Education

Introduction to Data Protection: Backup to Tape, Disk and Beyond

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Abstract

- Introduction to Data Protection: Backup to Tape, Disk and Beyond
- Extending the enterprise backup paradigm with disk-based technologies allow users to significantly shrink or eliminate the backup time window. This tutorial focuses on various methodologies that can deliver an efficient and cost effective disk-to-disk-to-tape (D2D2T) solution. This includes approaches to storage pooling inside of modern backup applications, using disk and file systems within these pools, as well as how and when to utilize deduplication and virtual tape libraries (VTL) within these infrastructures.

- Learning Objective:
  - Get a basic grounding in backup and restore technology including tape, disk, snapshots, deduplication, virtual tape, and replication technologies.
  - Compare and contrast backup and restore alternatives to achieve data protection and data recovery.
  - Identify and define backup and restore operations and terms.

Backup to Tape, Disk and Beyond

- Fundamental concepts in Data Protection
- Overview of Backup Mechanisms
- Backup Technologies
- Appendix

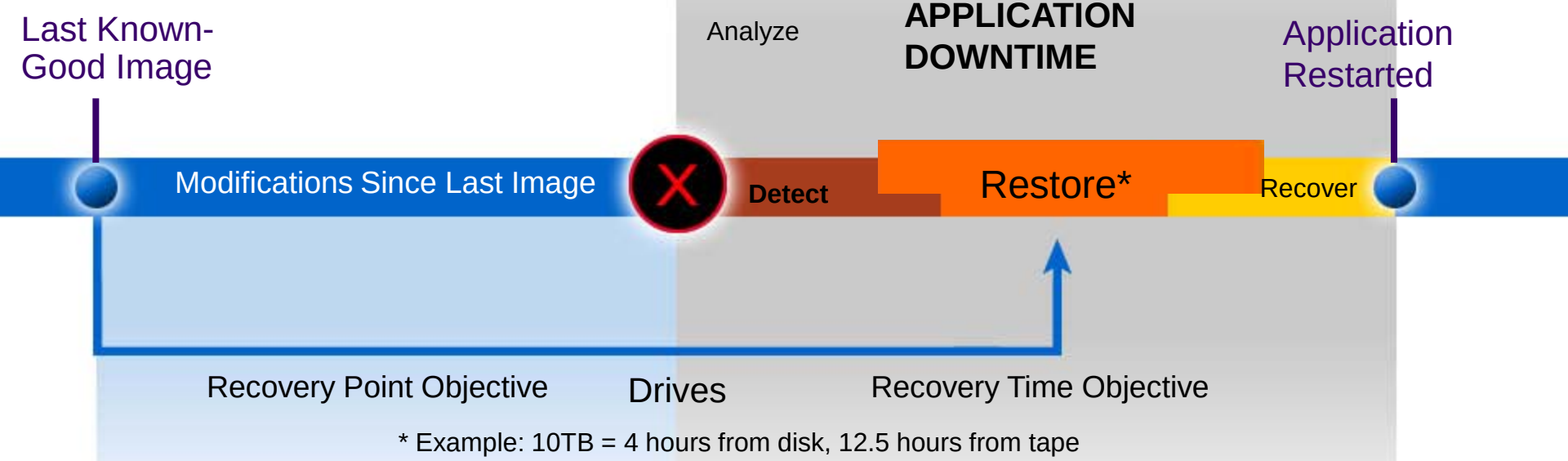
Data Protection

- Data protection is about data availability
- SNIA definition of Data Protection: Assurance that data is not corrupted, is accessible for authorized purposes only, and is in compliance with applicable requirements.
- There are a wide variety of tools available to us to achieve data protection, including backup, restoration, replication and recovery.
- It is critical to stay focused on the actual goal -- availability of the data -- using the right set of tools for the specific job -- within time and $ budgets.
- Held in the balance are concepts like the value of the data (data importance or business criticality), budget, speed, and cost of downtime.

The Process of Recovery

- Detection
  - Corruption or failure reported
- Diagnosis / Decision
  - What went wrong?
  - What recovery point should be used?
  - What method of recovery should be used -- overall strategy for the recovery?
- Restoration
  - Moving the data from backup to primary location
  - From tape to disk, or disk to disk, or cloud to disk; Restore the lost or corrupted information from the backup or archive (source), to the primary or production disks.
- Recovery – Almost done!
  - Application environment - perform standard recovery and startup operations
  - Any additional steps
    - Replay log may be applied to a database
    - Journals may be replayed for a file system
- Test and Verify

Traditional Recovery



* Example: 10TB = 4 hours from disk, 12.5 hours from tape

Protection Based on Recovery

Years Days Hrs Mins Secs

Recovery Point

Secs Mins Hrs Days ????

Recovery Time

Protection Methods

Tape Backups
Vaults
Archival
Capture on Write
Disk Backups
Snapshots
Synthetic Backup
Data Replication
Cloud Backup

Recovery Methods

Instant Recovery
Restore from Tape, Disk, Cloud
Point-in-Time Recovery
Roll Back
Search & Retrieve

Backup Methodologies

- Cold
  - Offline image of all the data
  - As backup window shrinks and data size expands, cold backup becomes untenable.
  - Cheapest and simplest way to backup data
- Application Consistent
  - Application supports ability to take parts of the data set offline during backup
  - Application knows how to recover from a collection of consistent pieces.
  - Avoids downtime due to backup window.
- Crash Consistent or Atomic
  - Data copied or frozen at the exact same moment across the entire dataset.
  - Application recovery from an atomic backup similar to a application failover.
  - No backup window.

