



Education

# Tiered File System without Tiers

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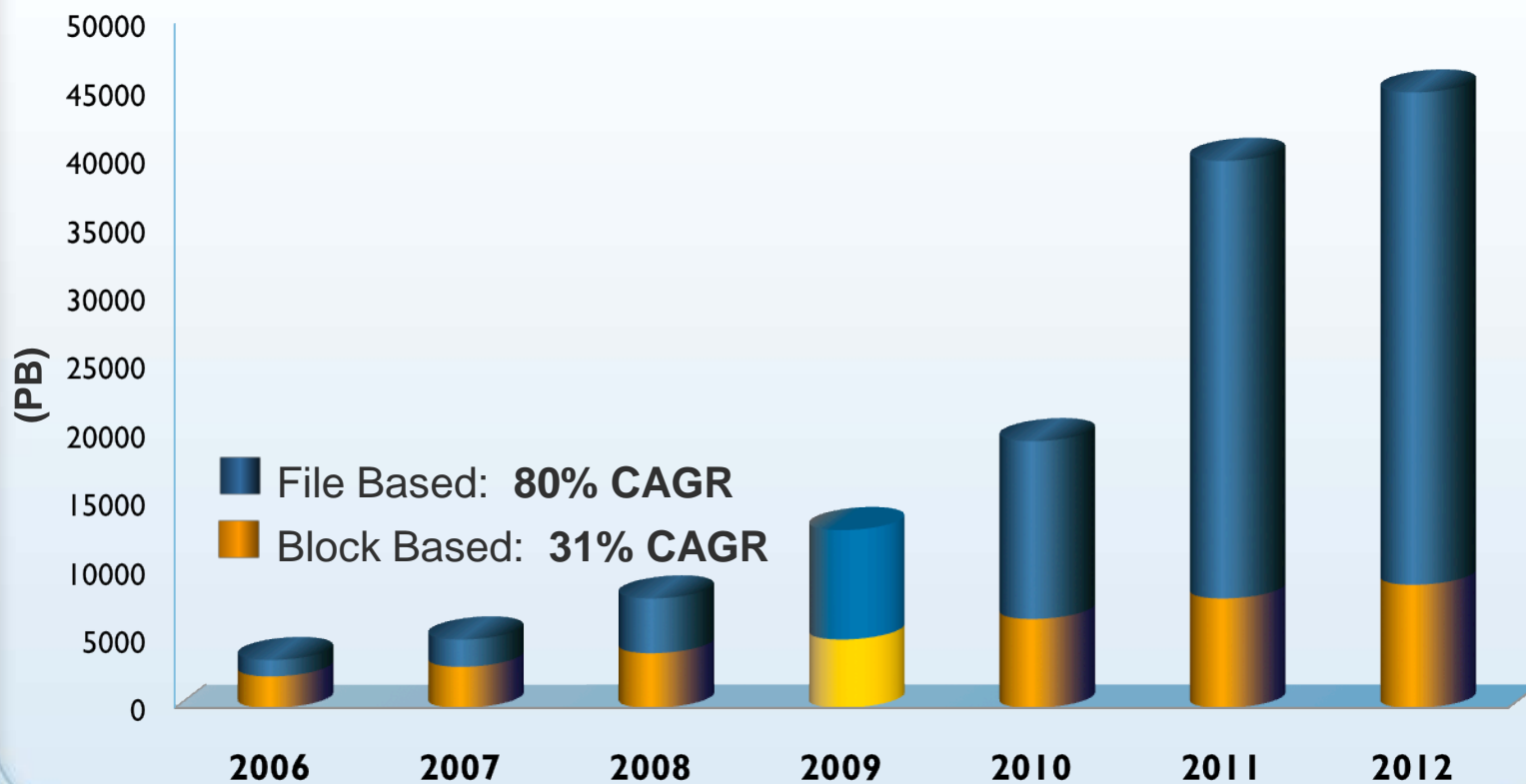
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## ➤ Tiered File System - without Tiers

- ◆ File systems have evolved considerably, yet the vast majority of them are still a simple organizational layer on top of a block device. As the sheer amount of data scales in an organization, it becomes absolutely critical that file systems evolve as well.
- ◆ This presentation focuses on a modern file system which includes native tiering capabilities, native per-file performance and protection capabilities, and advanced scalability.

