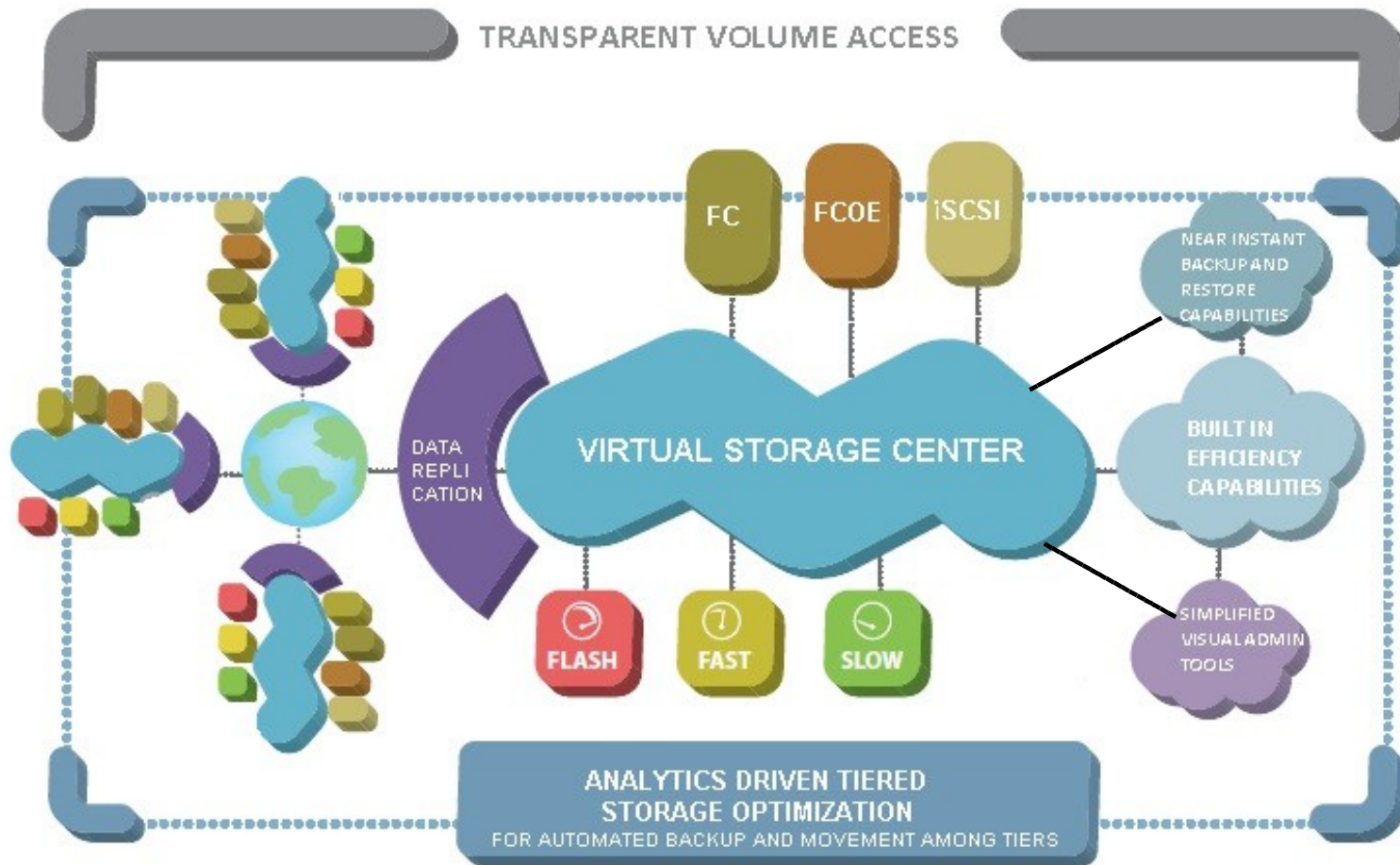


Virtual Storage Center (VSC)

Implementation of our Software
Defined Storage Approach for
Block Storage

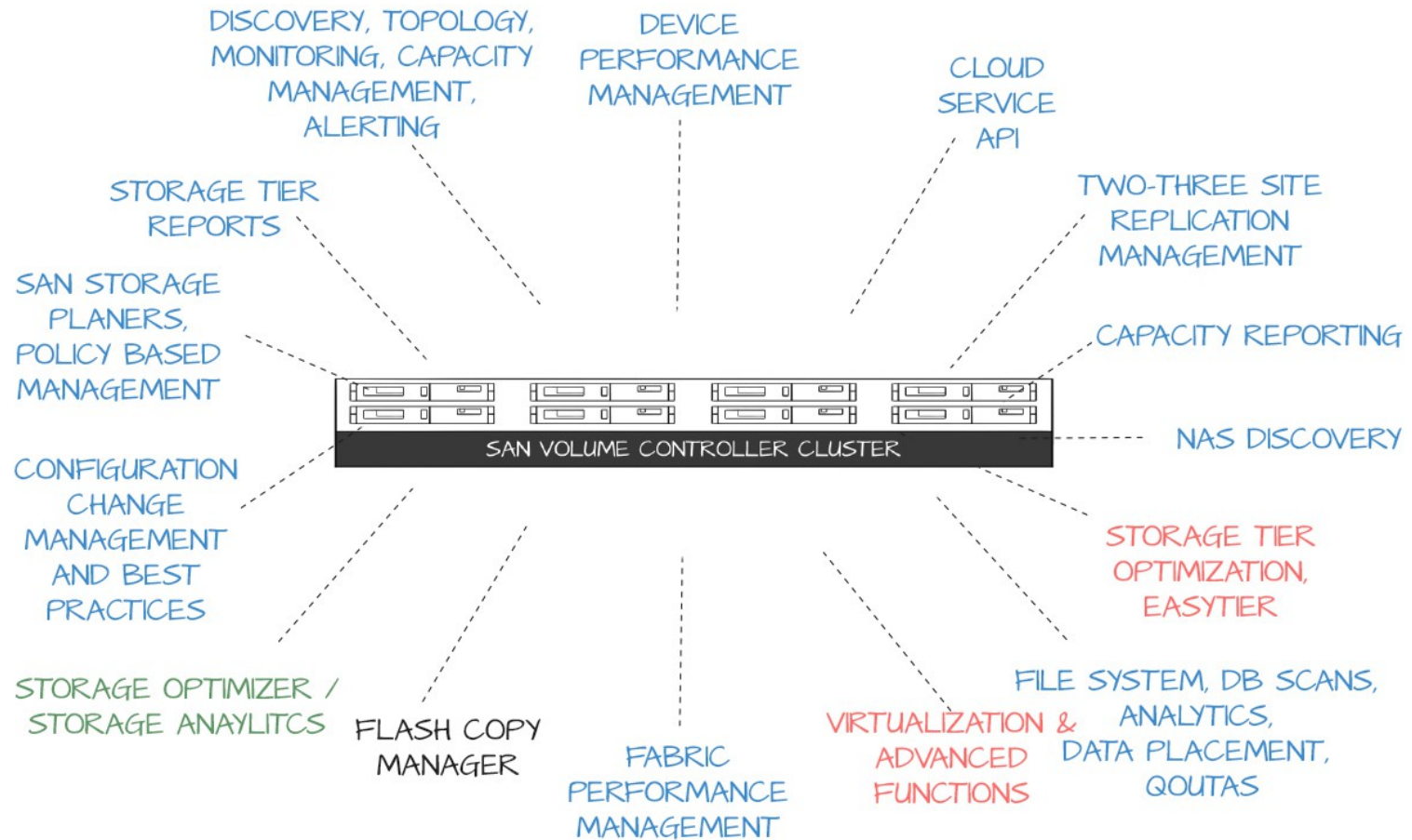


SDS for Block = VSC





SDS for Block = VSC



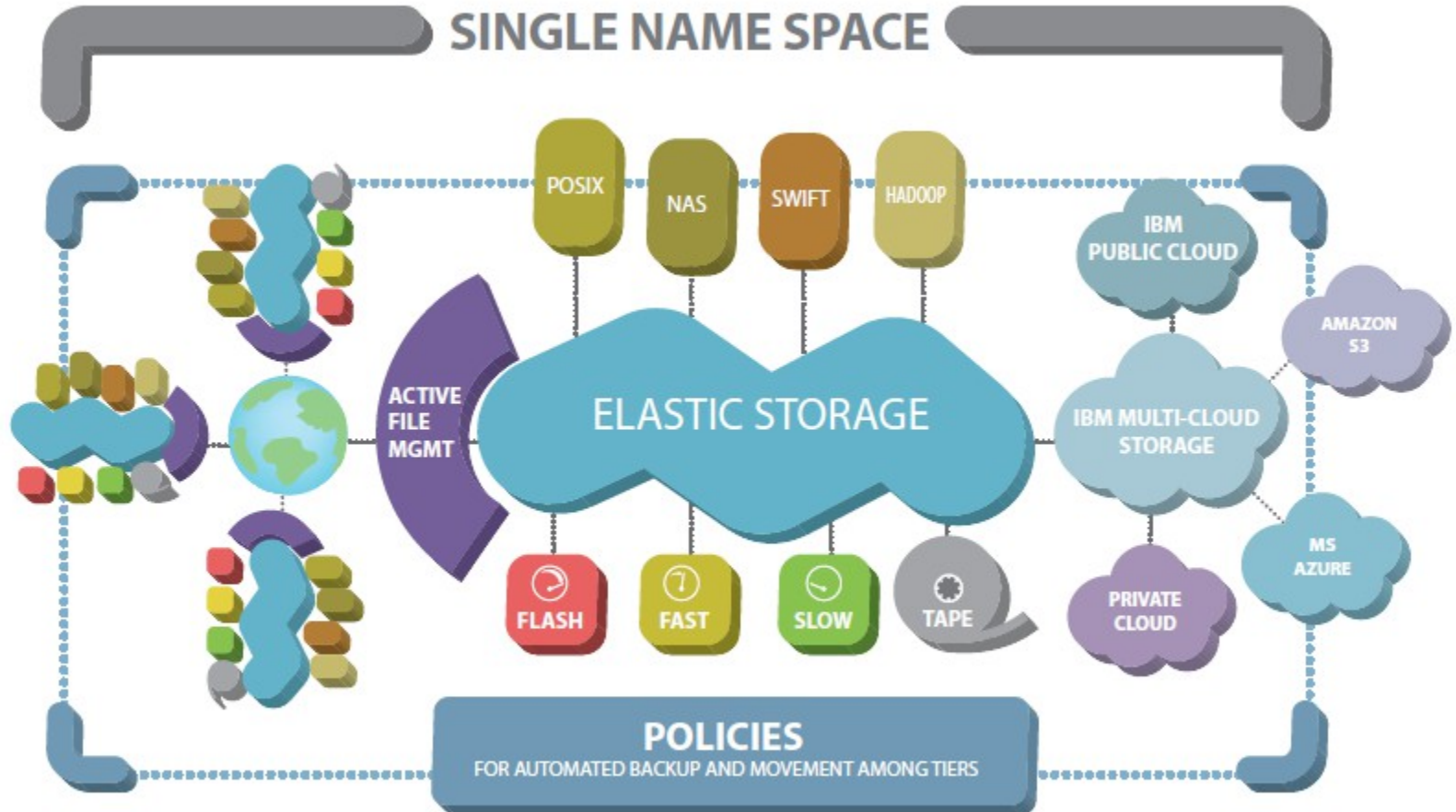


Elastic Storage

Implementation of our Software
Defined Storage Approach for
File Storage



SDS for File = Elastic Storage

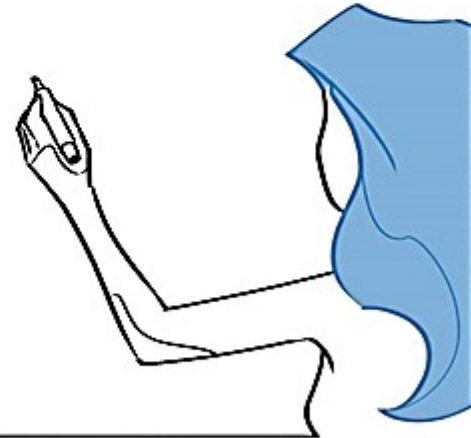




IBM Software Defined Storage (SDS)
is a single layer controlling I/O
communication.....

it needs to fulfill the following criteria

- HIGH PERFORMANCE
- HIGH AVAILABILITY - 'FIVE NINES'
- HIGHEST SCALABILITY IN ONE BOX
- EVERY SOLUTION GETS TESTED BEFORE SHIPMENT
- DEDICATED RAID CPU
- INCLUDED 24X7 MAINTENANCE
- LICENSING MODELS
- SCALABLE ADVANCED FUNCTIONS
- MAINFRAME ATTACH
- ACTIVE/ACTIVE LUN ACCESS



ATTRIBUTES OF HIGH END STORAGE SUBSYSTEM

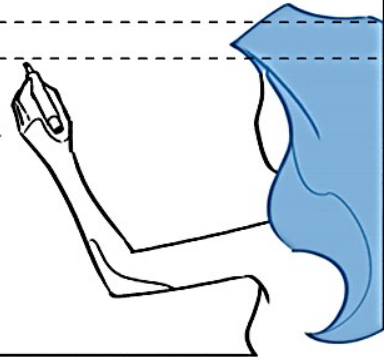
- HIGH PERFORMANCE
- HIGH AVAILABILITY (RELIABILITY, AVAILABILITY & SERVICABILITY)
- SCALABILITY & FLEXIBILITY
(CAPACITY / PERFORMANCE MANAGEMENT)
- EASY TO USE & MANAGE
- ONLINE INFRASTRUCTURE LIFECYCLE MANAGEMENT
- EASY ADDING NEW FUNCTIONALITY
- SUPPORT FOR VARIOUS BACKEND
SYSTEMS & TECHNOLOGIES
- SCALABLE ADVANCED FUNCTIONS
- ABILITY TO PERFORM FAST BACKUP
- ACTIVE/ACTIVE LUN ACCESS
- LOW TCO / FAST ROI



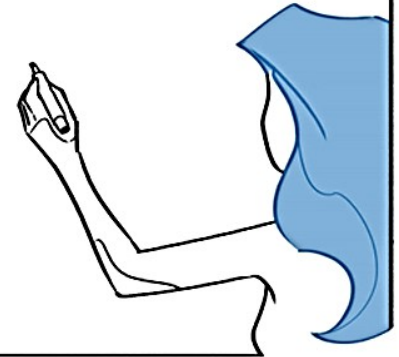
WHAT ARE EXPECTATIONS FROM SOFTWARE DEFINED STORAGE (VIRTUAL STORAGE INFRASTRUCTURE)

IBM CEE STORAGE TEAM

- HIGH PERFORMANCE
- HIGH AVAILABILITY (RELIABILITY, AVAILABILITY & SERVICABILITY)
- SCALABILITY & FLEXIBILITY
(CAPACITY / PERFORMANCE MANAGEMENT)
- ABILITY TO PERFORM FAST BACKUP
- SCALABLE ADVANCED FUNCTIONS
- ACTIVE/ACTIVE LUN ACCESS
- EASY TO USE & MANAGE
- ONLINE INFRASTRUCTURE LIFECYCLE MANAGEMENT
- EASY ADDING NEW FUNCTIONALITY
- SUPPORT FOR VARIOUS BACKEND SYSTEMS & TECHNOLOGIES
- LOW TCO / FAST ROI



- HIGH PERFORMANCE
- HIGH AVAILABILITY - 'FIVE NINES'
- HIGHEST SCALABILITY IN ONE BOX
- EVERY SOLUTION GETS TESTED BEFORE SHIPMENT
- DEDICATED RAID CPU
- SCALABLE ADVANCED FUNCTIONS
- ACTIVE/ACTIVE LUN ACCESS
- INCLUDED 24X7 MAINTENANCE
- LICENSING MODELS
- MAINFRAME ATTACH



VIRTUAL STORAGE INFRASTRUCTURE ATTRIBUTES vs.
ATTRIBUTES OF HIGH END STORAGE SUBSYSTEM

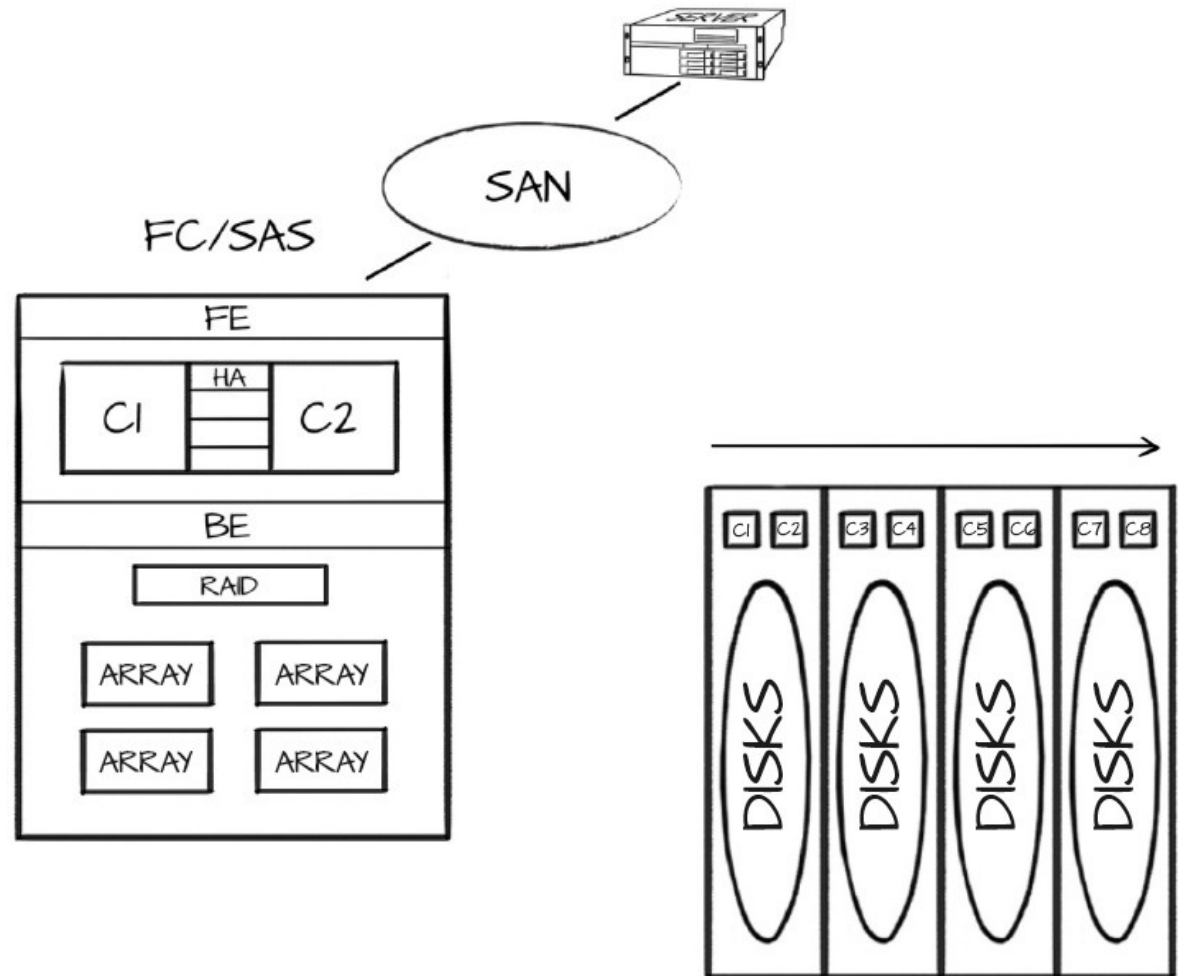
IBM CEE STORAGE TEAM



Let's now take a look how IBM Software Defined Storage (SDS) software stack for block storage (VSC) provides required capabilities

