Advanced Data Reduction Concepts

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About the SNIA DPCO Committee

- This tutorial has been developed, reviewed and approved by members of the Data Protection and Capacity Optimization (DPCO) Committee which any SNIA member can join for free
- The mission of the DPCO is to foster the growth and success of the market for data protection and capacity optimization technologies
  - Online DPCO Knowledge Base: www.snia.org/dpco/knowledge
  - Online Product Selection Guide: http://sniadataprotectionguide.org
- 2013 goals include educating the vendor and user communities, market outreach, and advocacy and support of any technical work associated with data protection and capacity optimization

Check out these SNIA Tutorials online:

- **Understanding Data Deduplication**
- **Deduplication's Role in Disaster Recovery**

Abstract

Since arriving on the scene ~20 years ago, the adoption of data reduction has become widespread throughout the storage and data protection community. This tutorial assumes a basic understanding of data reduction techniques and covers topics that attendees will find helpful in understanding today's expanded use of this technology.

Topics will include:

- Trends in data reduction design and usage
- Practical data reduction of primary storage
- Using data reduction techniques to reduce storage network traffic
- Pervasive data reduction across storage tiers

Terminology from SNIA Dictionary

Capacity Optimization Methods [Storage System]

Methods which reduce the consumption of space required to store a data set, such as compression, data deduplication, thin provisioning, and delta snapshots

Data Deduplication [Storage System]

The replacement of multiple copies of data—at variable levels of granularity—with references to a shared copy in order to save storage space and/or bandwidth.

Compression [General]

The process of encoding data to reduce its size. Lossy compression (i.e., compression using a technique in which a portion of the original information is lost) is acceptable for some forms of data (e.g., digital images) in some applications, but for most IT applications, lossless compression (i.e., compression using a technique that preserves the entire content of the original data, and from which the original data can be reconstructed exactly) is required.

Data Reduction Trends

- The value of data reduction technologies has not changed:
  - Satisfy ROI/TCO requirements
  - Manage data growth
  - Increase efficiency of storage and backup
  - Reduce overall cost of storage
  - Reduce network bandwidth requirements
  - Reduce operational costs including:
    - Infrastructure costs: space, power and cooling
      - Movement toward a greener data center
  - Reduce administrative costs

- Increasing integration with OSes, file systems and applications
  - e.g., Windows Server 2012 ReFS, ZFS, Cloud Gateways

Data Reduction Techniques

- Compression
- Deduplication
  - File level (Single Instance Storage, aka “SIS”)
  - Block level (hash-based or delta block)
  - Content-aware or application-aware
  - In-line vs. post-process vs. hybrid
- Thin Provisioning

Note: Some techniques may be combined

Deduplication and Compression

- Dedupe and compression are similar
  - Both are dependant on data patterns
    - Results can vary from little/no optimization to high percentage
  - Both consume system resources
  - Both can optimize required storage capacity or bandwidth utilization
- Dedupe and compression are different
  - Dedupe and compression can be complementary
  - But some knowledge about the data pattern is helpful
  - Some data is best optimized via dedupe
  - Some data is best optimized via compression
  - Some data can be optimized via dedupe **and** compression
- Sequence of optimization is important when encryption is used
  - Typically dedupe first, then compress, and encrypt last (reverse order at other end)

Data Reduction Scope

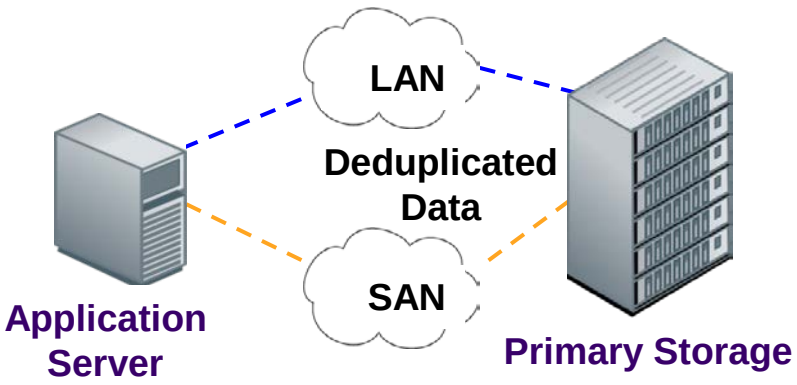
The scope of data reduction is broadening:

- **Primary Storage**
  - Reduced physical capacity for storage of active data
- **Data Protection**
  - Reduced capacity for backup with longer retention periods
- **Replication**
  - Reduced capacity for disaster recovery and business continuity
- **Archivals**
  - Reduced capacity for data retention and preservation
- **Movement / Migration of data, especially to/from Cloud**
  - Reduced bandwidth requirements for data-in-transit

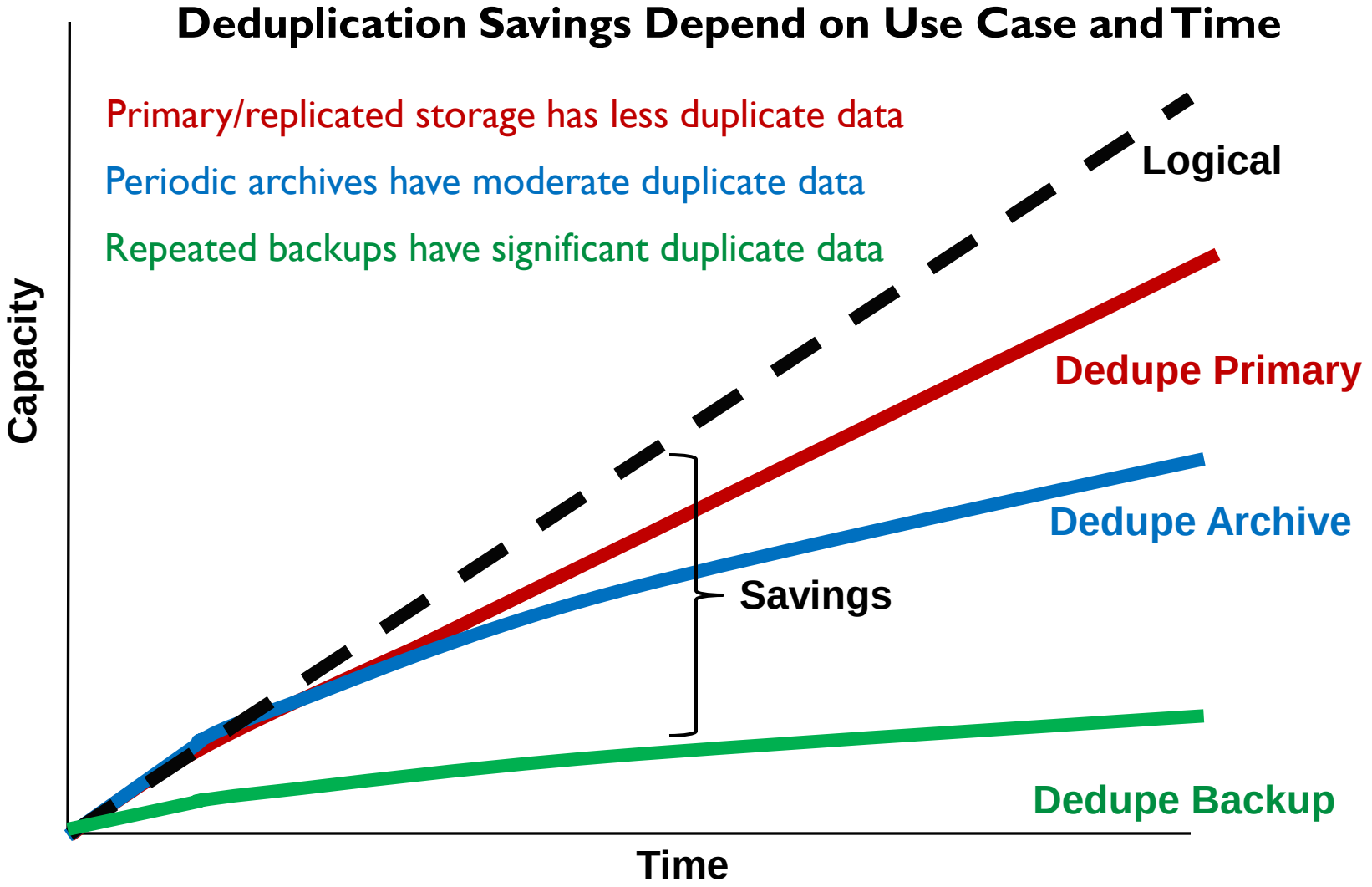
Data Reduction in Primary Storage

Effective for specific workloads:

- Performance/Capacity Tradeoffs: a factor for compression or deduplication