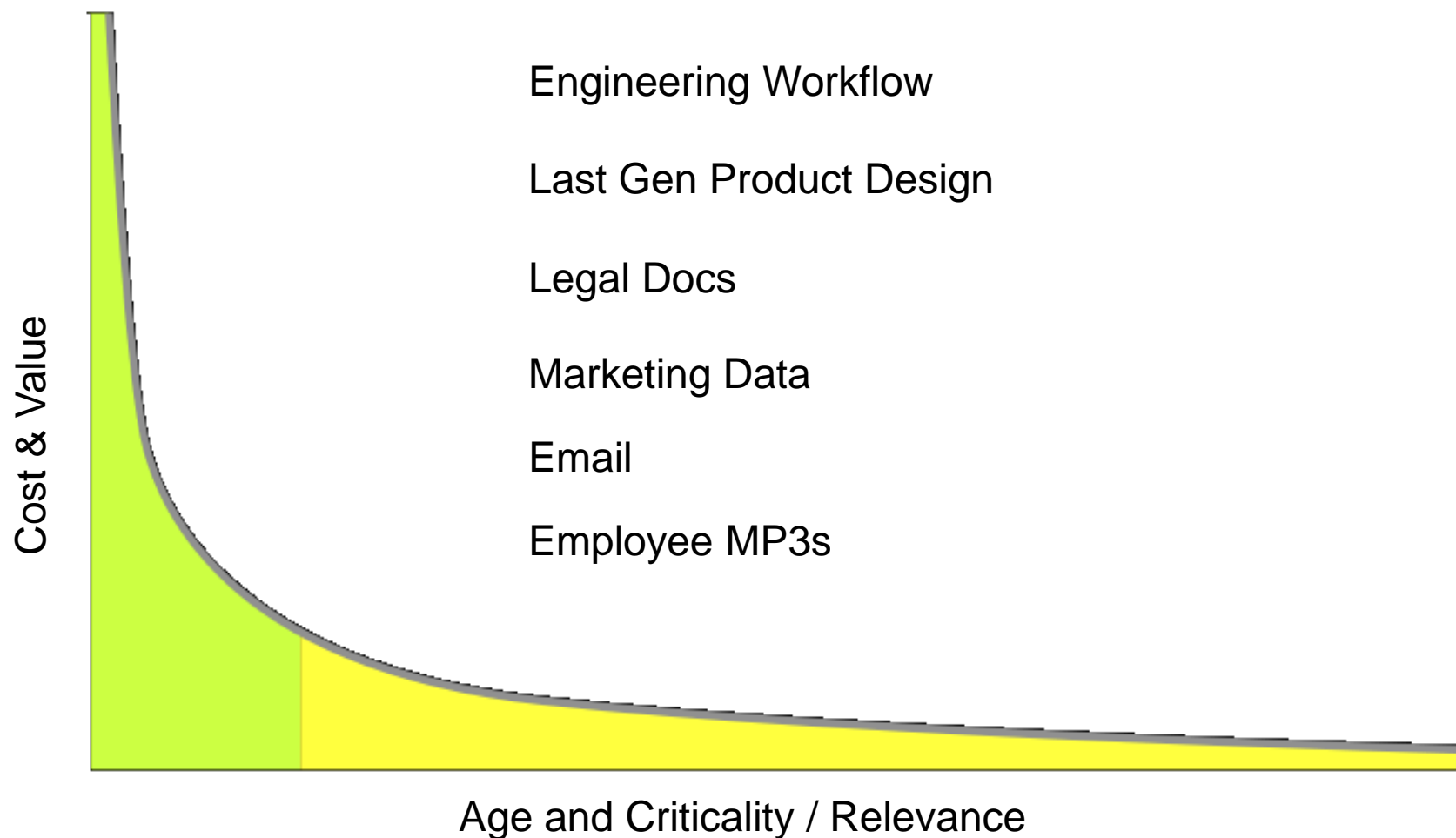
# You Face a Deluge of Data Growth

## Worldwide File And Block Disk Storage Systems, 2005-2012\*



\* Source: IDC

# Is Most of That Data Valuable?



# What are the challenges?

## ➤ CIO/Director of IT

- ◆ Budget – Storage Cost VS Value of Data
- ◆ Business Compliance and Security Requirements