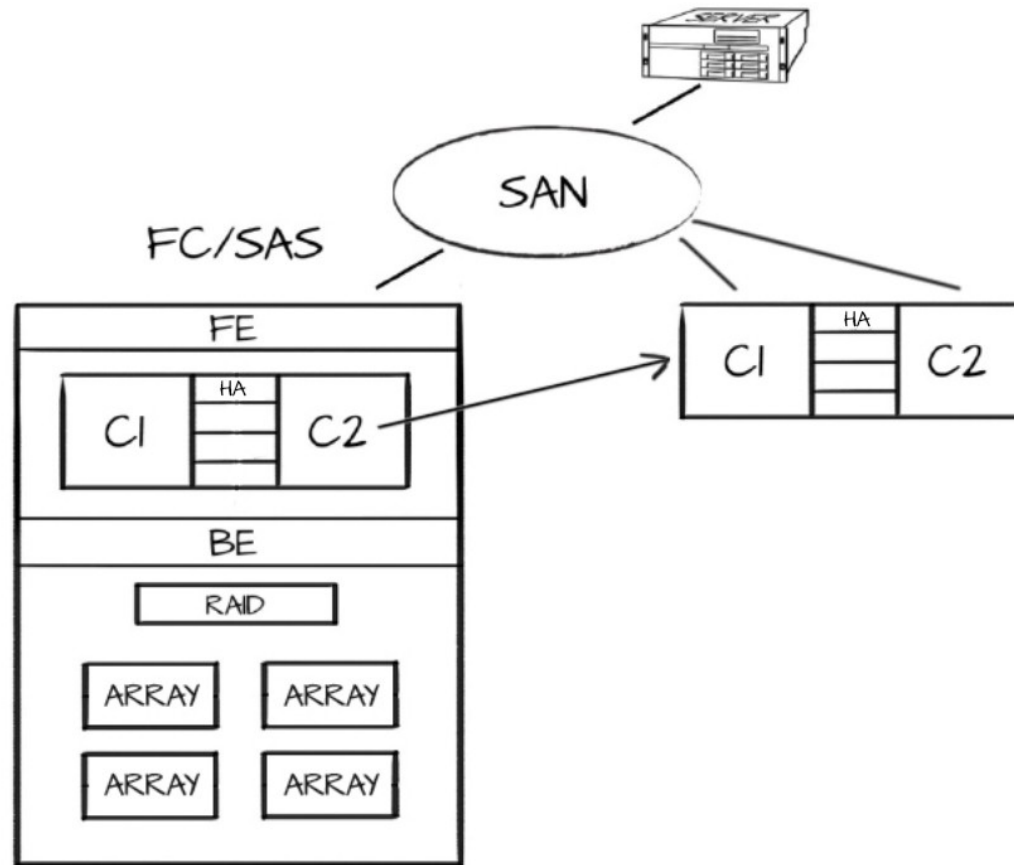


HIGH PERFORMANCE



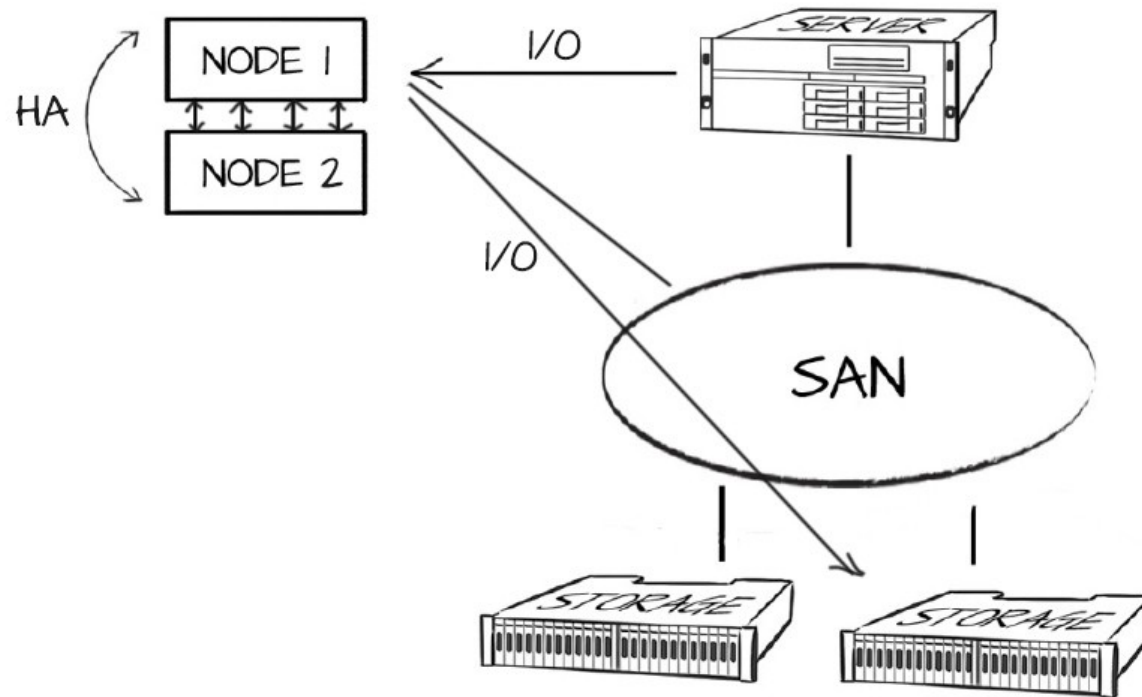
CLASSICAL HIGH END DESIGN

IBM CEE STORAGE TEAM



VIRTUALIZATION APPROACH

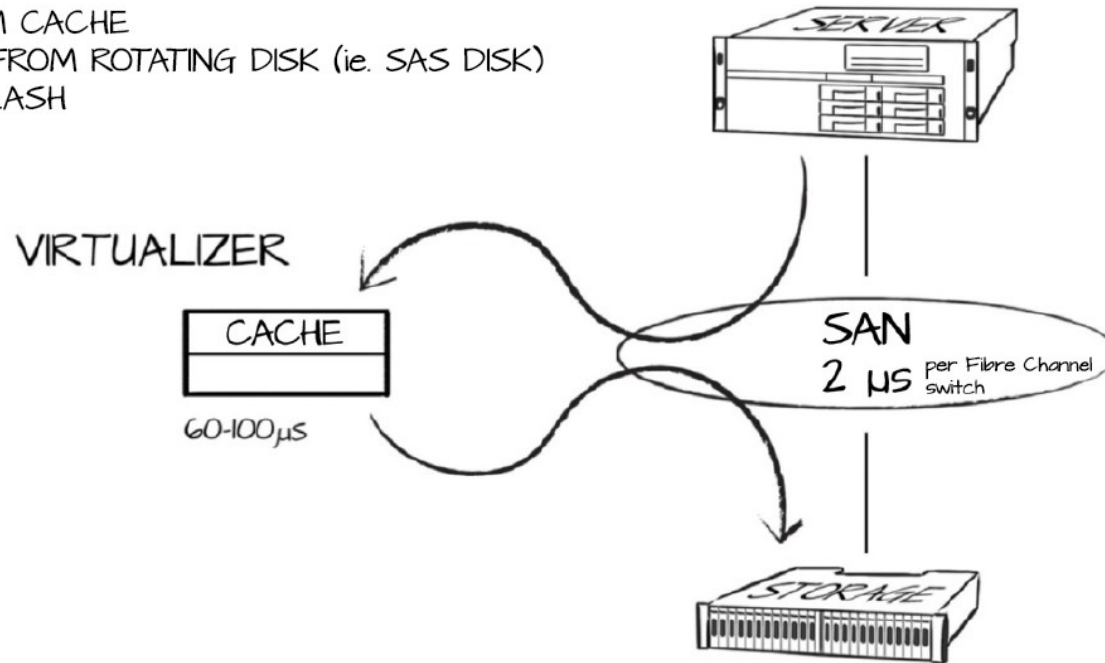
IBM CEE STORAGE TEAM

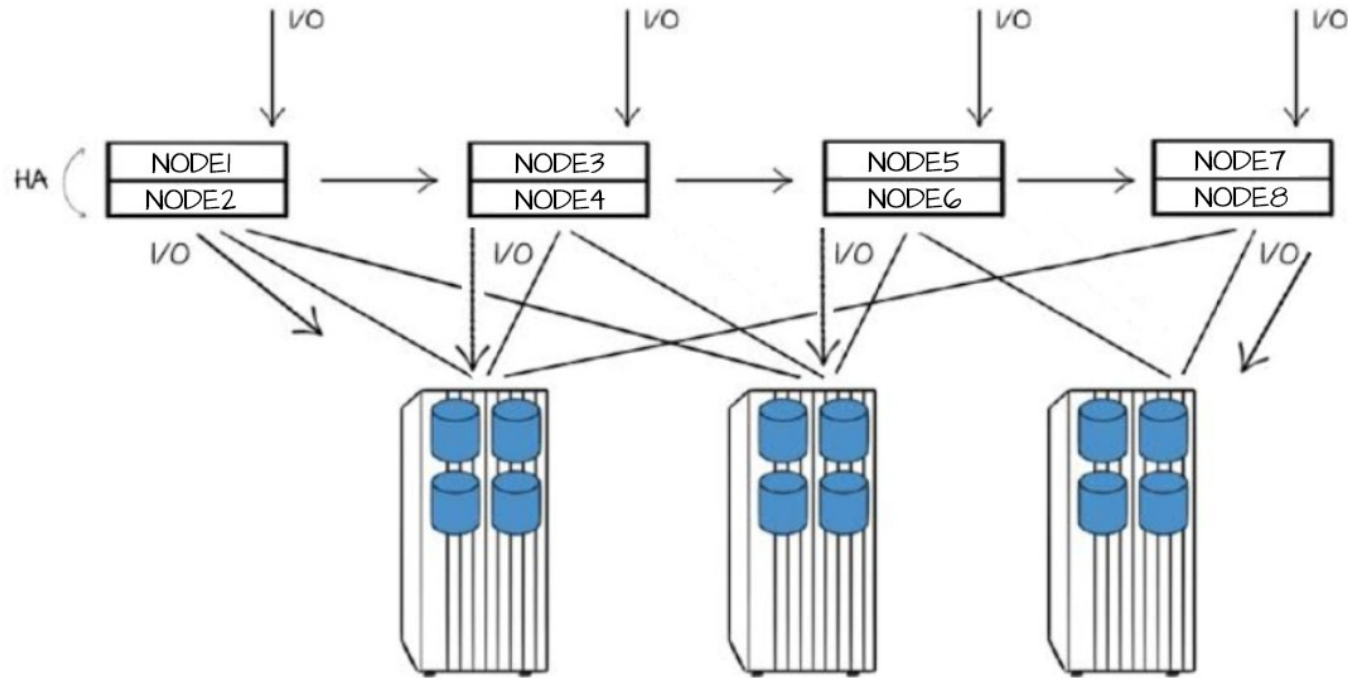


VIRTUALIZATION - I/O PATH

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$< 1 \text{ ms}$ - FROM CACHE
 $3 \text{ ms} < 5 \text{ ms}$ - FROM ROTATING DISK (ie. SAS DISK)
 $100\text{-}200 \text{ } \mu\text{s}$ - FLASH



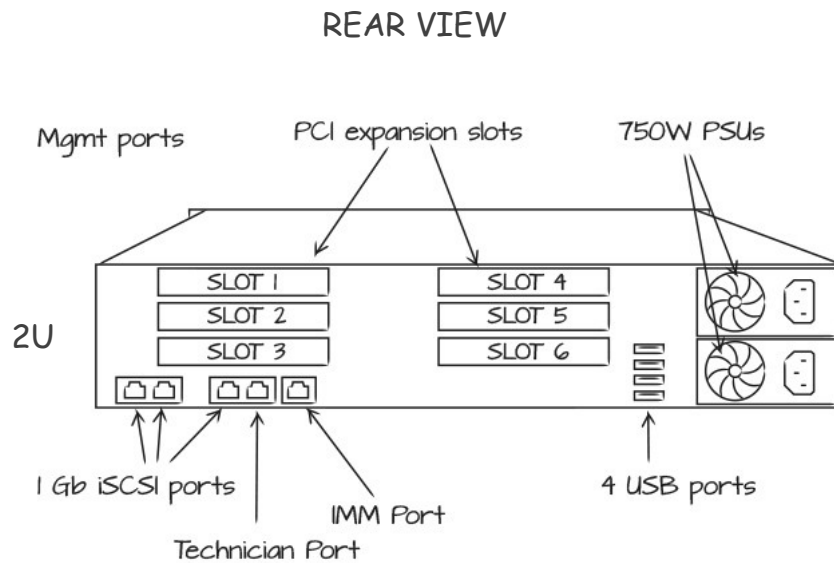


HISTORY:

DEVELOPMENT STARTS: 1999
FIRST PRODUCT: 2003

VIRTUALIZATION - SCALABILITY

IBM CEE STORAGE TEAM



	SVC CG8	SVC DH8
Cache Read MB/s	6,050	17,000
Cache Write MB/s	3500	7,000
Cache Read IOPs	800,000	1,150,000
Cache Write IOPs	300,000	500,000
Disk Read MB/s	5,380	14,000
Disk Write MB/s	2,800	4,000
Disk Read IOPs	365,000	700,000
Disk Write IOPs	115,000	200,000
70/30 Mixed IOPs	200,000	395,000

SUMMARY: DH8 is 2x IOPs and up to 3x MB/s of CG8

SVC tests use FlashSystem 840 and 820 backend storage controllers

DH8 includes all 3 PF I/O Cards - scales linearly from 1, through 3 for bandwidth

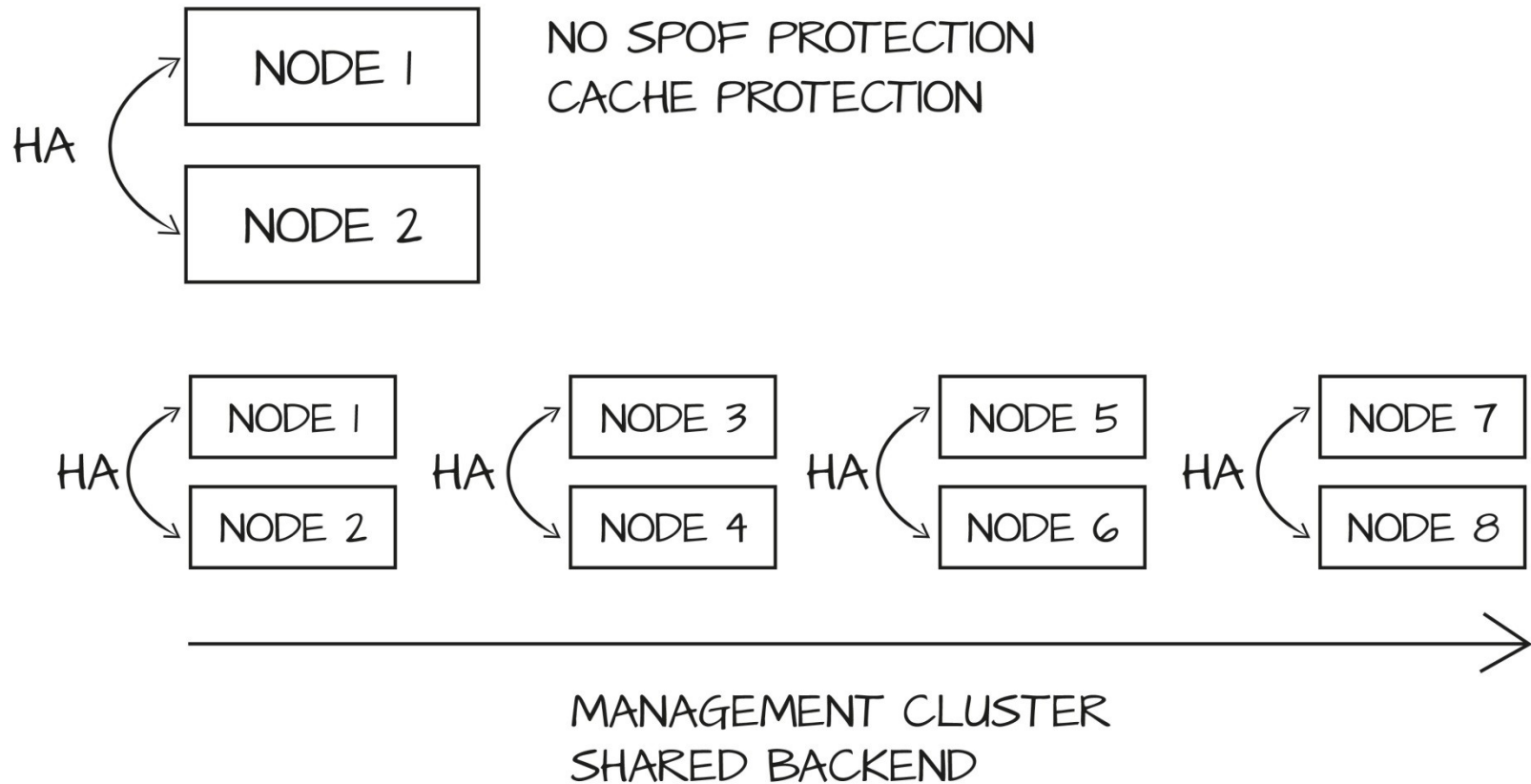
Requires 2 cards for may IOPs - 1 card approx half, or roughly CG8 equivalent

VIRTUALIZATION - PERFORMANCE (BIG NODE)

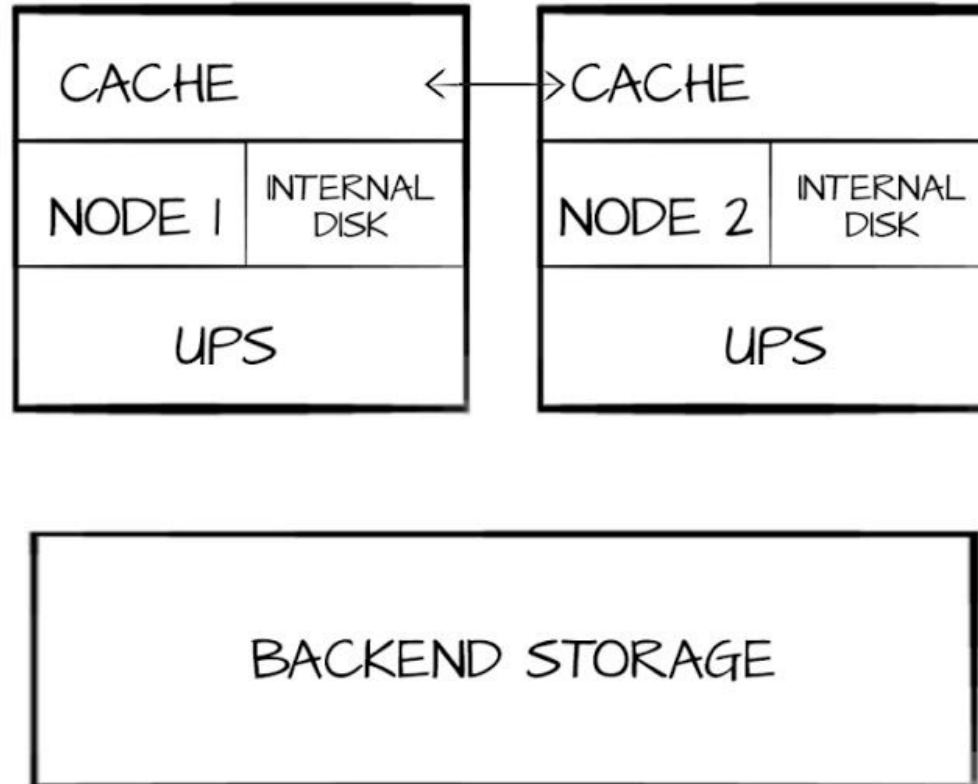
IBM CEE STORAGE TEAM

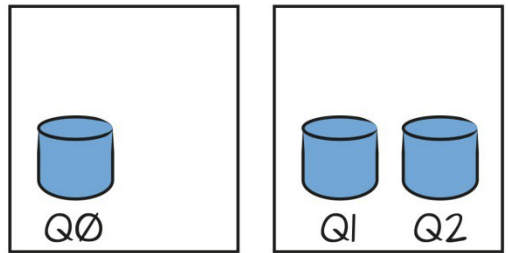
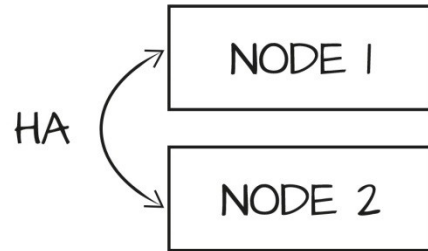


HIGH AVAILABILITY



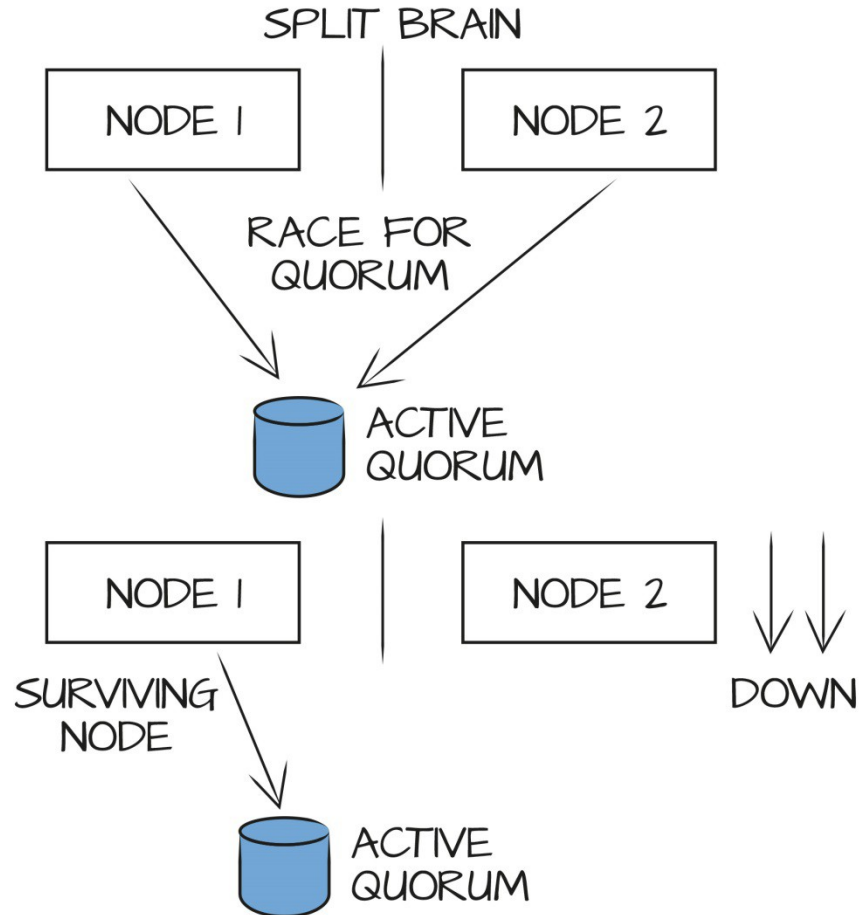
CACHE MIRRORING





BACKEND 1 BACKEND 2

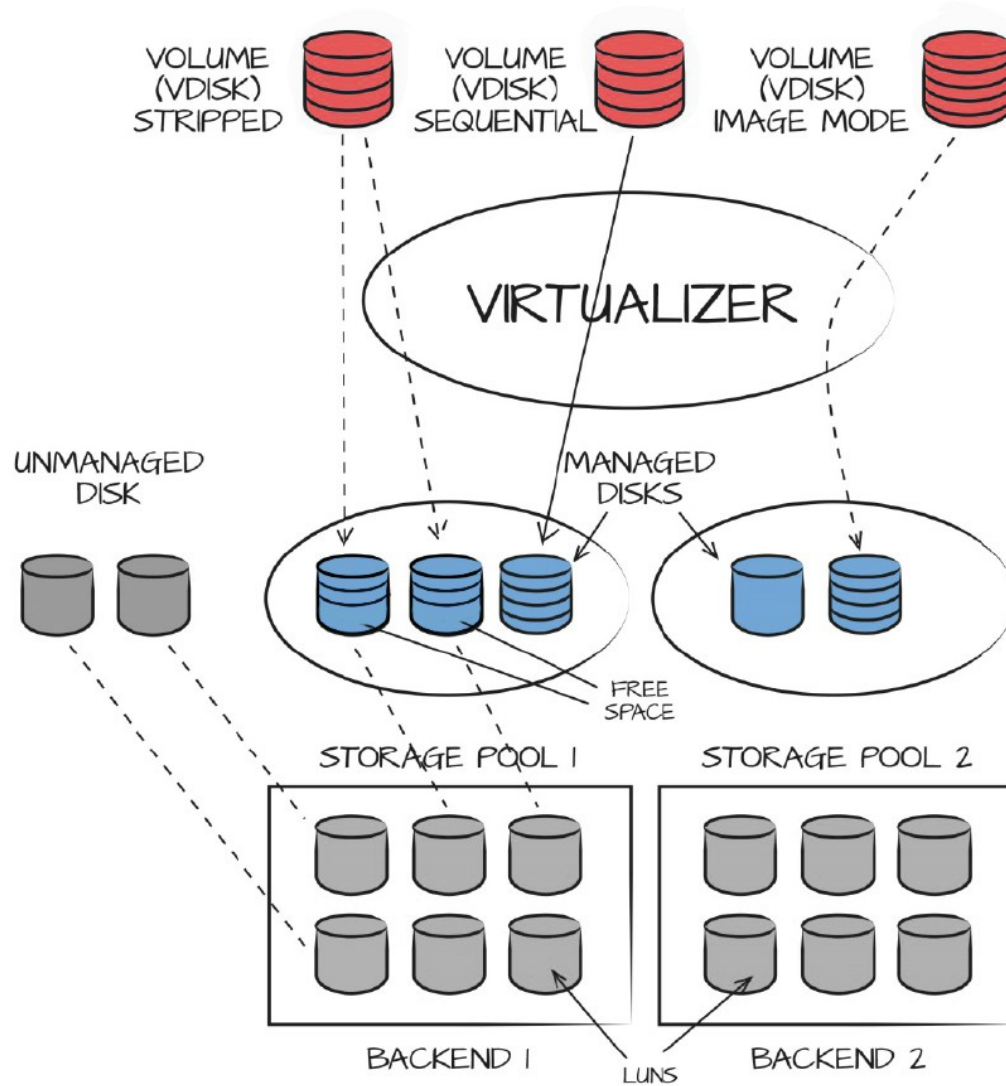
0, 1, 2 - QUORUM INDEX
ONE QUORUM IS ACTIVE