  - In-line ingestion
  - Network-based
  - Post-processing
- Deduplication works best with applications with high data redundancy
  - Virtual servers and desktops
  - Collaborative file “sharing”
  - Email (software SIS replacement)
- Compression varies by data type



Deduplication Savings Expectation



Primary Storage Array Cache/SSD

Array Cache

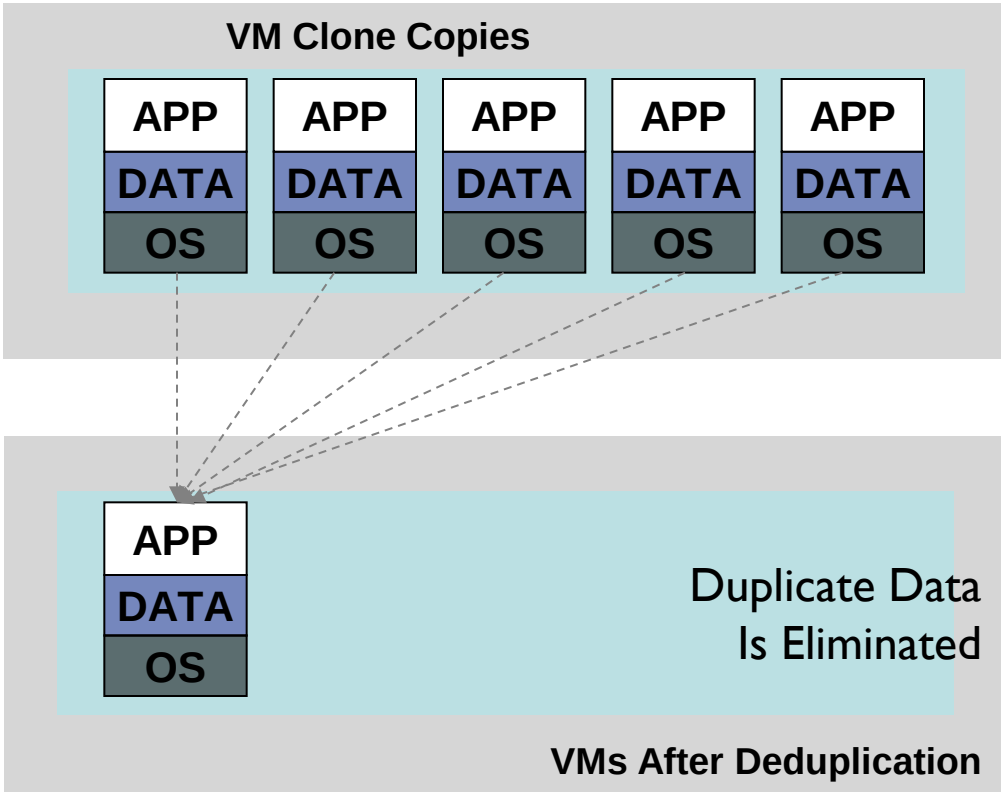
- Intelligent cache can be "dedupe-aware"
- Hot data is cached with dedupe attributes
- Reduces rotating media latencies
- Example: Virtual Desktop "boot storms"

