Getting the Most Out of the Storage You Have: Avoiding the Expensive Headaches of ‘Rip & Replace’

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Dragon Slayer Consulting Intro

- Marc Staimer - President & CDS
  - 14 years consulting
    - Storage, SANS, SW, networks, server, data centers, MSPs
    - Consults vendors (> 200)
    - Consults end users (> 600)
    - Market and technology analysis
    - Publishes consistently with TechTarget
    - Periodically published for trade magazines
  - 32 years industry experience
Things Are Not Always How They Appear
Plethora of New Capacity & Performance Technologies
Big Problem: Requires “Rip-out & Replace”
Leveraging New Technologies w/o “Rip-Out-Replace”
Conclusions - Recommendations
How to Cost-Effectively Handle Exponential Data Growth

- Massive **EXponential** digital data growth*
  - Unstructured data
    - Today = ~60%
    - ~62% CAGR
  - Structured data
    - Today = ~40%
    - ~21% CAGR
  - Overall CAGR
    - ~54%
  - 1.8 ZBs 2011

*Source: IDC & DSC
Exponential Data Growth Led to Plethora of New Capacity & Performance Enhancement Tech

- Thin provisioning
- Data reduction
  - Secondary & primary storage
- Auto storage tiering
- Flash SSD caching/storage
- Cloud storage
Thin Provisioning

- Increases usable capacity
  - Eliminates overprovisioning of LUNs or file stores
  - Reduces raw capacity purchase requirements
Thin Provisioning Strengths

● Reduces storage over provisioning
  - Less underutilized usable capacity
  - More storage admin flexibility
Thin Provisioning Weaknesses

- Does not reduce usable capacity requirements
- Requires some form of fail-safes
  - Auto provisioning based on utilization policies
  - Annoying alarms when thresholds are met
Data Reduction

- 3 types
  - Lossy compression
  - Lossless compression
  - Deduplication
Lossy Compression

- Solves file bloat caused by inefficient software
  - Reads & decompresses MS PowerPoint, Word, Excel, JPEGs, PDFs
  - Removes superfluous unnecessary baggage
    - E.G. junk data, or excessive resolution without
    - Reducing visual content integrity, breaking files, removing content
  - Then re-compresses them in their native format
### Independent Production Results

<table>
<thead>
<tr>
<th>File Type</th>
<th>Original</th>
<th>Optimized</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerPoint</td>
<td>110MB</td>
<td>17.4MB</td>
<td>84%</td>
</tr>
<tr>
<td>Excel</td>
<td>10MB</td>
<td>2.4MB</td>
<td>72%</td>
</tr>
<tr>
<td>Word</td>
<td>10MB</td>
<td>3.2MB</td>
<td>68%</td>
</tr>
</tbody>
</table>

Results on JPEGs and PDFs are significantly lower

- 50% data reduction or less

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\(^1\) Average results source:
NXPowerLite Trident Warrior Results, FORCEnet
Lossy Compression Strengths

● Very effective with Office files
  - Reduces file size forever at a very affordable license cost
  - Readable by native applications & all users
    ● No reader software required AND no rehydration is required
  - Faster backups, transfers, migrations, reads, response times

● Works cooperatively with compression & dedupe
  - Not mutually exclusive
Lossy Compression Weaknesses

- Offline disruptive post processing only
  - After hours
- Limited file format support
- Combination of art & science
  - Can permanently corrupt a file
    - More the exception than the rule
- Only 2 vendors adds to risk
  - Neuxpower with over 1M users
  - Balesio with a few hundred
Lossless Compression

- Allows exact original data reconstruction
  - From compressed data
  - Contrast to lossy data compression
    - Allows an approximation of original data to be reconstructed
    - In exchange for better compression rates
  - Lossless compression techniques involve no loss of information
    - Data recovered exactly
    - From compressed data after a compress/expand cycle
  - Generally used for "discrete" data, such as:
    - Databases, spreadsheets, document, some image & video files
  - Lossless compression algorithms are required when
    - Reconstruction must be identical to the original
Lossless Compression Strengths

- It is very effective with:
  - Uncompressed files
  - Unstructured data (DBMS)
  - Golden images
  - Redundant ISO files
  - Virtual desktop
  - Structured data

- Expect storage consumption reduction
  - Ranging from 10% to 90% & in some cases, better
Lossless Compression Weaknesses

● Additional write & read latency =
  - Longer response times
  - Compression on writes takes time
    ● There’s no free lunch
  - Data must be “rehydrated” to be read

