# Trends in Data Protection and Restoration Technologies

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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
- 2016 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 at:** www.snia.org/education/tutorials

- **Intro to Data Protection: Backup to Tape, Disk & Beyond**
- **Advanced Data Reduction Concepts**
- **Data Protection in the Big Data World**
- **Data Protection vs Privacy: How EU legislation is changing**
- **Intro to Encryption**

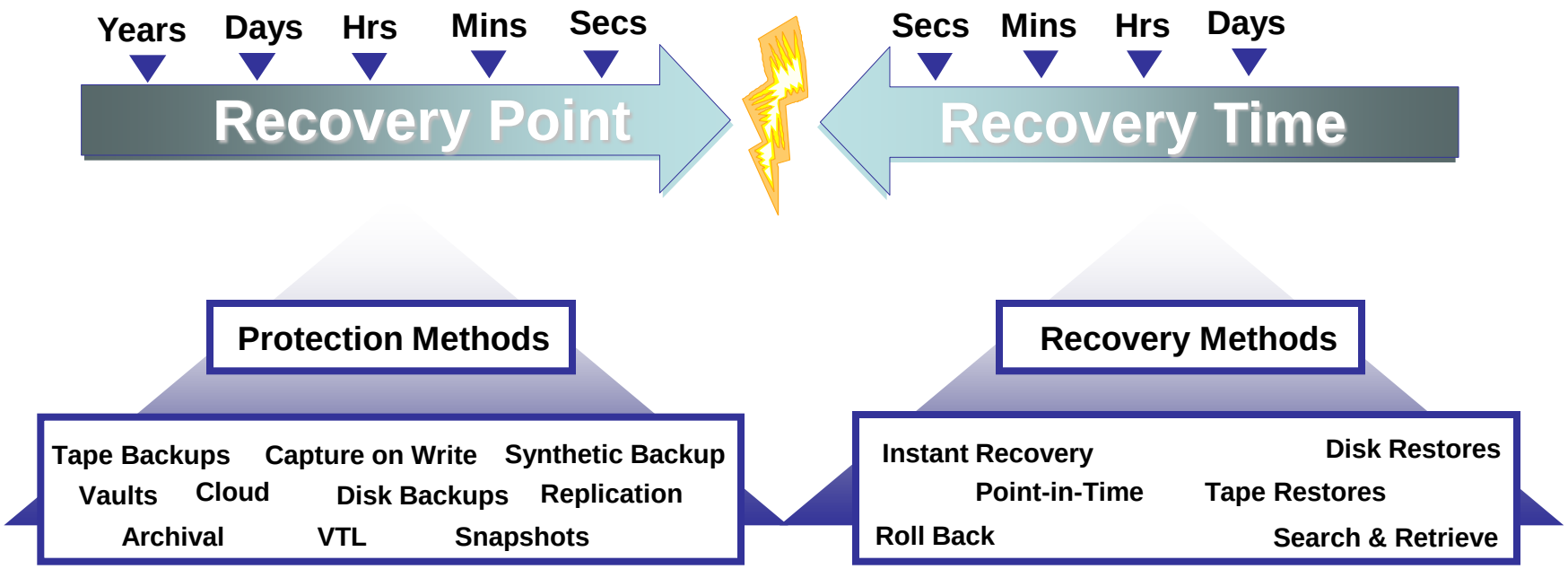
# Abstract

- Many disk technologies, both old and new, are being used to augment tried and true backup and data protection methodologies to deliver better information and application restoration performance; These technologies work in parallel with the existing backup paradigm

- This session will discuss many of these technologies in detail; Important considerations of data protection include performance, scale, regulatory compliance, recovery objectives and cost; Technologies include contemporary backup, disk based backups, snapshots, continuous data protection and capacity optimized storage, as well as cloud services.

