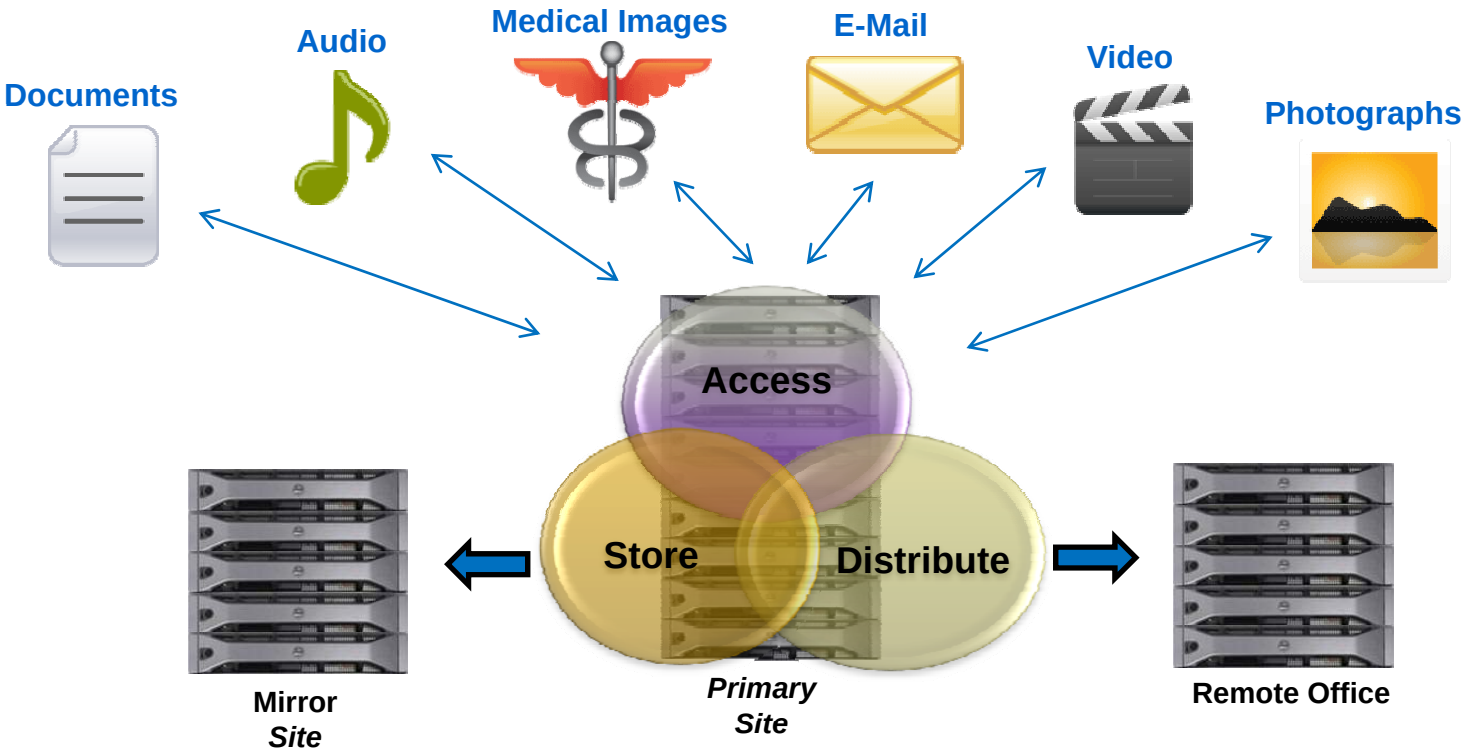
Object-based Storage:
Benefits from Archive to the Cloud

Derek Gascon
Product & Marketing Strategist
Dell, Inc.

Object Storage for Unstructured Data



Object storage is designed to address the unique challenges of unstructured data using **<u>an affordable, simple and scalable clustered storage infrastructure.</u>**

Interesting Characteristics of Unstructured Data…

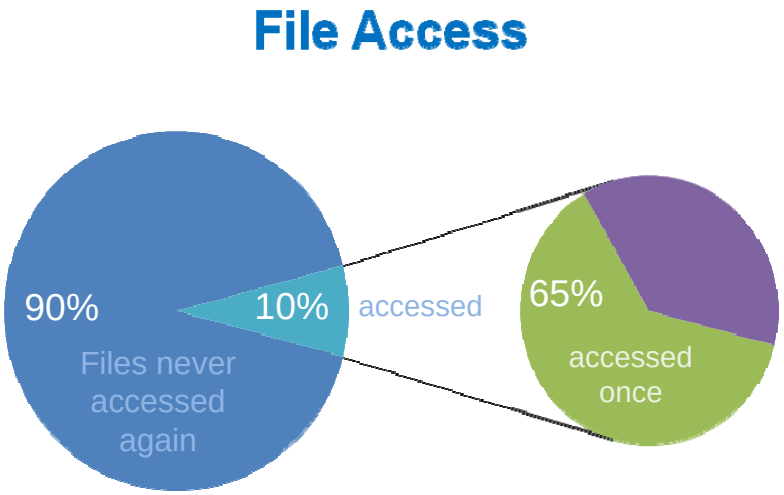
Unstructured data
- 70% to 90% is “unstructured”