VIRTUALIZATION - QUORUM

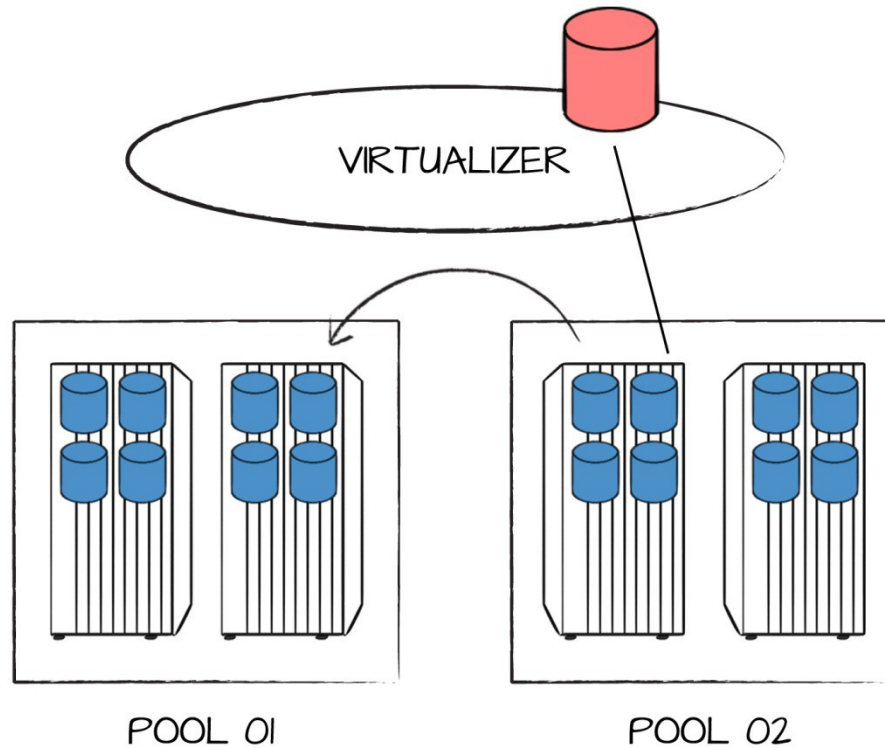


SCALABILITY & FLEXIBILITY



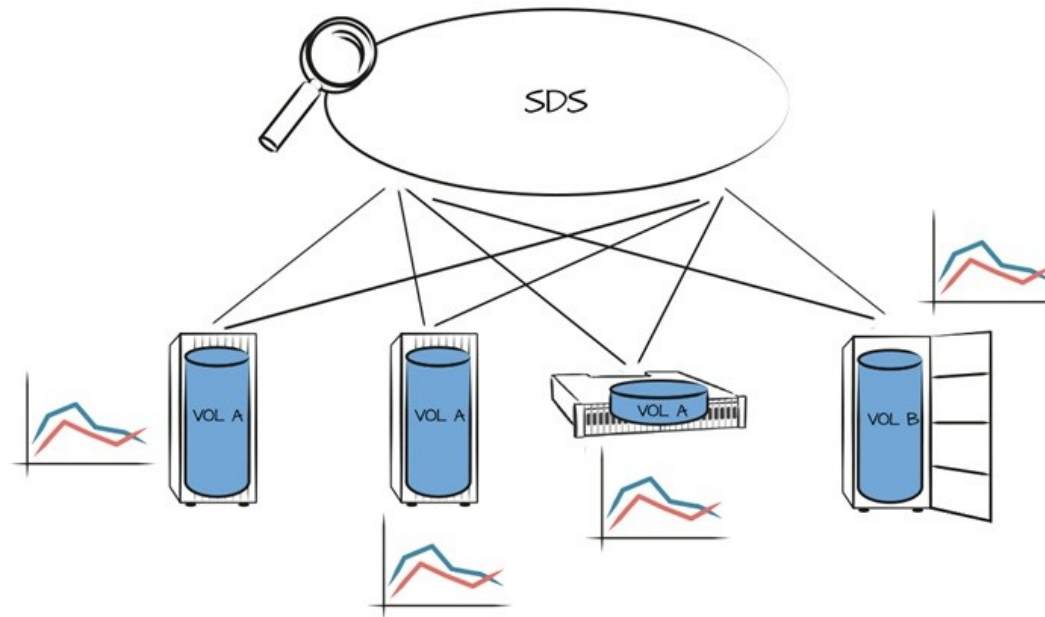
VIRTUALIZATION - OBJECT HIERARCHY

IBM CEE STORAGE TEAM



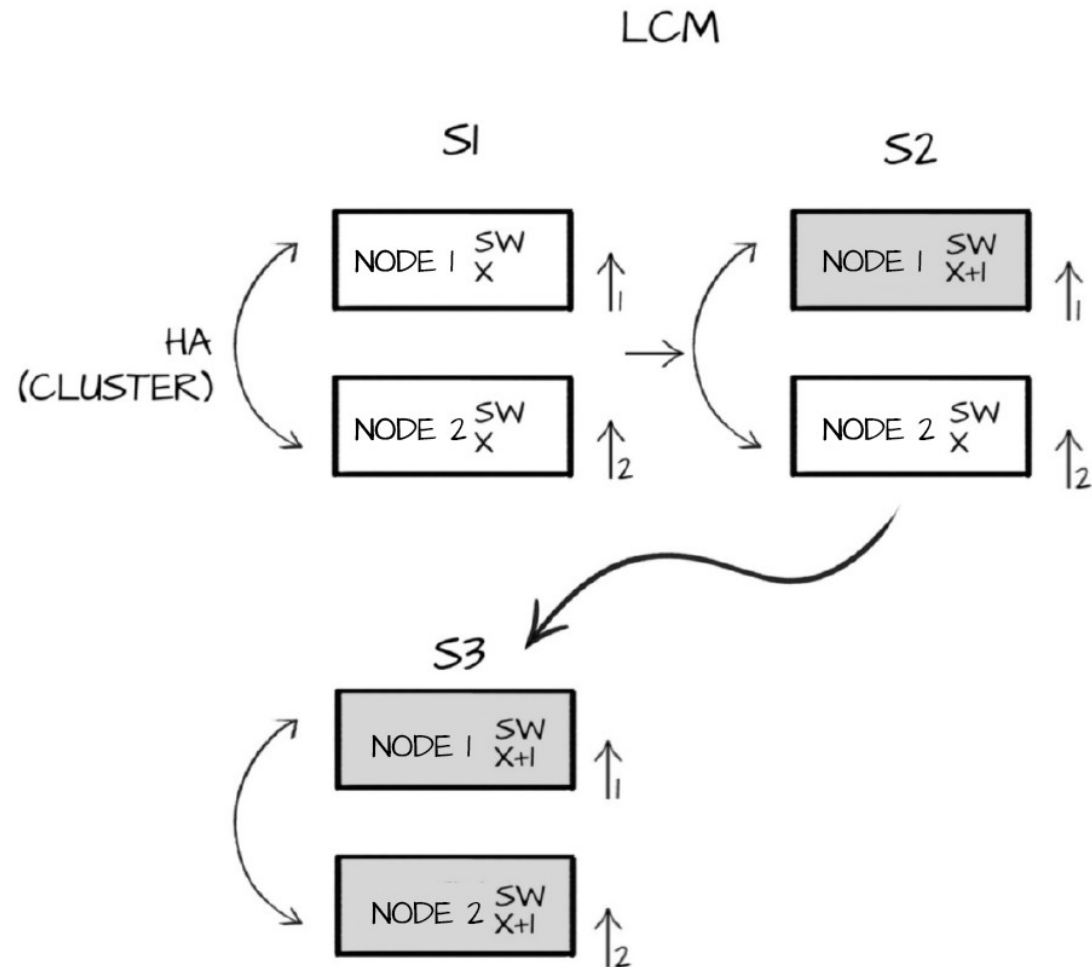


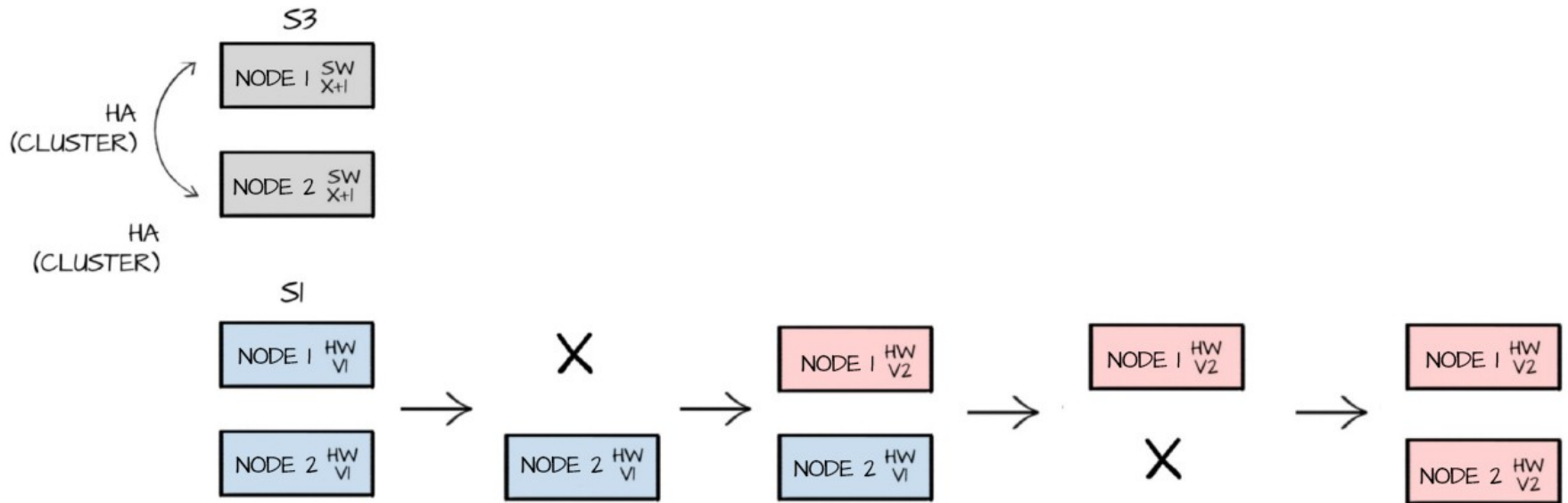
EASY TO USE & MANAGE





ONLINE INFRASTRUCTURE LIFECYCLE MANAGEMENT





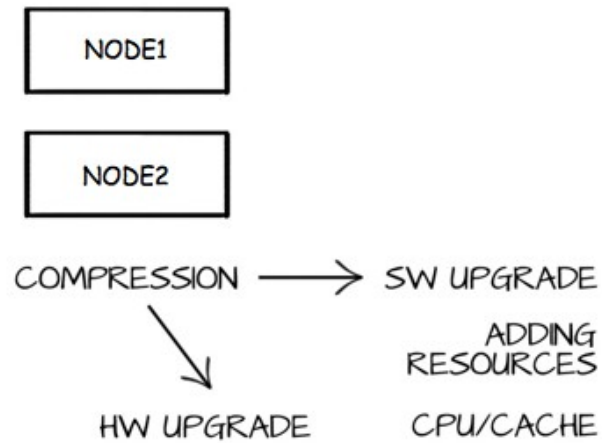
VIRTUALIZATION - HARDWARE UPGRADE

IBM CEE STORAGE TEAM



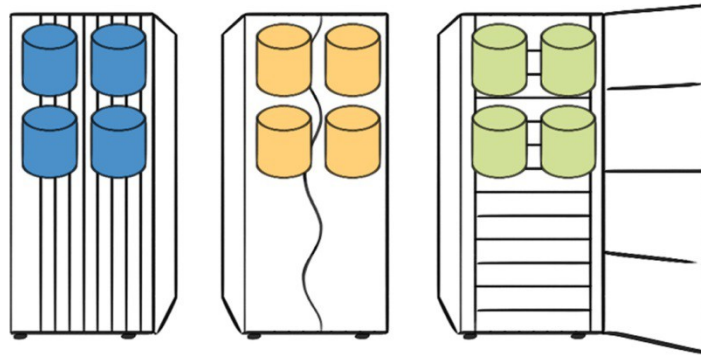
EASY ADDING NEW FUNCTIONALITY

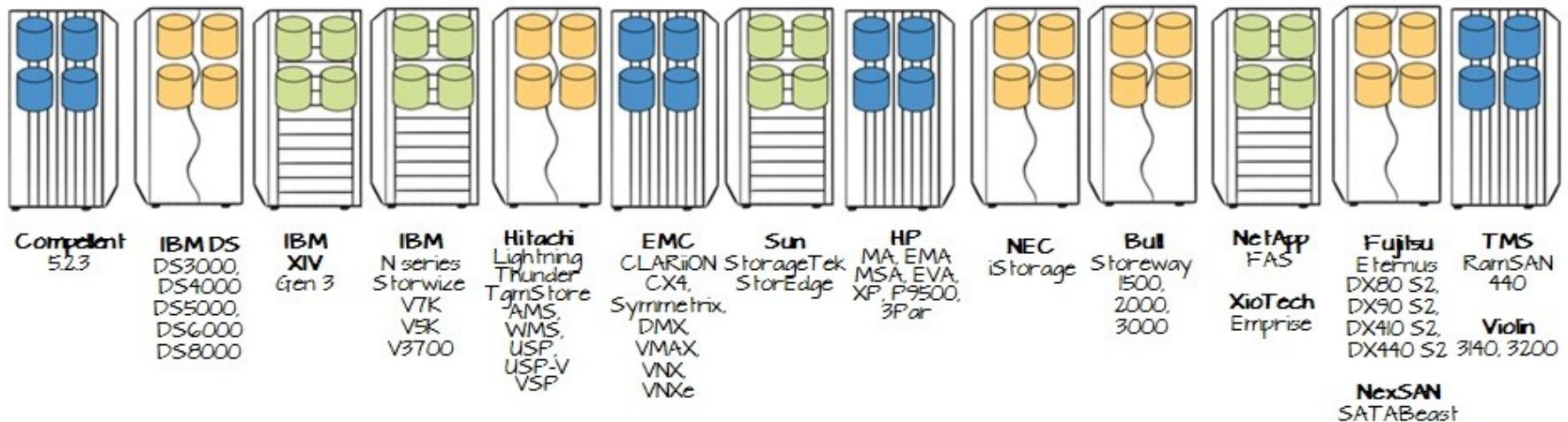
ADD NEW FUNCTIONS





SUPPORT FOR VARIOUS BACKEND SYSTEMS & TECHNOLOGIES



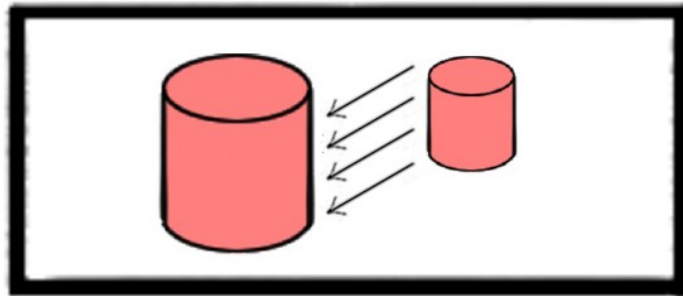


Multivendor Support +260 Storage models

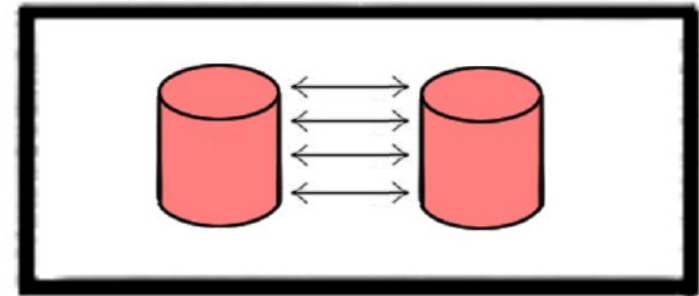


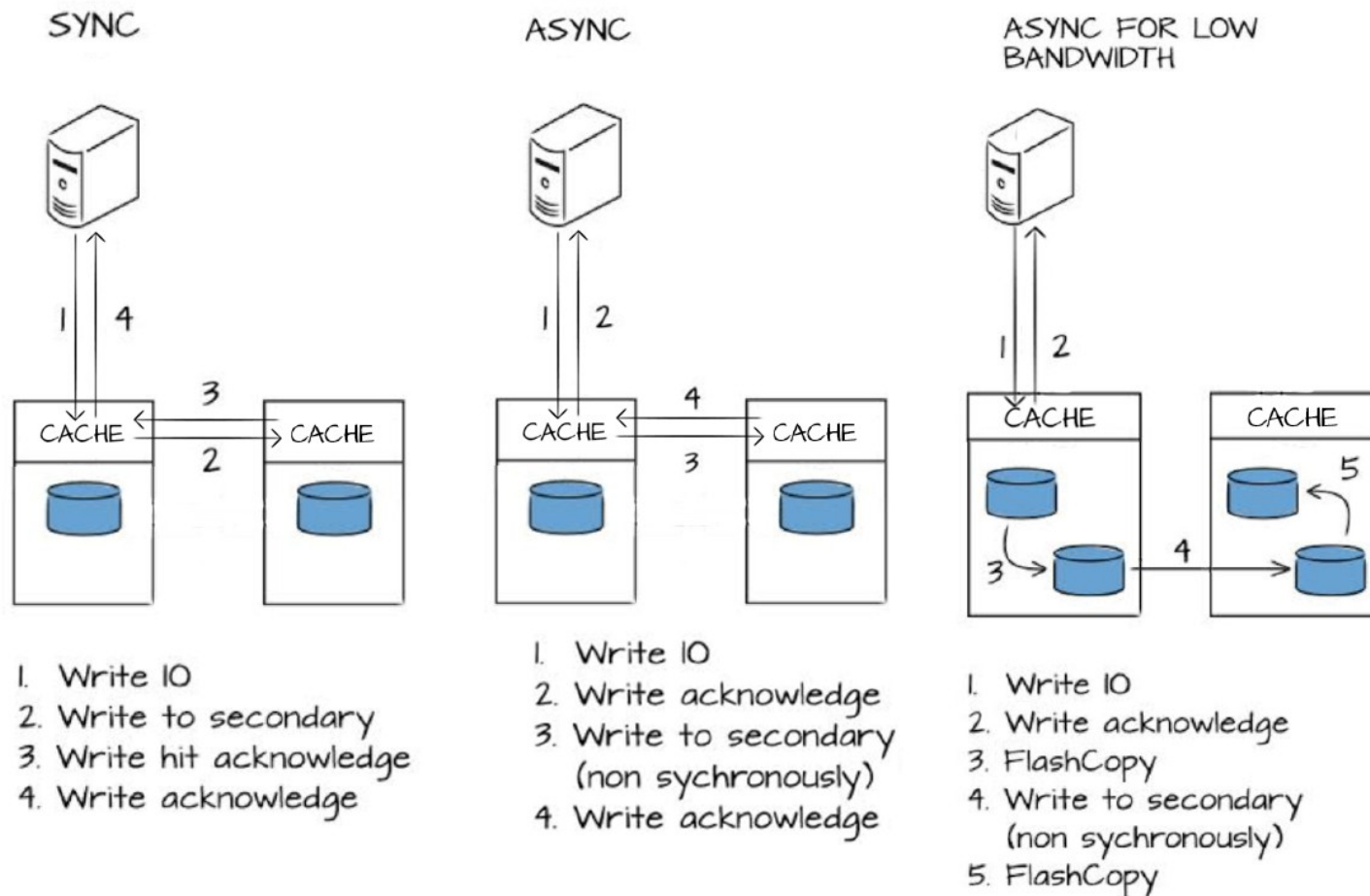
SCALABLE ADVANCED FUNCTIONS

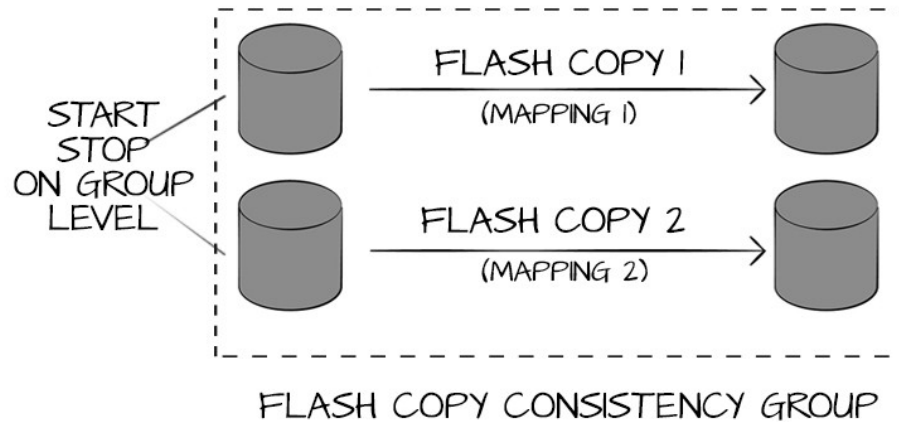
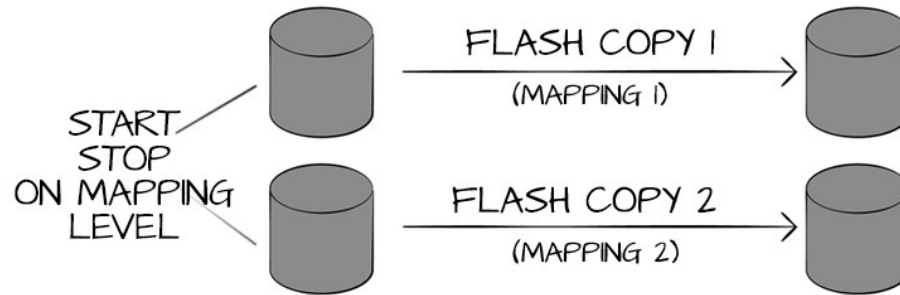
SNAPSHOT



