Preparing Your Storage for Handling Even More Capacity - Again

Block Storage

By Yosef Shatsky
Storage Security & Software Architect
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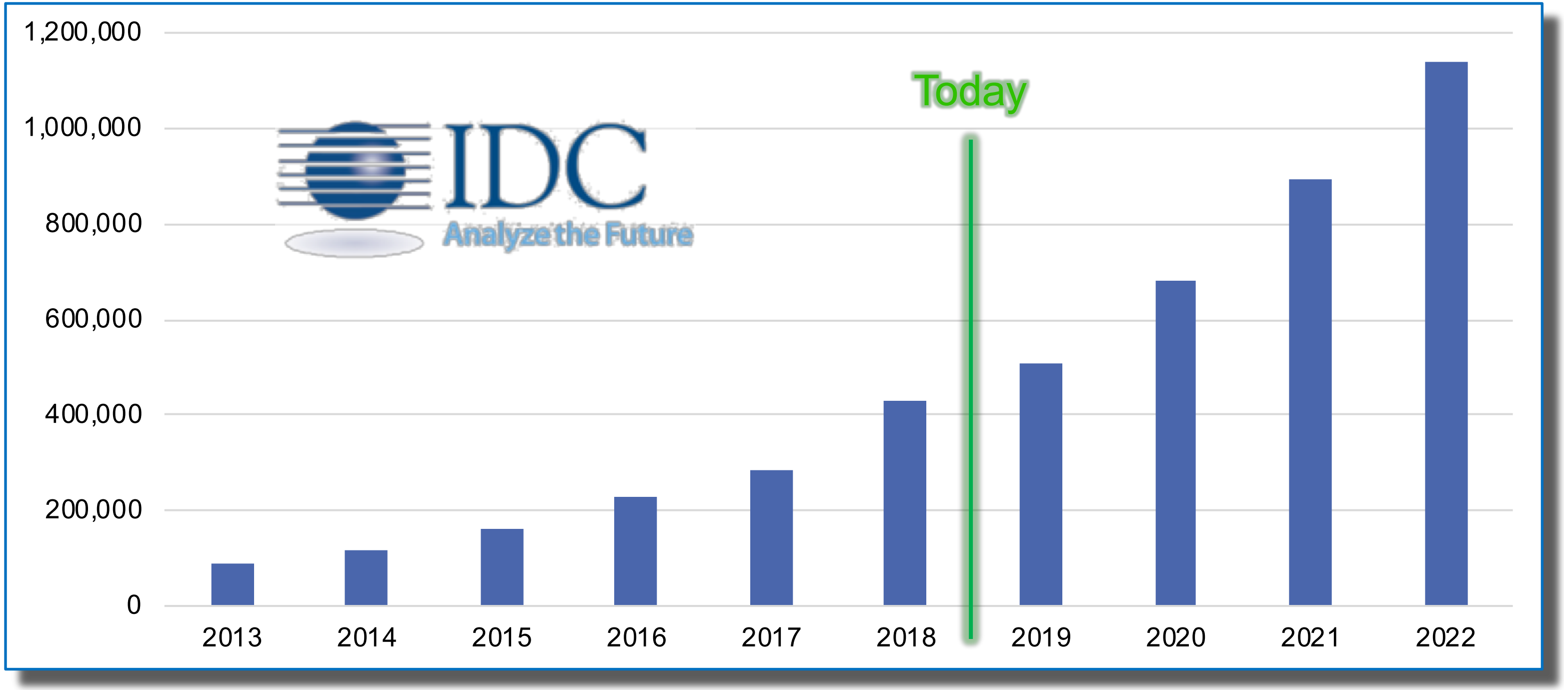
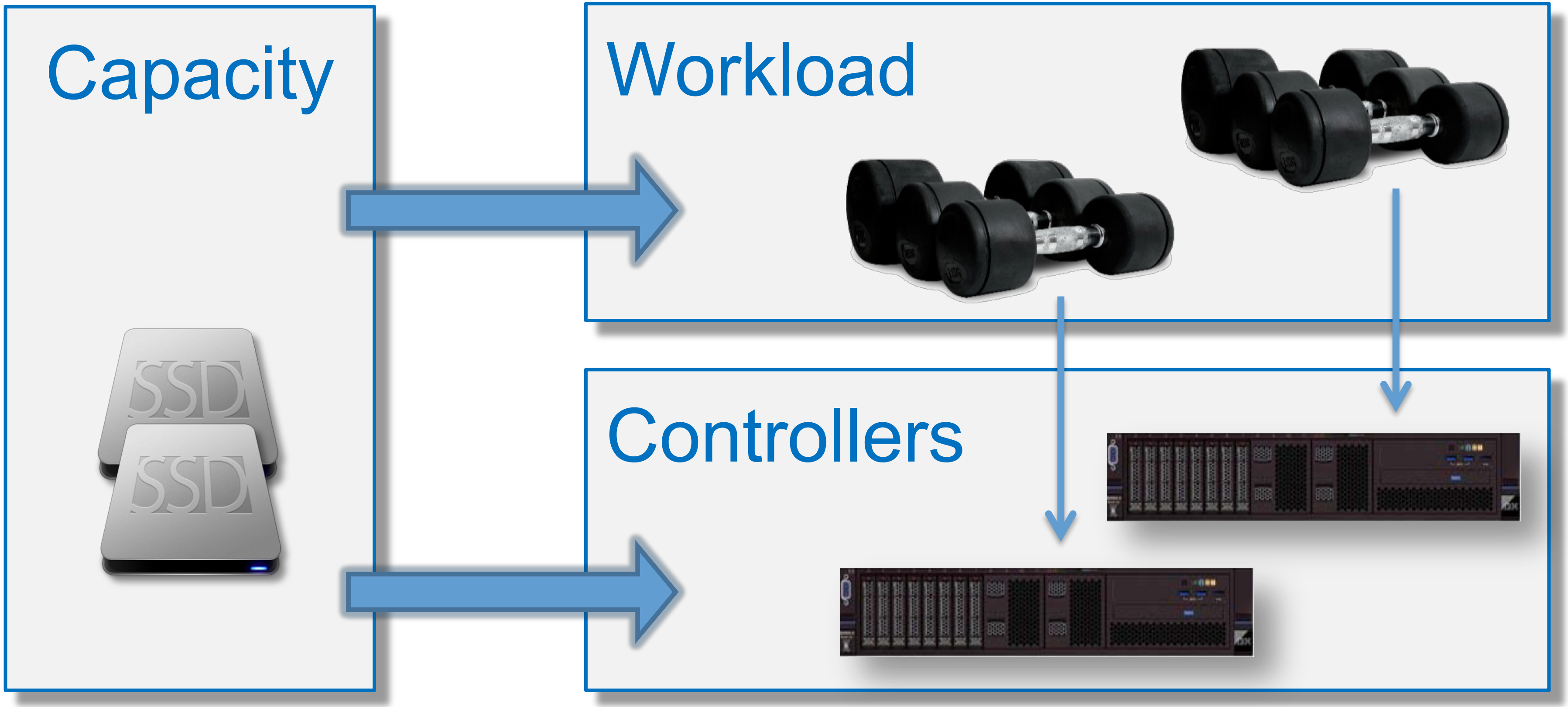
Introduction