## ➤ Storage Administrator

- ◆ Policies for Managing Data
- ◆ Policies for Managing User Interaction
- ◆ Storage System Management

## ➤ End-User

- ◆ Forced to Manage Data
- ◆ Forced to Understand Storage Landscape

- Scalability with Flat Operating Costs
- Average Cost Tracks Cost/Commodity Curve
- Automated and Granular Data Classification
- Automated and Granular Data Movement
- Transparency to Application and End-User
- Simple, Easy-To-Manage, Scales “Ininitely”

## ➤ Turtle Strategy – Slow Growth

- ◆ Data-growth is significantly below Industry Average
- ◆ Provision Additional Storage When Necessary
- ◆ Migrate All Data to New Storage
- ◆ Little Impact on User Data Management



Storage Array



Storage Array

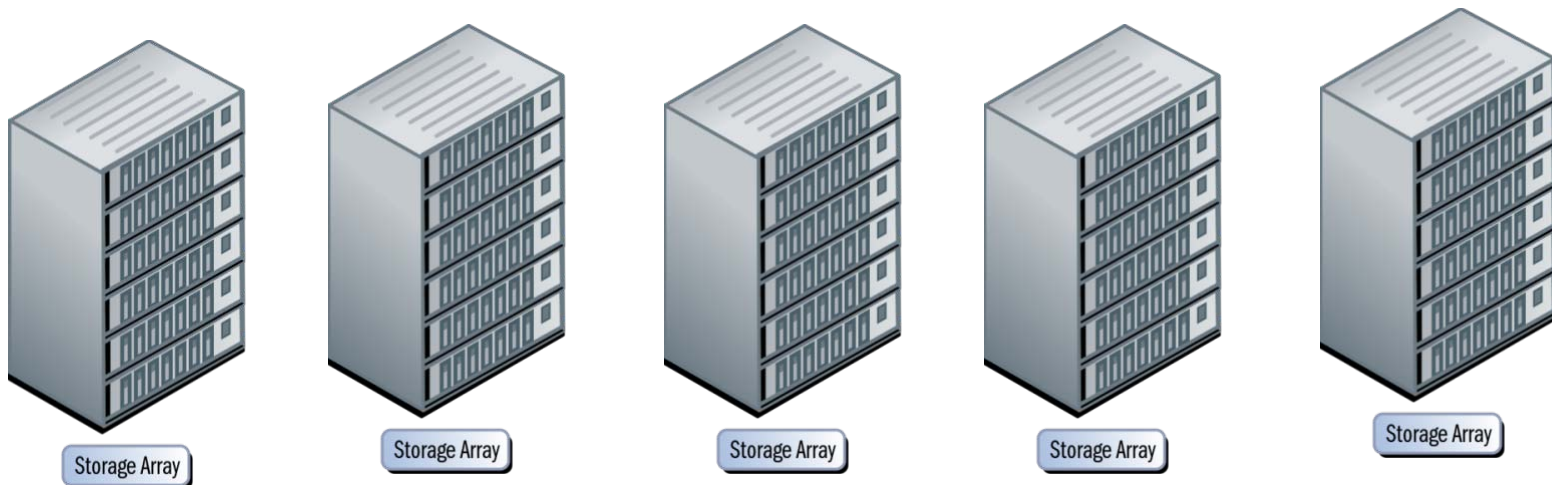


Storage Array



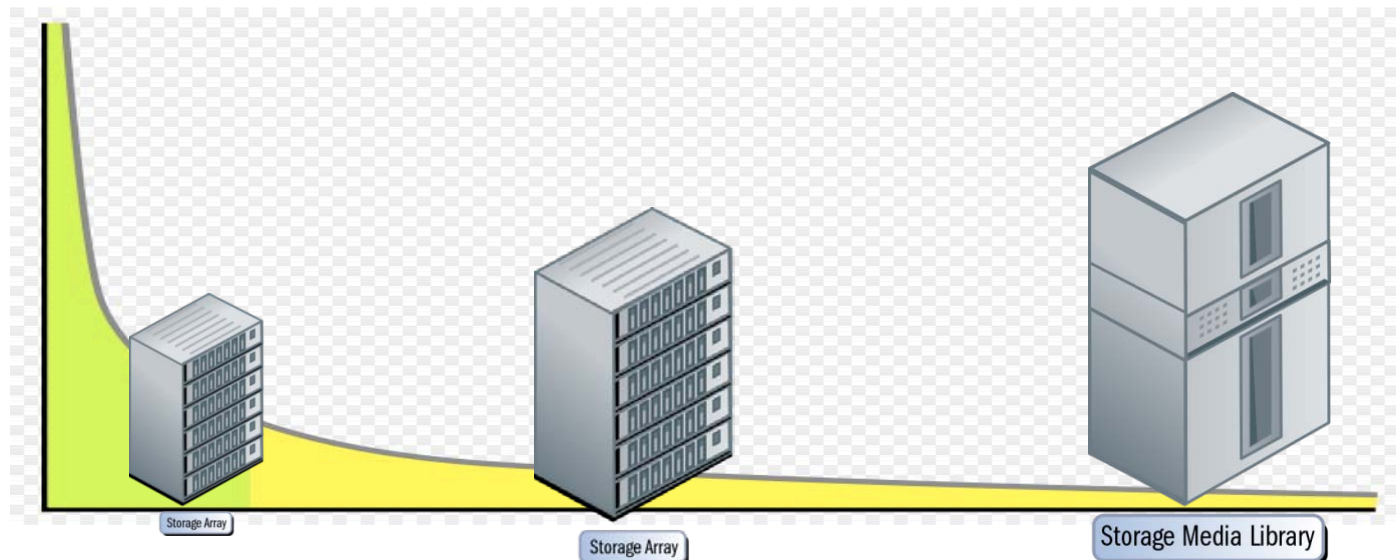
## ► Pod Strategy – Silos of Storage

- ◆ Data-growth  $\geq$  Industry Average
- ◆ Provision Additional Storage On Regular Cycle
- ◆ Manual Migration of New Data to New Storage
- ◆ Users Manage Data Locations



## ➤ Tiering/Hierarchical Storage

- ◆ Data-growth  $\geq$  Industry Average
- ◆ Provision Additional Storage as Needed
- ◆ Automated Migration of New Data to New Storage
- ◆ System Manages Data Locations