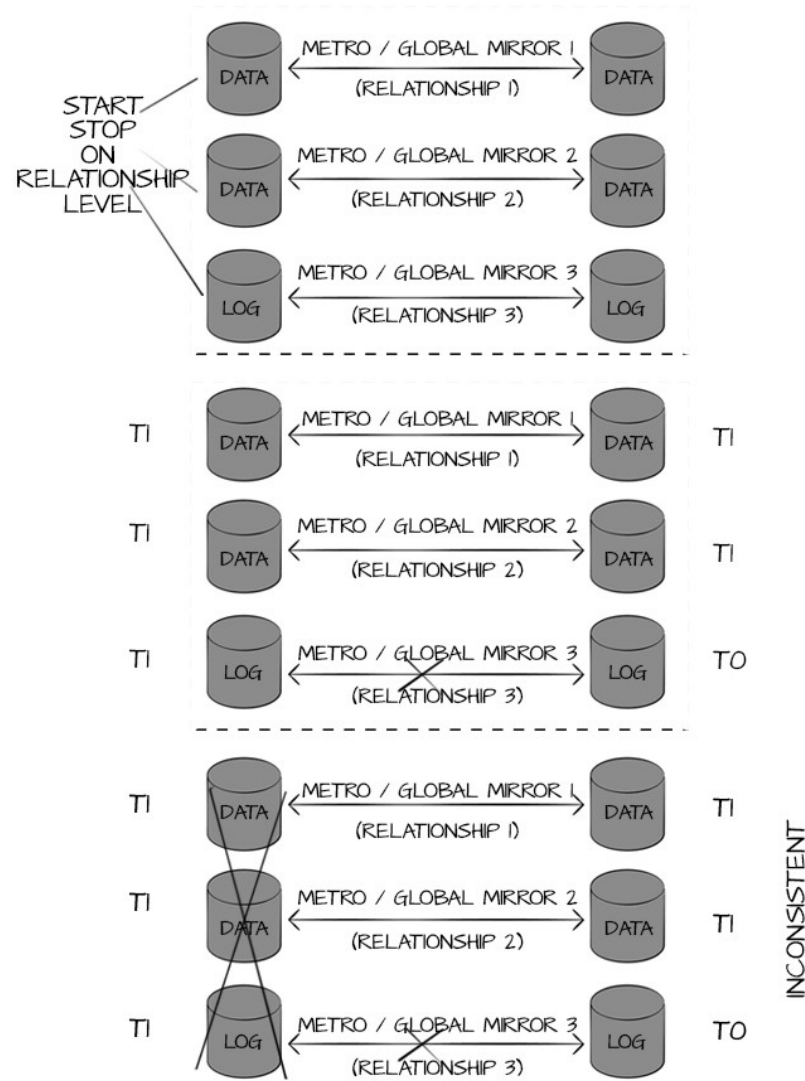
CLONE



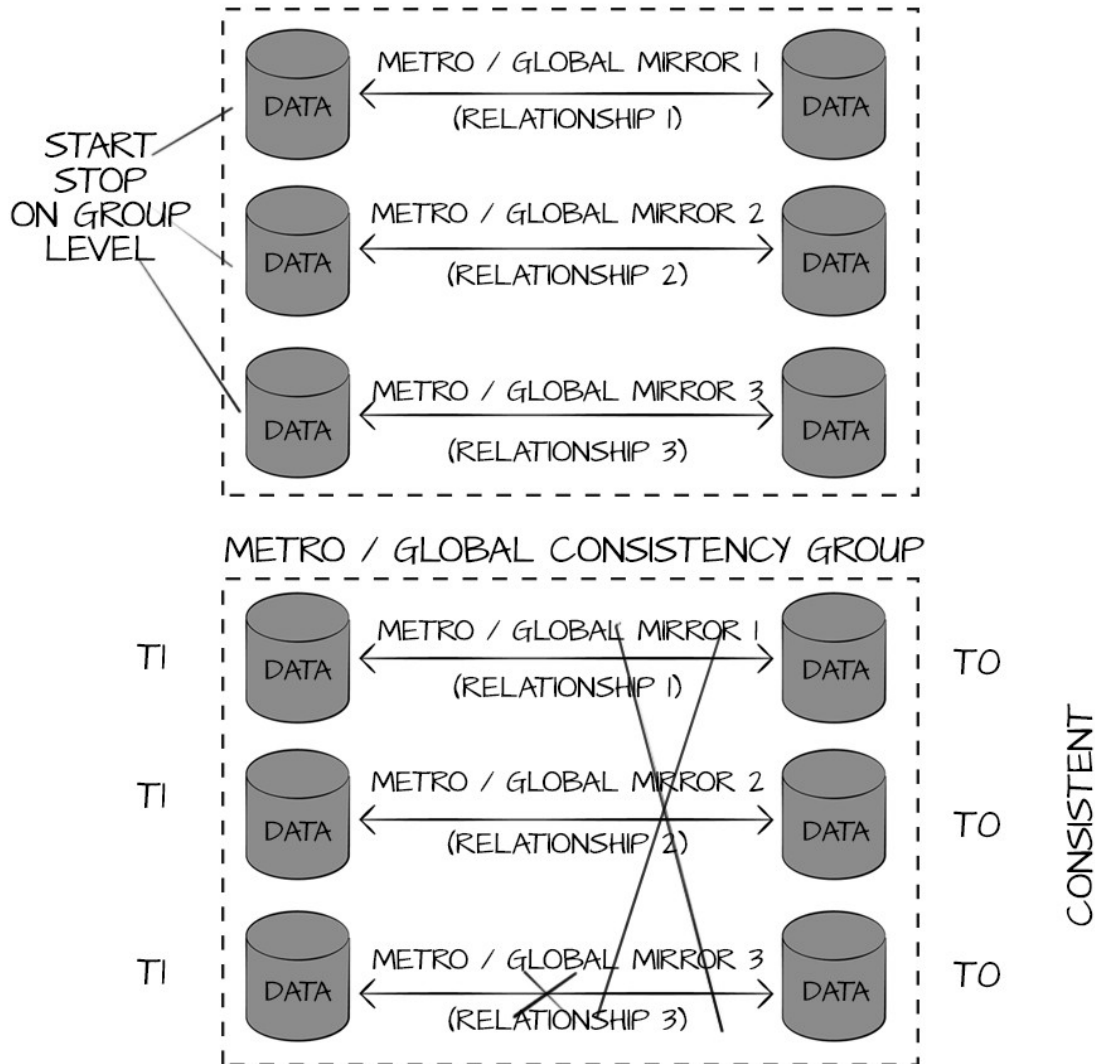




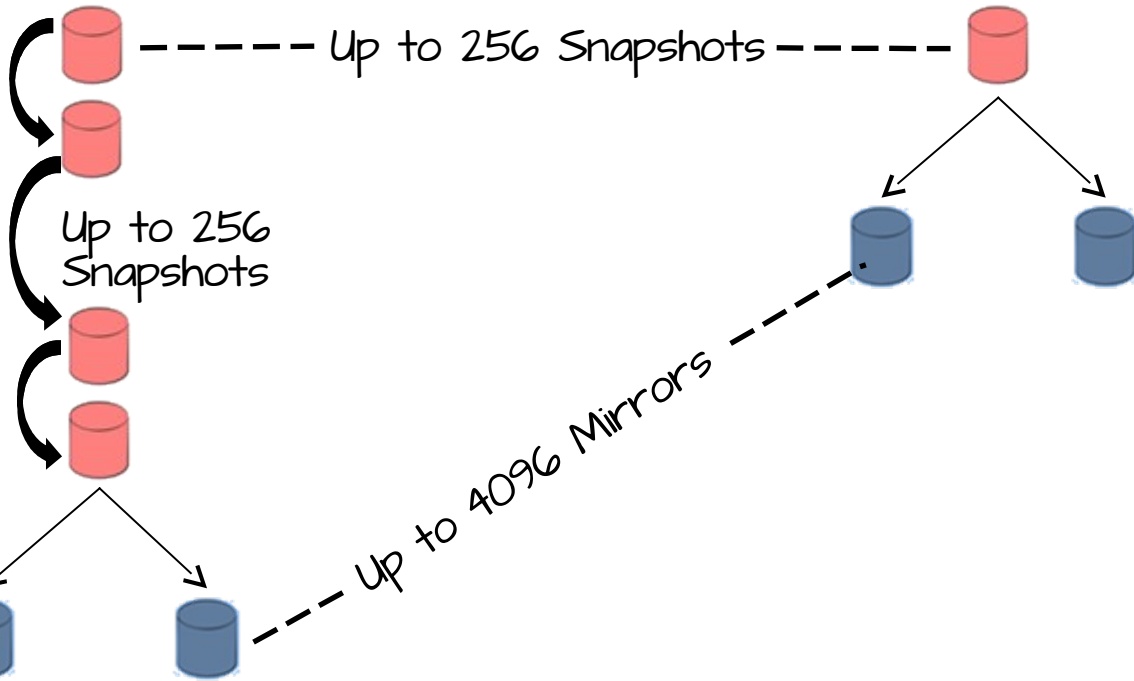
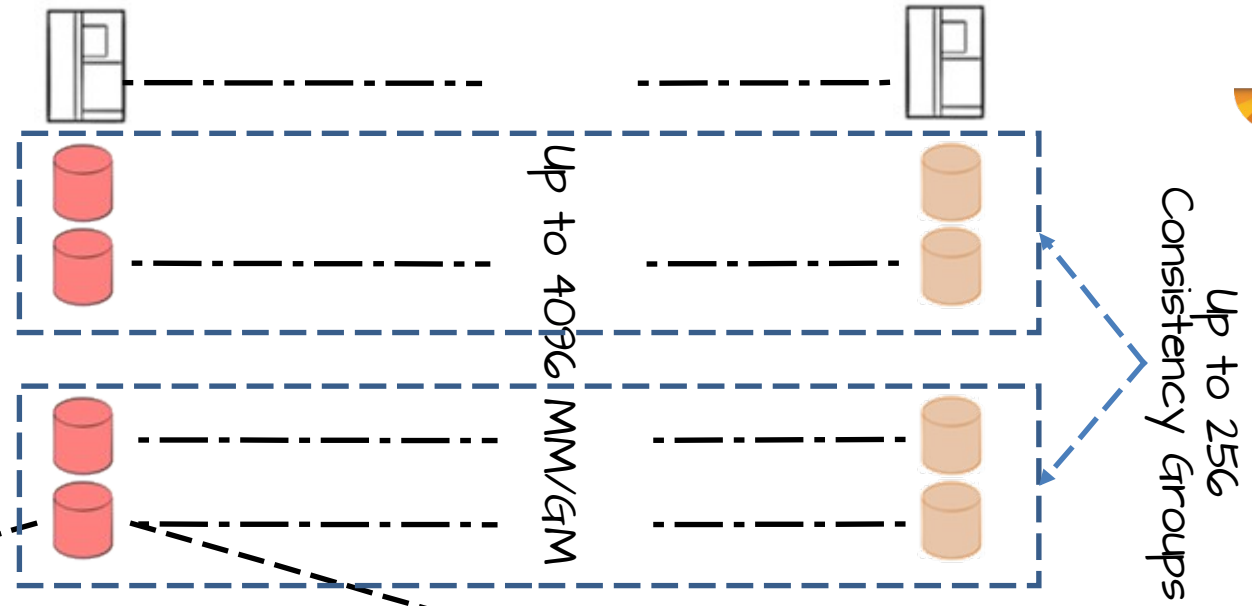
VIRTUALIZATION - ADVANCED FUNCTIONS - FLASH COPY CONSISTENCY GROUPS



VIRTUALIZATION - ADVANCED FUNCTIONS - REPLICATION CONSISTENCY GROUPS



VIRTUALIZATION - ADVANCED FUNCTIONS - REPLICATION CONSISTENCY GROUPS

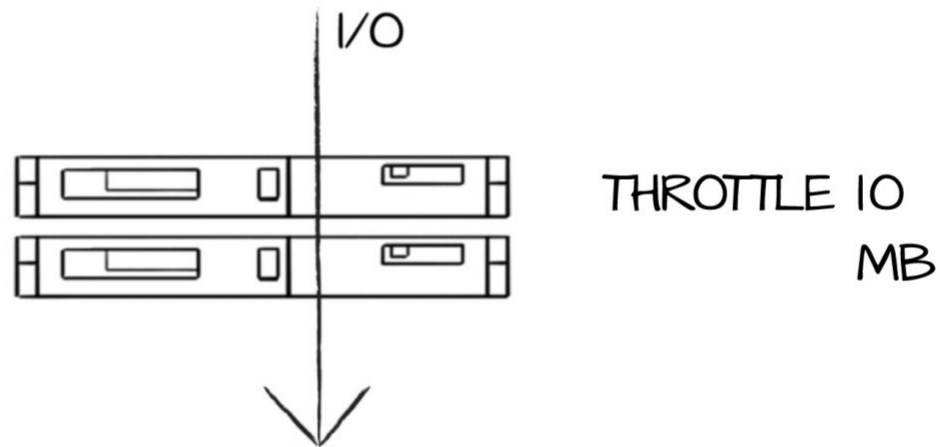


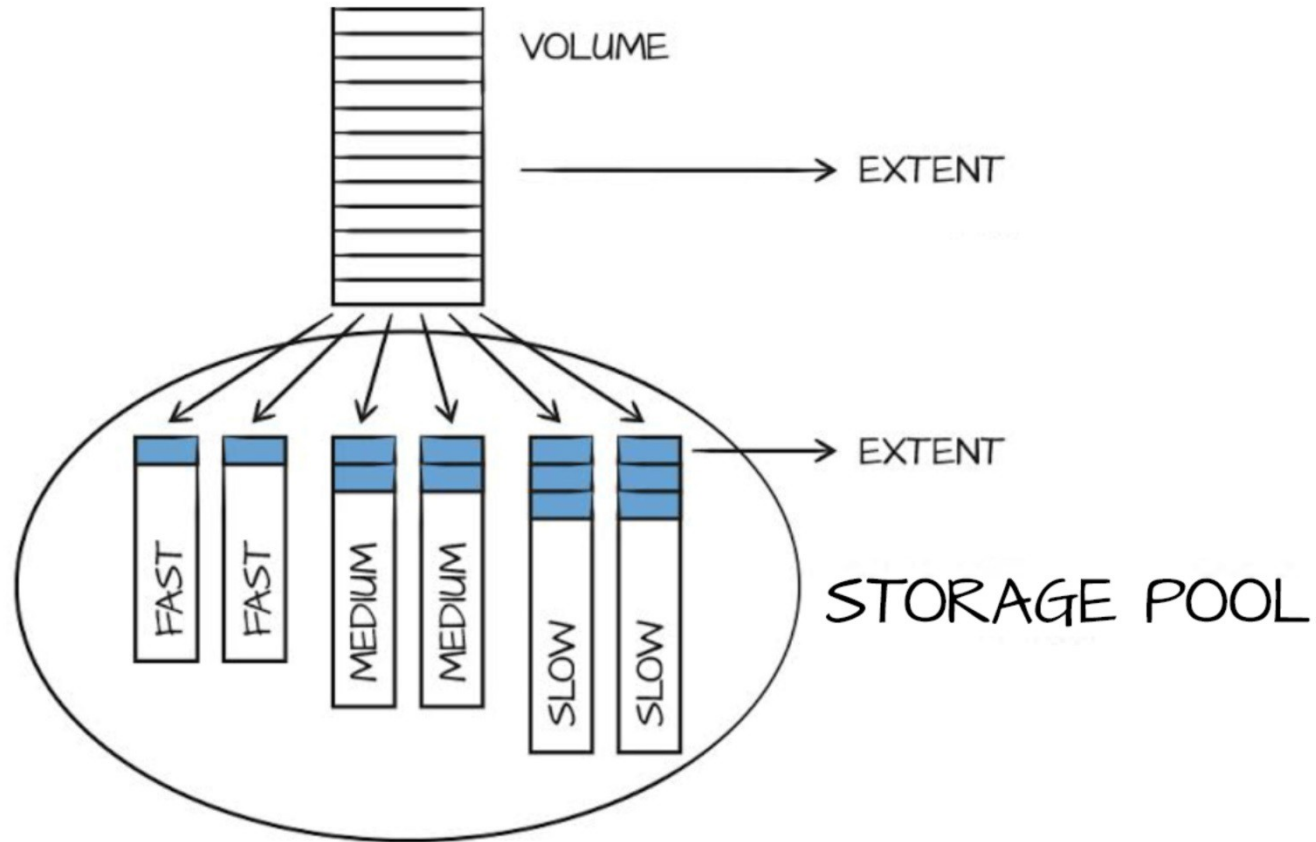
VIRTUALIZATION - ADVANCED FUNCTIONS - SCALABILITY

IBM CEE STORAGE TEAM

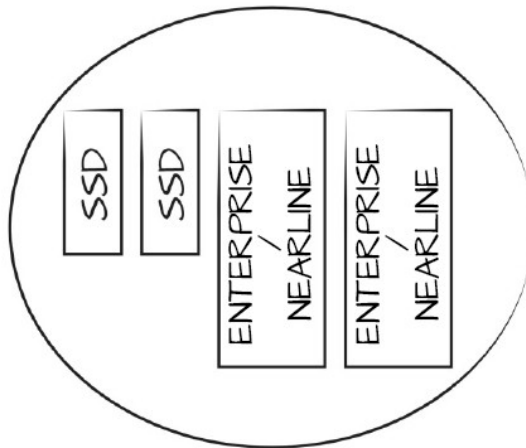
REPLICATION

- 
- SYNCHRONOUS REPLICATION
 - ASYNCHRONOUS REPLICATION
 - ASYNCHRONOUS REPLICATION FOR LOW BANDWIDTH
 - FC REPLICATION PROTOCOL
 - IP REPLICATION PROTOCOL

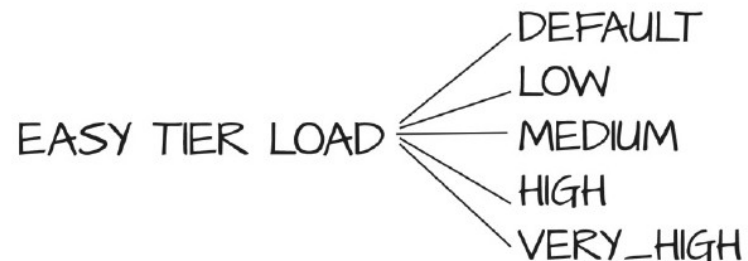
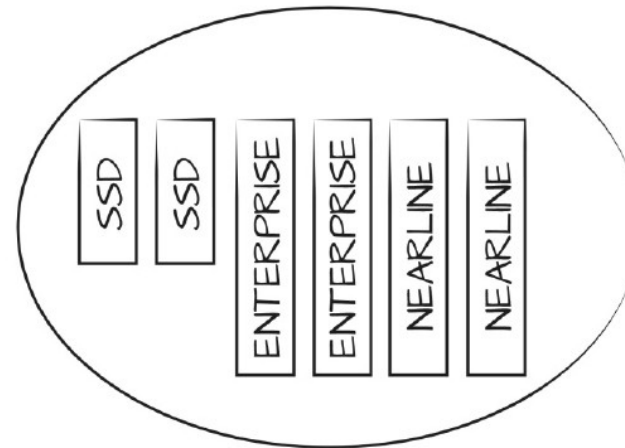