Check out SNIA Tutorial:

Trends in Application Recovery

Data Protection Design Trade-offs

- Assessing your priorities
  - Backup Performance
    - Shorter backup window
  - Recovery Time Objective (RTO)
    - Speed of recovery
    - What is the cost of application downtime?
  - Recovery Point Objective (RPO)
    - Amount of data loss
    - How far back in time to recover data?
  - Move data offsite for DR or archive

- There are trade-offs everywhere
  - Newer technology improves but cannot eliminate trade-offs
    - Cost, downtime, business impact,
  - Need to identify the priority order, and establish SLA targets for each data
    - What is the cost of lost application?

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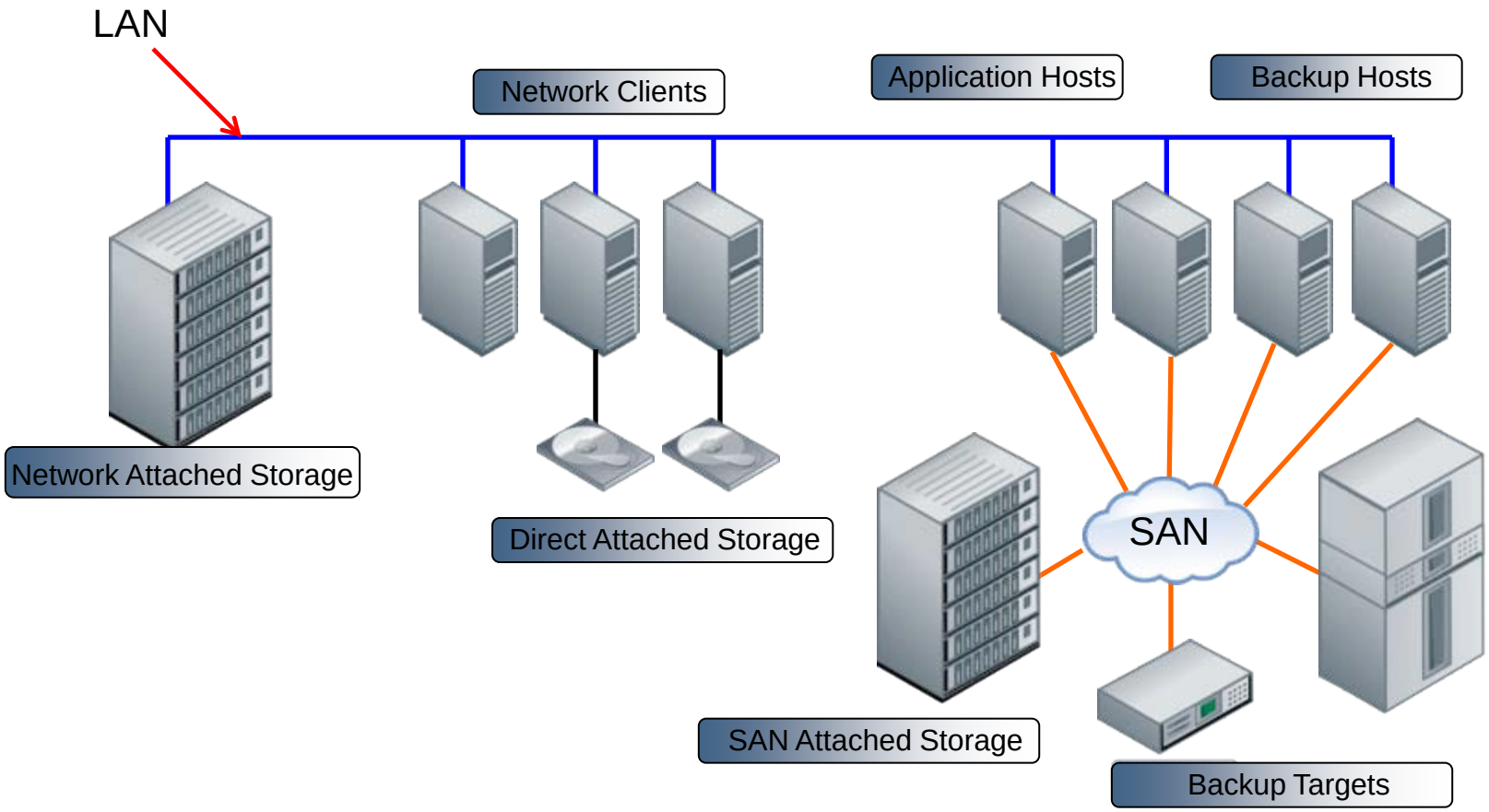
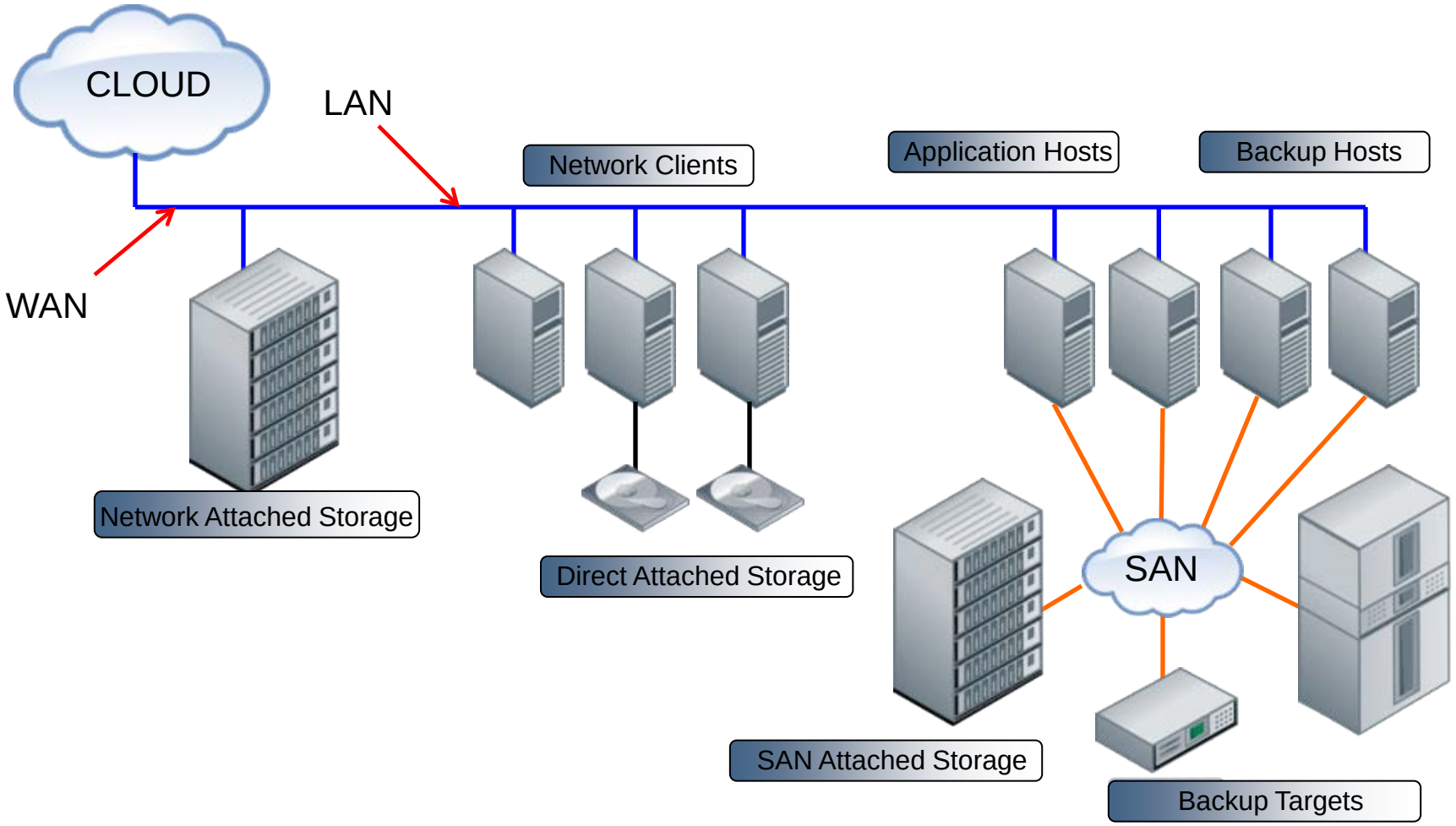
Backup Networking 101