Massive file growth
- From 50% to >100% per year

Low reuse of files[1]
- 90% never accessed after creation
- Only 65% of files that are accessed only accessed once[3]

Aging files occupying expensive storage
- Software needed to migrate files to secondary storage
- Added cost and complexity

Must meet compliance mandates
- Secondary storage tier required



[1]Measurement and Analysis of Large-Scale Network File System Workloads, UC Santa Cruz

…More Interesting Characteristics

Estimated capacity for 2011

- 1,800 Exabytes new digital information produced

Not just capacity growth

- "Containers": Files, images, packets, video, RFID
- Growing 50% faster than capacity
- 20 quadrillion (20 million billion)

Regulatory compliance

- Spending on IT infrastructure to double
- Up to $21.4 billion worldwide in 2010

Content Partitioned in silos[2]

- 78% of companies have more than one repository
- 43% have six or more

[2]Forrester Research

Object Storage Infrastructure

Common Requirements for Archive & Cloud

- Massive scale to billions of objects
  - Flat address space for scale
- TB's to Petabytes of capacity
  - Peer Scaling
  - Flexible Scaling Increments
- Non-Disruptive Administration
  - Capacity expansion
  - Technology transitions/retirement
- Cluster on affordable x86 hardware
  - Leverages standard server technology
- Open Standard Access Protocol
  - Native HTTP
  - As ubiquitous as the Web
- Self-Managing, Self Healing
- Policy-Based Data Management
- Data protection without traditional backup - Replication
- *Metadata* capabilities for intelligent management, governance and compliance
- Multi-tenancy to segment departmental and/or customer data
  - Charge-back and billing

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Simplified Expansion and Technology Refresh

Adding capacity must be simple

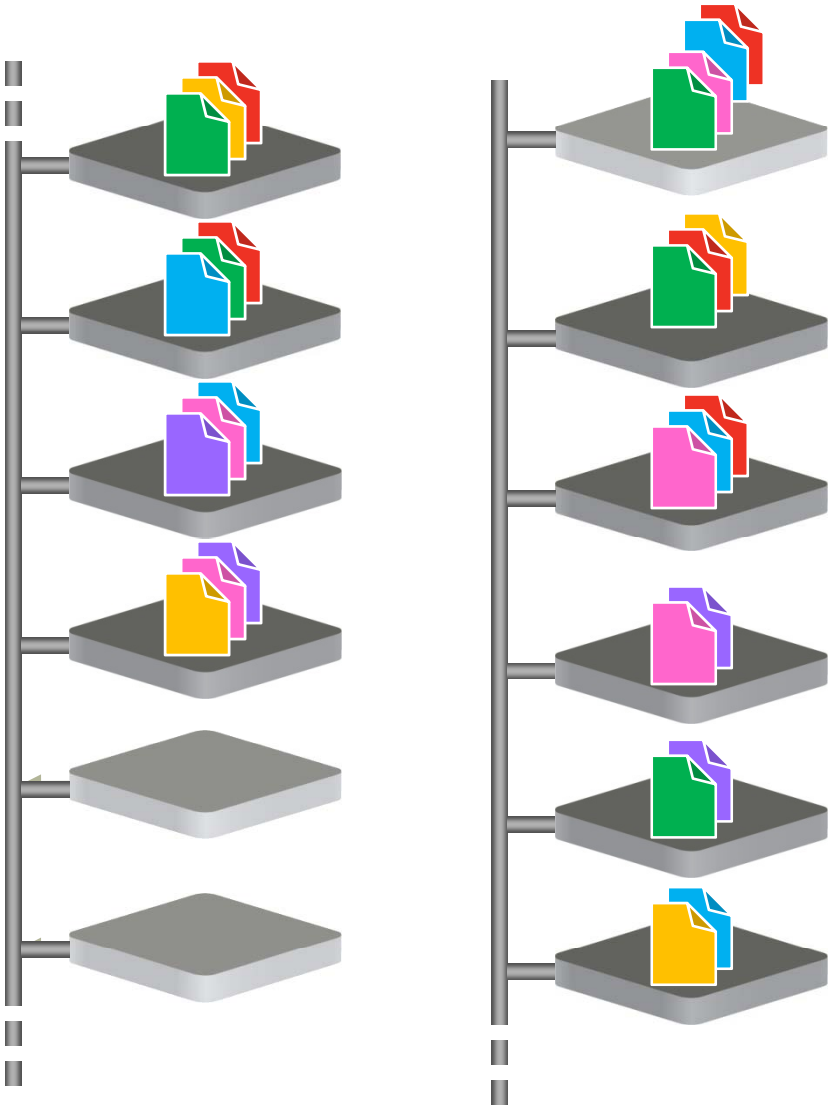
- Rack & Cable
- Power-up

Refresh must be just as easy

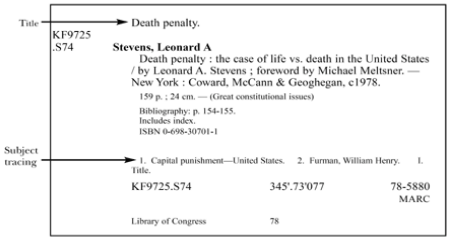
- Upgrade without interruption
- Retire node or volume
- Replicates data to another node or volume

Recovery & balancing must be automatic

- Continuous data availability
- Load and capacity balanced



Analog Object: A Book……



Title → Death penalty.