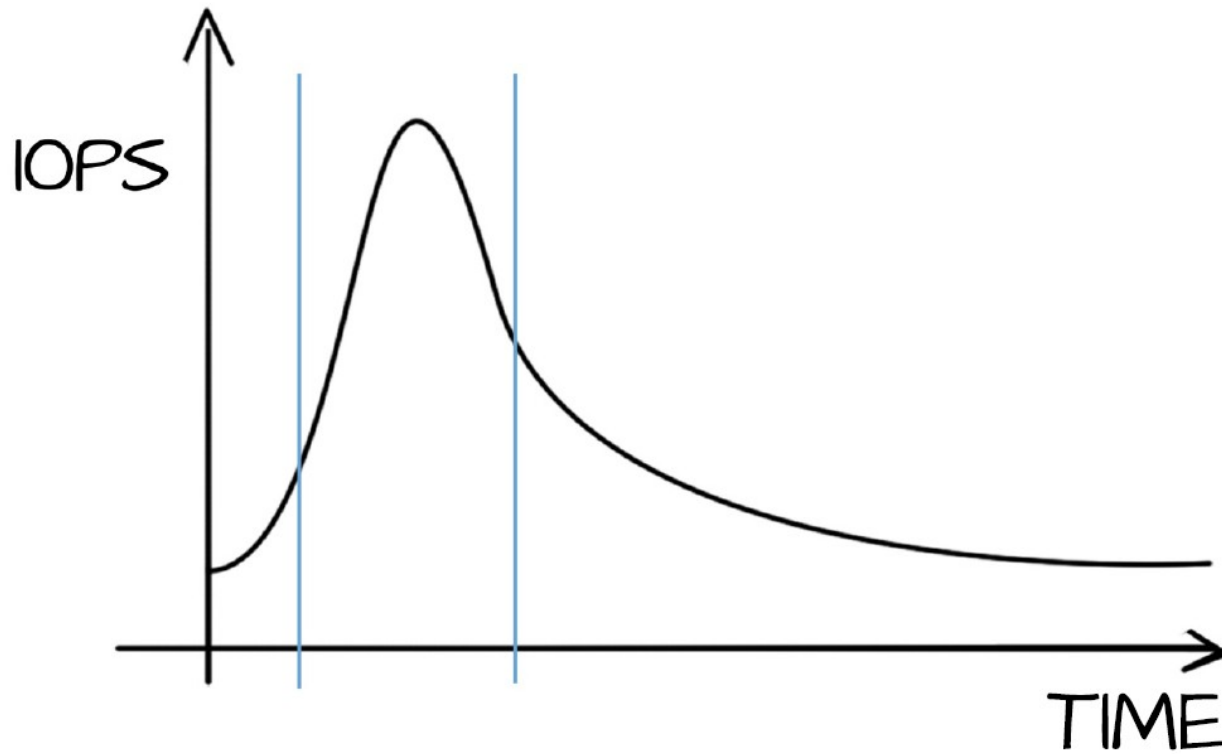
2 WAY
STORAGE POOL

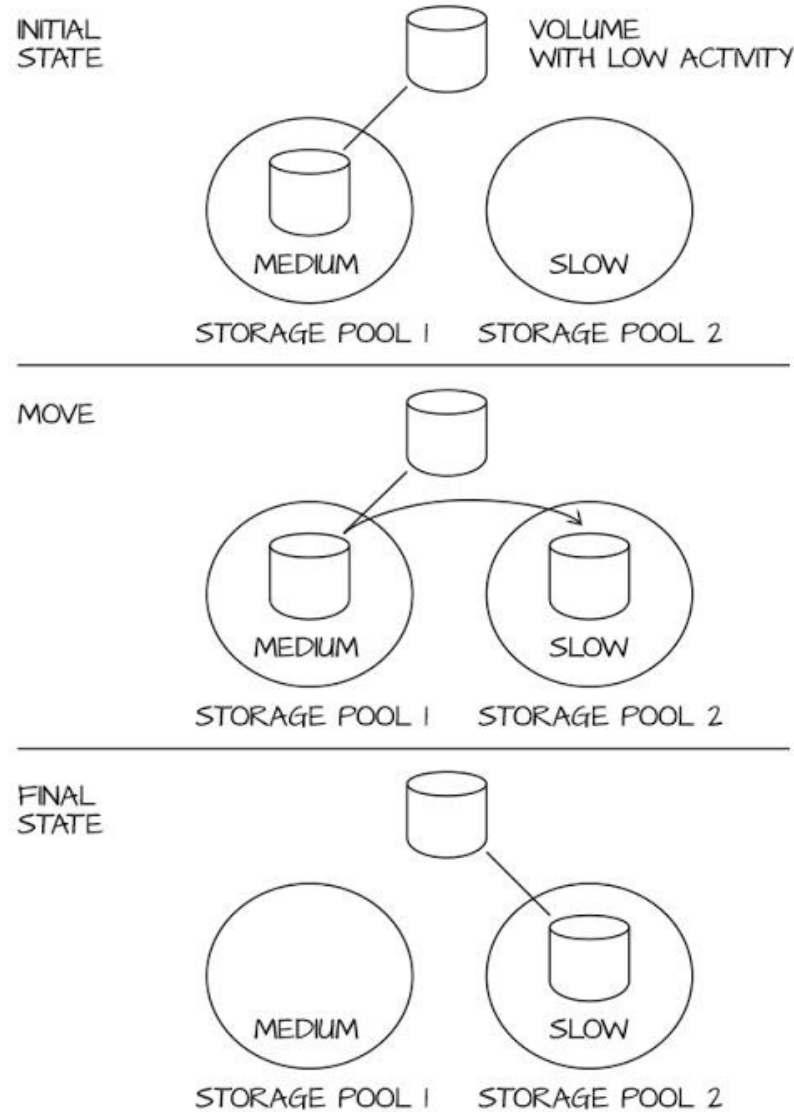


3 WAY
STORAGE POOL



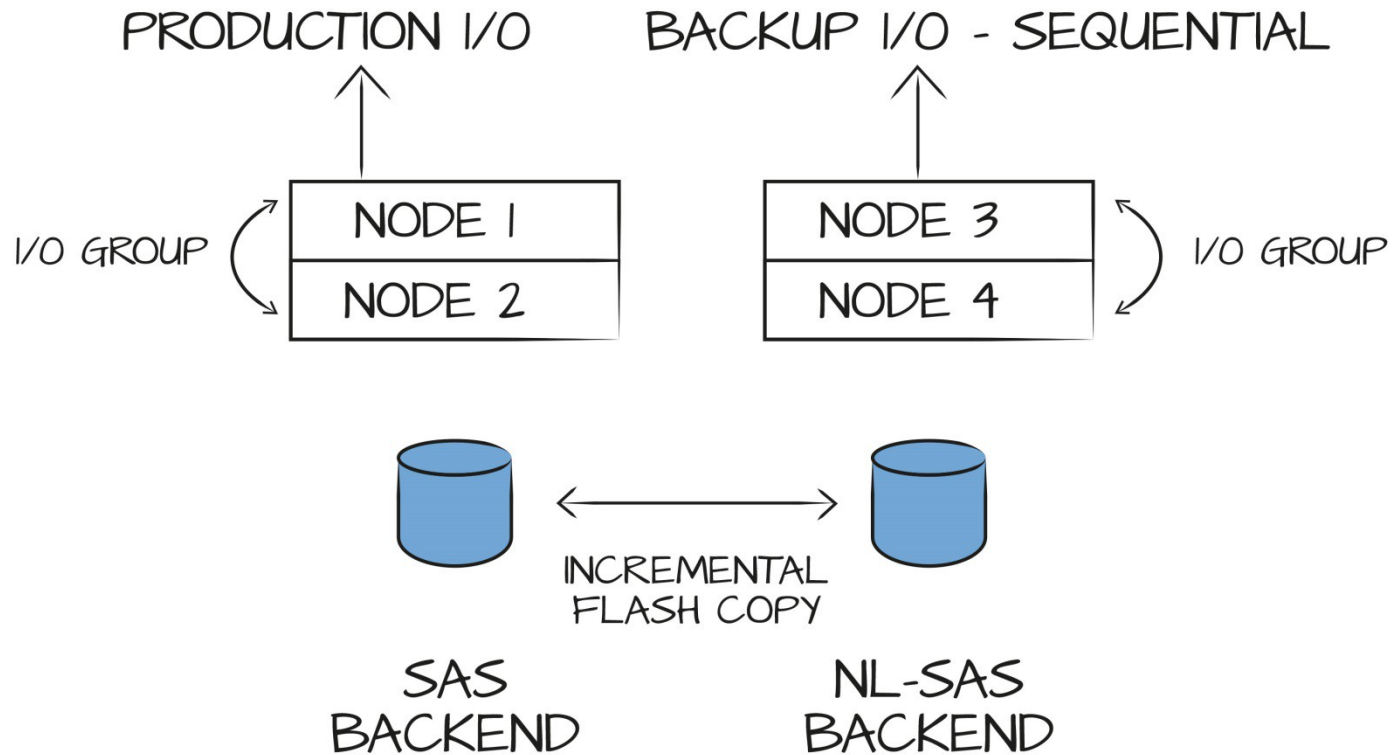
VIRTUALIZATION - ADVANCED FUNCTIONS - SUB VOLUME TIERING
MDISK LOAD PARAMETER







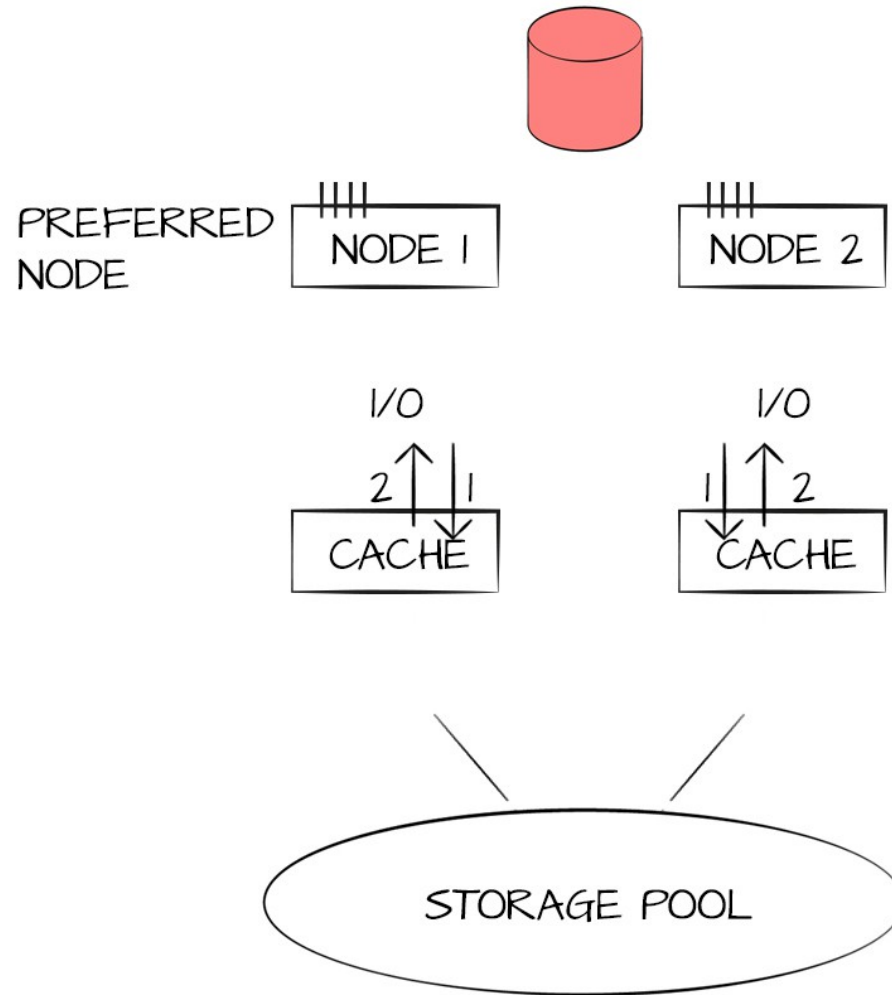
ABILITY TO PERFORM FAST BACKUPS



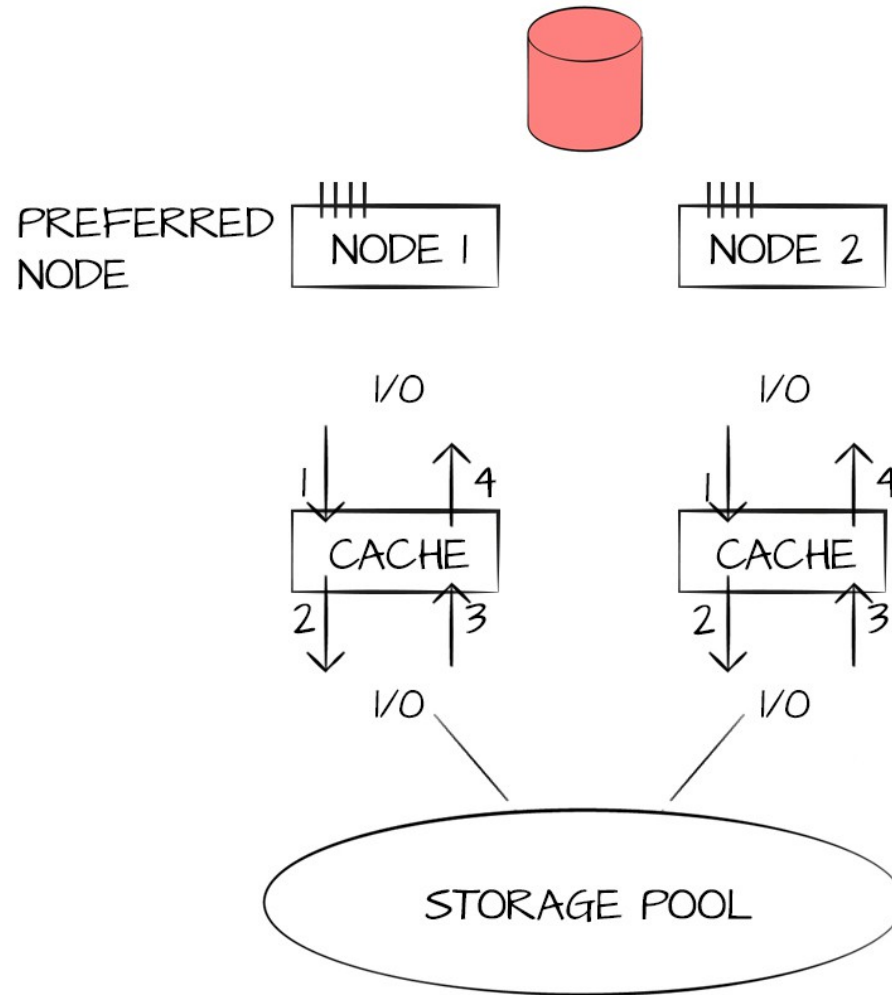
VIRTUALIZATION - ADVANCED FUNCTIONS - SNAPSHOTS/CLONES
FLASH COPY TO DEDICATED I/O GROUP / BACKEND



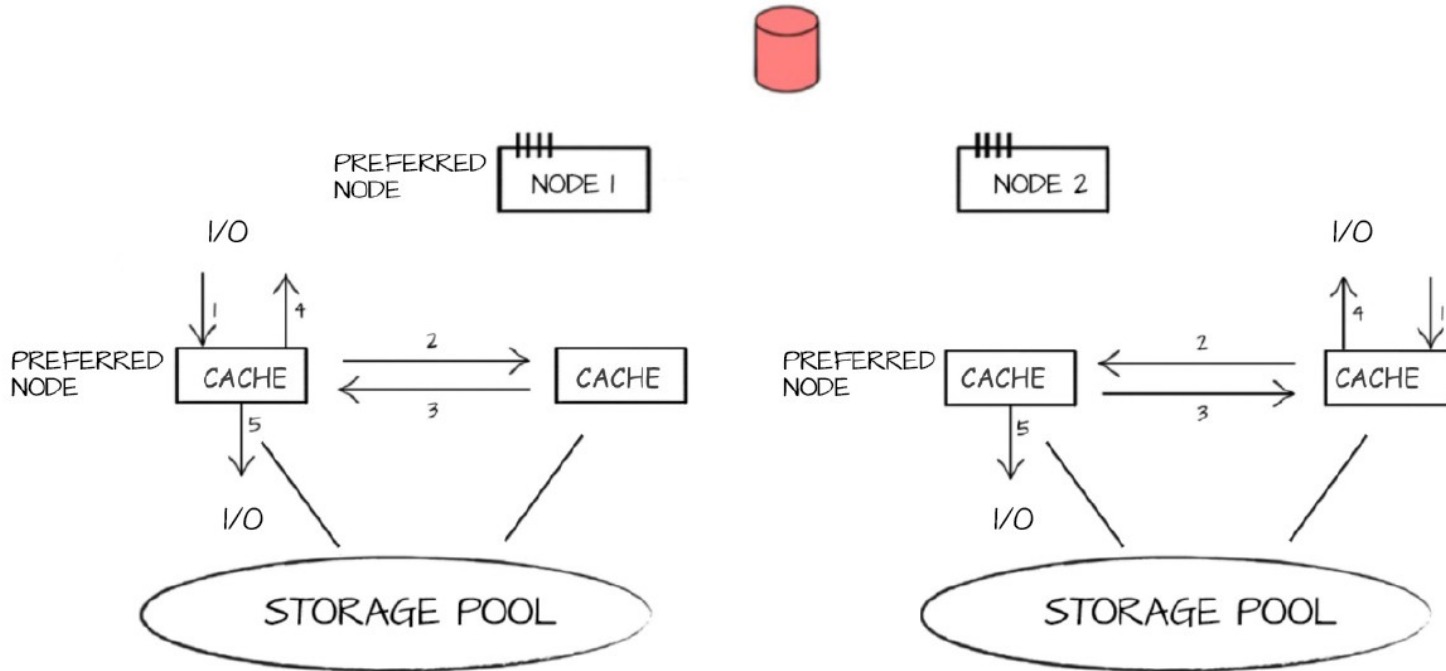
ACTIVE/ACTIVE LUN ACCESS



VIRTUALIZATION - ACTIVE/ACTIVE IO
READ CACHE HIT



VIRTUALIZATION - ACTIVE/ACTIVE IO
READ CACHE MISS



VIRTUALIZATION - ACTIVE/ACTIVE IO
WRITE (ALWAYS CACHE HIT)



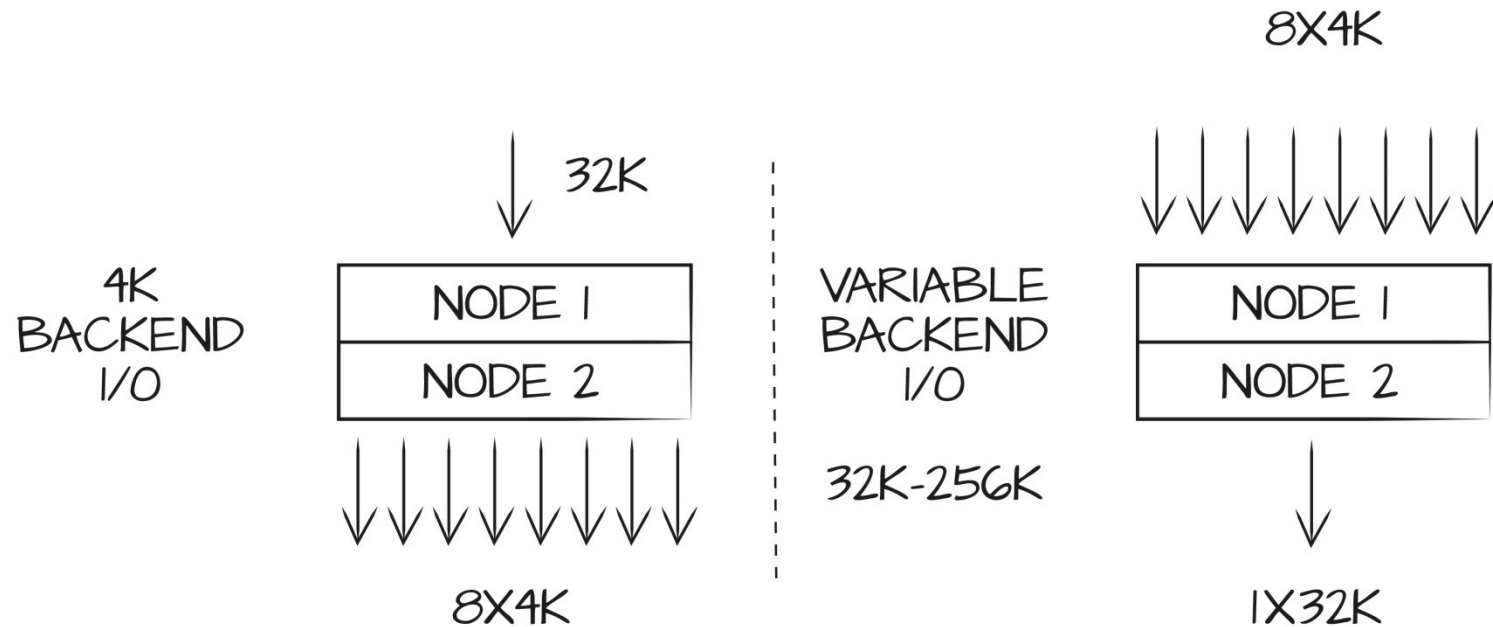
LOW TCO / FAST ROI



... this is technical presentation ...
... commercial topics are out of scope
today ...