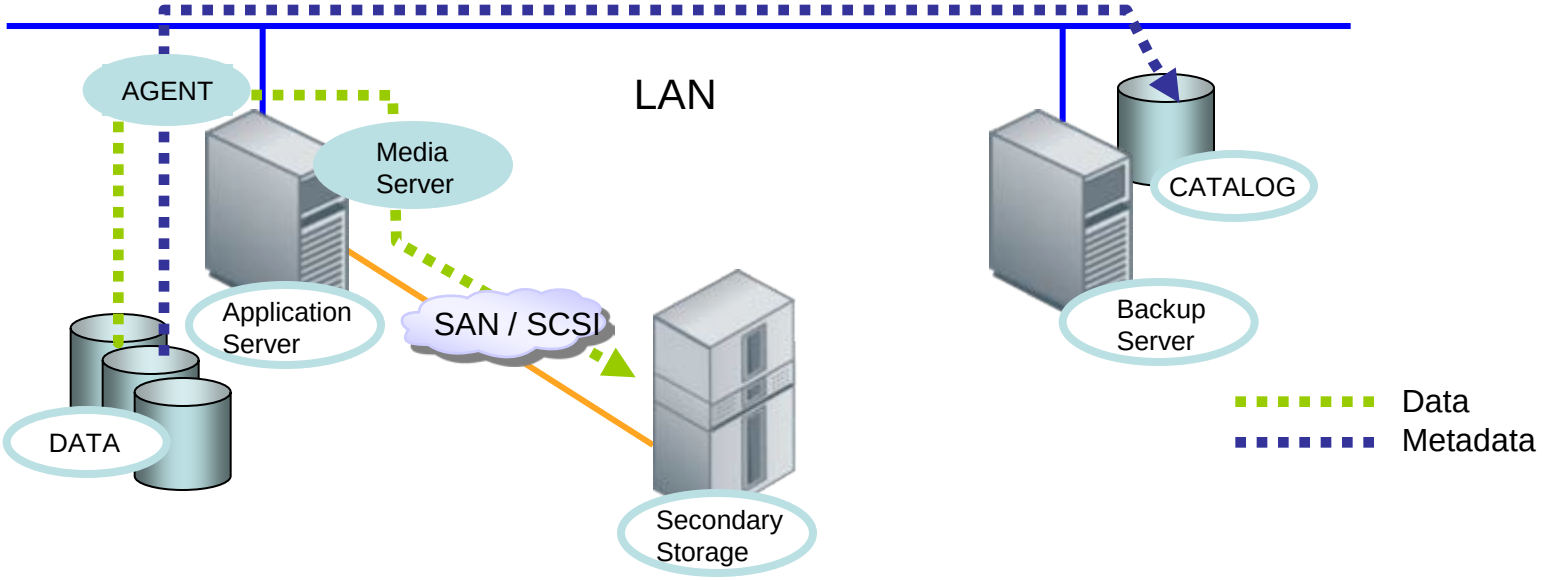
Internet aka Cloud Backup



Backup Topology Components

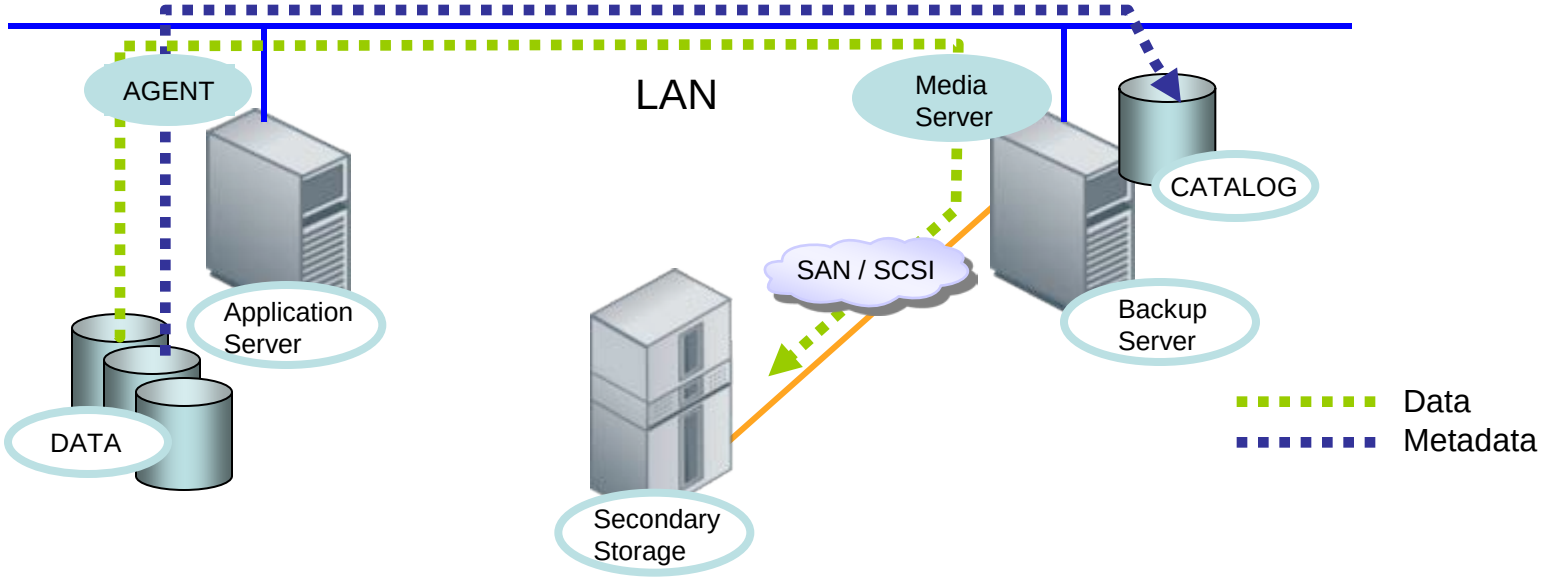
- Backup Server
  - Typically single point of administration
  - Owns the Metadata catalog
    - Must protect the catalog
- Storage Node or Media Server
  - Collects the data from the Agent
  - Read and writes to a secondary storage device
- Agent
  - Manages the collection of the data and Metadata
  - Traditional thin client or modern intelligent client