Solid State Drives

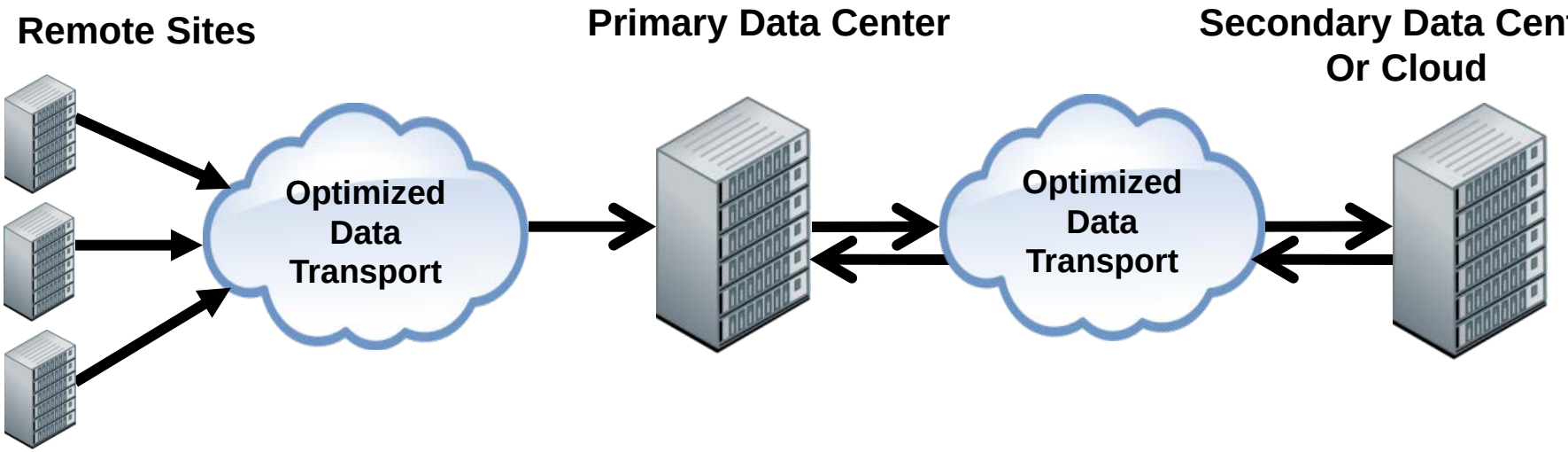
- Deduplication/Compression helps offset the higher cost/GB of SSD's
- High performance applications with highly redundant data

Primary Storage Considerations

- Balance the tradeoff between cost savings and performance impact
- Some workloads lend themselves better to data reduction
  - Storage resource sharing across VMs
- Walk before you run
  - Use estimation tools
  - Perform POCs
  - Implement one workload at a time