- Capacity has always been increasing – what’s new?
- What is the influence on the storage controller?
- Capacity is *one* of many factors
  - Workload
  - Performance
  - Feature set (disaster recovery, high availability, security, data reduction)

Worldwide Enterprise Storage Systems Capacity Shipped (PB)



Workload

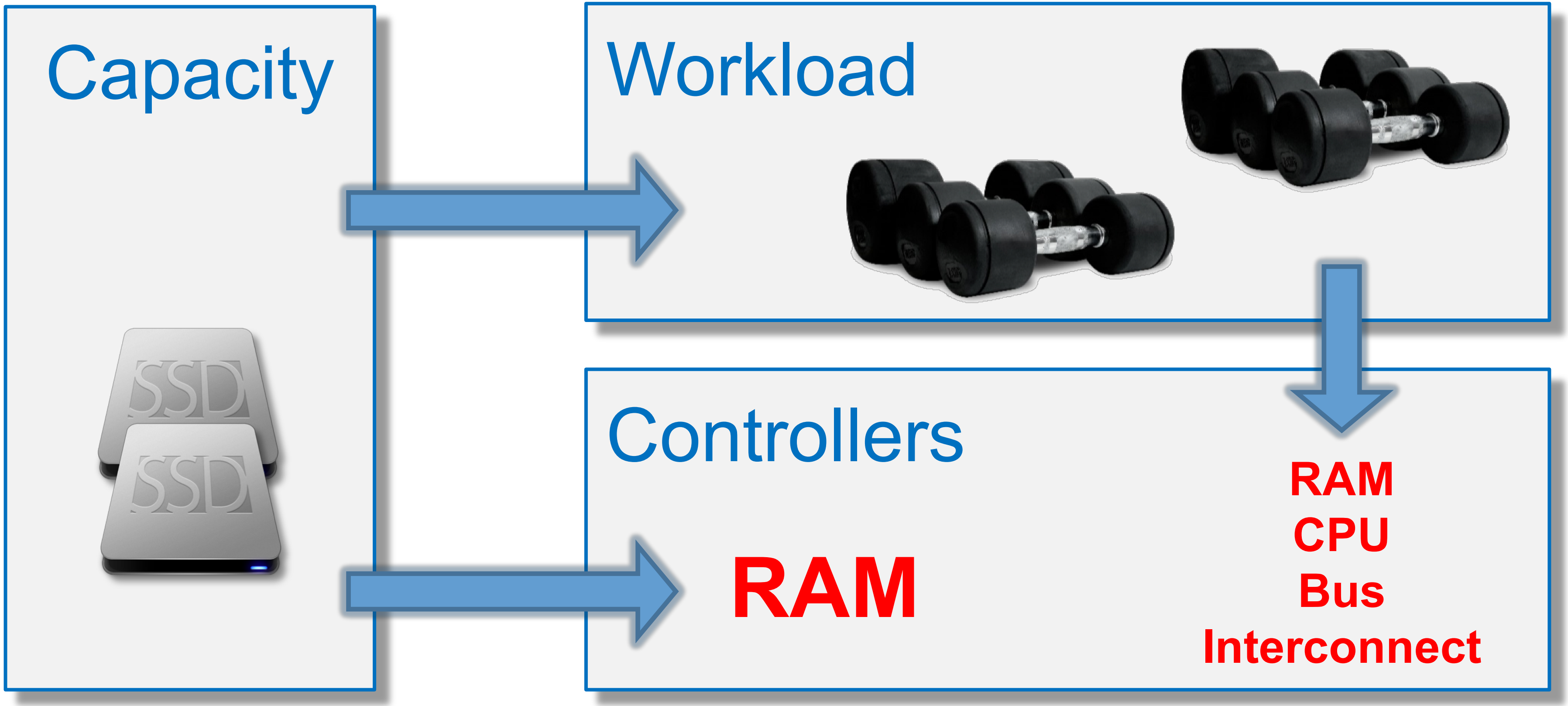


Capacity

Workload

Controllers

Workload



Capacity

Workload

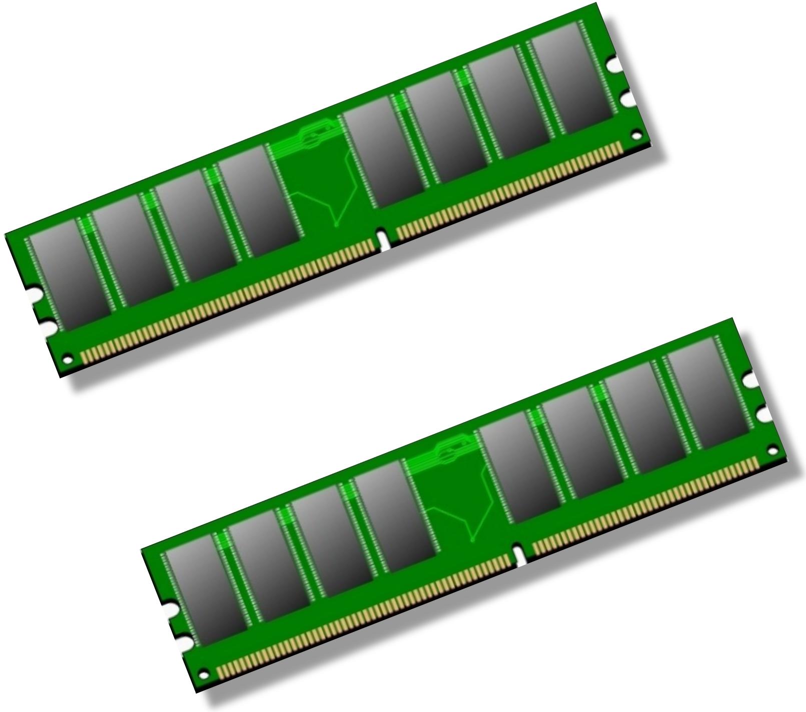
Controllers