- Application Server
  - Server that owns (produces) the data
  - Maybe structured or unstructured data
- Secondary Storage
  - Target media (destination) for the backup data

Local Data Mover



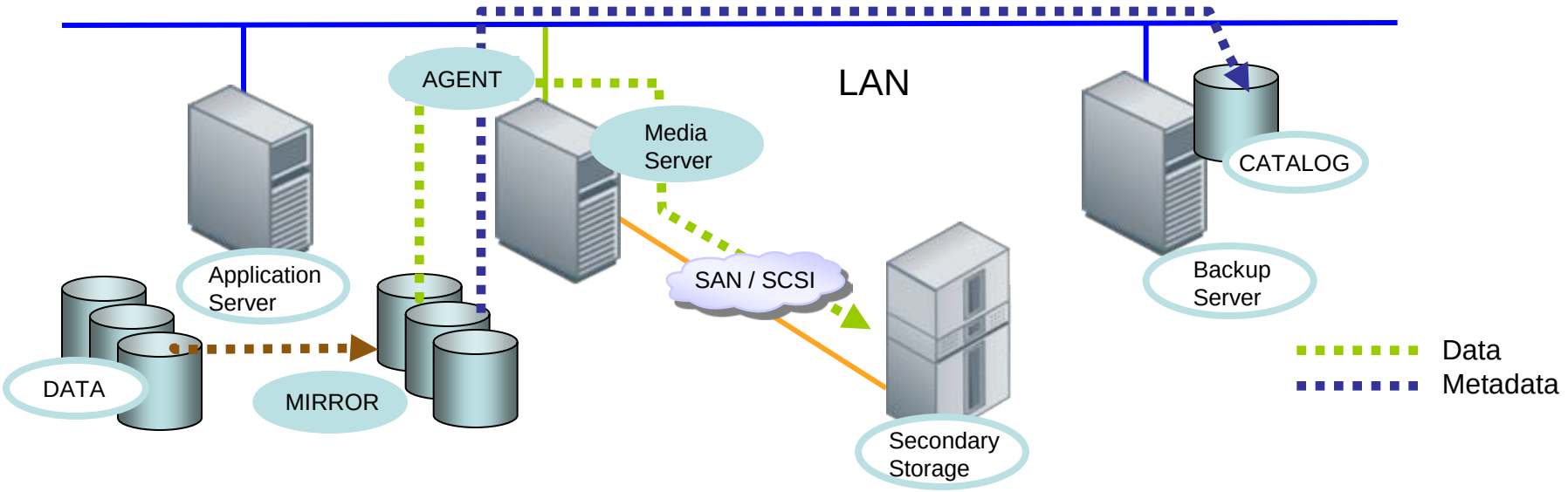
- Sometimes known as LAN-Free backup
- Application server reads and writes the data locally
  - Application server acts as a media server
  - Storage is accessible by the application server
- Minimal LAN impact.
- Significant application server impact.