KF9725
.S74

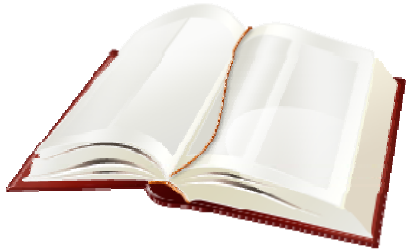
Stevens, Leonard A
Death penalty : the case of life vs. death in the United States / by Leonard A. Stevens ; foreword by Michael Meltsner. — New York : Coward, McCann & Geoghegan, c1978.
159 p. ; 24 cm. — (Great constitutional issues)
Bibliography: p. 154-155.
Includes index.
ISBN 0-698-30701-1

Subject tracing → 1. Capital punishment—United States. 2. Furman, William Henry. I. Title.

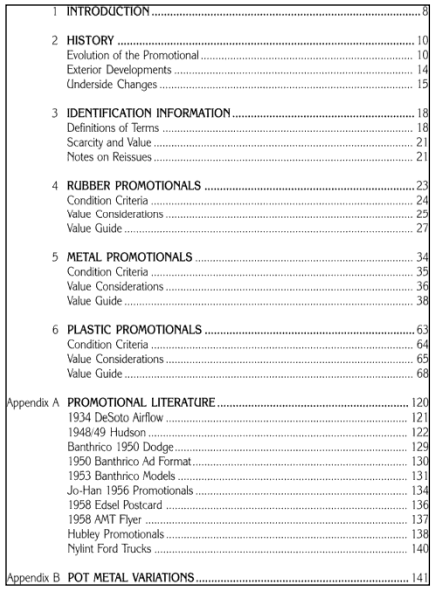
KF9725.S74 345'.73'077 78-5880
MARC

Library of Congress 78

Figure 2. Subject Tracing on Card Catalog Record



- ISBN = Unique Identifier
- Metadata =
  - Title
  - Author
  - LOC Catalog
  - Table of Contents
  - # of Pages
  - Keywords…
- Text = File Content
- Components always stay together



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The Digital Object

Object Address

UUID	Metadata	1010001010101001110101011000101101 00…110010

HTTP/1.1 200 OK
Date: Thu, 26 Jun 2008 21:26:34 GMT
Server: Object Cluster/2.2
Application-Name: MS Word
Create-Date: 2008-06-26 21:26:14.687000
System-Cluster: Internet Demo Cluster
System-Created: Thu, 26 Jun 2008 21:26:20 GMT
Content-Disposition: inline; filename=Sports %Segment%206-26-08.doc
Content-Length: 8619354
Content-type: application/doc
lifepoint: [Thu, 03 Jul 2015 21:26:14 GMT] reps=2, deletable=True
lifepoint: [] delete
Replica-Count: 2
CUSTOM ELEMENTS

- Object = Metadata + File Data
- Stored together for life of object
- Metadata:
  - Rich, descriptive data about the data
  - Context persisted over time
  - Enables policy-based management