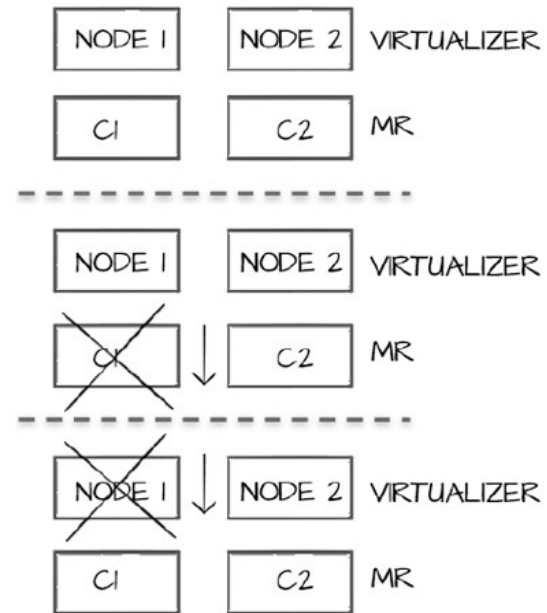
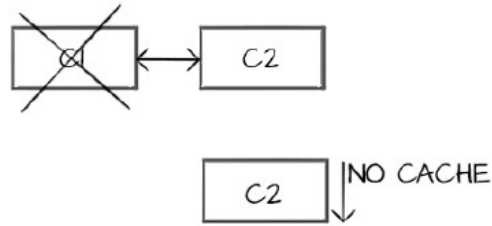
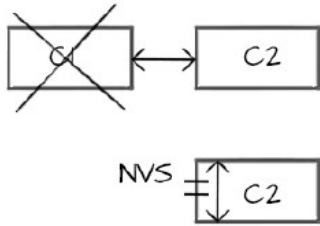
ADDITIONAL BENEFITS OF IBM'S STORAGE VIRTUALIZATION



HE

MR

VIRTUALIZER + MR



VIRTUALIZATION - DUAL LAYER CACHE

IBM CEE STORAGE TEAM

USUAL READ/WRITE RATIOS

70/30 R/W

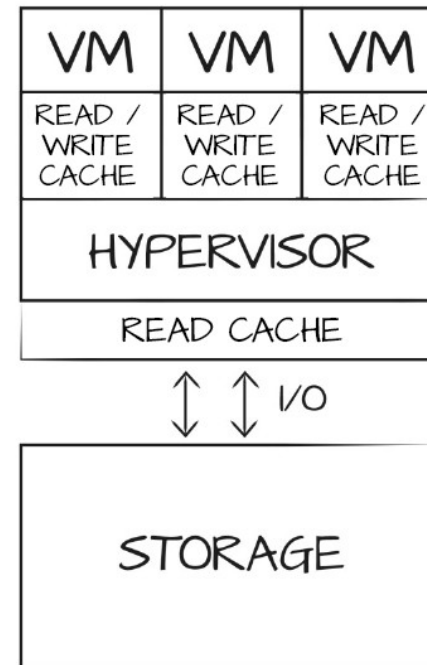
80/20 R/W

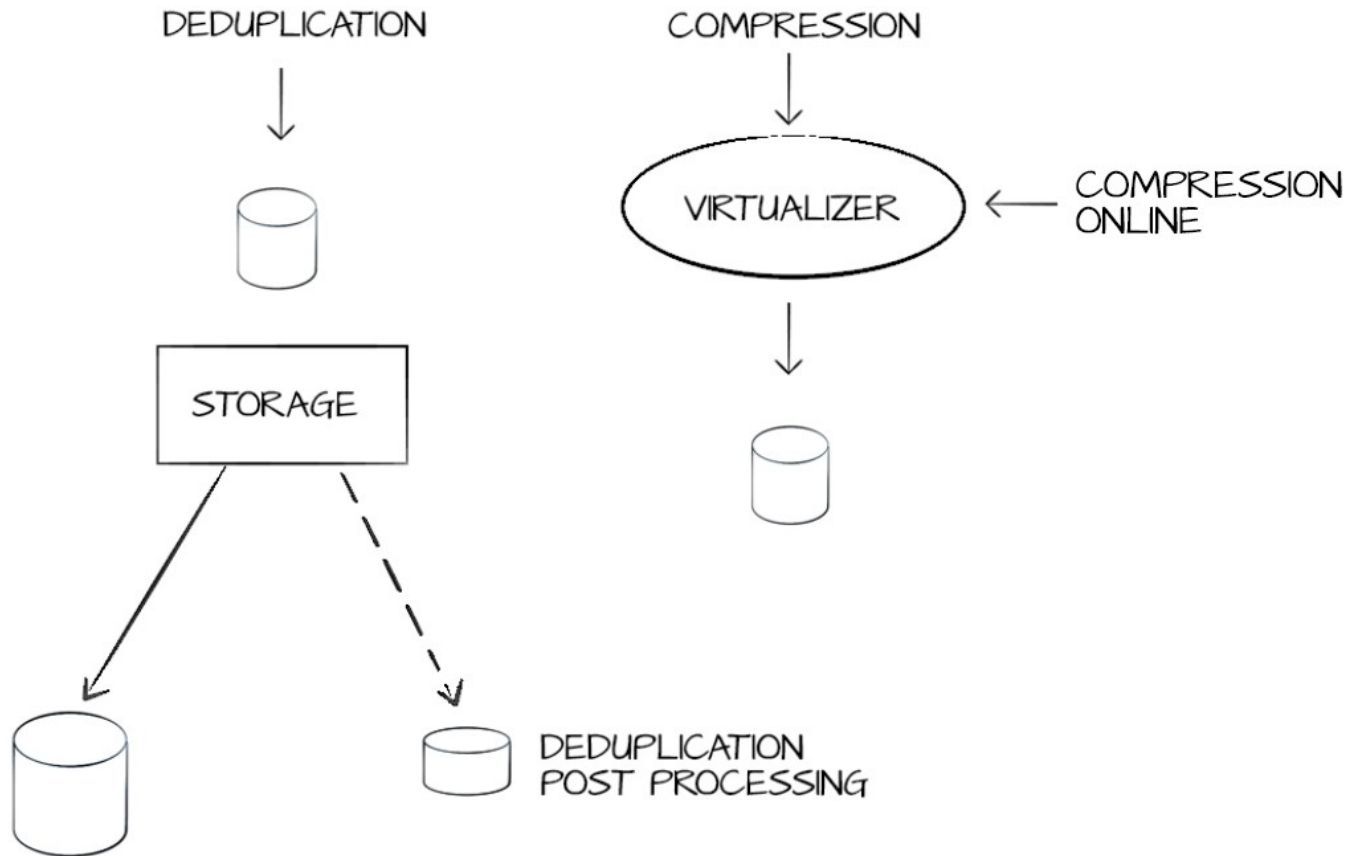
60/40 R/W

VIRTUAL ENVIRONMENTS READ/WRITE RATIOS

30/70 R/W

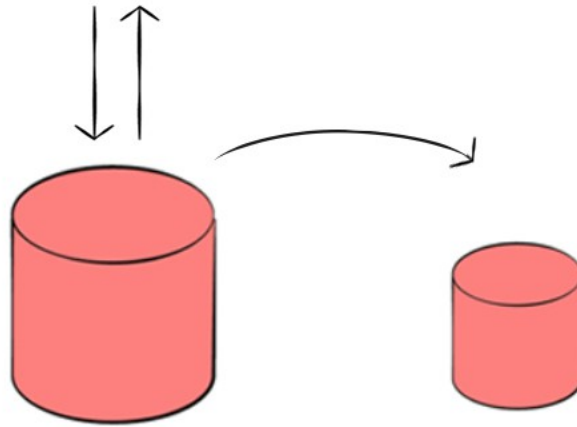
WHY?