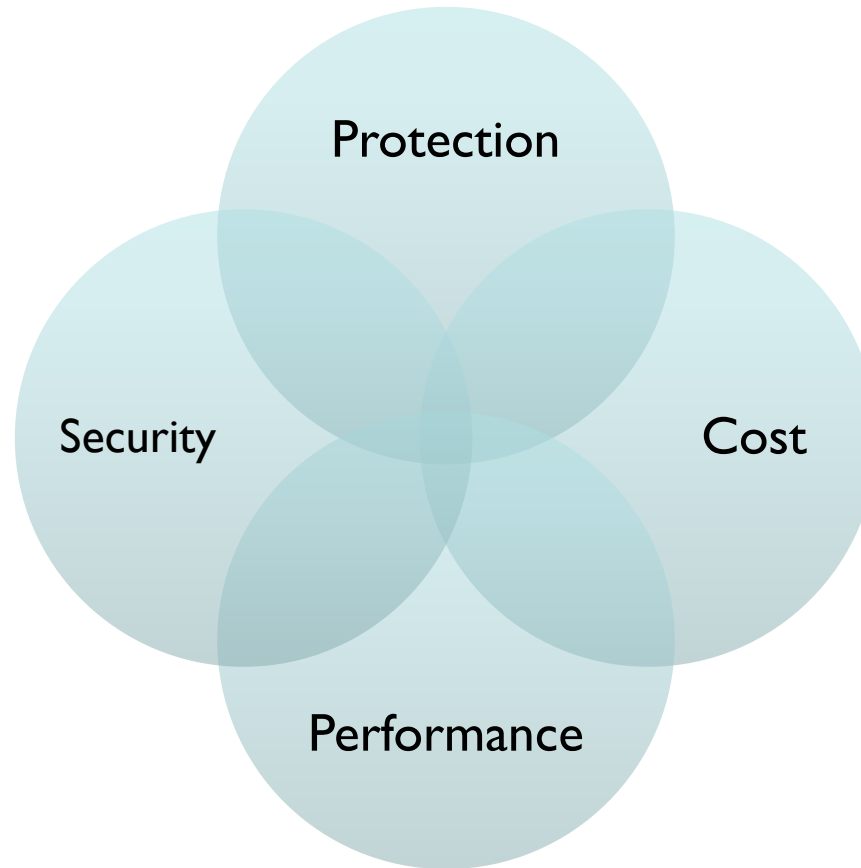


Tiered File System without Tiers

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Tiering means establishing a hierarchy of storage systems based on service requirements such as performance, business continuity, security, protection, retention, compliance, and cost.

# Tiering Decisions



# Today's Tiering Implementations

## ➤ “Stubbing”

- ◆ Copy/Delete Scheme
- ◆ Leaves References

## ➤ Pros

- ◆ Helps End-User

## ➤ Cons

- ◆ Technical Challenges
- ◆ Increased Management
- ◆ Silos of Storage
- ◆ Affects Backup, DR, etc.

## ➤ Software-Layer

- ◆ Client Software
- ◆ Asset Management

## ➤ Pros

- ◆ Helps Administrator

## ➤ Cons

- ◆ Unfamiliar for Users
- ◆ 3<sup>rd</sup> Party Dependency
- ◆ Silos of Storage
- ◆ Affects Backup, DR, etc.

- An Abstraction on Top of Storage Media
- Organizes Data into Files, Databases, Indexes
- Network Attached System (NAS)
  - ◆ File System is Understood by the Storage System
  - ◆ Clients and Storage System Share a Higher-Level Protocol
- Storage Area Networking (SAN)
  - ◆ File System is Understood by the Client (s)
  - ◆ Clients and Storage System Share a Lower-Level Protocol

- Tiering Multiple File Systems Introduces Complexity
- Tiering Requires Different Storage Media
- Effective Scaling Requires Networking
  
- File Systems are Media and Network Agnostic
  - ◆ File Systems interact with Volumes and LUNs
  - ◆ File Systems are ignorant of the underlying media
  - ◆ File Systems are built for single systems
  
- Hardware Abstraction is No Longer Necessary
  - ◆ It complicates scaling, management, and increases costs

## ➤ What Can You Do with a Single File System?

- ◆ That spans multiple hardware tiers of storage ...
- ◆ That can scale seamlessly from GBs to EBs ...
- ◆ That allows old hardware to be removed ...
- ◆ That allows new hardware to be added ...
- ◆ That performs protection and security at a file-level ...
- ◆ That can optimize for specific hardware and media ...
- ◆ That can optimize for specific types of files over time ...

## ➤ You can implement Tiered Storage ...



# Building a Tiered File System

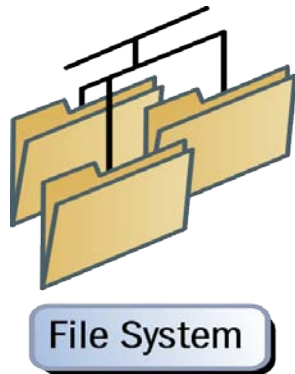
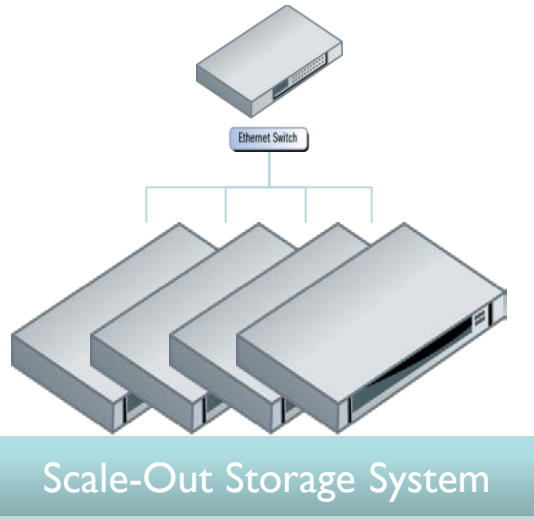
## ➤ Critical Design Principles