● Compressing compressed files produces limited results
  - Office XML JPEGs PDFs CATIA CAD/CAM MP3s MP4s Zip etc.
    ● Data can actually end up being bigger
  - Encrypted data

● Doesn’t reduce duplicate data between files

\(^1\)IBM realtime compression is the exception. Add’l latency is nominal. Also works with deduped data.
Deduplication – Also Lossless

- 3 different types
  - File
  - Block or blocklet
  - Content aware
1. Storage Based File Based Dedupe

- Reduces duplicate files
- Reduces primary storage consumption by:
  - Eliminating duplicate identical files
    - Coarse granularity approach
    - Identical files
    - Any difference what-so-ever does not get deduped
File Dedupe Strengths

● Inexpensive
  - Often available @ no license fee w/some storage systems

● Very effective on:
  - Duplicate email attachments
  - Duplicate ISO files
  - Golden images (as NAS files)
  - Virtual desktop images (as NAS files)

● Usable storage capacity increases
  - Can range from 10% to 800%
    ● Depending on data type
    ● Much more for secondary versus primary storage
File Dedupe Weaknesses

- Granularity is at the file level or coarse grain
  - Only dedupes identical files
    - Any change eliminates ability to be deduped
- Add’l write & read latency = longer response times
  - File dedupe takes time
  - Data must be “rehydrated” to be read – more time
- Does not work with most compressed or encrypted files
  - Previously compressed data such as
    - MS Office, JPEGs, MP3s, MP4s, Zip, etc.
2. Storage Block or Blocklet Based Dedupe

● Reduces storage consumption by eliminating:
  - Duplicate data blocks or blocklets
  - Blocklets are sub-blocks
    ● Fewer than 512 bytes
    ● Fine granularity approach

● Similar to lossless compression
  - Except is works cross files
    ● Blocks or blocklets deduped across files
Block or Blocklet Dedupe Strengths

- Excellent dedupe
  - App, protocol, file, pathname, & block address independent

- Very effective on backup data, less so on primary
  - Duplicate email attachments
  - Duplicate ISO files
  - Golden images
  - Virtual desktop images
  - Structured data

- Market-proven

- Storage usable capacity increases
  - Can range from 20% to 1000%
    - Depending on data type
Block & Blocklet Dedupe Weaknesses

- Add’l write & read latency = longer response times
  - Block & blocklet dedupe takes time
  - Data rehydration for reads also takes time
- Does not work with most compressed or encrypted files
  - Previously compressed data such as
    - MS Office, JPEGs, MP3s, MP4s, Zip, etc.
- Designed primarily for secondary data
  - Backup, replication, etc.
  - Much lower reduction ratios with primary data
  - Tends to have a relatively high cost premium

**NOTE:** Inline dedupe add’l latency on new SSD systems is often insignificant
3. Content Aware Based Storage Dedupe

- Unstructured file storage object deduplication
  - Reads & decompresses files
  - Removes duplicate storage objects
    - Replaces them with pointers
  - Optimizes remaining storage objects
    - Then re-compresses them in their native format
Content Aware Dedupe Strengths

- Incredibly effective on most file types
  - 100s of different already compressed file types
    - MPEGs, JPEGs, Office, Zip, PDFs, etc.
  - Duplicate email attachments
  - Duplicate ISO files
  - Golden images (as NAS files)
  - Virtual desktop images (as NAS files)
- Storage usable capacity increases
  - Can range from 20% up to 800%
    - Depending on file & compression types
Content Aware Dedupe Weaknesses

- Post processing only
  - Must be scheduled and performed after hours
  - Requires additional storage for caching before dedupe
- Higher response times (latency) for reading files
  - Data must be “rehydrated” to be read
- Doesn’t work so well with structured data
- Requires unique “reader” software
  - On user desktop, server, or NAS to read deduped files
- Only available from one vendor (Dell)
  - Relatively high licensing costs
  - Vendor lock-in
Auto Storage Tiering

- Data value-storage cost alignment
  - Moves data from higher performance higher cost storage
    - To lower performance lower cost storage
    - As data ages or becomes less valuable
Auto Storage Tiering Strengths

- Optimizes SSD performance w/high capacity HDDs
  - Reduces HDD count while increasing IOPS & throughput
  - Decreases power, cooling, & total storage infrastructure
  - Lowers TCO
Auto Storage Tiering Weaknesses

- Few systems offer it
- Can be costly
- Moving up storage tiers
  - More complicated
FLASH SSD Caching/Storage

- 5 different types
  1. 100% Flash solid-state drive (SSD) based storage system
  2. Storage system w/Flash as cache
  3. Storage system w/Flash SSDs utilized as Tier 0 storage
  4. PCIe Flash SSD cards in app servers
  5. Caching appliance
100% Flash SSD Storage System Strengths