VIRTUALIZATION - COMPRESSION & DEDUPLICATION

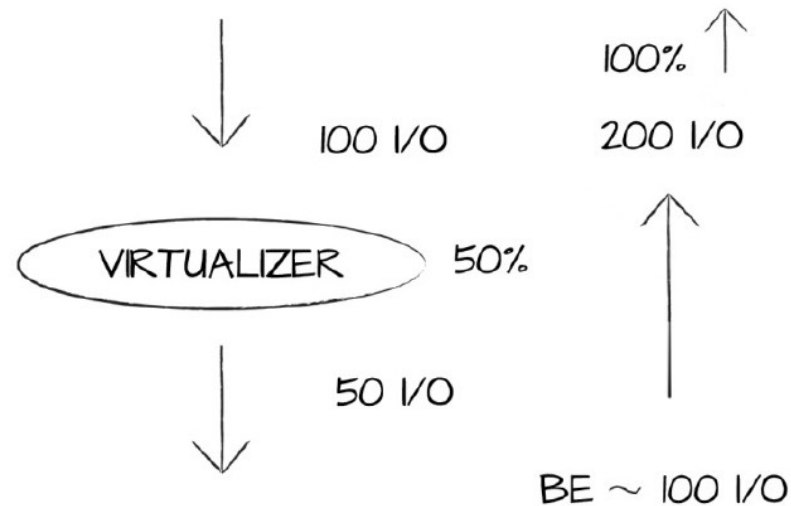
COMPRESSION - ONLINE

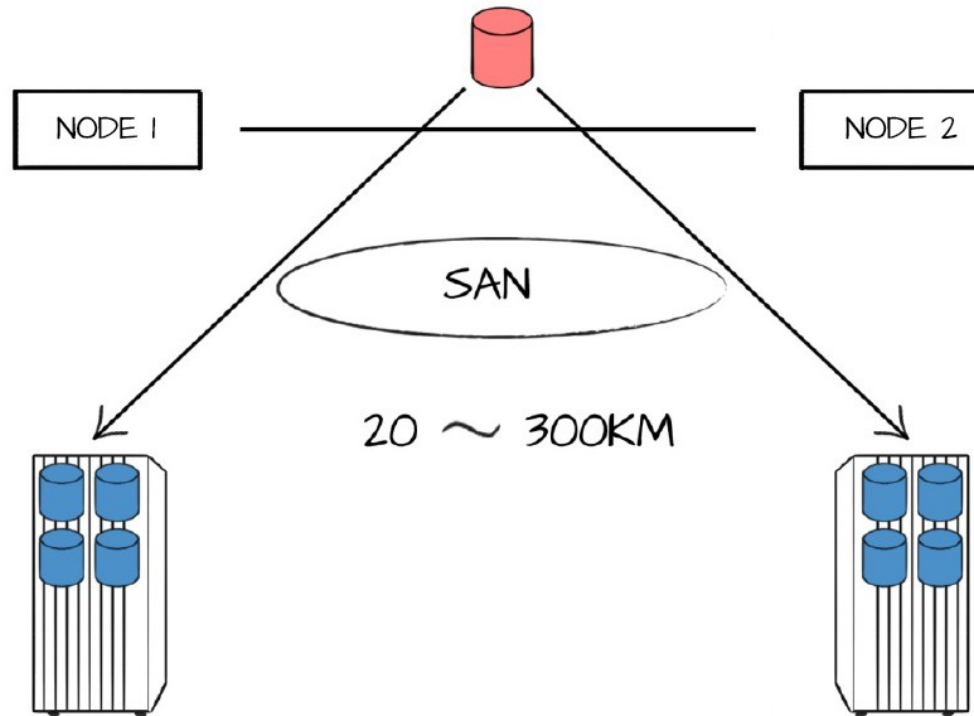


VIRTUALIZATION - COMPRESSION

IBM CEE STORAGE TEAM

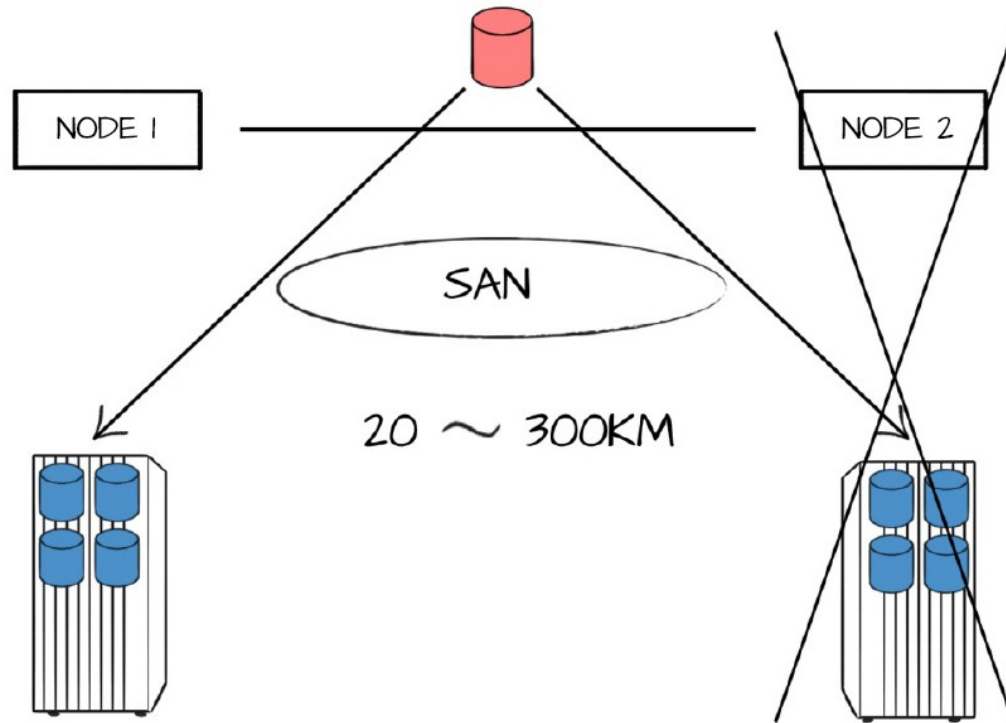
COMPRESSION BENEFIT





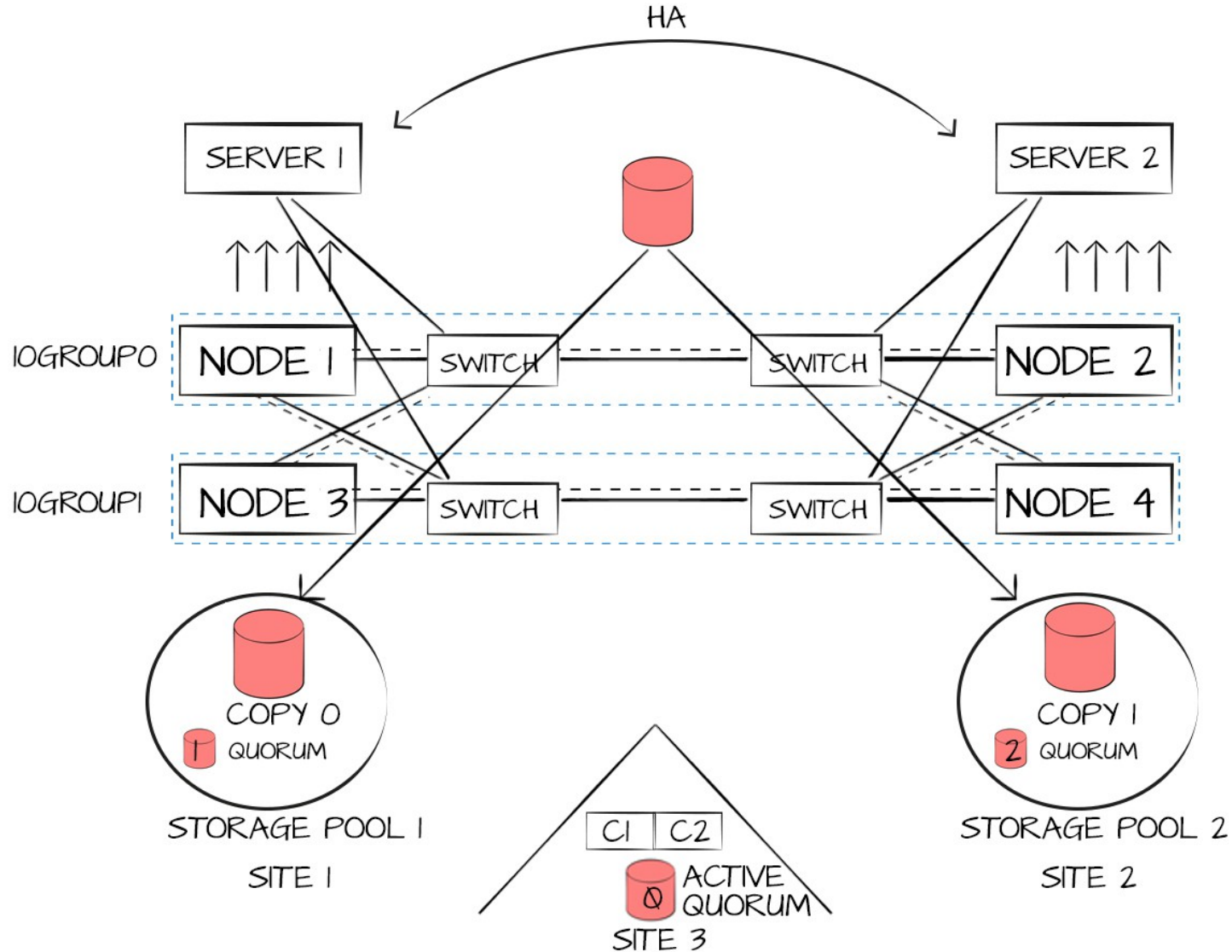
VIRTUALIZATION - STRETCHED CLUSTER

IBM CEE STORAGE TEAM



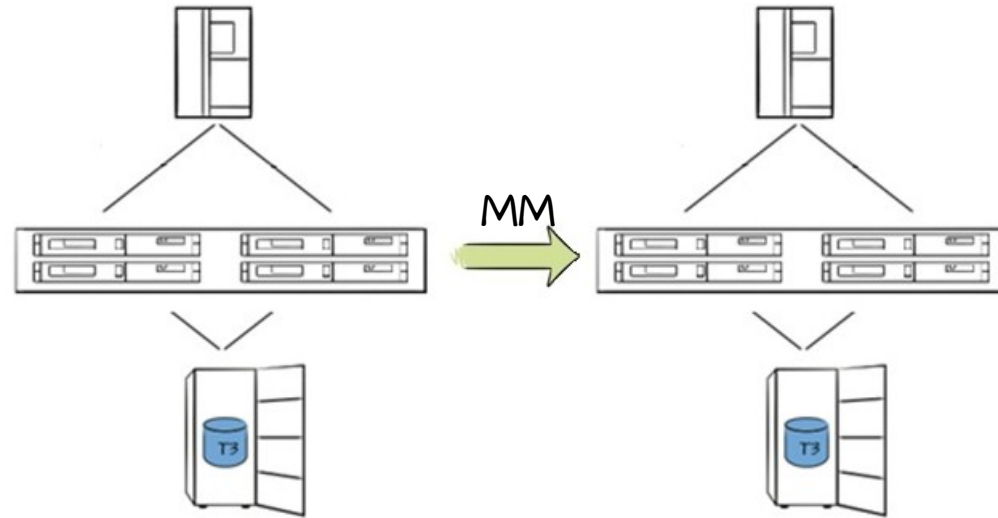
VIRTUALIZATION - STRETCHED CLUSTER

IBM CEE STORAGE TEAM

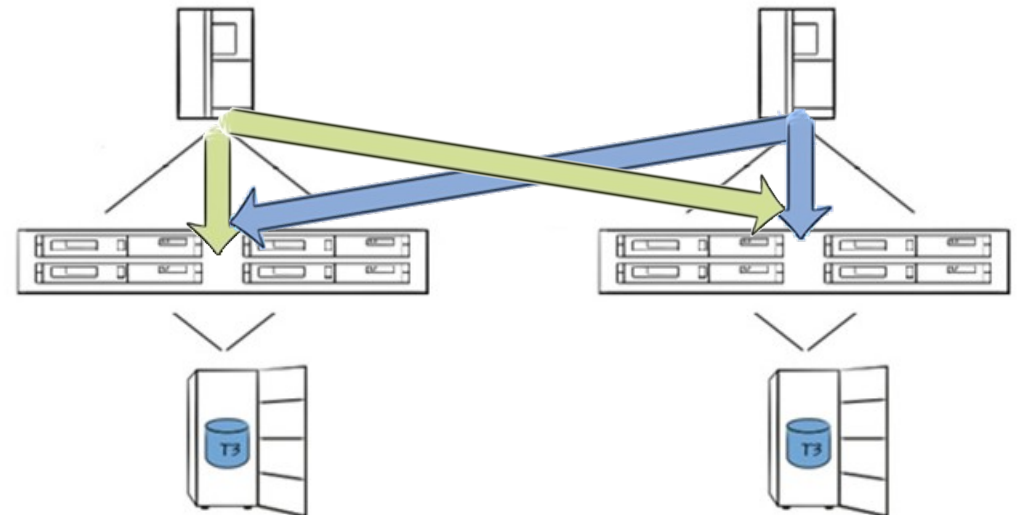


VIRTUALIZATION - STRETCHED CLUSTER DETAILS

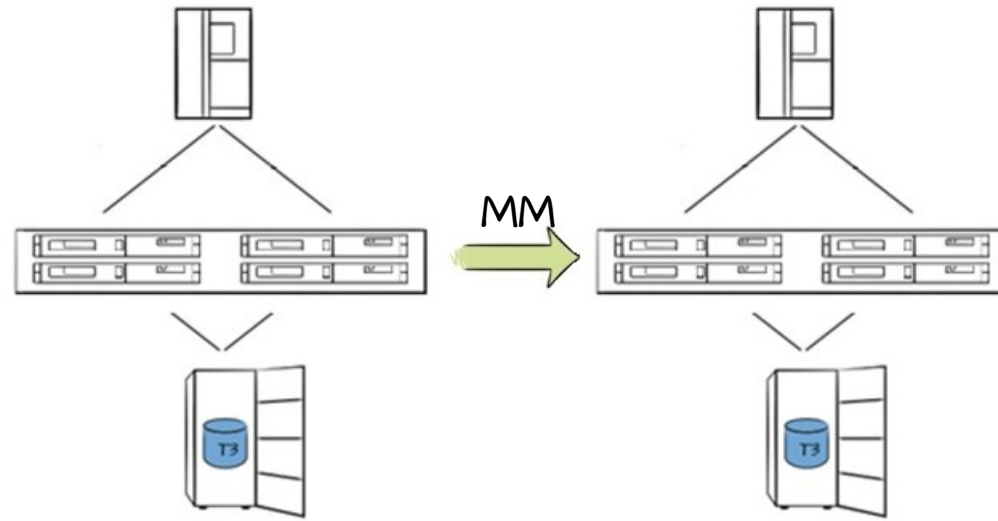
MetroMirror - Mirror between Clusters



StretchCluster - Mirror in Cluster



VIRTUALIZATION - SYNC REPLICATION vs. STRETCHED CLUSTER



MetroMirror - Mirror between Clusters

Host Cluster Needed

MM License Needed

No automatic Failover

DownTime needed for Failover

StretchCluster - Mirror in Cluster

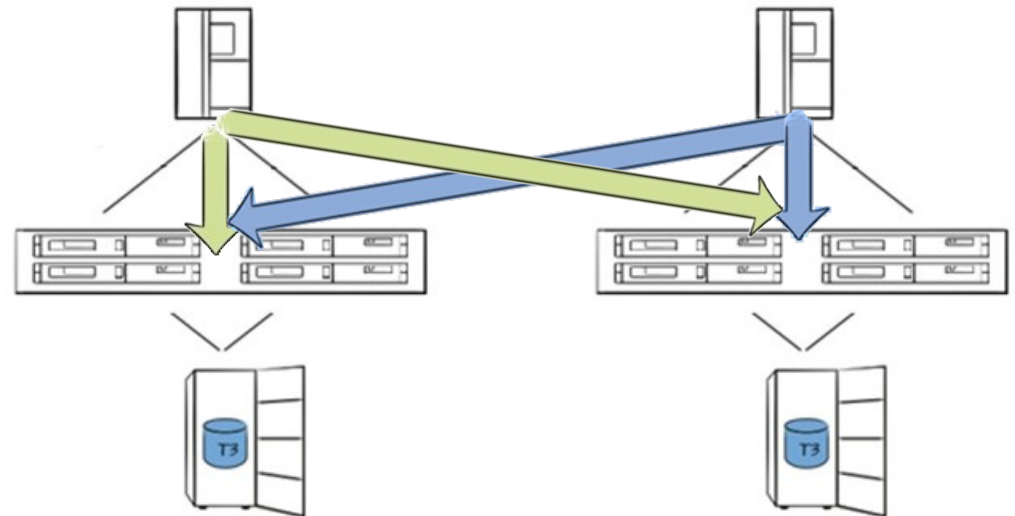
Single Host data can be mirrored

No additional license needed

Automatic Failover

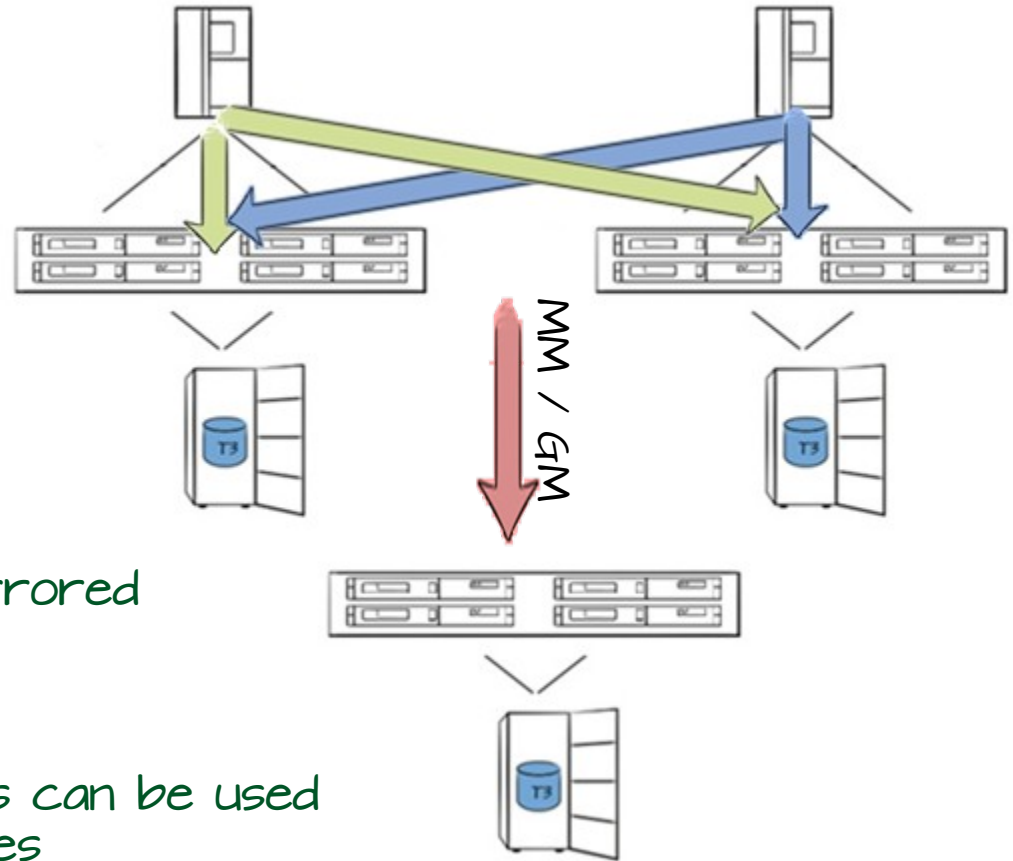
No DownTime for Failover

Both of the Sites/Storages can be used



VIRTUALIZATION - SYNC REPLICATION vs. STRETCHED CLUSTER

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3-Site Disaster Recovery

Single Host data can be mirrored

No additional license needed

Automatic Failover

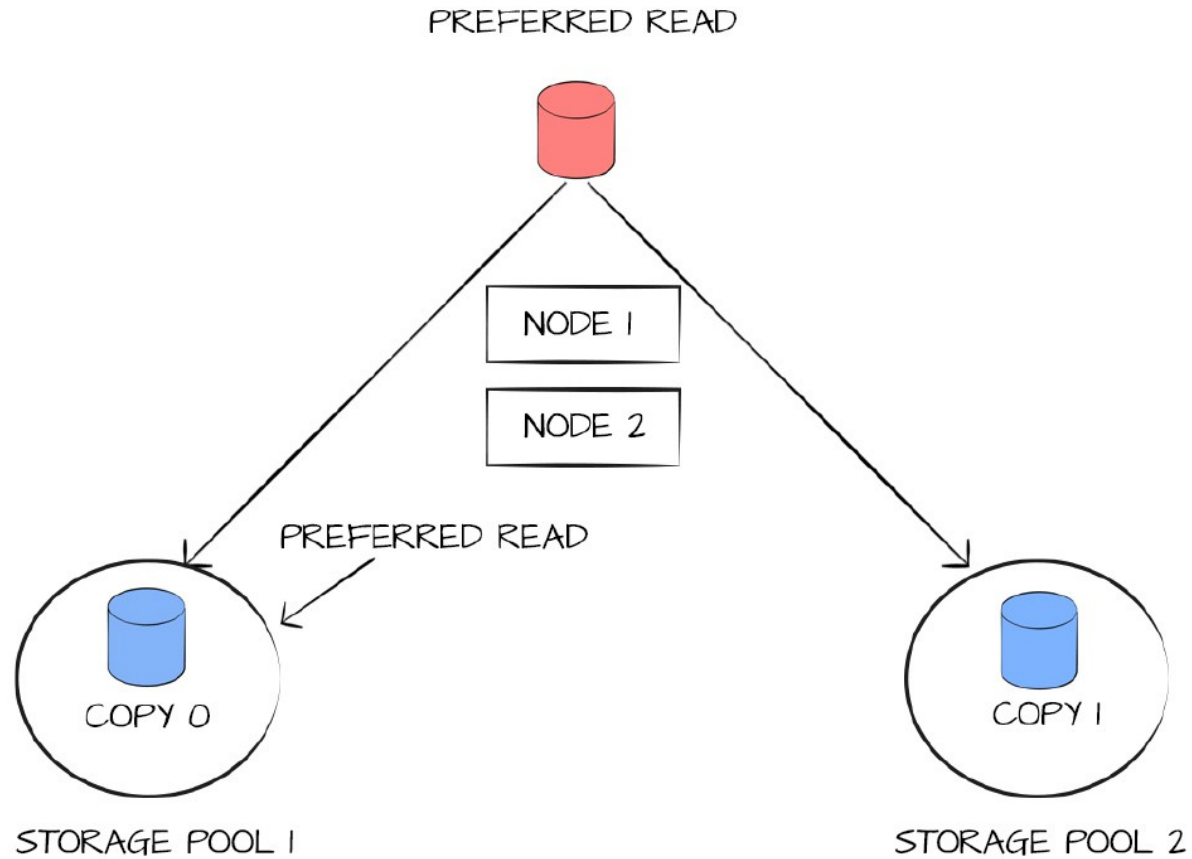
No DownTime for Failover

Both of the Sites/Storages can be used

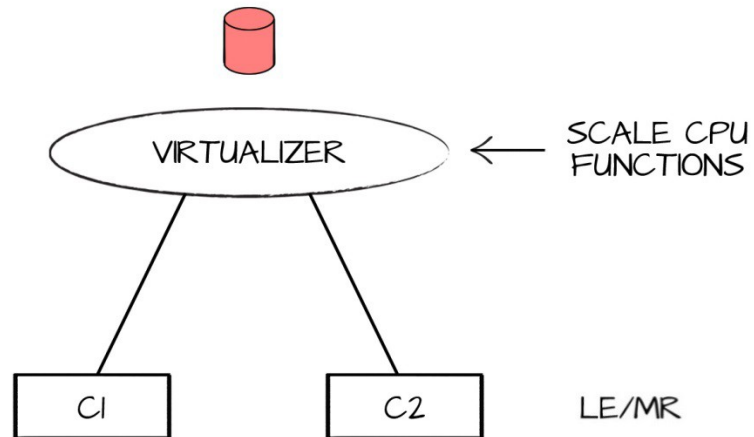
Protects against site failures

VIRTUALIZATION - STRETCHED CLUSTER + GM/MM

3 - SITE DISASTER RECOVERY

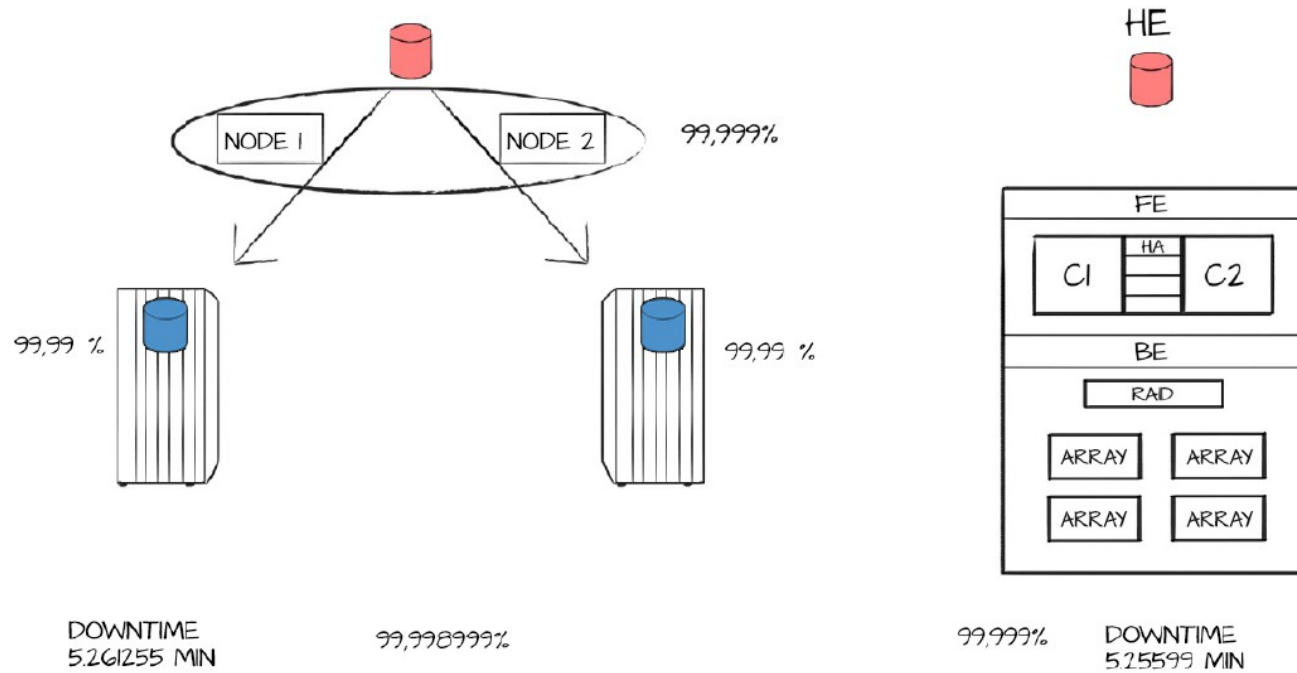


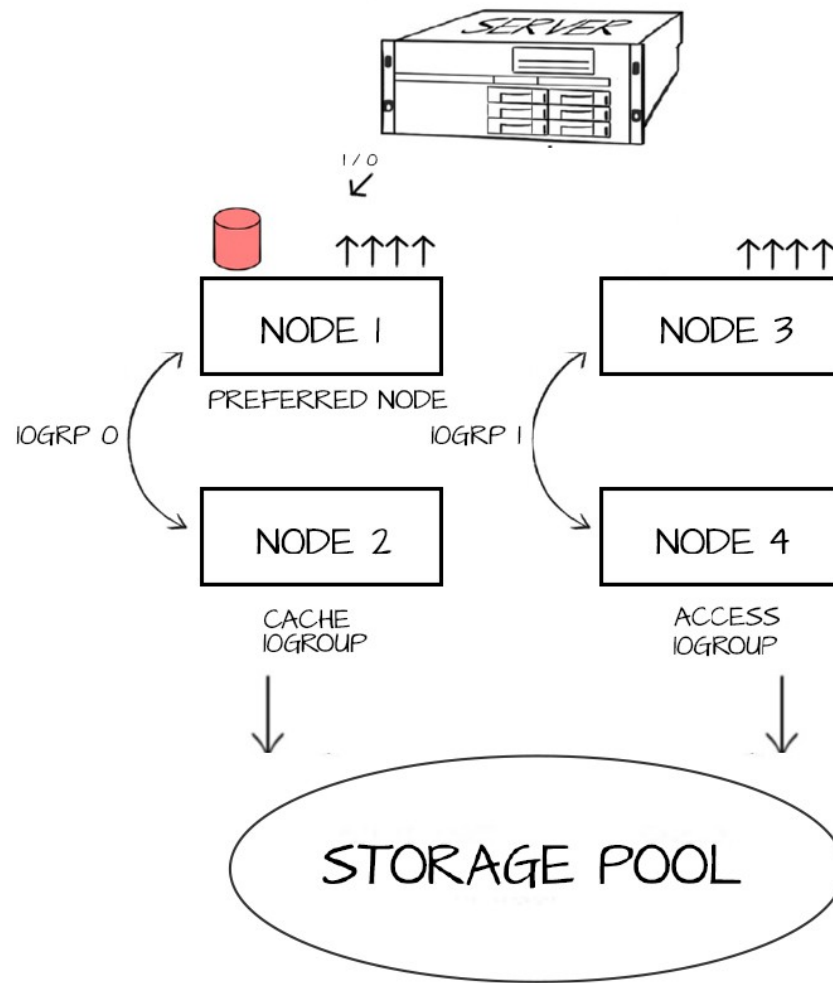
BUILDING HE FROM MR/LE



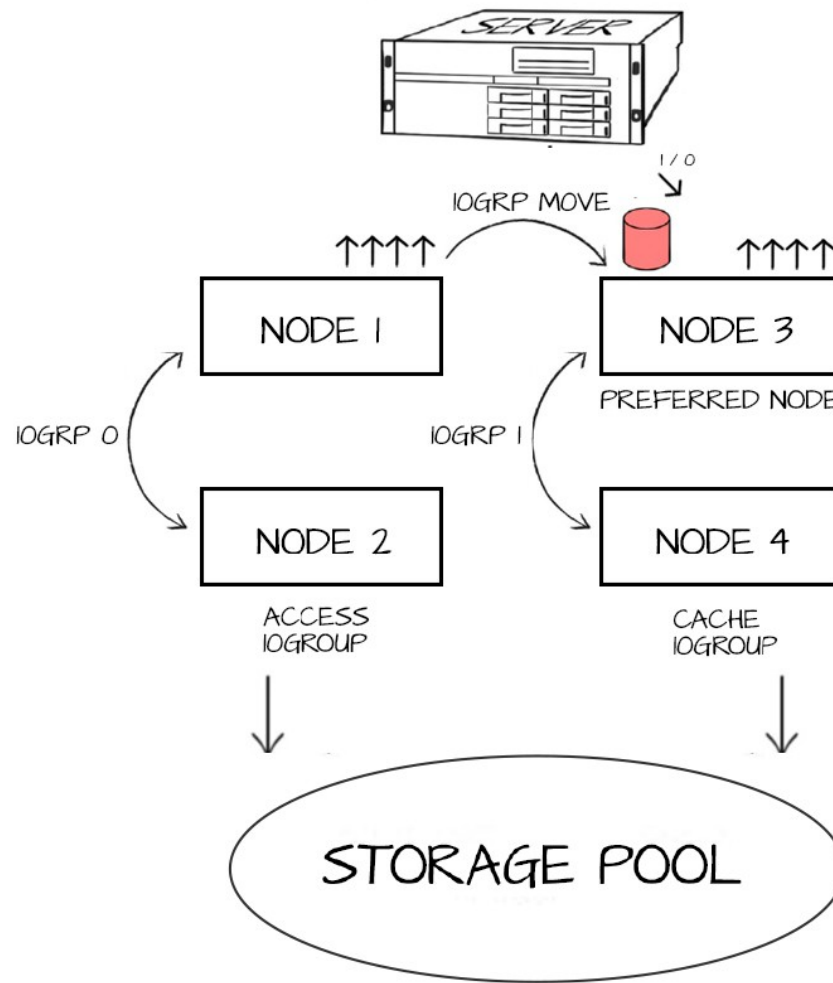
VIRTUALIZATION - HIGH END FROM MR
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SOFTWARE DEFINED STORAGE + MR/LE