RAM

RAM
CPU
Bus
Interconnect

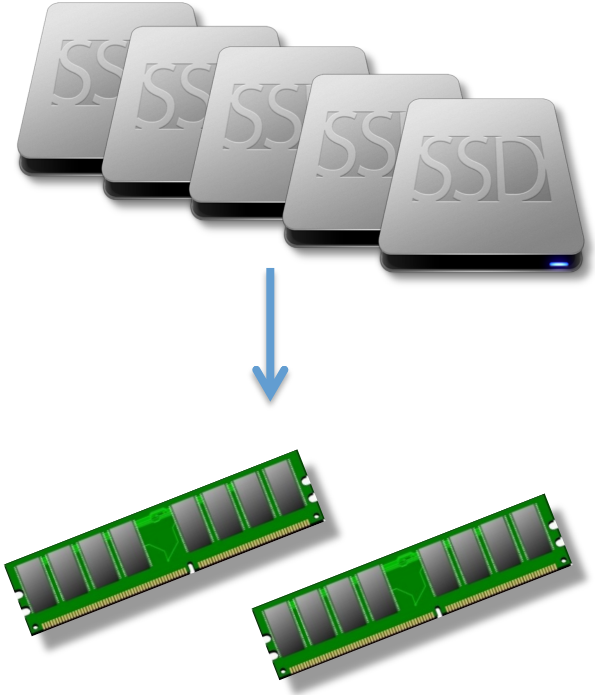
RAM Consumers in the Controller

- Physical capacity management
  - Free space mapping
  - Garbage collection metrics
- Read/write cache
- Virtual to physical lookup
- Deduplication database



RAM Consumers in the Controller

- Physical capacity management .... ◢
  - Free space mapping
  - Garbage collection metrics
- Read/write cache .... 🟩
- Virtual to physical lookup .. ◢
- Deduplication database .... ◢