Metadata Hierarchy

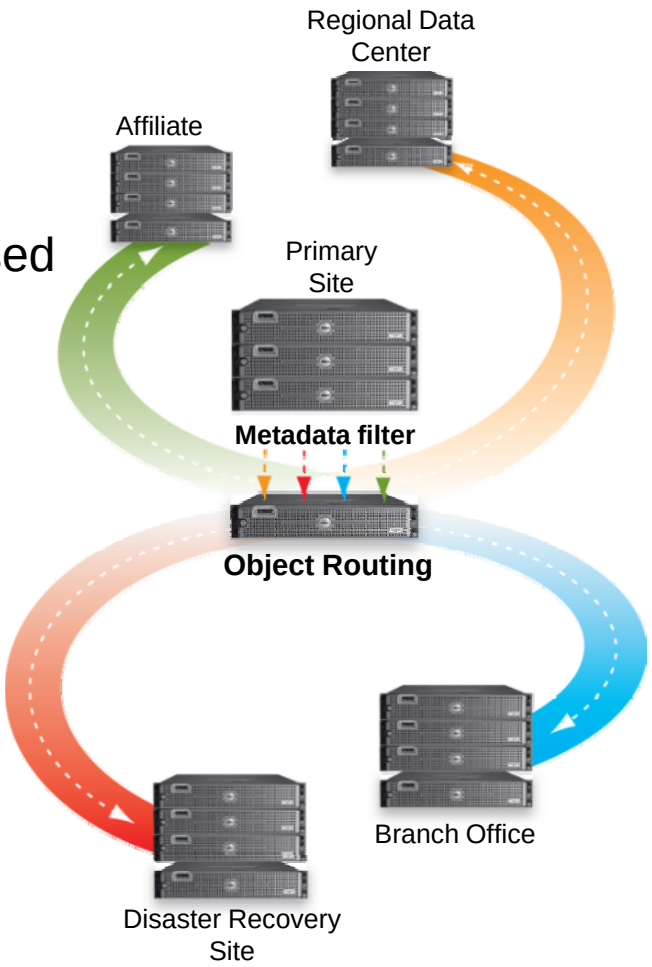
- Informational Value increases Through Each Tier of Metadata
- Structured Metadata Standards Defined or Being Defined Across Content Types
  - Dublin Core (Library Science)
  - NBII Biological Metadata Standard (Life Sciences)
  - DICOM (Medical Imaging)
  - Video On Demand Content Specification (Television/Cable)
  - Content Standard for Geospatial Metadata (Oil & Gas)
  - SMPTE (Television/Film)
  - Advanced Authoring Format (Motion Imaging)

Hierarchy Level	Description
Tier 1	**Base Metadata** – Foundation tier that consists of basic metadata elements for a traditional file system. File Name; File Size; Date Created, Owner, Last Modified, Location (Path), Etc…
Tier 2	**Structured Metadata** – Standards-based metadata or elements applied by the creator or generating application. Standards such as Dublin Core, SMPTE, Etc. Originating application, Creator, Unique Media ID, Media Format, Subject, Key Words, Etc…
Tier 3	**Unstructured Metadata** – Variable metadata elements contained within the body/content of the file/object itself. Such elements may be cataloged by a traditional index/search engine. Full-text Document Indexing, Video Key Frames, Speech to Text Conversion, Etc…

Source: Video Content Management in Broadcast, SMPTE Journal, February/March 2002

Intelligence through Metadata

- Policy-based replication to geographically distributed site(s)
- Policies driven by defined rules based on object metadata
- Multiple replication and distribution topologies supported
  - 1:1, 1:M, M:1, M:M
  - Customize to meet specific needs
- Replicate some or all files
- Fully automated
- *Extensible for use in other post-process functions*



HTTP: Web Access to Storage

A Simple Content Storage Protocol

Open standard protocol enabling ubiquitous access

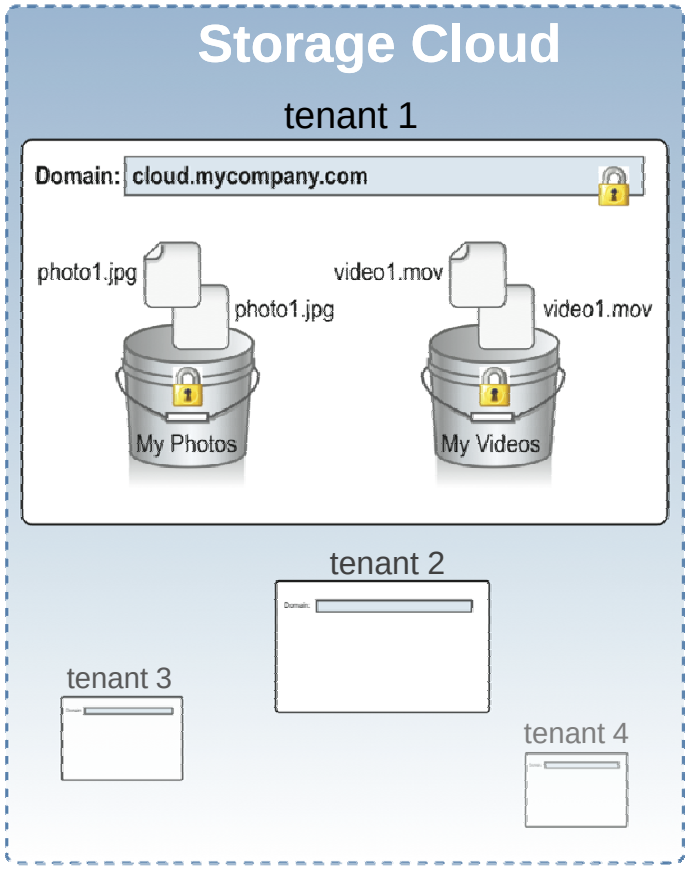
Basic HTTP methods

- Create with POST (write)
- Retrieve with GET (read)
- Update with PUT (update any part of an immutable object)
- Update with COPY (update object metadata)
- Update with APPEND (update object with appended content on the end of the existing stream)
- Retrieve metadata with HEAD (info)
- Remove with DELETE (delete)