- Fast, high performance Flash SSDs w/much lower latency
  - High IOPS
  - Incredible throughput
  - Faster response times
  - Inline deduplication &/or compression
  - TCO <= storage systems w/high performance HDDs
100% Flash SSD Storage System Weaknesses

- Relatively new systems technology
  - Shifts bottleneck to storage controller
    - SSDs have 20X performance of HDDs
    - Storage controllers utilize only a fraction of SSD performance
      - Some new controllers coming out claim better
  - Not shareable by other storage systems
  - Unproven long-term effectiveness, reliability, etc.
Storage System w/Flash as Cache Strengths

- Reduces latency
  - Improves IOPS, throughput, & response time
    - Primarily on reads
  - Add-on to proven storage systems
  - Available as PCIe SSDs or HDD form factor SAS or SATA SSDs
Storage System w/Flash as Cache Weaknesses

- Latency reduction & capacities less than expected
  - Limited cache sizes reduces cache hits
  - More redirected HDD reads slows latency & response time
  - Shifts bottleneck to storage controller
  - SSDs spike storage controller utilization
    - Limits SSD performance gains
- Cache not shareable by other storage systems
- Higher than expected TCO
Storage System w/Flash SSDs Utilized as Tier 0 Strengths

- Provides a chunk of pure SSD system performance
  - TCO is reduced by shifting HDDs
    - To high capacity lower performance
  - With potentially higher total capacities
    - 90% of data is passive & rarely accessed
  - Available as HDD form fact SAS or SATA SSDs
    - Read, write, and read only
Storage System w/Flash SSDs Utilized as Tier 0 Weaknesses

- Substantially similar to storage flash caching
  - Similar issues as well, but capacities are greater
    - More redirected HDD reads slows latency & response time
    - Shifts bottleneck to storage controller
    - SSDs spike storage controller utilization
      - Limits SSD performance gains
  - Tier 0 not shareable by other storage systems
    - TCO ends up a bit higher than expected
PCle Flash SSD Cards in App Servers Strengths

- Puts SSD closest to app = lowest latency
  - Works as server DAS or cache
  - Greatest IOPS per App
  - Highest throughput
  - Fastest response times
PCle Flash SSD Cards in App Servers

Weaknesses

- Costlier than most other Flash performance solutions
  - Server cycle hog using as much as 20% of the cycles
  - Requires caching SW
    - To move data from SSD to external storage
    - Otherwise useless for server virtualization
  - Measurably increases NAS NFS metadata burden
    - Radically increasing NAS controller utilization
    - Affecting all other apps using NAS
  - Each server w/PCle card(s)
    - Must be implemented & managed separately
    - Huge management burden
    - Flash not shareable by multiple servers
Caching Appliance Strengths

- Logically sits between servers/clients & storage system
  - Speeds reads
  - Especially effective with NAS
    - Best w/NFS reducing NFS metadata latencies
    - Effective w/CIFS reducing chatty latencies
  - Shareable by multiple servers & storage
  - Transparent write-through
  - Highly cost effective
    - Low TCO
    - No rip-out and replace required
Caching Appliance Weaknesses

- Limited capacities
  - Increases missed cache hits redirected to HDDs
  - Not as effective with block as with file
  - Separately managed from storage & servers
    - Increases management burden
Cloud Storage Strengths (A Lot of Them)

- Massively scalable in capacity, performance, & objects/files
- Many distributed resources acting as one
- Durable data persistence
- Inherently fault tolerant
- Auto-data protection w/autonomic healing
- App & data non-disruptive tech refresh
- On-demand resource allocation
- Bullet-proof security
- Multi-protocol access

- Multi-tenant/self service/detailed billing or chargeback
- Geographically dispersed & aware
- Usable storage efficient
- Paradigm shift lower storage TCO
- Many leading BU software write natively to storage clouds
Cloud Storage Weaknesses

- **Performance**
  - Higher latencies because of
  - Object, mirroring, erasure codes, etc.

- **No file or block interfaces**

- **Data has to be moved to storage clouds**
  - Movement between storage clouds
    - Not standard yet
    - Amazon S3 defacto standard
    - CDMI coming

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1 Scality Organic Ring is an exception to the performance issues
Big Problem w/Most of These Great Storage Technologies

- Unless your current system already has them…
  - Usually you have to “rip-out & replace” to get them

- Often not pragmatic
  - May not be amortized yet or off lease
  - Budgets may not allow
  - You have to wait
Good News!