- This tutorial will cover how these technologies interoperate, as well as best practices recommendations for deployment in today's heterogeneous data centers & you will:
  - Understand legacy & newer storage technologies that provide advanced data protection
  - Compare and contrast advanced data protection alternatives
  - Gain insights into emerging data protection technologies

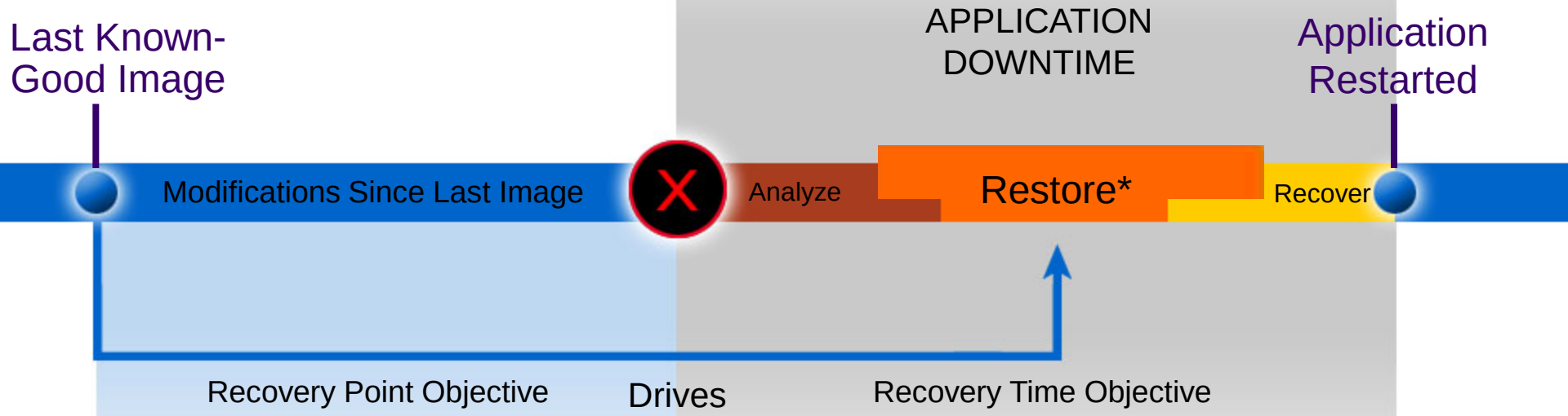
# Data Protection Based on Recovery




## Enabling Technologies

| | | | | | |
|---|---|---|---|---|---|
| Tape & Automation | Cloud | Deduplication | Replication | Snapshots | Backup to Disk |

# Application Recovery




*10TB restore from backup ~= 4 hours from disk, 12.5 hours from tape

Recovery from snapshots reduces "restore" but older point in time snap causes increase in recovery time

# Application Consistency

- What?
  - When an application is running during the "copy" process
  - Various techniques are available to ensure data consistency
- Why?
  - Much like the "open files" issue when backing up a file system that is in use, applications (like databases, messaging systems, etc) allow for different approaches to capturing a holistic picture of the applications data during a copy process, such as a snapshot, a split-mirror, or continuous data protection (CDP)
- Considerations
  - It is important to understand the consistency semantics of your application so that your data protection copies are recoverable

# Consistency – Offline/Cold Backup

- Shutdown the application / database
  - Guarantees  application consistency
  - All cache data copied to disk; all transactions closed
  - Optional: database consistency check
- Backup to another disk / tape
  - OR create a snapshot
- Optional: move / delete the transaction logs
  - Frees up disk space
  - Enables incremental backup based on transaction logs
- Start the application
- Optional: backup the snapshot to another device or location
- Recycle the snapshot
  - Keep the last # snapshots (snapshot rotation)

# Crash Consistent

- Create a snapshot while the application runs
  - Restore quality of application consistency after a system crash
  - Most applications / databases can survive system crashes
    - But some don't and some not always
  - Recovery cannot be guaranteed
  - Note: Some applications may force a database consistency check
- Use cases
  - 7 x 24 operations -> no backup window
  - Virtual Machine backup without agent or service API
  - Application lacks online backup mode feature
  - No resources for transaction logging during backup
  - Snapshots enable more points in time
  - Combine with consistent backups

