



[Digital Preservation System \(DPS\) Architecture](#)

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Who We Are

- Family Search (familysearch.org)
- World's largest genealogy organization
- In operation more than 100 years
- Non-profit
- Owned and funded by the Church of Jesus Christ of Latter-day Saints

What We Do

- Promote family history research
- Provide online tools to support research
- Engage non-researchers
- Publish digitized genealogical records
- Preserve both digital and physical records

Record Preservation

- Granite Mountain Records Vault
 - 2+ million rolls of microfilm
 - 3.6 billion images
 - records from 100+ countries



Record Preservation

- Granite Mountain Records Vault
 - granite walls 200 meters thick
 - climate controlled interior



FamilySearch

Preservation Volume – 1 Copy

Year	Total Artifact Count (Millions)	Yearly Additional Storage (PB)	Cumulative Storage (PB)
2012	522	4	6
2013	1205	7	13
2014	2023	11	23
2015	2866	19	42
2016	3501	17	59
2017	4052	17	76

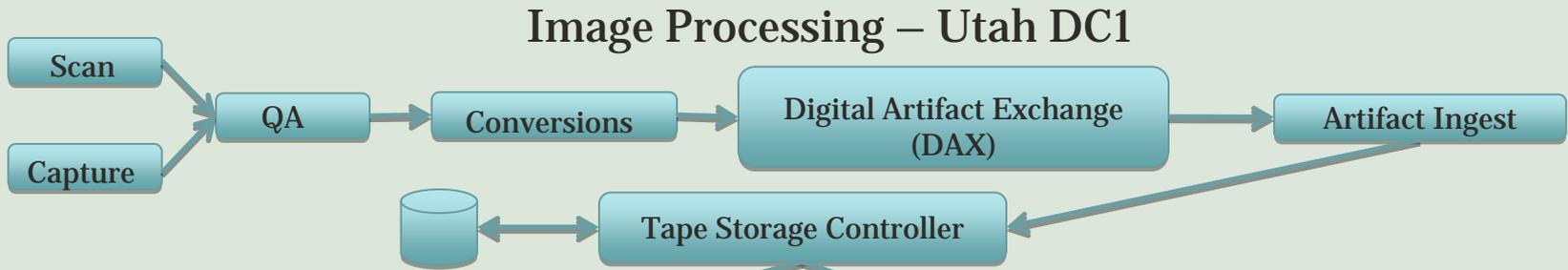
Managing Scale & Complexity

- Number of artifacts – billions
- Types of digital artifacts
- Artifact size
- Storage requirements – 100s of Petabytes
- User access – 10s to 100s of thousands
- User search on structured, unstructured, and semi-structured data
- Variable access rights
- High availability for end-user access
- Very low tolerance for artifact loss