- Installed capacity & performance can be increased
  - Without “rip-out & replace”
  - By addition & addition by way of subtraction
Increasing Usable Capacity & Performance by Addition

- More HDDs
- Flash PCIe SSD cards
- Flash cache appliances
- Cloud storage
- File virtualization
- Block virtualization
Add More HDDs

- More HDDs = > capacity & performance
  - High density 60 drive (or more) 4U enclosures available from:
    - **DDN**
    - **EMC**
    - **NetApp E-based OEM & VAR partners**
      - EVS, IBM, NEI, Oracle, RAID Inc., SGI, Teradata, T-platforms, & more
    - **Nexsan**
    - **Xyratex**
      - 84 drives in 5U
      - Dual 42 drive enclosures in 5U sheet metal
Adding More HDDs

Pros

- Easy
- Adds capacity & performance
- Works within your systems
  - Nothing new to learn
- Server/app transparent
- Relatively low cost

Cons

- Storage system HDD limitations
  - Can only add so many
  - Max #s per system
  - Newer HDDs & enclosures
    - Often not supported
  - Leads to storage system sprawl
- Storage system sprawl
  - Nightmarish & not fun
HDD Short-Stroking

- Reduces latency
  - By restricting data placement to outer platters sectors
HDD Short-Stroking

Pros

- Reduces seek times
- Lowers latencies
  - Reduced head movement
- Industry tests show
  - 29 to 33% less latency
- No upfront cost
  - Leverages unused capacity
- Nothing to purchase

Cons

- Reduced usable capacity
  - Discards 67% to 90%
- Wasted capacity does not save
  - Power, cooling, rack space, floor space, cables, conduit, etc.
- Negligible benefit
  - If bottleneck NAS controller
- Requires some expertise
Flash PCIe SSD Cards

- As previously discussed
  - Add to app servers
    - Physical or virtual
  - Radically > performance
  - Allows shared storage
    - > capacities as well
  - Available from:
    - Over 100 suppliers
Flash PCIe SSD Cards

Pros

- Best performance gains
- Adds capacity & performance
- Server/app transparent

Cons

- Expensive
  - Need card(s) per physical server
  - Must open up installed servers
    - Or buy new servers w/cards
  - Requires server caching SW
  - Consumes server resources
    - That could be used on apps

- Not so good with NAS
  - Increases NAS utilization
Flash Cache Appliances

- As previously discussed
  - Logically sits between
    - Servers/clients
    - And storage system
  - Available from:
    - Alacritech (NFS/CIFS)
    - Astute (iSCSI)
    - TMS (FC, FCoE, iSCSI)
    - Violin (PCIe)
Flash Cache Appliances

**Pros**
- File or NAS best approach
  - Simplest
  - Implement, operate, manage
  - Most transparent
  - Lowest cost
  - And low TCO
- Shareable for multiple
  - Apps/servers/NAS systems

**Cons**
- Limited capacities
  - Typically less than 10TB
- SAN versions not so simple
  - Requires a lot of SAN knowledge
Cloud Storage

- As previously discussed
  - Additive technology
  - Public/private/hybrid
    - Public provides near infinite capacity
  - Easy to add
    - Direct REST or SOAP
    - HW or SW gateways
      - NFS, CIFS, iSCSI
  - Available from dozens of suppliers
    - See chart in hybrid cloud presentation
Cloud Storage

Pros

- Infinite capacities
- Very low cost
  - Pay-by-the-drink
  - No unutilized storage
  - No underutilized storage
  - No upfront costs
- Very high data resilience
  - Eliminates tech refresh issues
  - Excellent for BU and/or archive
- Ideal for geo-distributed
  - Collaboration

Cons

- Performance
  - Not a primary storage system
- Gateways add complexity
  - Data must be migrated to them 1st
  - Usually add cost as well
File Virtualization

- Global namespace
  - Combines multi-NAS into 1 namespace
  - Allows repurposing of older NAS
    - And filers
  - No rip-out-&-replace
  - Available from
    - Avere
    - F5
File Virtualization

Pros

● No NAS/Filer rip-out-&-replace

● Relatively low cost
  - Repurposes older NAS
  - Commoditizes NAS/filer systems

● Allows near linear scaling
  - Up to max systems supported

● Can add other capacity/perf.
  - Capabilities such as
    ● Thin provisioning
    ● Auto tiering
    ● Deduplication