Multi-Tenancy Supports Internal & External Customers

To enable a new tenant you define a new Domain in the cluster

- **Buckets**: Users can create containers for named objects
- **Domains** and Buckets have associated Security Realms containing authorization lists - list of users and credentials
- Maintenance and administration of these **Security Realms** can be delegated to administrators who own a Domain
- Individual **Objects** can have authorization lists attached as well



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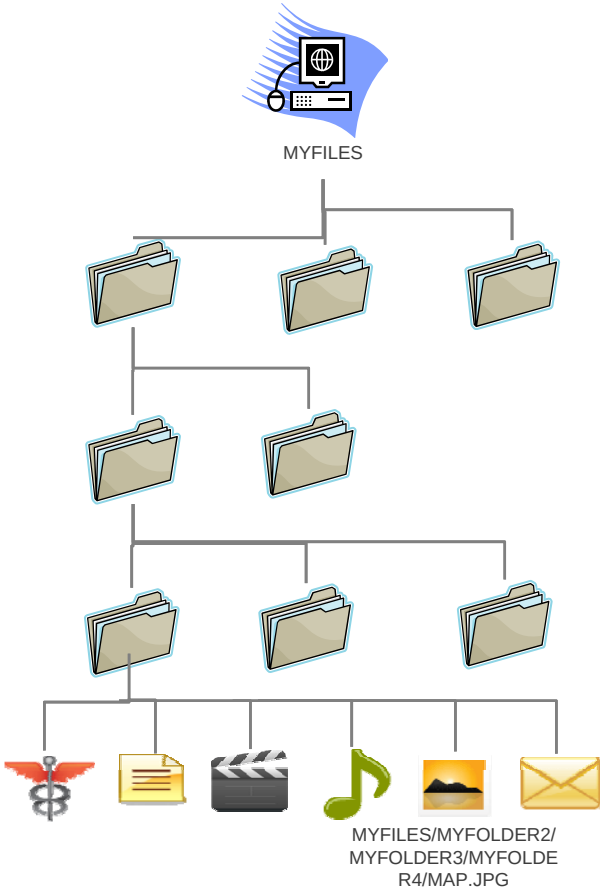
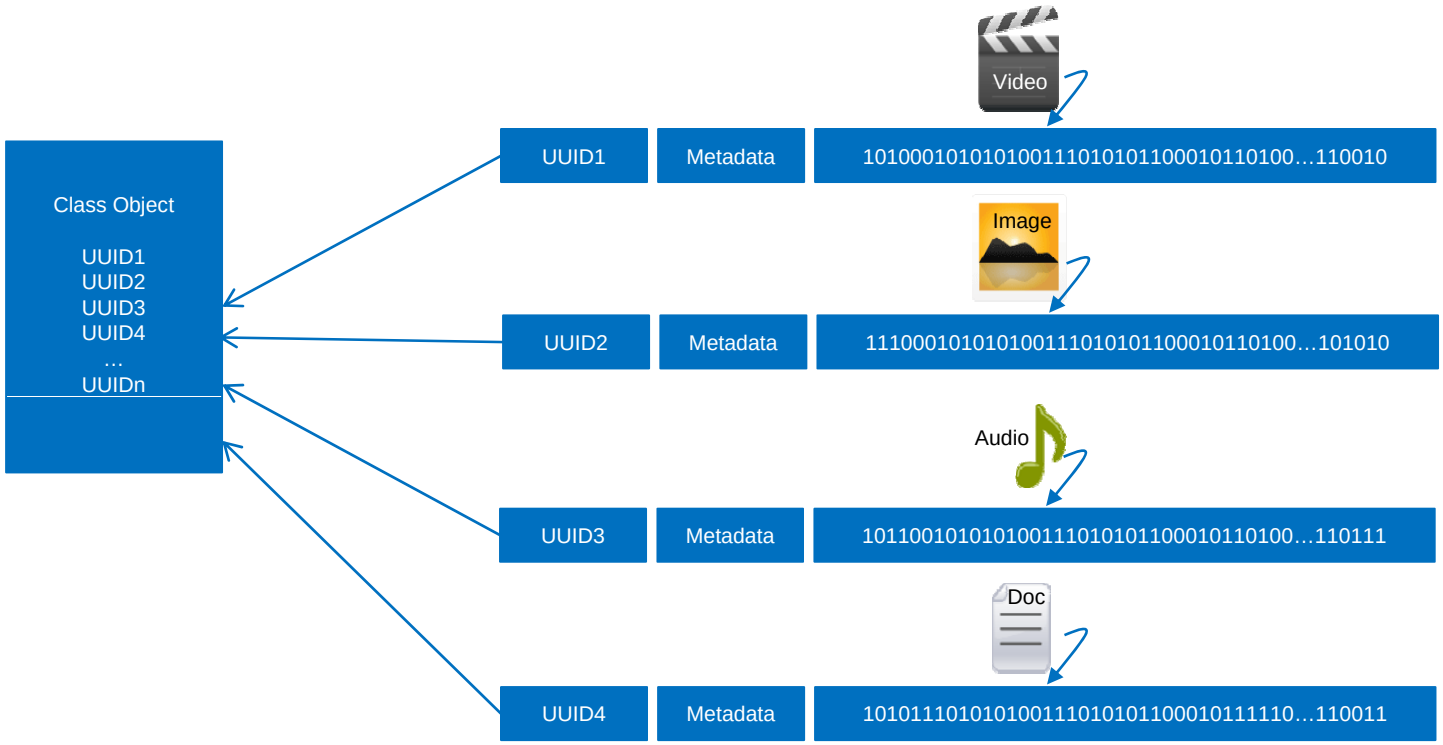
File Systems Impose Rigid Structure