# Consistency - Online

- Database(s) are in “backup mode“ during backup
  - Data files don‘t change while in backup mode
  - Changes during backup happen in the cache and go into logs
  - After backup all changes are applied to the data files
  - Optional: backup of the transaction logs & delete logs afterwards
  - Optional: ongoing log file backup after database backup -> CDP
- Consistent search index
  - All databases need to go into the backup mode
  - Must ensure consistency across all nodes
- Use cases
  - 7 x 24 operations -> no backup window
  - Guaranteed & fully supported consistent recovery

# Data Protection & Data Management

## Data Management

- Information classification
- Information valuation ($$$)
- Information lifecycle management
- Data indexing

## Tiered Storage

- Primary
- Secondary
- Archive
- Backup
- Cloud

## Data Protection

- Disk-Assisted and Disk-based protection methods
- Array and storage network based data protection
- Object based Archival
- Snapshots and replication
- Tape based data protection
- Backup to Virtual Tape
- Backup to Disk
- Backup of Virtual Machines

# SLAs: 85/95/5 Retention & Recovery Model

- 85% of restores are local
  - These are the faster restores
    - Leverage snapshots where available
    - End user restores, project restores
  - Single file, email, table space, complete database leveraging logs
- Up to 95% from D2D
  - Usually D2D with Replication
  - Can be onsite or offsite depending on RPO/RTO requirements
- Everything else or 5% from Tape and/or Cloud
  - Example: eDiscovery, system recovery
  - In most cases restores to different/new set of disks
- Tape is leveraged for long term and infinite retention
  - Best practice to keep offsite or third location

# Backup of Virtual Machines

- What?
  - Backup virtual machines and hypervisors
  - Avoid resource contention (i.e., Impact of backing up 20 VMs)
  - Address backup storage growth
  - Consider your recovery goals and objectives
- Why?
  - Deliver granularity of “client” backup and restore
  - Improve operations by reducing backup and restore times
  - Eliminate redundant data
  - Reduce complexity
- Considerations
  - VM Clones are not “backups”
  - Native backup tools
  - Integration with hypervisor
  - Capacity, performance, scale

# Virtual Machine Backups: Best Practices

- Consider hypervisor-based backup tools for “simple” environments
  - Available from backup and storage vendors
  - Larger configurations may require more advanced tools
- Consider snapshots, clones and copies
- Isolate data files that don’t need backups
  - Temporary and/or transient data
  - Focus on Users and Applications
- Insist on integration with hypervisor tools and APIs
- Backup the hypervisor AND THEN back up the virtual hosts

# Snapshots

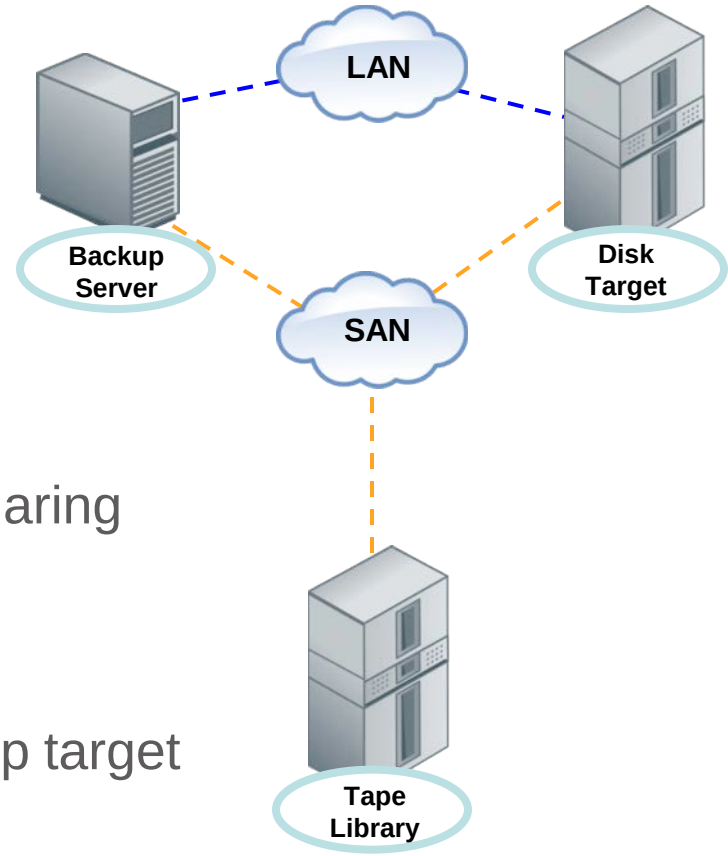
- What?
  - A disk or VM based “instant copy” captures the original data at a specific point in time; Snapshots can be read-only or read-write
  - Also known as Checkpoint, Point-in-Time, Stable Image, Clone
  - Any technology that presents a consistent point-in-time view
- Why?
  - Allows for complete backup or restore
    - With application downtime measured in minutes (or less)
  - 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