LAN Backup



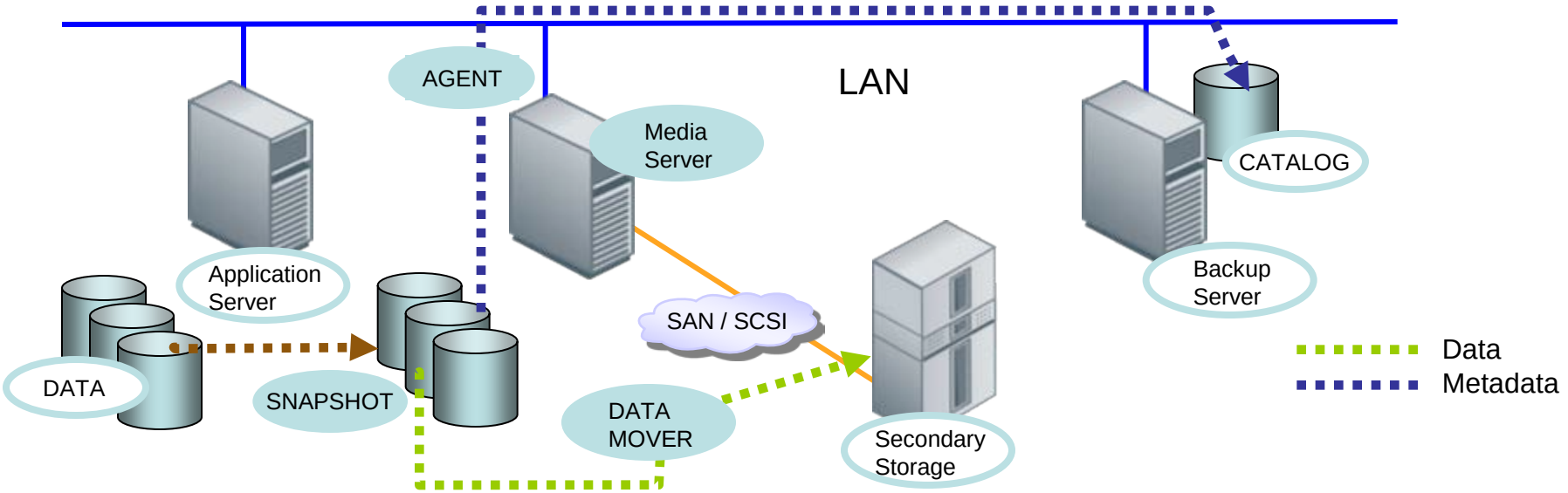
- Backup server receives data and Metadata from application server across the LAN
  - LAN is impacted by both backup and restore requests
  - Application server may be impacted by storage I/O
  - CIFS, NFS, iSCSI, NDMP, or vendor specific