Data Reduction and Replication

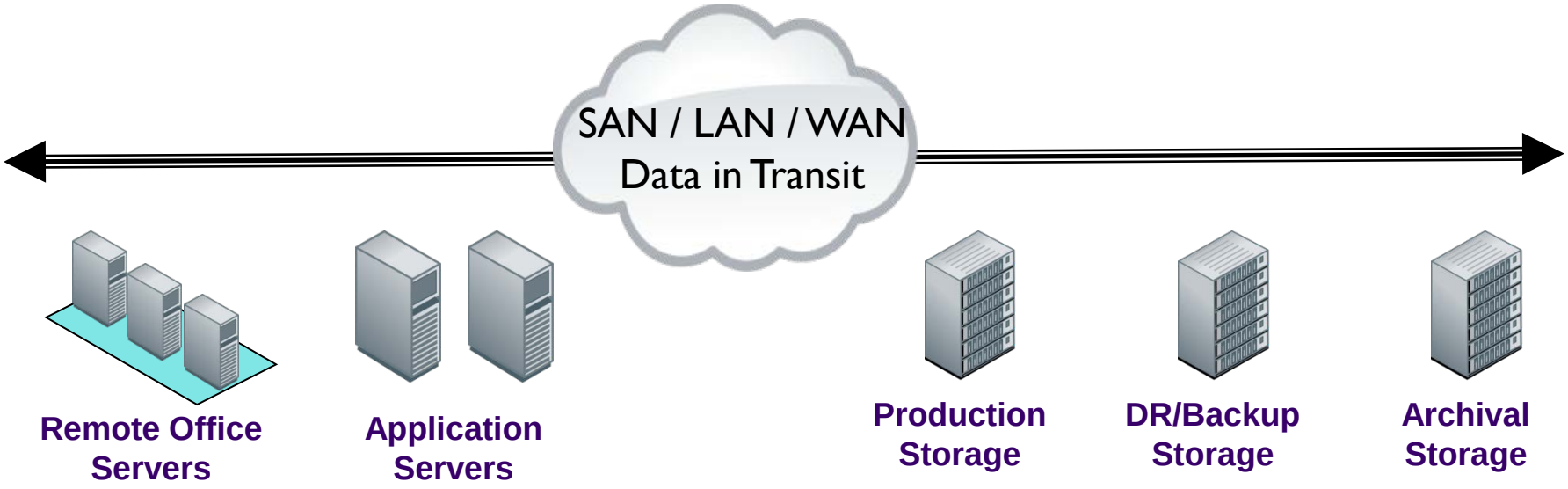


- Can be one-way, bi-directional, multi-hop, or cascade
- Optimized location(s) can be configured based on bandwidth constraints and data volume
- Data reduction makes replication more affordable
- Data reduction enables replication on constrained networks

Replication Considerations

- Focus on your Service Level Agreements (SLAs) first
  - Needs to meet window for *Replication*
  - Needs to meet SLA for System *Recovery or Data Restore*
- Is DR site planned as failover site?
  - If so, need to consider handling of data reduction re-hydration

Data Reduction and Network Traffic



- Consider use of data reduction for any/all network transfers
- Increased SAN / LAN / WAN Efficiency
  - Compression/deduplication for data in flight
  - Transfer data references instead of data objects
  - Shorten data transfer times by sending less data

Deduplication and Backups

The Original Promise: (delivered!)

- Faster data recovery from disk
- Reduction in D2D cost per terabyte stored
- Reduction in D2D backup storage footprint
- Less network bandwidth required for D2D backups
- Makes longer retention possible

What's New?

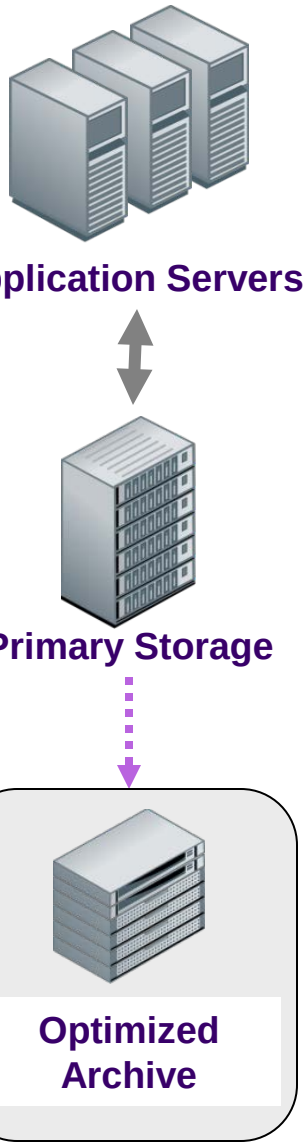
- Wide use as part of backup software
- Scalability of deduplication appliances
- Deduplication across appliances
- Cloud for backup, archive: throughput and metadata considerations
- Deduplication when using tape

Backup Considerations

- Deduplication at appliance or in backup server (software)
- Source or target deduplication?
- Variable or fixed-length deduplication?
- File or sub-file deduplication?
- Compression WITH deduplication?