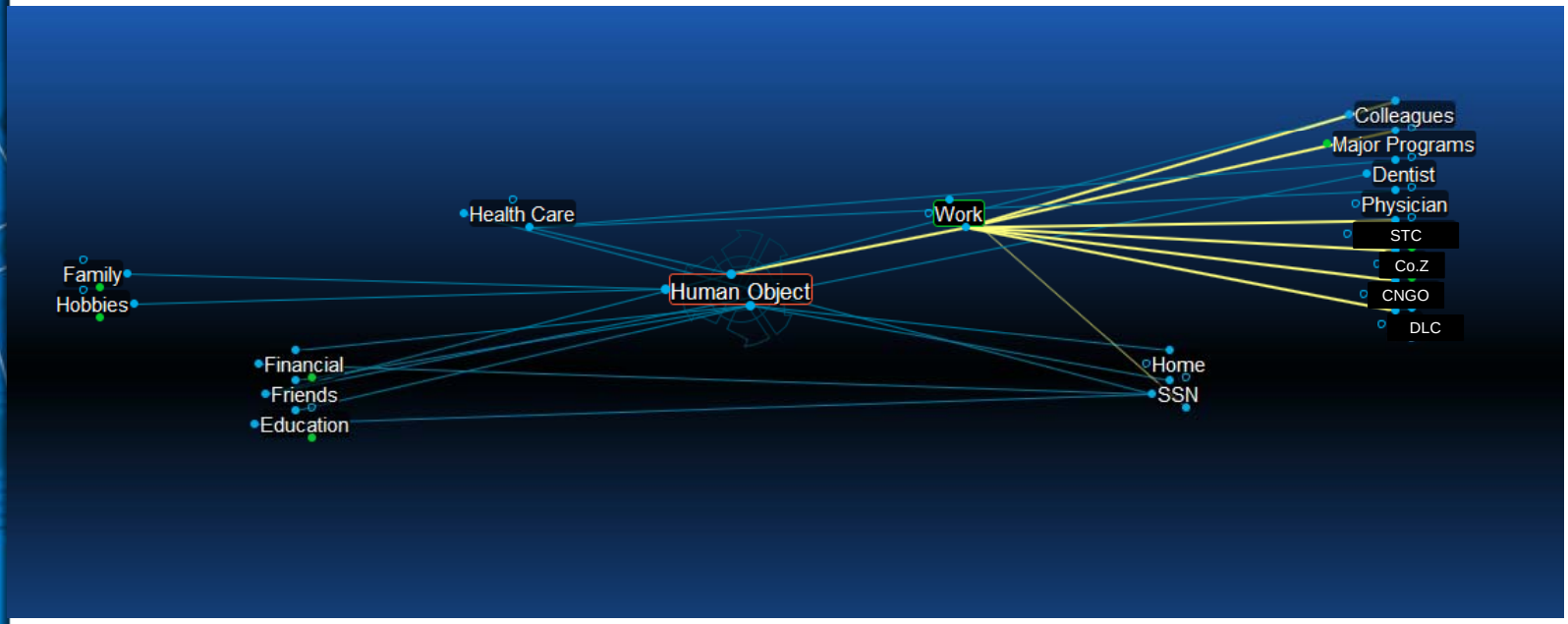
- Relationships established through hierarchy
- Folder/Sub-folder model gets unwieldy at scale
- Context for file data is easily lost (or forgotten)
- Growth to millions of folders and multi-millions of files is becoming the new reality

Objects Enable Associative Structure



- Relate multiple content elements and persist in storage
  - Video, promo photo, audio and transcript
  - Build relationships based on metadata descriptors
  - Update over time with new elements
- Similar to how we associate information and concepts