RAM Supply

> *“The DRAM shortage will continue through 3Q19”*

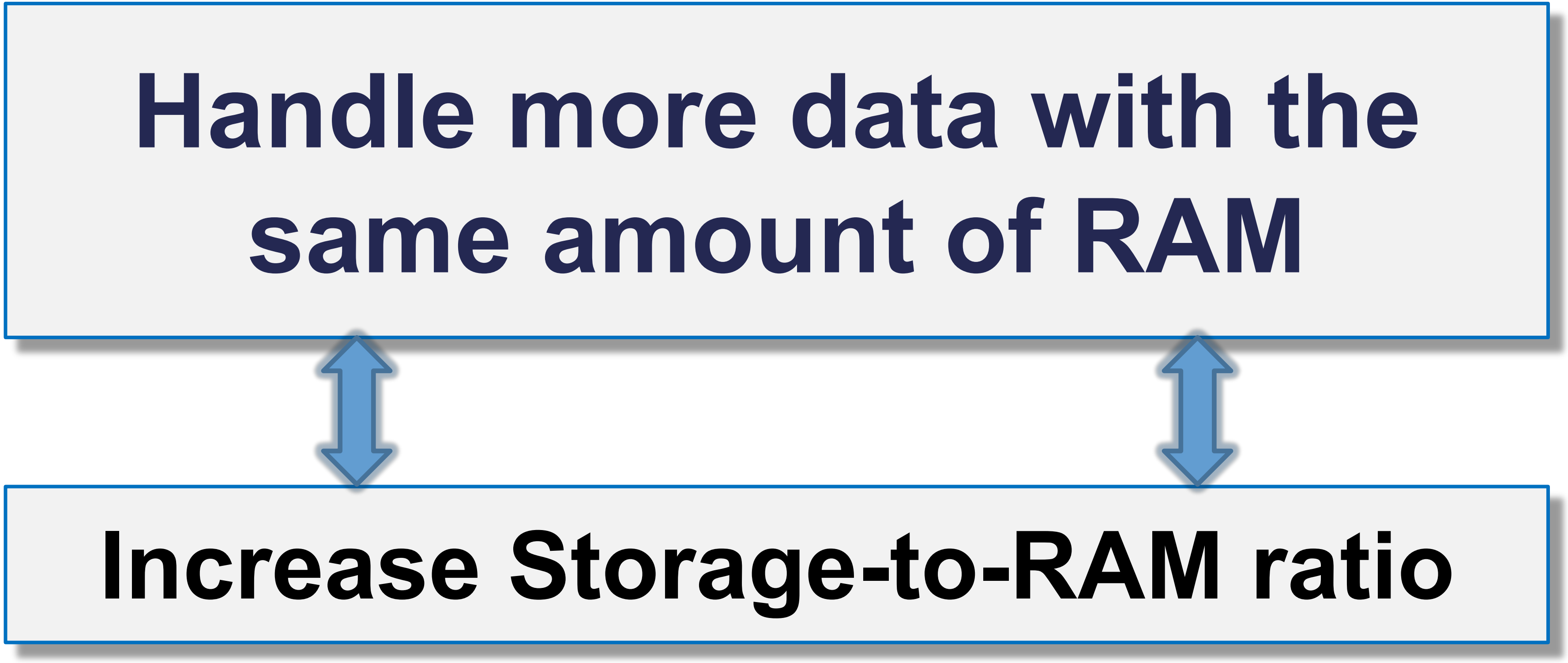
Gartner

> *“While the DRAM supply shortage continues, there is a limit on capacity for the entire market”*

IDC

Analyze the Future

The Metadata Challenge



Handle more data with the same amount of RAM

Increase Storage-to-RAM ratio

Swappable Structures

Metadata	Swap Mechanism
Deduplication database	Content based
Virtual to physical lookup	Location based
Physical capacity management	Freed areas

- Typically, most of the data is cold
- Tailor each type of metadata to its workload
  - Read / write
  - Random / sequential