Today Focus On Two Elements

- Storage architecture
- Data organization

DPS 2.0 Storage Implementation



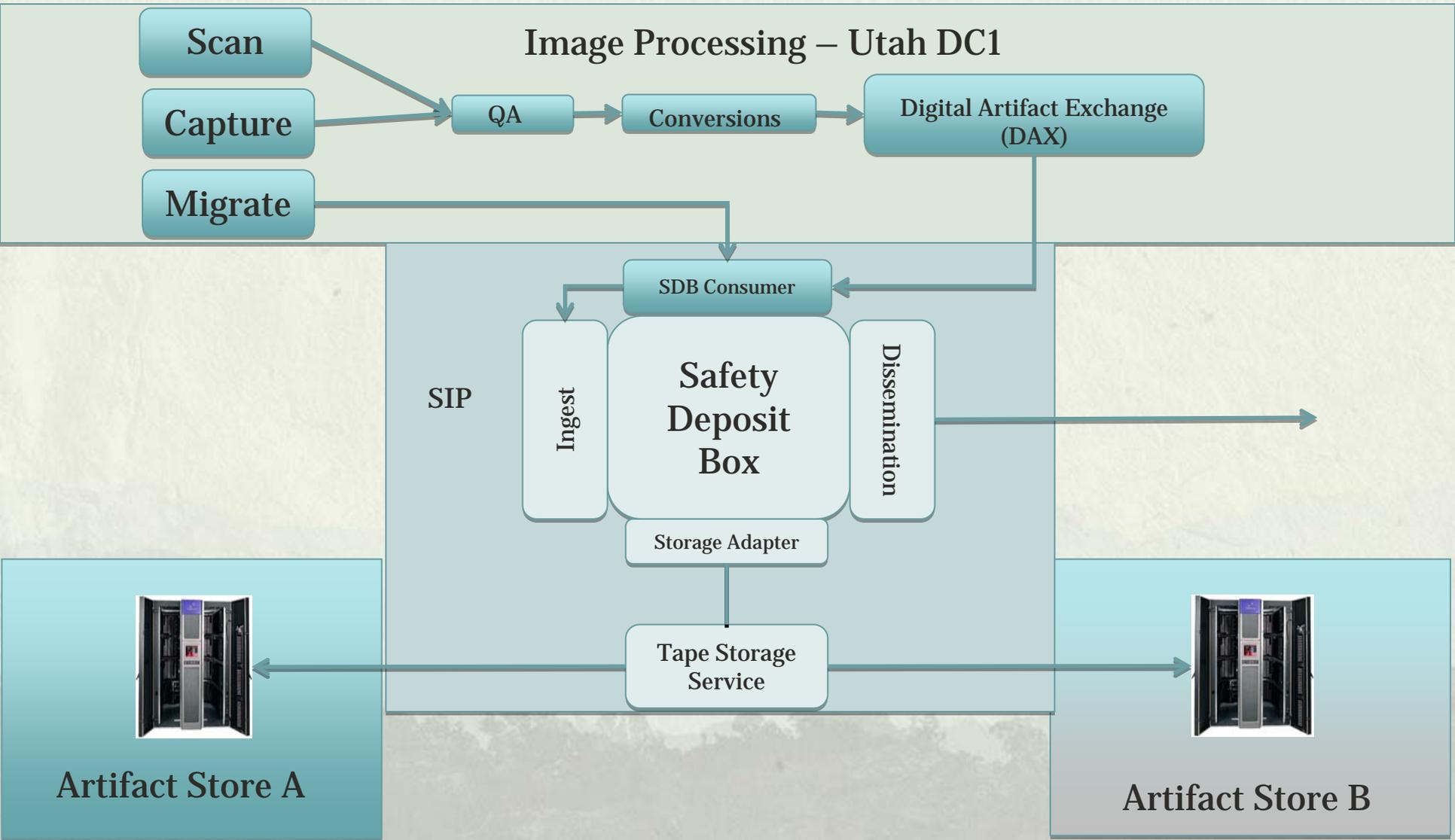
Artifact Store – Utah DC2

5000
Cartridges
Each

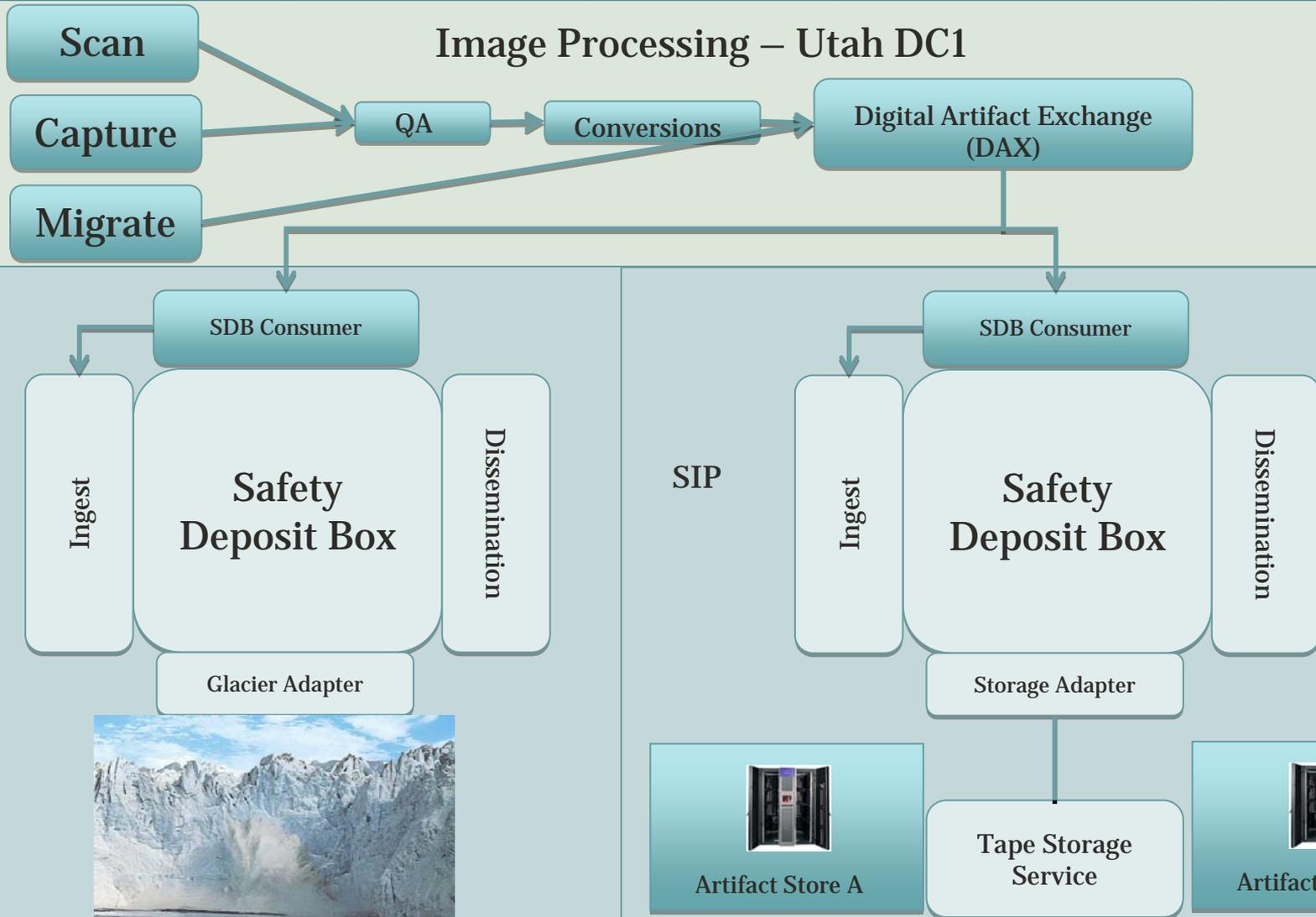


Artifact Store – Utah DC3

DPS 3.0 Storage Implementation



DPS 3.x Storage Vision



Data Organization

- Ability to access data independent of preservation software
- Ability to access data with minimal support layers (such as HSM)
- Optimize storage cost and write speed
- Optimize for ongoing data integrity validation
- Enable efficient artifact access

Linear Tape File System

- Previously used custom packaging using multi-part mime.
- Could use tar or maybe afx
- We now have implemented LTFS
 - Specification not hard to follow
 - Oracle open source library and utilities great for testing implementation.
 - Great for “direct” access to data.
 - Could use BagIt format within LTFS

LTFS Implementation Project

- Oracle helped us implement LTFS by guiding us on SCSI commands to implement partitions on the T10K tapes. Then also updated their official documentation.
- Oracle's OSS LTFS project allowed us to look at working source code which helped as well.