(Application) Server-free Backup



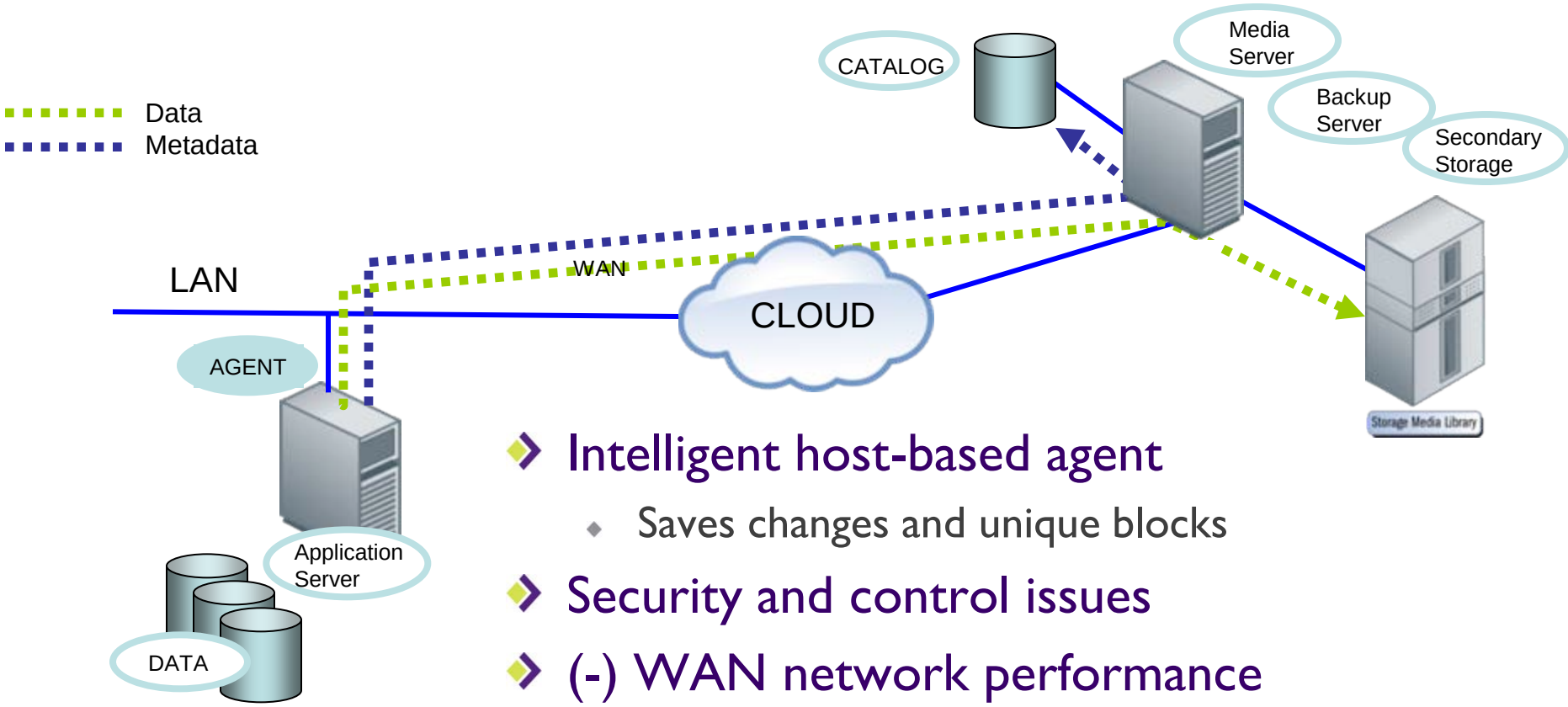
- The application server allocates a snapshot/mirror of the primary storage volume to a media server that delivers the data over the LAN or SAN
  - Media server must understand the volume structure
    - Mirror: Application server impacted when creating the mirror
    - Snapshot: Application server impacted by volume access
  - Metadata over the LAN to the backup server

Server-free (Server-less) Backup



- Backup server delegates the data movement and I/O processing to a "Data-mover" enabled on a device within the environment
  - Network Data Management Protocol (NDMP)
    - NDMP is a general open network protocol for controlling the exchange of data between two parties
  - SCSI Extended Copy (XCOPY or "Third-Party Copy")
    - Metadata still sent to the backup server for catalog updates
    - Much less impact on the LAN

CLOUD Backup



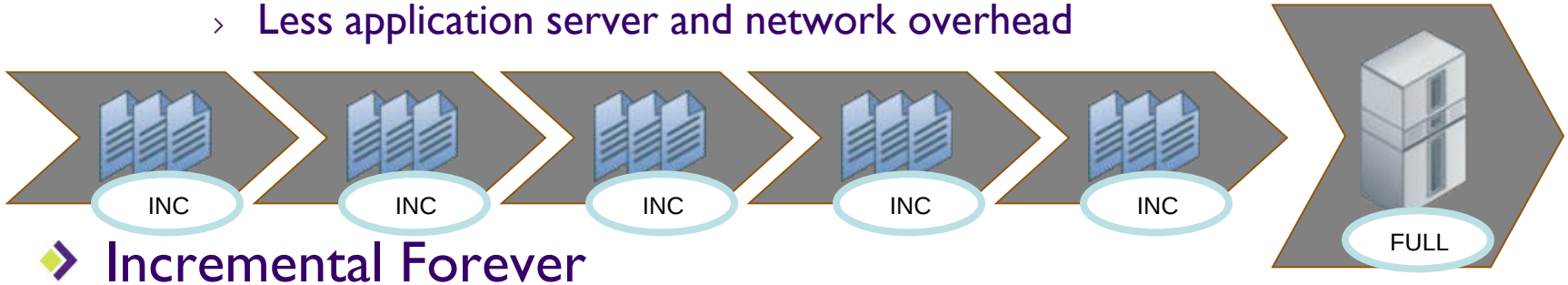
- Intelligent host-based agent
  - Saves changes and unique blocks
- Security and control issues
- (-) WAN network performance
- (+) Low CAPEX
- (+) Off-site protection

Traditional Backup Schedules

- Full Backup
  - Everything copied to backup (cold or hot backup)
    - Full view of the volume at that point in time
  - Restoration straight-forward as all data is available in one backup image
  - Huge resource consumption (server, network, tapes)
- Incremental Backup
  - Only the data that changed since last full or incremental
    - Change in the archive bit
  - Usually requires multiple increments and previous full backup to do full restore
  - Much less data is transferred
- Differential backup
  - All of the data that changed from the last full backup
  - Usually less data is transferred than a full
  - Usually less time to restore full dataset than incremental

Synthetic Backup & Incremental Forever

- Synthetic Full Backups
  - Incremental backups are performed each day
    - Full backups are constructed from incrementals typically weekly or monthly
    - Less application server and network overhead



- Incremental Forever
  - Incremental backups are performed every day
  - Primary backups are often sent to disk-based targets
  - Collections of combined incrementals used for offsite copies
    - Usually consolidate images from clients or application and create tapes