# Snapshot Considerations

- Snaps of production storage or VM may impact production
  - Consider performance, storage, virtual-machine impacts
- Retention policy impact
  - Number of copies retained
  - Recovery granularity
  - Meeting off-site protection via distance replication
- On-array, off-array, VM-based alternatives
- Cost trade-offs and information classification
- May combine snapshots with replication

# Backup to Disk (B2D)

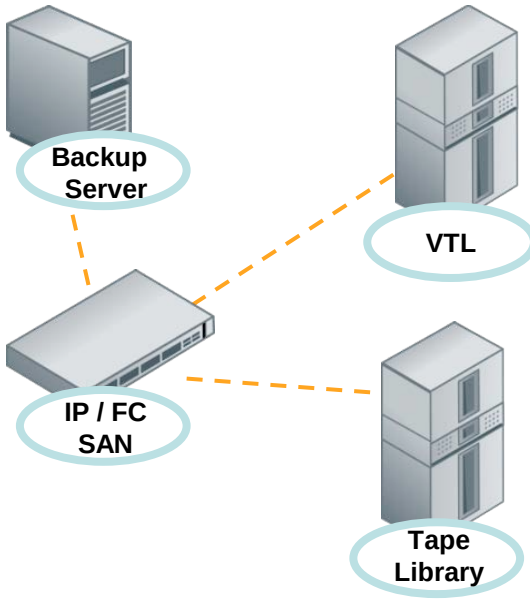
- What
  - Replace tape targets with disks
  - Perform snapshot-based backups
  - Recover from data on-line versus on-truck
- Why?
  - Leverage disk reliability and performance
  - Simplify backup process, reduce device sharing
  - Improved security
- What to watch out for
  - Bottlenecks, which may NOT be the backup target
  - Potential for added complexity and training
  - Advanced features may increase SW costs
  - Backup window issues may still exist
  - Meeting offsite or off-line backup requirements



# Virtual Tape Library (VTL)

## What?

- Virtual Tape Libraries emulate traditional tape
- Easy to deploy and integrate
- Reduce / eliminate tape handling




## Why?

- Improved performance and reliability
- Reduced complexity
- Unlimited tape drives reduce device sharing, improve backup times
- Leverage technologies such as remote replication, deduplication