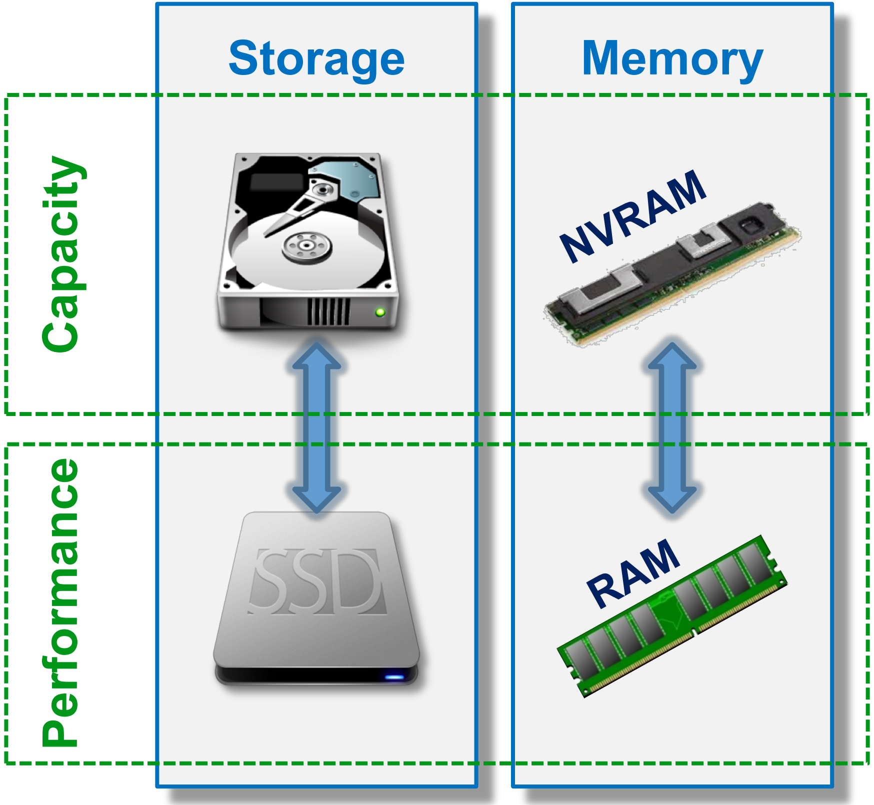
Workload Optimized Metadata

Structure	Read Workload	Write Workload
Deduplication database	✗	✓
Read/write cache	✓	✓
Virtual to physical lookup	✓	✓
Physical capacity management	✗	✓

Optimize at a fine granularity (e.g. volume), not system-wide

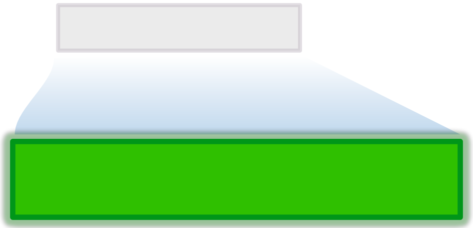
Storage Class Memory / NVRAM

- Metadata persistency
- Read / write cache
  – Even without utilizing persistency
- Memory structure tiering
  – Similarly to data tiering with HDD and SDD

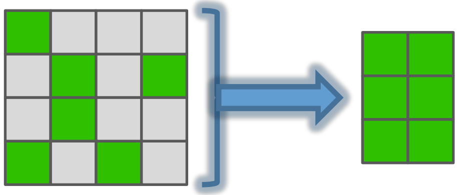


Metadata Structure Efficiency

- Use larger chunk sizes
  - Increases the amount of data per metadata entry
  - Fewer entries are required



- Use a sparse deduplication database
  - Reduces database size
  - Implement supplemental lookup algorithms



Proliferation of Storage Objects

- More: Volumes, Pools, Mirrors
- Caused by:
  - Increasing capacity
  - VVols
    - Adoption rate was slow
    - Support is increasing
    - Vvols 2 – replication
  - CDP - Continuous Data Protection
    - More snapshots

Capacity Cap on Failure Domains

- How much data would you place in a single system?
- Can we keep increasing the capacity of a single system?

- Clients prefer not to put all their eggs in the same basket
- Clients want to limit the size of a failure domain
- Concern involves failures that lead to:
  - Data loss
  - Offline time
- Failures may also include security breaches

Failure Domain = a System

Failure Domain

Failure Domain

Failure Domain

Failure Domain < a System

If due to increased capacity density even small systems have too much capacity for a failure domain?