Cons

● Performance
  - GNS adds latency
  - As well as mgmt complexity

● Will cause vendor finger pointing

● May invalidate system warranty
  - Irritates NAS vendors

● Tends be a stopgap measure
Block Storage Virtualization

- A.K.A. SAN storage virtualization
  - Combines multi-arrays into 1 storage pool
  - Allows repurposing of older SAN storage
  - No rip-out-&-replace
  - Available from:
    - DataCore Software
    - Dot Hill
    - HDS
    - NetApp
    - Nexenta
    - TwinStrata
Block Storage Virtualization

**Pros**
- Repurposes SAN storage
  - Pools storage
  - Limits rip-out & replace
- Allows near linear scaling
  - Up to max systems supported
- Can add other capacity/perf.
  - Capabilities such as
    - Thin provisioning
    - Auto tiering
    - Deduplication

**Cons**
- Performance
  - Adds latency
  - As well as mgmt complexity
- Will cause vendor finger pointing
- May invalidate system warranty
  - Irritates storage vendors
- Tends be a stopgap measure
Increasing Usable Capacity & Performance with Addition by Way of Subtraction

- Automated file optimization
- Lossy data reduction
- Real-time data compression Appliance
Automated File Optimization

- Policy driven file mgmt w/o rip-out & replace
  - Finds all in-use, stale, & duplicate files + owners
    ● Cleans up NAS & filers
    ● Allows admin or user driven deletion or movement
  - Auto moves data
    ● From expensive storage to inexpensive storage
    ● From old to new simplifying data migration
  - Enables prevention of unwanted files (MPEGs, JPEGs, etc.)
  - Provides history, trending, & control
  - Some can handle billions of files w/o scanning
- Available from:
  ● Northern
  ● NTP
  ● Symantec
Automated File Optimization Examples

![Bar Chart]

- Current State
- Excluding Files Not Changed in Past Six Months
Automated File Optimization Examples

- **Local System Name:** CLTESTBOX
- **Local OS:** Microsoft Windows 2003 Enterprise Server
- **File System:** NTFS

**General Information**
- **Drive Capacity:** 19.99 GB
- **Free Space:** 2.47 GB
- **Percent Space Used:** 87.66%

**Current Path Statistics**
- **Sub-Folders:** 6,015
- **Files:** 38,250
- **Logical Space Used:** 17.78 GB
- **Percent Space Used:** 88.94%

**Current Report Statistics**
- **Duplicate Files:** 25
- **Logical Space Used:** 393.56 MB
- **Percent Space Used:** 1.92%
Automated File Optimization Examples

96% of files have not been ACCESSED in over 6 months
Automated File Optimization Examples
Automated File Optimization

**Pros**
- SW reclaims lots of NAS storage
- Pays for itself < 1 yr
- Easy to use
- Works with all file storage
- Insight
- Control
- Growth predictability
- Better data protection
- Easier file storage mgmt
- Much lower cost

**Cons**
- Add-on management product
  - Separate console
- Some vendors don’t scale well
  - Must scan the file systems
  - Can be onerous with large file #s
Lossy Data Reduction

- As previously discussed: Reads & decompresses
  - MS Office, JPEGs, PNGs, PDFs
  - Removes superfluous unnecessary baggage
  - E.G. junk data, or excessive resolution without
    - Reducing visual content integrity
    - Breaking files
    - Removing content
  - Re-compresses them in their native format
  - Works with dedupe & compression
  - Available from: Balesio & Neuxpower
Lossy Data Reduction

**Pros**
- Dramatically reduces file bloat
  - Especially MS files
- Low licensing costs
- No reader SW required
  - Readable in native format
- Doesn’t preclude use of:
  - Dedupe or compression

**Cons**
- Post processing only
  - After hours
- Limited file format support
- Can occasionally corrupt a file
- Only 2 vendors
Realtime Data Compression Appliance

- Works only with NAS or file storage
  - Sits in front
  - Reduces file storage up to 80%
  - No noticeable latency
  - Works with dedupe
  - Available only from
    - IBM – Realtime compression for NAS
Realtime Compression Appliance

**Pros**
- Great for NAS/file storage
  - Operates at line speed
    - Nominal hit to response time
    - Reads or writes
  - Works with all NAS/file storage
  - Greatly expands usable capacity
  - Cost justifiable

**Cons**
- Only offered by IBM
  - And their channel partners
- A bit pricey
  - May need more than one
    - Depending on system #s
Conclusions – Recommendations

- Many great new technologies now available
  - Aimed at increasing usable capacity
  - And/or increasing performance
  - Most require you “rip-out & replace”
  - You don’t necessarily have to do that
  - To get some or most of the benefits
  - There are choices
  - Use the ones that fit best in your ecosystem
  - Remember, you can use more than one!
Now You Know Where the Rocks Are…
Questions? Thank You!

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