Object Oriented Structure



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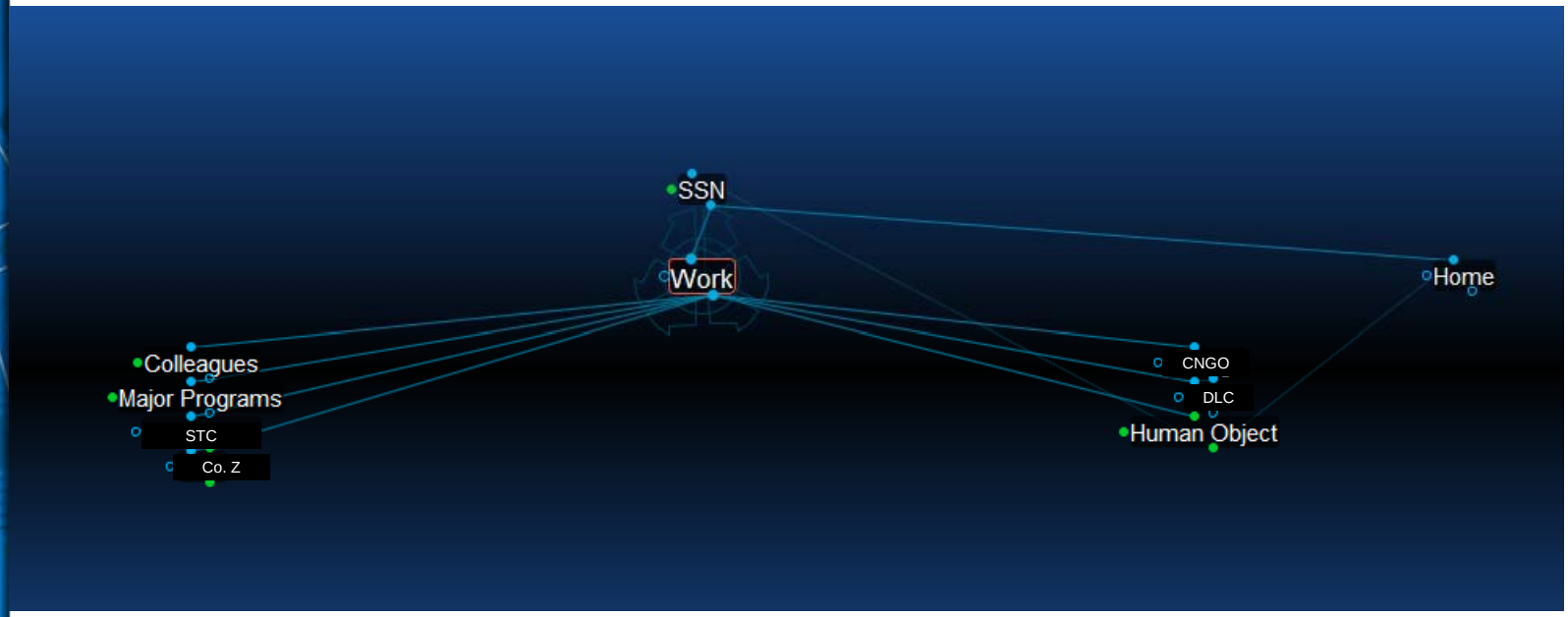
Navigate Instead of Traverse



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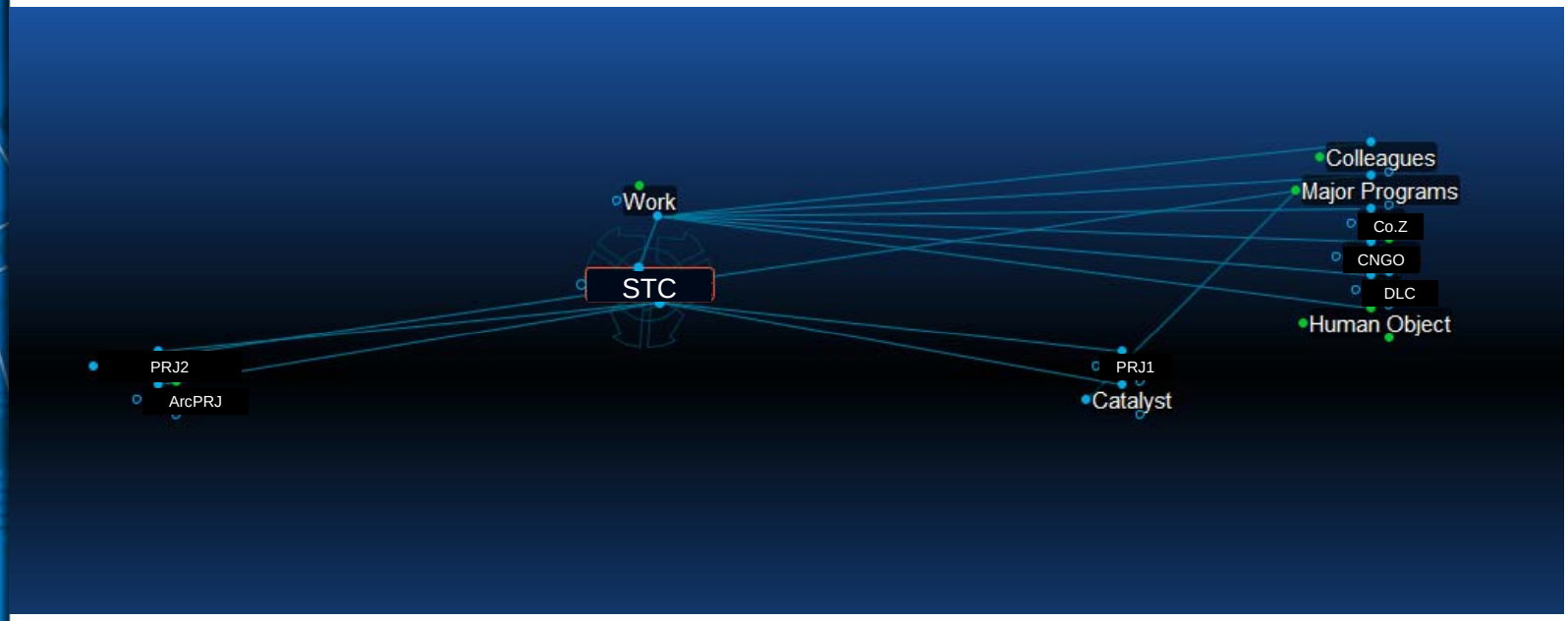
Visualize Related Information