What gets backed up and how

- File-level backups
  - Any change to a file will cause entire file to be backed up
  - Open files often require special handling SW
    - Open files may get passed over – measure the risks
  - PRO: Ease of BU and restore CON: Moves tons of data
- Block-level backups
  - Only the blocks that change in a file are saved
  - Requires client-side processing to discover change blocks
  - PRO: Smaller backups, Less network impact, Faster
  - CON: Client-side impact, increased complexity
- Client-side backups
  - Intelligent agent monitors changes and protects only new blocks
  - Agent enables advanced technology, granular backups and user policies
  - Deduplication can enable network efficiency, reduce BU data volume
  - PRO: Efficiently distributes work CON: Complex client/server

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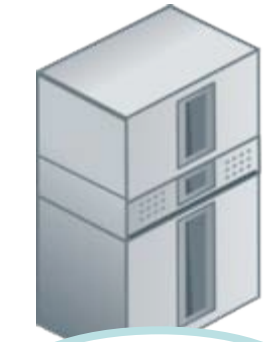
Introduction to Tape

- Sequential access technology
  - Versus random access
- Can be removed and stored on a shelf or offsite
  - Disaster Recovery
  - Encrypted, Archived for compliance?
  - Reduce power consumption
- Media replacement costs
  - Tape life, reusability
- Performance and Utilization
  - Can accept data at very high speeds, if you can push it
  - Streaming and multiplexing
- Typically Managed by backup and recovery software
  - Controls robotics (Inventory)
  - Media management



Tape Library

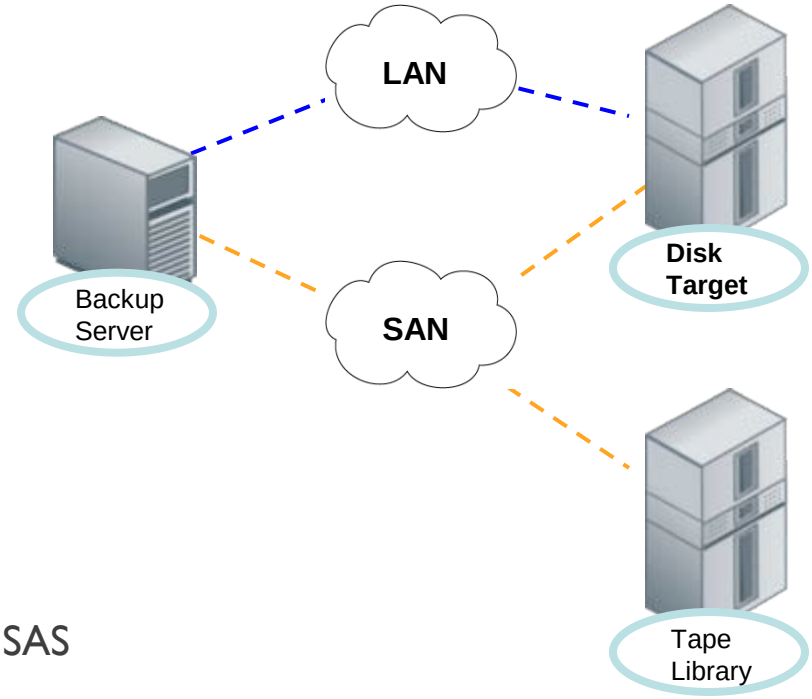
Tape is not Dead!

Tape Based Backup: Considerations

- Tape drives run faster than most backup jobs – Is this good?
  - Matching backup speed is more important than exceeding it
  - Avoid shoe-shining
- Slower hosts can tie up an expensive drive
  - It's a shame to waste a drive on these hosts.
- Slower tapes can tie up expensive (important) servers.
  - It's a shame to let the tape drive throttle backup servers
  - Slow backup can impact production servers as well
- Replacing your tapes may not solve your backup challenges
  - A well designed backup architecture is the best answer
- If backup target speed is your issue:
  - Consider multiplexing – Good for backup, not-so-good for restore
  - Consider alternates such as virtual tape or D2D2T.
- Security, security, security……..

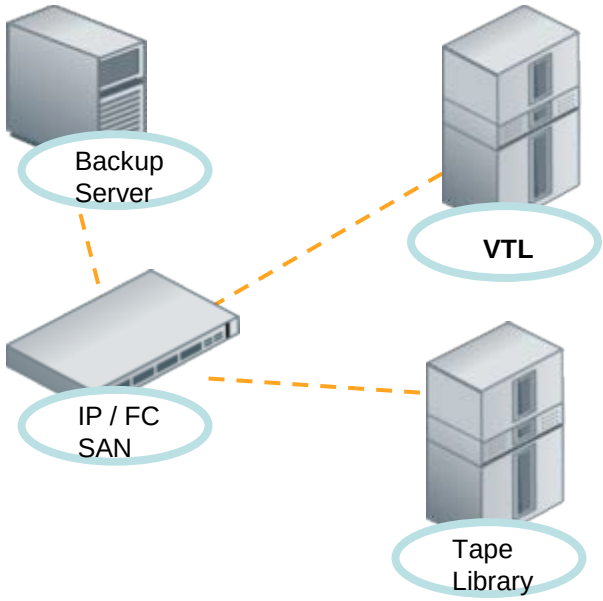
Introduction to B2D/D2D

- What?
  - Backup to Disk / Disk to Disk Backup
  - Disk as a primary backup target
- Why?
  - Performance and reliability
    - Reduced backup window
    - Greatly improved restores
    - RAID protection
    - Eliminate mechanical interfaces
  - Eliminate (tape) multiplexing
  - More effective sharing of backup targets
- Considerations
  - Fibre Channel Disks versus SATA versus SAS
    - I/O random access vs. MB/s sequential
  - SAN, NAS or DAS
  - B2D or VTL
  - Consider a mix of Disk and Tape (D2D2T)



