Deduplication in a Storage System

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May, 2008
Introduction

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Yes, I am a Jayhawk!!
Key Take-Away

• Deduplication is a very important technology
  – Large amounts of digital data being created
  – Green play

• Data integrity is of great concern
  – Can’t lose or corrupt data
  – Chunk size to signature?

• High level of processing power is needed

• Questions persist
• Last year digital cameras and camera phones in world surpassed 1 billion
• Digital TVs should surpass 500 million by 2011

Regulatory requirements are increasing information retention

LSI Definition of Deduplication

• By any name, Deduplication, data reduction, capacity optimization, factoring, . . .

• Defined by LSI as any way to save space/reduce bytes, most commonly disk space

• Most typically used and first implemented in the backup, archive and VTL industries

• Technologies
  – Compression
  – SIS
  – Byte-Level Delta compare
  – Hash
  – Proprietary algorithms
Where to De-dupe?
File System Level

• Client
  – Typically for bandwidth reduction
  – Within a file
  – May have a negative affect on client performance
  – Only affects data on this client

• Server/Appliance
  – Well known

  – Slide set example
  – Search example
Block Level

• Storage System
  – Can be applied across entire incoming data set, but may make you an island

  – Functionality
    • Chunking the data stream
      – Chunk size
      – Fixed or variable length
    • Finding candidates/hits
      – Hash
      – Fingerprinting
    • Byte compare
      – Guarantee data integrity
    • Table lookups
      – Drive access

• Deduplicating across Storage Systems may be key to future products
• Performance balance and Scaling high on the “important” list
File & Block

• File level has value

• Block level has value

• We believe Block Deduplication has value even when File Deduplication is used
In-line vs Post-Processing

• In-line is familiar for storage industry
• In-line should maintain balance
  – Front side, 10 to 40 Gbs
  – Memory, <10 to 30 GBs
  – Numbers of drives
• Uses a lot of processing power, performance is an issue

• Post processing uses more disk space
• However it’s really like a staging area, it could get reused

• Bottom line is it really depends on your goal

• Hybrid may be best!!
## Comparison

<table>
<thead>
<tr>
<th></th>
<th>In-line</th>
<th>Post Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td><img src="#" alt="Green" /></td>
<td><img src="#" alt="Red" /></td>
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<tr>
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<tr>
<td>Memory space</td>
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<tr>
<td>Processing overhead</td>
<td><img src="#" alt="Red" /></td>
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<tr>
<td>Bandwidth reduction</td>
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<td>Assist conducive</td>
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<td>Replication conducive</td>
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</tbody>
</table>
Hash for Deduplication

• What hash to use?
  – MD5
  – SHA-1
  – SHA-2

• Do we care if they are secure? Do we care if someone can create a collision on purpose?

• Do we care if small changes to the data produce similar signatures?

• If not maybe smallest and fastest is best.

• Collisions must be handled!
Data Integrity

• Customers will not accept data loss

• No matter what the % of chance, if the window is not closed it is not closed

• The byte compare is very costly for performance

• We’ve heard arguments
  – Not a practical concern
  – Other parts of the system will fail first
  – 1 in $10^{38}$ chance of getting a collision

• If there is a chance for error do you want your bank account data to be de-duped??

• Possible good research area.
Resources Needed

• We know most solutions are using multiple dual and quad core processors with large amounts of memory, 4-16 GB

• How much power is needed?
  – Typically using multiple dual cores for <30 drives
  – Multiple quad cores will support more drives

• Multiprocessor Affect
  – Can this resolve the processing power issue?

• Must maintain balance between performance and capacity

• Use of SSD’s for metadata may help
More areas

• Primary Storage
  – From SNW 2008, secondary storage costs 5-10 times more than primary
  – Value proposition for use in primary storage may be changing
  – Most if not all Deduplication use today is in secondary storage
  – Performance issues abound
  – How do we maintain performance balance?

• Hardware Assist
  – Chunking the data stream
  – Hash
  – Table lookup
Green Aspects

• Direct relation to disk use

• Processing power reduction or increase?

• Typical savings in the range from 10:1 to 25:1

• Using easy calculations if each drive uses 15 watts a 20:1 ratio saves you 285 watts, plus cooling
  – Assuming of course you have them powered down or don’t buy

• Is this Greenwashing?
Addressable Market Segments

• Source based Deduplication used at the lower end of the market
  – Remote office environments

• The middle of the market has NAS based implementations
  – Easy to use and Ethernet based

• VTL approaches in the enterprise
  – Typically utilize FC
  – But tape still in use, Salt Mine issues

• De-dupe mostly being used for small to medium data sets. Due to speed and power issues.
Concluding

• Digital content is exploding
• YouTube 250 million unique visitors on a monthly basis
• 5 million surveillance cameras in use across Britain
  – Deduplication is a very important technology for storage

• Customers will not accept data loss
  – Data integrity is of great concern

• These functions are compute and disk intensive
  – High level of processing power is needed
Thank You