VIRTUALIZATION - NON-DISRUPTIVE VOLUME MOVE

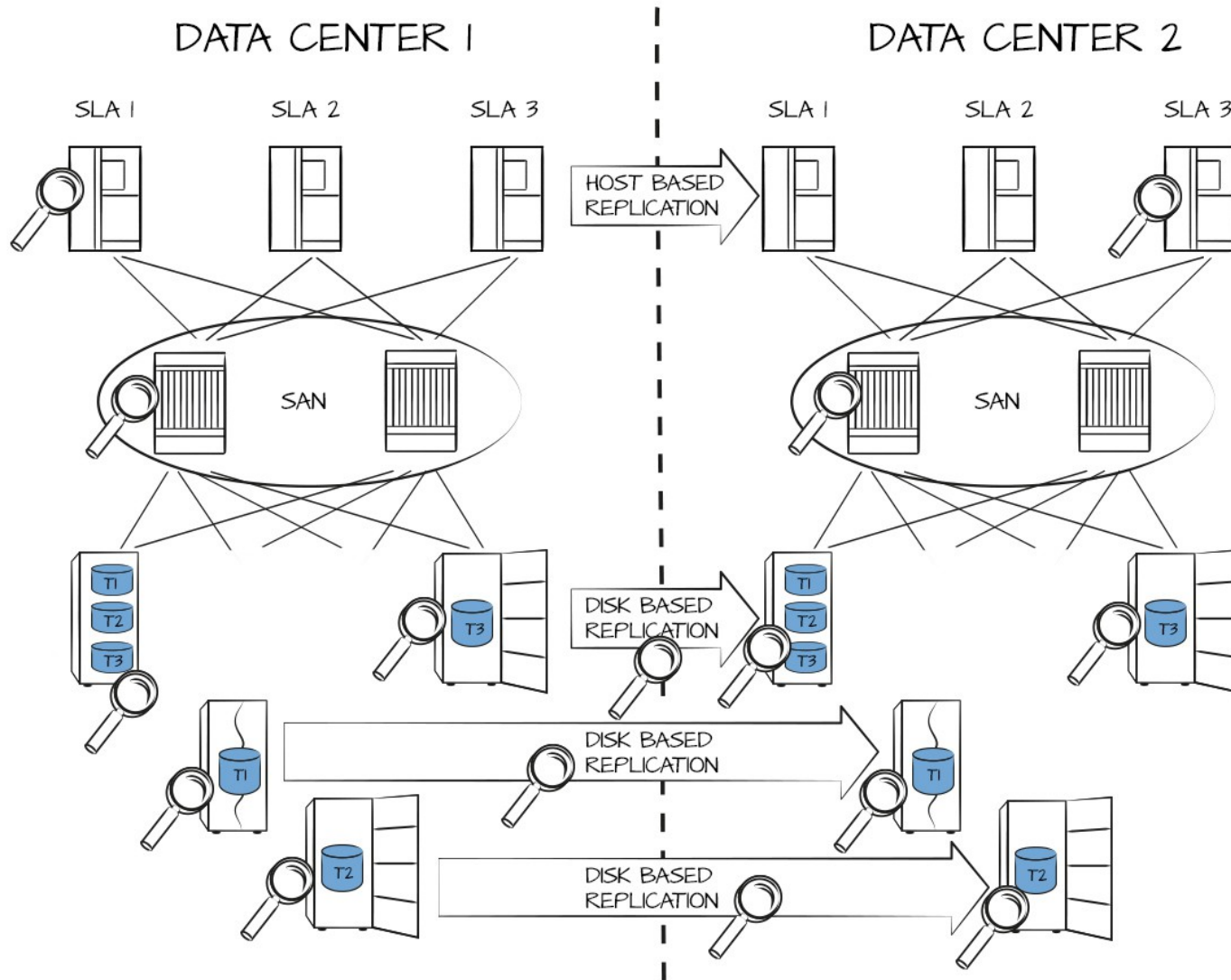


VIRTUALIZATION - NON-DISRUPTIVE VOLUME MOVE

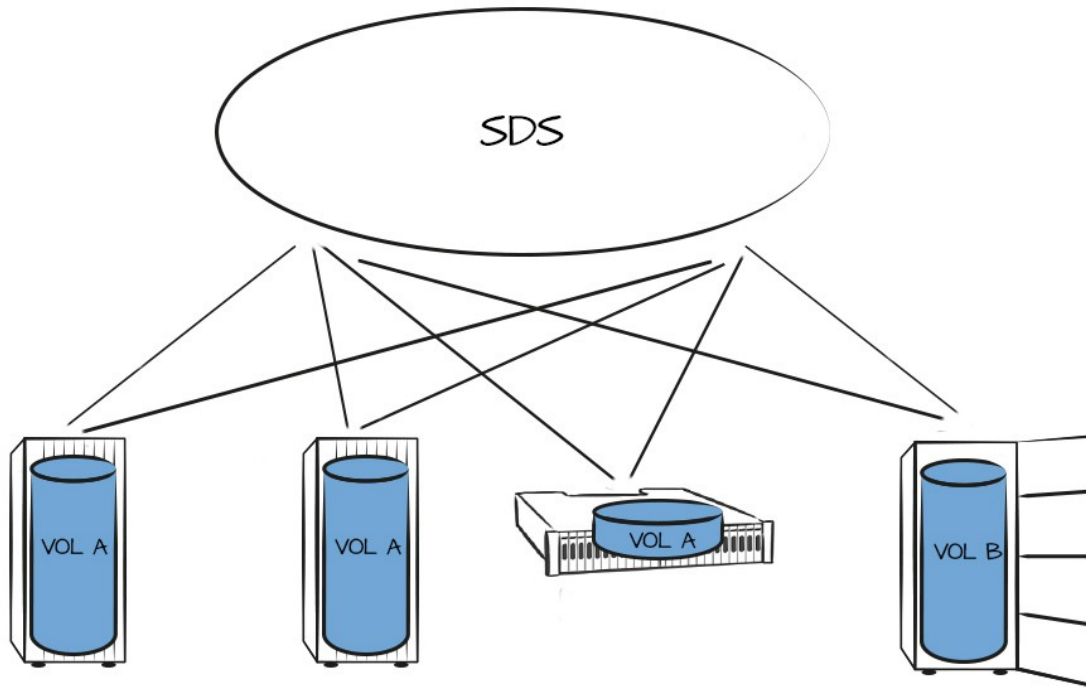


One of the most important part of
SDS is,

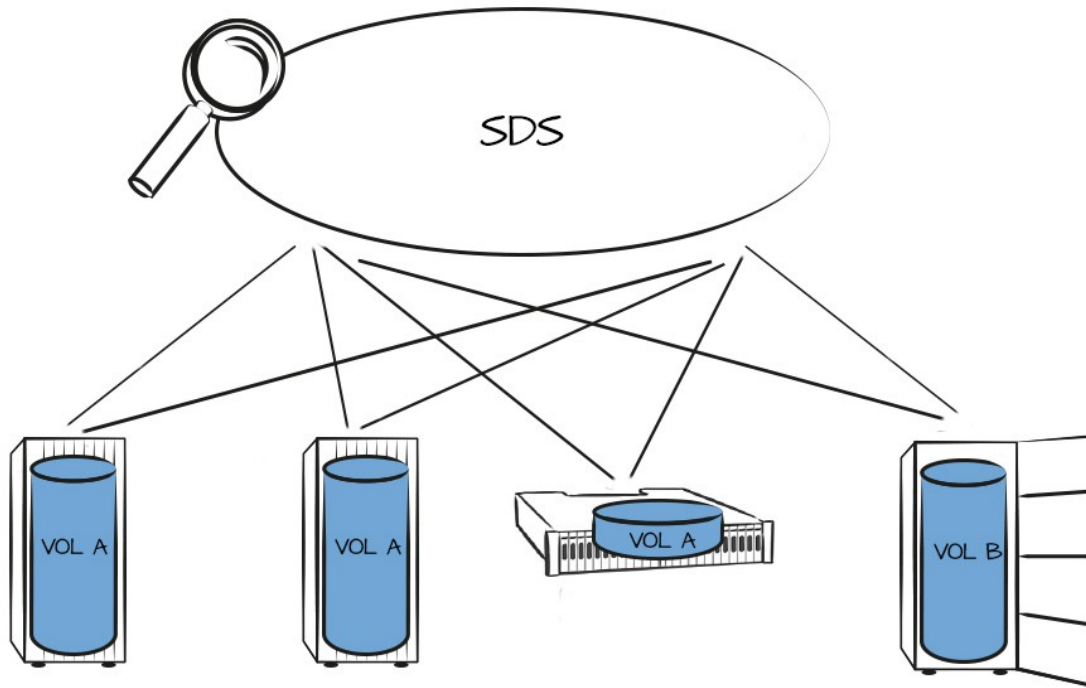
Monitoring and Analytics



MONITORING CAN BE A NIGHTMARE IN A BIG AND HETEROGENOUS ENVIRONMENTS

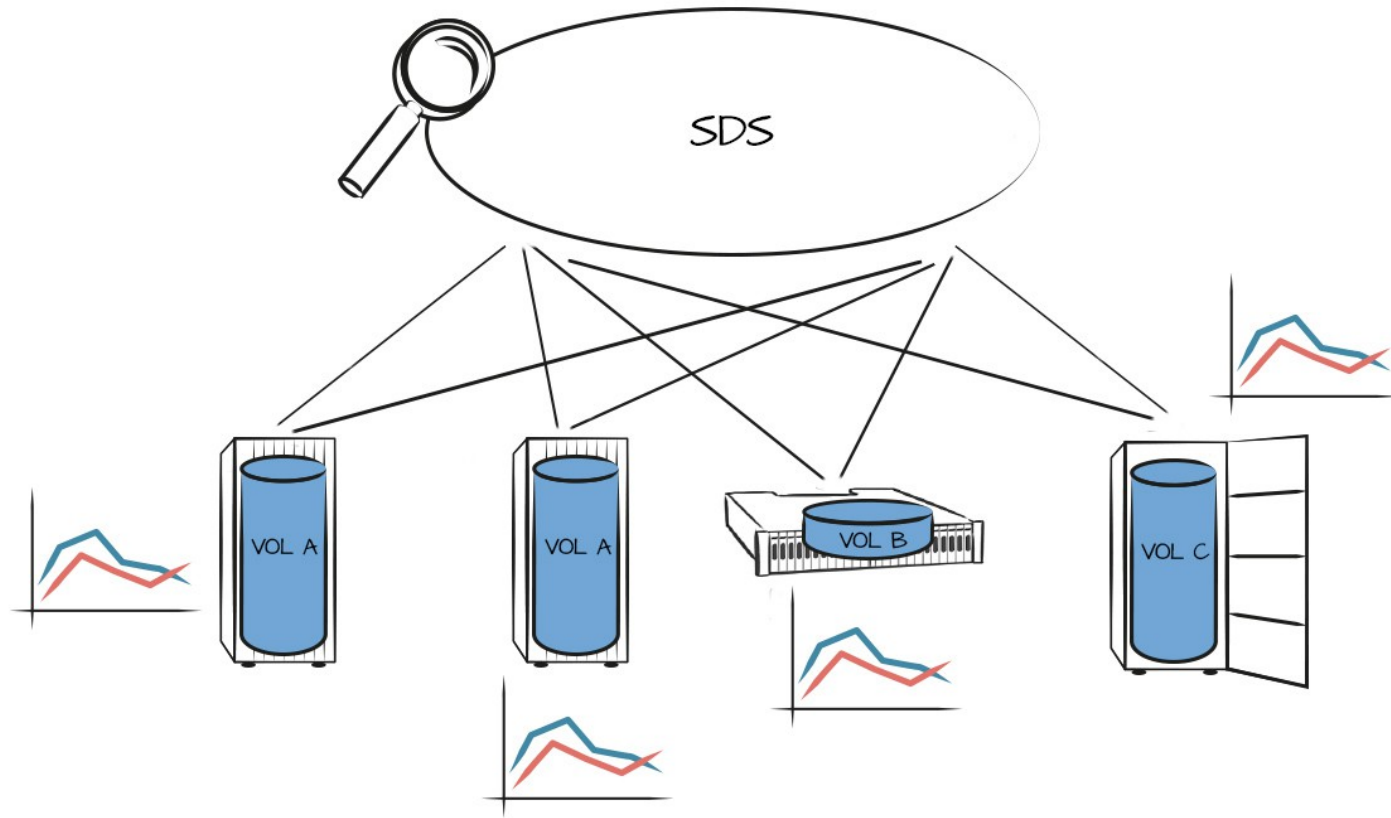


BUT IN AN SDS ENVIRONMENT..
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YOU JUST MONITOR THE SDS LAYER...

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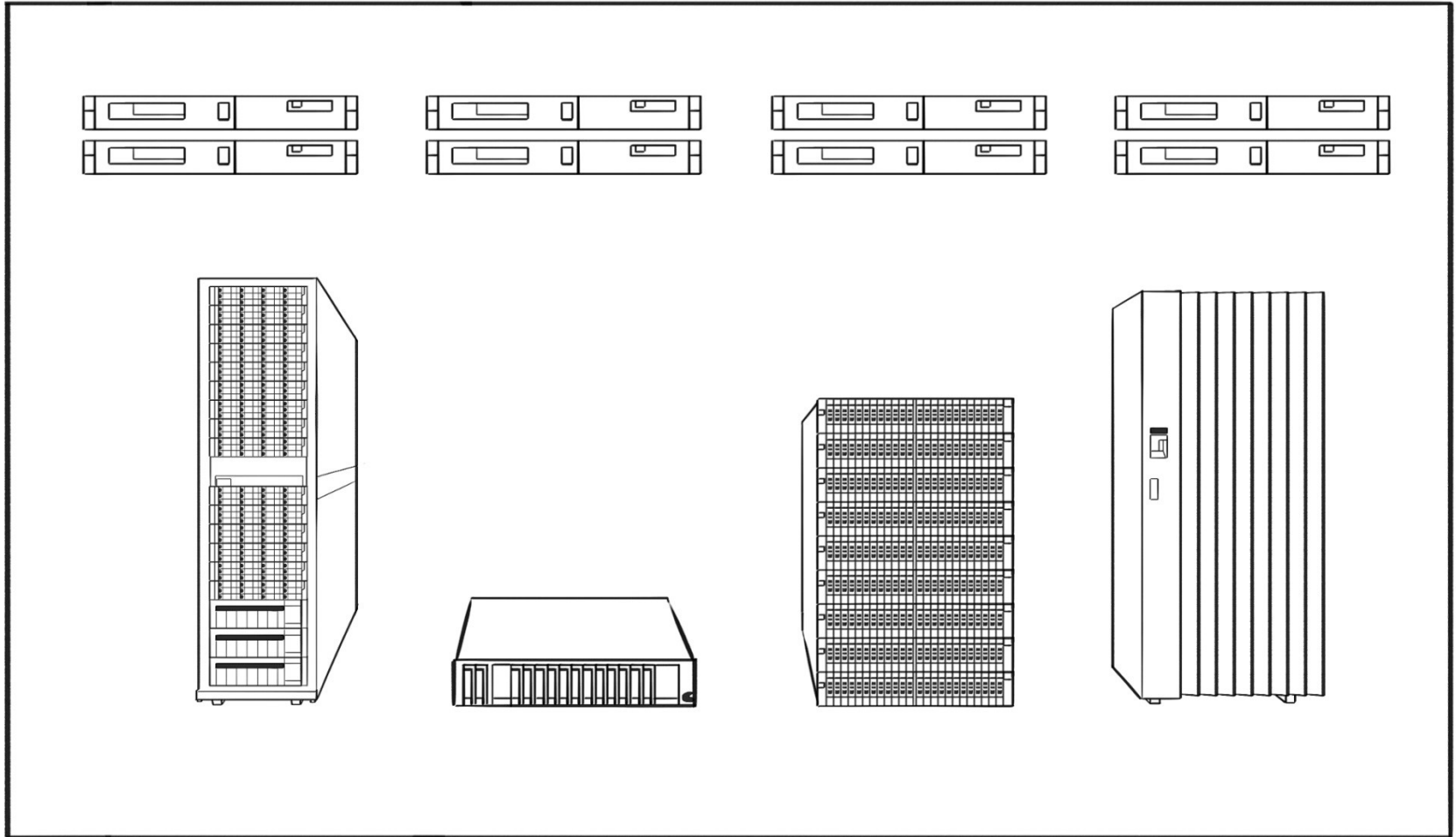


SO, YOU CAN COLLECT DATA FROM ALL VENDOR'S
SYSTEMS, ANALYZE AND MOVE BASED ON RULES

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SAN VOLUME CONTROLLER TRANSFORMS EVERYTHING IN THE SOFTWARE-DEFINED-STORAGE



SAN VOLUME CONTROLLER TRANSFORMS
EVERYTHING IN THE SOFTWARE-DEFINED-STORAGE

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IBM SYSTEMS FOR BACKEND STORAGE

IBM DS8000 - the race horse



IBM DS8870

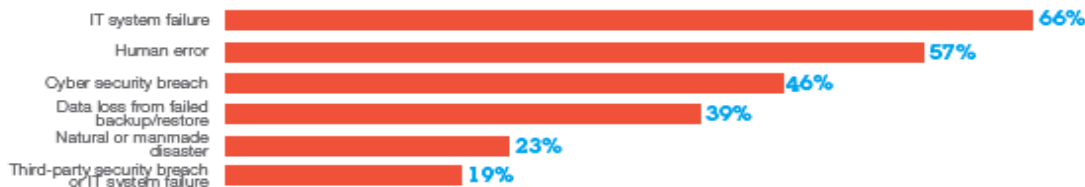
Keeps mission-critical applications online and your data secure

Your IT infrastructure matters. See how the newest IBM DS8870 can help your business meet the resiliency and security challenges of your critical enterprise data

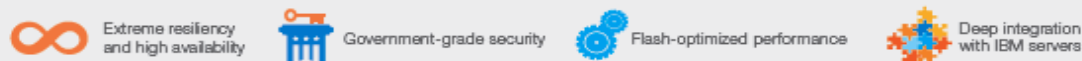
What is sub-optimal IT resiliency and security costing you?



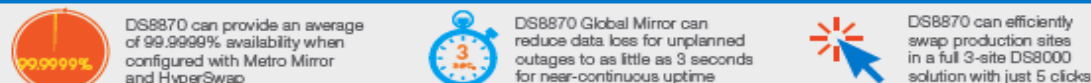
Threats that impact reputation and brand value experienced over the past 24 months



IBM DS8870 enterprise storage offers:



Keep information available



Keep information secure



- Up to 99,9999% availability
- Low latency
- Highest security, Protection

Sources: The economics of IT risk and reputation-What business continuity and IT security really mean to your organization, IBM Global Study, 2013

ibm.com/systems/storage/disk/ds8000

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IBM XIV - the working horse



IBM® XIV® Storage System Gen3

Unpredictable World | Predictable Performance

Lower management cost



Lower software cost



Lower energy cost



Turbo-Charged
Disk Rebuilds



Self-tuning,
Always Optimized



Revolutionary
Flash Performance



- Self-Tuning
- Ease of Use
- Fastest Raid rebuild

Application-optimized storage



Lower SAP TCO



Primed for analytics
94% less time to
process loan scoring



120K
Top ESRP results for
Exchange 2013
120,000 mailboxes



IBM Storwize - the "pony" horse



IBM Storwize Family

Efficient, easy, dependable data virtualization for software defined environments

Clients are spending too much money and time managing where their data is stored

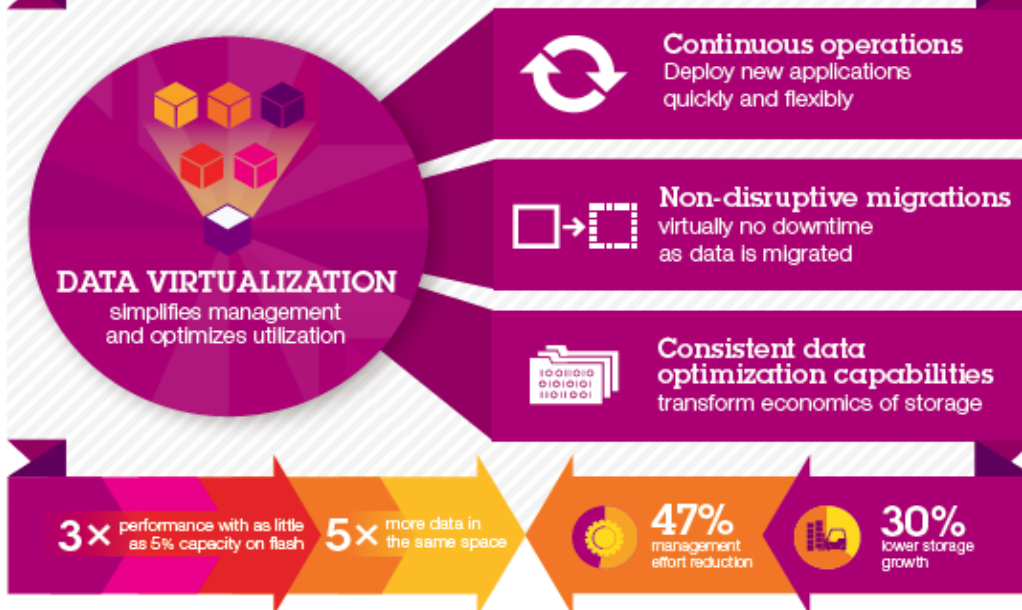
They purchase 24% more storage every year¹, but use less than 50% of the capacity they already have²



They spend 70% of IT budgets on operations and maintenance instead of innovation and insights



IBM Storwize Family can help



- Uses SVC SW stack
- Built in Virtualization
- Simplified Management
- Non-disruptive Migrations

IBM Flash - a "must" in every data centre



Extreme Performance



IBM MicroLatency™

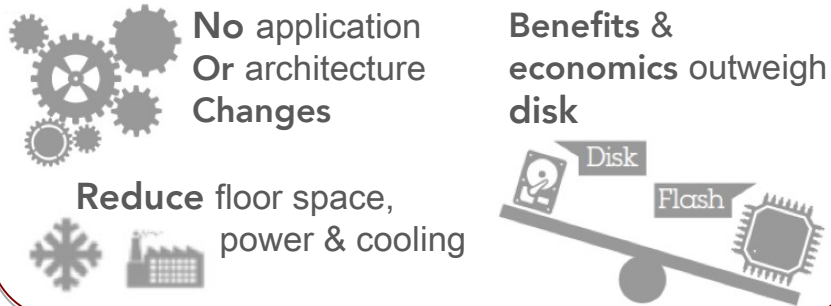
Servers, Applications and Databases are **FASTER!**



Go FROM
7 milliseconds to
700 microseconds



Macro Efficiency



Enterprise Reliability



Highest Reliability levels



Purposed-built,
Enterprise Architecture

- Micro Latency
- Tier 0 Storage

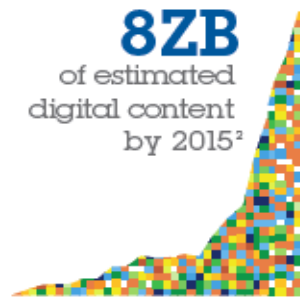
•  "IBM #1 in Flash"

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IBM Linear Tape File System

Changing the game



Rapid data growth is
driving up storage
capacity requirements.

Is your need to store
and manage data
becoming more costly
and difficult?



Lower your
total cost of
ownership
for storing
and archiving
data by over
50%¹

- Tape as Storage Tier
- Lowest TCO
- Long Shelf Life 30ys

Use LTFS and tape for a lower cost, easy-to-manage, high capacity storage tier



LTFS—why wait? Start saving now.

Sources

1. Internal IBM 3 year TCO comparison of 3PB IBM enterprise tape configuration against

ibm.com/storage/tape/ltfs

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And at the end...



Why IBM?



- Proven technology
 - 55.000 SVC installations
- IBM was first in industry with Storage Virtualization
 - SVC since 2003 (development started in 1999)
- IDC ranked IBM No#1 in SDS
- Multivendor Support +260 Storage models
- All functions in a single SW stack
- IBM help you to achieve optimized cloud enabled storage infrastructure



THANK YOU !

Discussion Questions