Failure Domain

Failure Domain < a System

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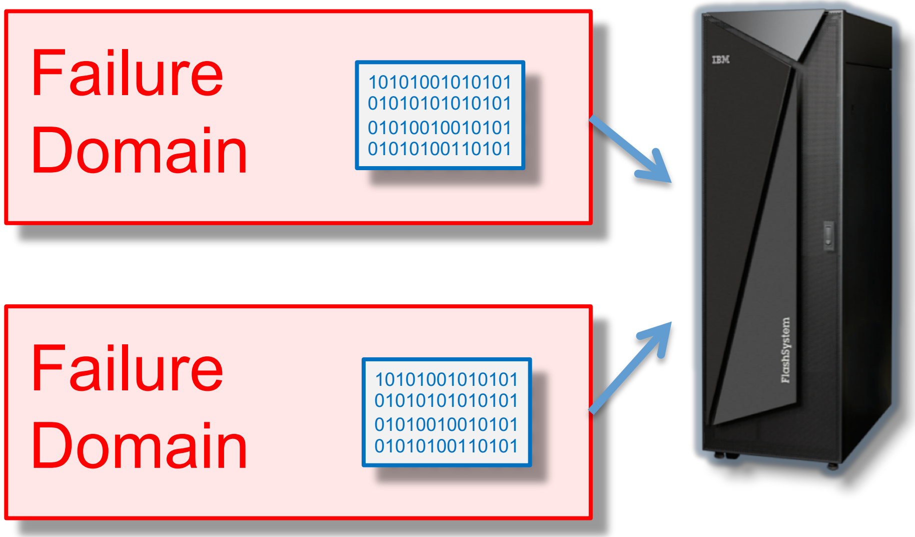


Failure Domain

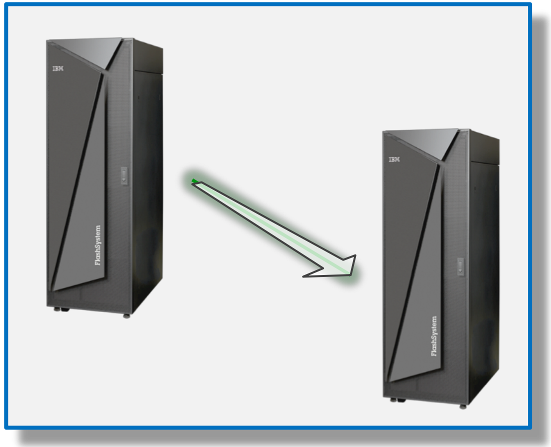
10101001010101
01010101010101
01010010010101
01010100110101