## Considerations

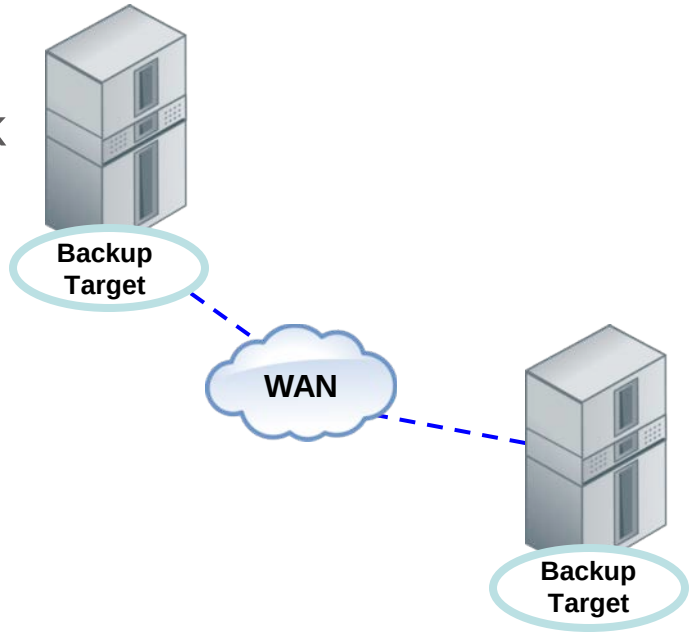
- Avoids mechanical and performance limitations of tape
- Integration with physical tape
- Consider total aggregate speed as well as speed per-drive

# Data Deduplication

- What?
  - The process of examining a dataset or I/O stream at the sub-file level and storing and/or sending only unique data
  - Client-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
- Considerations
  - Greater amount of data stored in less physical space
  - Suitable for backup, archive and now more often 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
  - Tradeoffs (Performance, Encryption, Compression)

# Backup Replication

- What
  - Multiple copies of backup data
  - Copy tape-to-tape, disk-to-tape, disk-to-disk
  - Replication can be network based
- Why
  - Off-site data protection
  - Media consolidation
  - Increased security
  - Leverage the Cloud / Cloud Storage




- Considerations
  - Network bandwidth - Leverage dedupe, network devices, “fat” pipes
  - Recovery process and resources
  - Leveraging the copies (data mining opportunities)
  - Backup versus archival

# Encryption

- What
  - Converting data to an encrypted form so that only authorized users can access to the data using the appropriate decryption key
- Why
  - Sensitive data
  - Confidential data
  - Restricted data
  - Top Secret
  - Etc.
- Considerations
  - Encryption can be accomplished at various points (Application, file system, HBA, Network, Storage Array, Disk Drive, Tape Drive, etc.)
  - Key management is one of the biggest issues with encryption
    - Key Loss, Disclosure of Keys, Key Availability, etc.

# Public Cloud & Private Cloud

- What
  - Backing up data to a cloud service provider
    - Various cloud models available
- Why
  - Less cost than buying infrastructure (in the case of outsourcing)
  - Eliminates costs and complexities of data protection schemes
- Considerations
  - Who owns the data?
  - Security of the data?
  - What is the data availability rating?
  - How will the data be recovered? (e.g., cloud, physical media, WAN)
  - How fast can I recover my data in the event of a disaster?

# Data Protection Summary

- Data growth requires us to plan for tomorrow
  - Investigate data and information management technology
- Information value determines data protection levels
  - Stop protecting employee home movies, last years news
  - Not all data assets are created equal
- Architecture
  - Applications are not all the same
  - Understand your networks, hosts, applications
  - PLAN ahead – Avoid reactionary thinking
- Do your homework
  - SNIA offers seminars, classes, workshops…..

# Additional Resources

- Related tutorials
  - Advanced Data Reduction Concepts
  - Managing Backup and Recovery in Today's Agile, Complex and Heterogeneous Data Centers
  - The Changing Role of Data Protection in a Virtualized World
  - Protecting Data in the Big Data World
  - Retaining Information for 100 Years
- Visit the Data Protection and Capacity Optimization Committee (DPCO) website http://www.snia.org/forums/dpco/
- DPCO – Data Protection Best Practices White Paper

  http://www.snia.org/forums/dpco/
- DPCO – Online Product Selection Guide

  http://sniadataprotectionguide.org/

# Attribution & Feedback

The SNIA Education Committee thanks the following individuals for their contributions to this Tutorial:

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