- ◆ The File System Must Be Aware of All Media
- ◆ The File System Must Be Scalable
- ◆ The File System Must Be Easy To Manage

## ➤ Consequences

- ◆ File System Provides Data Protection
- ◆ File System Addresses Different Storage Media
- ◆ File System Accesses Networked Components
- ◆ File System Allows for Easy Addition and Removal
- ◆ The File System Must Provide Granular Policies

# Implement Tiering with Scale-Out



- Hardware Building Blocks – “Nodes”
- Single File System and Volume
- High Performance Network Interconnect
- Integrated Multiple Tiers of Storage
- Easy-to-Use, Cost-Effective
- SAN or NAS

## ➤ Different Hardware Nodes

- ◆ Globally distributed DRAM cache
- ◆ Blazing Fast Tier 0/1 – SSD or SAS nodes
- ◆ Mid-Range Tier 2 – performance SATA
- ◆ Cost-Optimized Tier 3 – dense SATA
- ◆ Performance Nodes – All CPU, DRAM, no disk
- ◆ Meta-Data Acceleration

## ➤ Per-File/LUN Granularity

## ➤ Single File System, Single Volume, Single Namespace

# Tiered Storage - Example 1

- Executive Staff Files (and Exchange Mail Store)
  - ◆ Optimize for Random Access and Meta-Data Lookups
  - ◆ Data Protection: +3 (survive three simultaneous failures)
  - ◆ Use Tier-1 Storage Nodes (SSD or SAS)
  - ◆ Automatically Migrate to Tier-2 (SATA) after 3 days
  - ◆ Automatically Migrate to Tier-3 (dense SATA) after 7 days
  - ◆ Store Snapshots on Tier-3 (dense SATA) immediately
- Optimizes for **Immediate** Performance
- Minimizes High-End Performance Cost
- Continual Protection At All Times
- Cost Reduce “Old” Data Very Quickly

- Virtual Machine Images (both LUNs and files)
  - ◆ Optimize for Random Access
  - ◆ Default Protection: 2x (survive two simultaneous failures)
  - ◆ Use Tier-1 Storage Nodes (SAS)
  - ◆ Store Snapshots on Tier-2 (mid-range SATA)
  
- Optimizes for **Application** Performance
- Different Protection Scheme for Performance
- Cost Reduce as Value Declines

- Archive Policy – For Everything Else
  - ◆ Default Protection: +2 (survive 2 simultaneous failures)
  - ◆ Use Tier-3 Storage Nodes (dense SATA)
  - ◆ Move Data to Tier-2 If Activity Increases
  
- Optimize Cost Across the File System
- No Manual Intervention
- No User Visibility

# Scale-Out is Perfect for Tiering

- Scalability with Flat Operating Costs
  - ◆ Single File System, Single Point of Management
- Average Cost Tracks Cost/Commodity Curve
  - ◆ Automatically Drive Data to the Most Cost Effective Tier
  - ◆ Constantly Minimize the Use of the Performance Tier
- Automated/Granular Data Classification/Movement
  - ◆ Policy-Based, Per-File/LUN Classification
  - ◆ Protection, Performance, Security, and Cost
- Transparency to Application and End-User
  - ◆ Single Name Space, No Name Space Tricks, No Stubs
- Simple, Easy-To-Manage, Scales “Ininitely”

- Please send any questions or comments on this presentation to SNIA: [trackfilemgmt@snia.org](mailto:trackfilemgmt@snia.org)

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