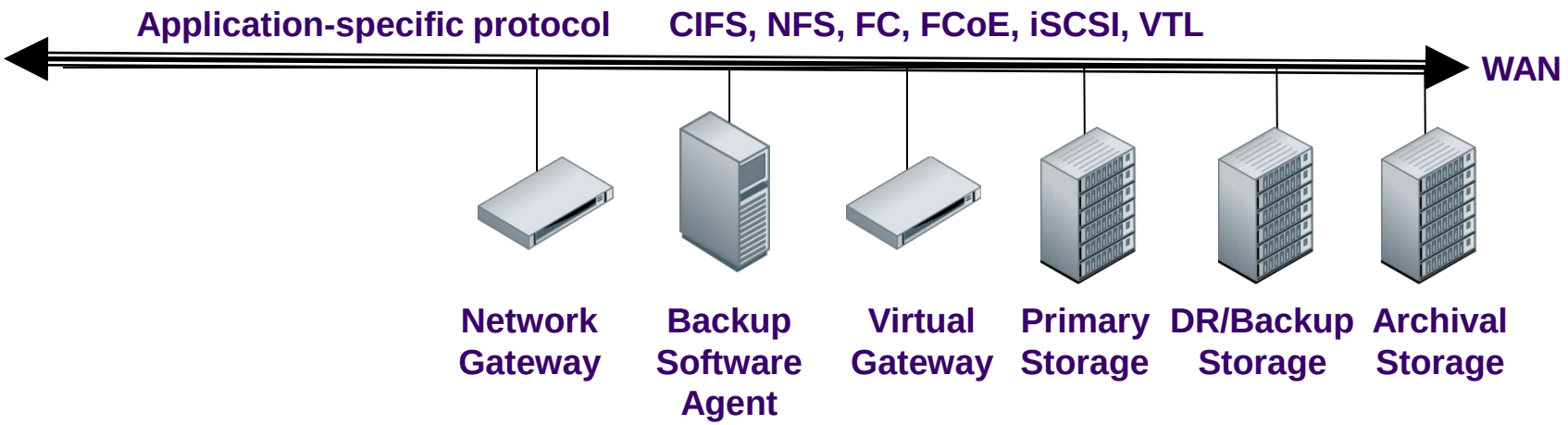
- Answers depend on the problem you are trying to solve

Data Reduction and Archival



- Data reduction can reduce the cost of online archive repositories
- These repositories are often required for regulatory compliance
- No standard exists today for "approved" use of data reduction techniques with regulatory data
- Service provider should provide assurances that the ability to retrieve data in its original form is not impaired

Consideration Matrix for Data Reduction Location



	Network Gateway	Backup Software Agent	Virtual Gateway	Primary Storage	DR/Backup Storage	Archival Storage
Reduce Network Traffic	✖	✖	✖		✖	
Reduce Physical Capacity		✖	✖	✖	✖	✖
Reduce Backup Time		✖	✖			
Reduce Recovery Time		✖			✖	
Reduce Replication Time	✖		✖	✖		
Reduce Media Latency				✖		

Summary

- The primary value of data reduction is in reducing costs and helping manage data growth
- The scope of data reduction is broadening
  - All storage tiers including primary and cloud
  - Various levels of granularity
  - Bandwidth reduction
  - Data subject to regularity rules
- Content-Aware and application-aware data reduction is becoming more prevalent
  - Potential for greater data reduction with more knowledge of specific data structures and data types

Summary – 2

- Is it Necessary to Optimize All Data?
  - Mission-critical applications
  - May have regulatory issues for some data
  - Some data types not conducive to data reduction
  - Replicate incremental changes only, without other optimization
- New use cases and new technologies bring new challenges
  - And new opportunities!

Attribution & Feedback

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