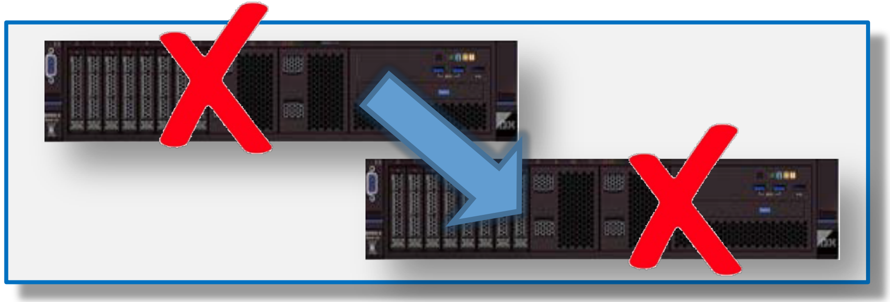
Failure Domain

10101001010101
01010101010101
01010010010101
01010100110101

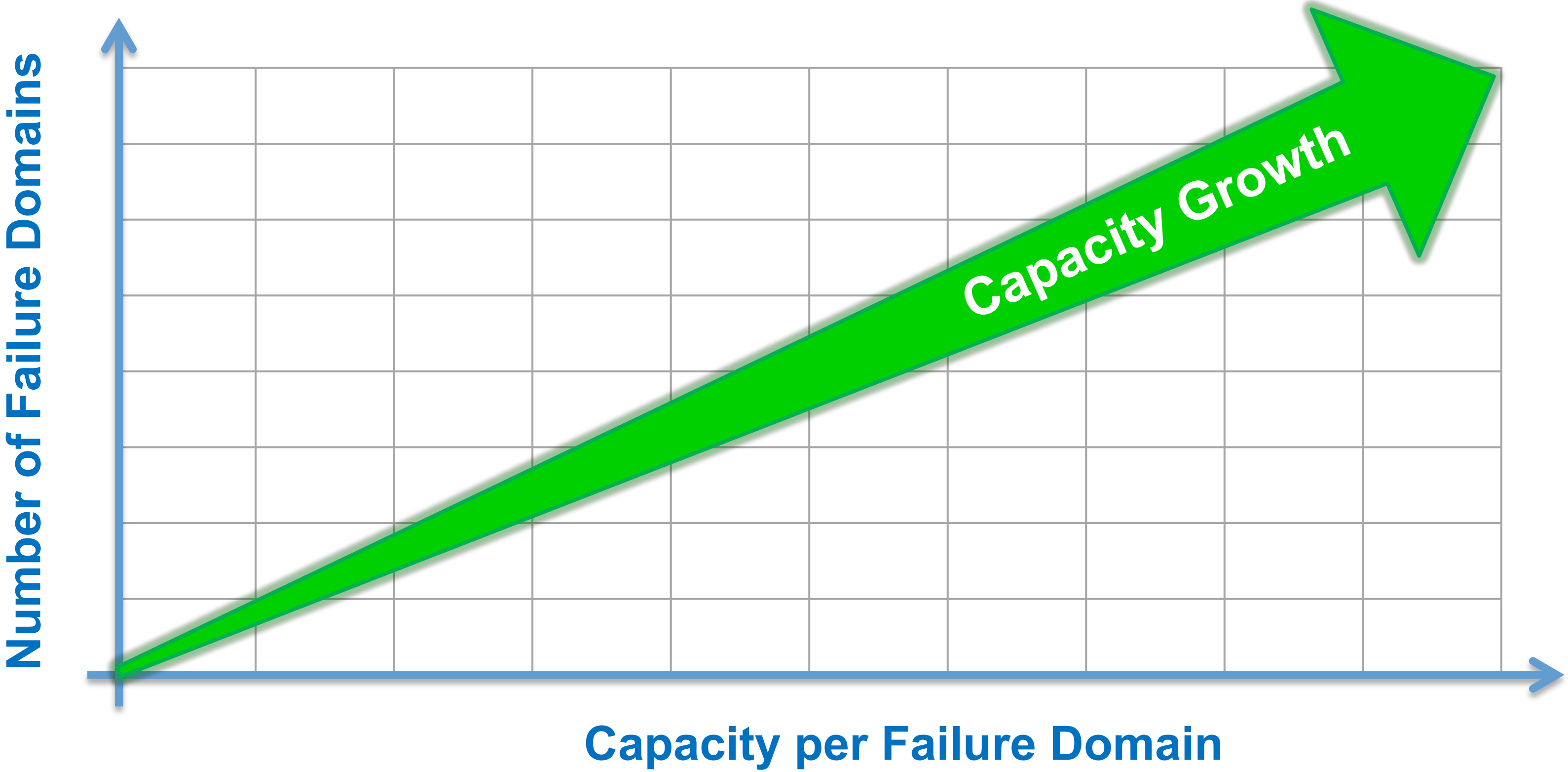
Failure Model

- Single failure → redundant components
- System failure → DR site
  - DR sites are expensive
  - May not be immediate failover
- Software failure domain
  - Same error in all nodes
  - Triggered by state
  - Cascading





Domains by Capacity Growth



Conclusions

Storage to RAM ratio

- Swappable memory structures
- Workload optimized structures
- Sparse deduplication database

Object Proliferation

- Support
- Management

Failure domain

- Many physical systems
- Software/logical failure domains