Introduction to VTL

- What:
  - Virtual Tape Libraries emulate traditional tape
  - Fits within existing backup environment
  - Easy to deploy and integrate
  - Reduce / eliminate tape handling

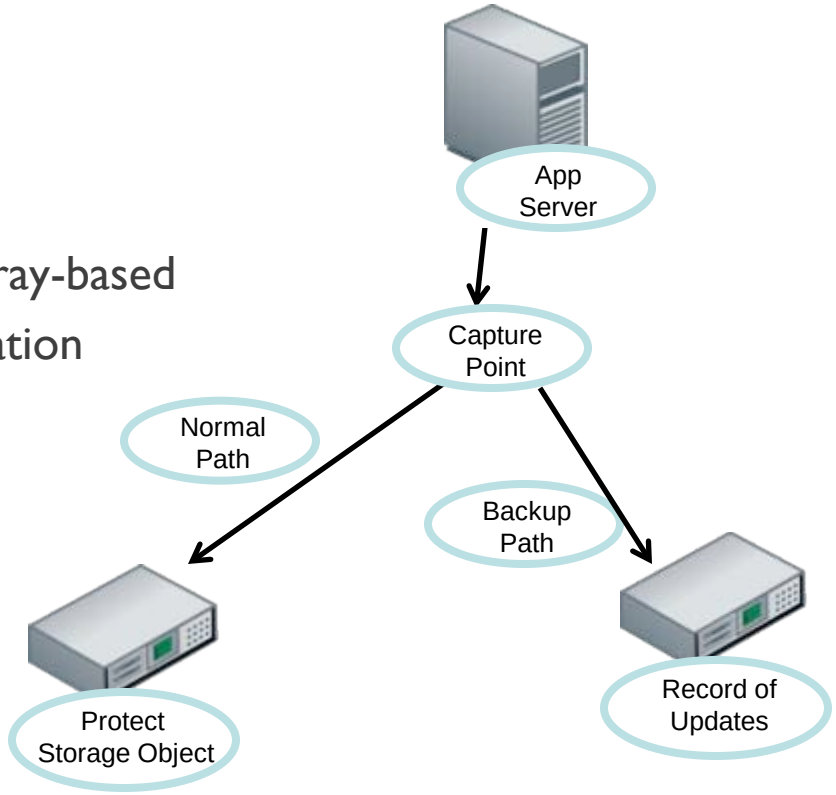


- Why:
  - Improved performance and reliability (see B2D)
  - Reduced complexity versus straight B2D or tape
  - Unlimited tape drives reduce device sharing, improve backup times
  - Enables technologies such as remote replication, deduplication

- Considerations:
  - Easy to manage in traditional backup software environment:
  - Can extend the life of current physical tape investment

Introduction to CDP

- What:
  - Continuous Data Protection
  - Capture every change as it occurs
  - May be host-based, SAN-based, array-based
  - Protected copy in a secondary location
  - Recover to any point in time
- How:
  - Block-based
  - File-based
  - Application-based
- Why:
  - Implementations of true CDP today are delivering zero data loss, zero backup window and simple recovery. CDP customers can protect all data at all times and recover directly to any point in time.
  - Near CDP (Snapshots, checkpoints) may also help but will not catch every change



Introduction to Snapshots

- What?
  - A disk based "instant copy" that captures the original data at a specific point in time. Snapshots can be read-only or read-write.
  - Also known as Checkpoint, Point-in-Time, Stable Image, Clone
  - Usually handled at the storage level
- Why?
  - Allows for complete backup or restore
    - With application downtime measured in minutes (or less)
  - Maybe able to be combined with replication
  - Most vendors: Image only = (entire Volume)
  - Backup/Restore of individual files is possible
    - If conventional backup is done from snapshot
    - Or, if file-map is stored with Image backup

Introduction to Data Deduplication

- What?
  - The process of examining a data-set or I/O stream at the sub-file level and storing and/or sending only unique data
  - Cleint-side SW, Target-side HW or SW, can be both client and target
- Why?
  - Reduction in cost per terabyte stored
  - Significant reduction in storage footprint
  - Less network bandwidth required

Check out SNIA Tutorial:

Advanced Deduplication Concepts

- Considerations
  - Greater amount of data stored in less physical space
  - Suitable for backup, archive and (maybe) primary storage
  - Enables lower cost replication for offsite copies
  - Store more data for longer periods
  - Beware 1000:1 dedupe claims – Know your data and use case
  - Multiple performance trade-offs

Next Steps in Data Protection

- Choose the appropriate level of protection
  - Assess risk versus cost versus complexity
  - Include your "customers" in your decisions
- Match RPO, RTO goals with technology
  - Consider resources required to support your decisions
  - Consider centralized versus distributed solutions
- Performance is ALWAYS a consideration
  - Assess your system today for strengths and weaknesses
  - A new box or new SW may NOT be the answer
- When in doubt, call in the experts

Where to Get More Information

- Related tutorials
  - Active Archive – Data Protection for the Data Center
  - Advanced Deduplication Concepts
  - Trends in Data Protection and Restoration Technologies
  - Understanding Data Deduplication
  - Retaining Information for 100 Years
- Visit the Data Protection and Capacity Optimization Committee website http://www.snia.org/dpco/
- DPCO online Product Selection Guide – *Coming Soon*

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Many thanks to the following individuals for their contributions to this tutorial.

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