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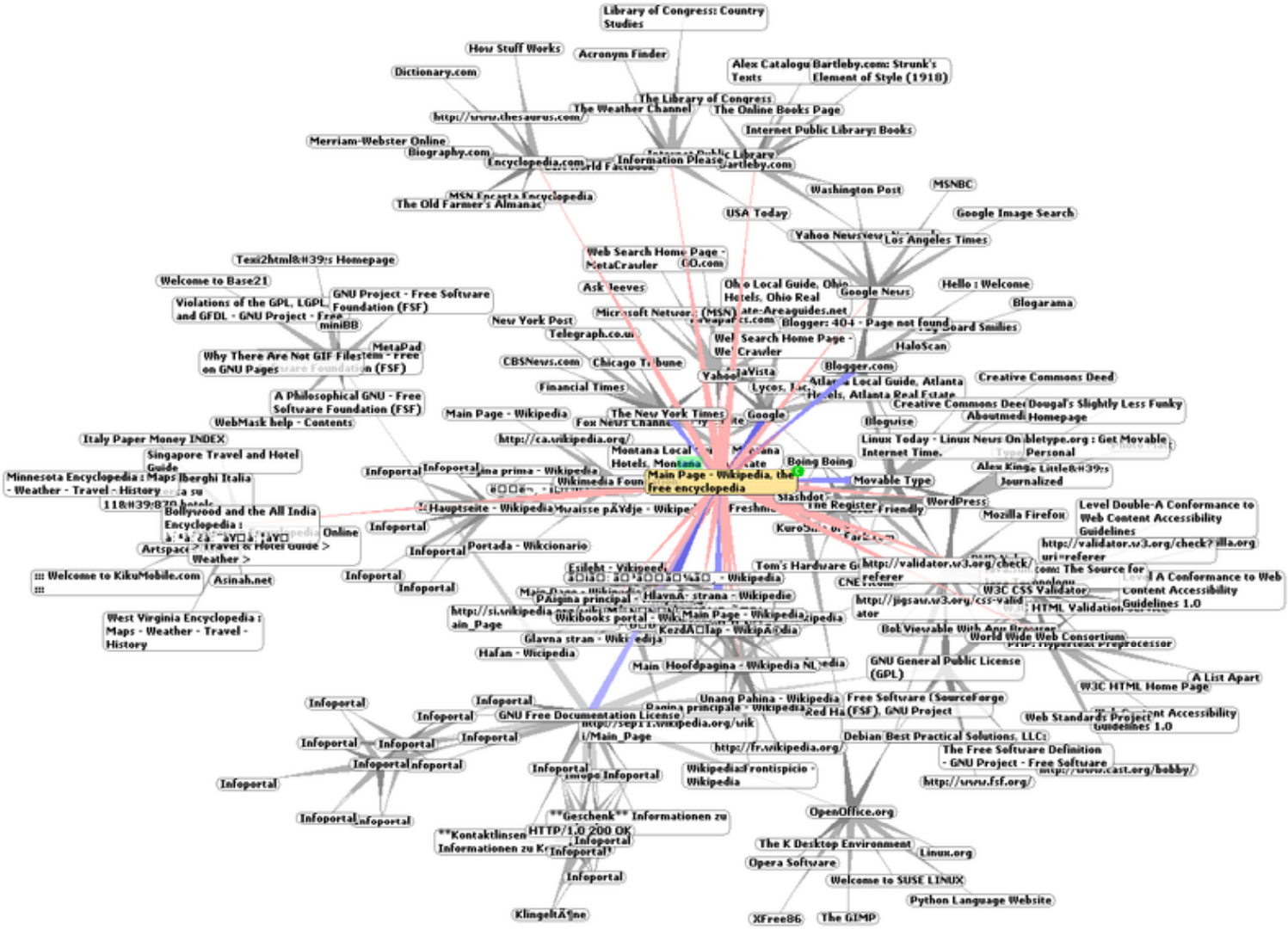
The Web: A Giant Content (Object) Repository



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Thank You!

Questions??

Derek Gascon
Product & Marketing Strategist
Dell, Inc.

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