Current Specification – v2.1

http://snia.org/sites/default/files/LTFSv2.1r0DRAFT_0.pdf



Linear Tape File System (LTFS) Format Specification

Version 2.1 rev 0

"Publication of this Working Draft for review and comment has been approved by the LTFS TWG. This draft represents a "best effort" attempt by the LTFS TWG to reach preliminary consensus, and it may be updated, replaced, or made obsolete at any time. This document should not be used as reference material or cited as other than a "work in progress." Suggestion for revision should be directed to <http://www.snia.org/feedback/>"

Working Draft

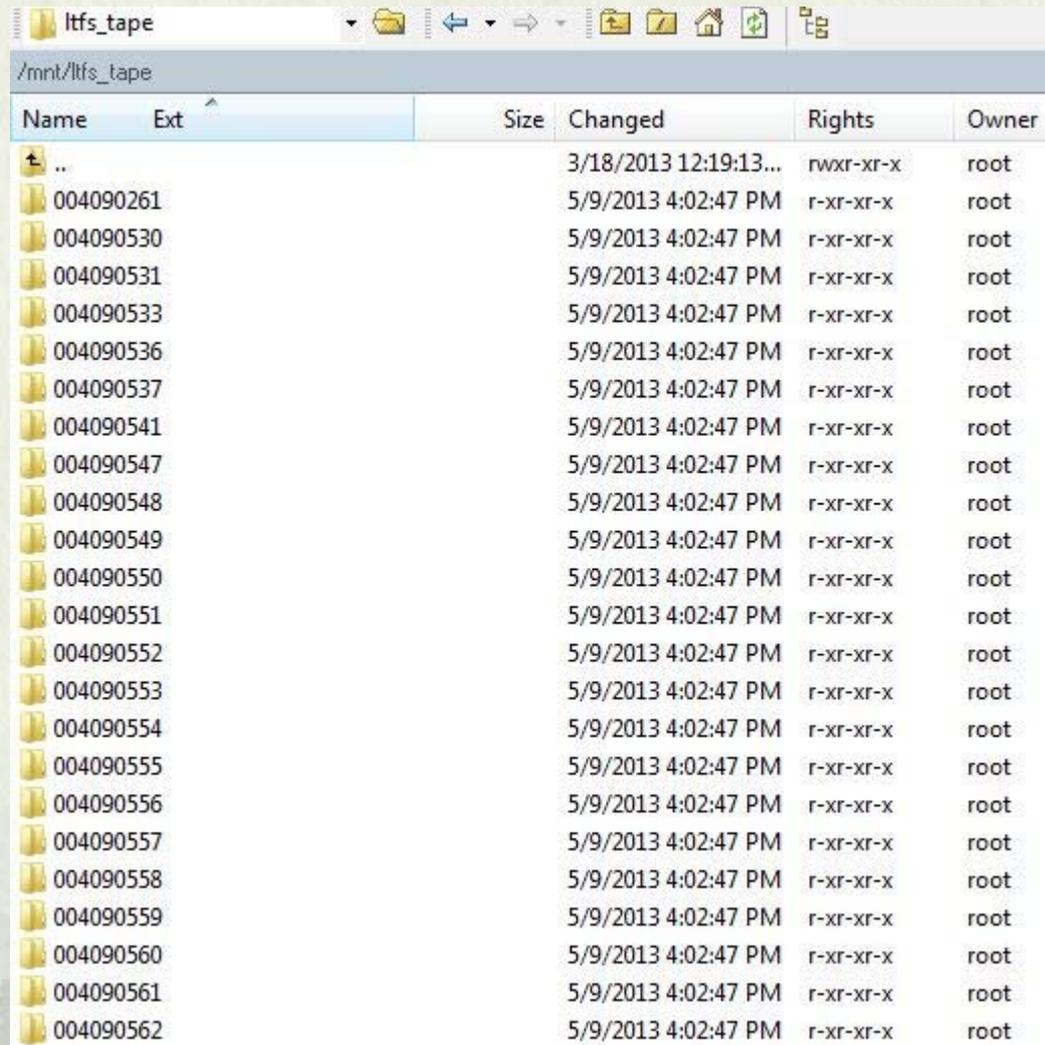
October 18, 2012

FamilySearch AIP Store Using LTFS

- Each Digital Genealogical Society Number (DGS) identifies a “collection” of images and associated metadata
- Each DGS contains hundreds to thousands of images
- Each DGS typically becomes an AIP.
- Each AIP has a directory with subdirectories for each artifact.

A List of AIP Directories

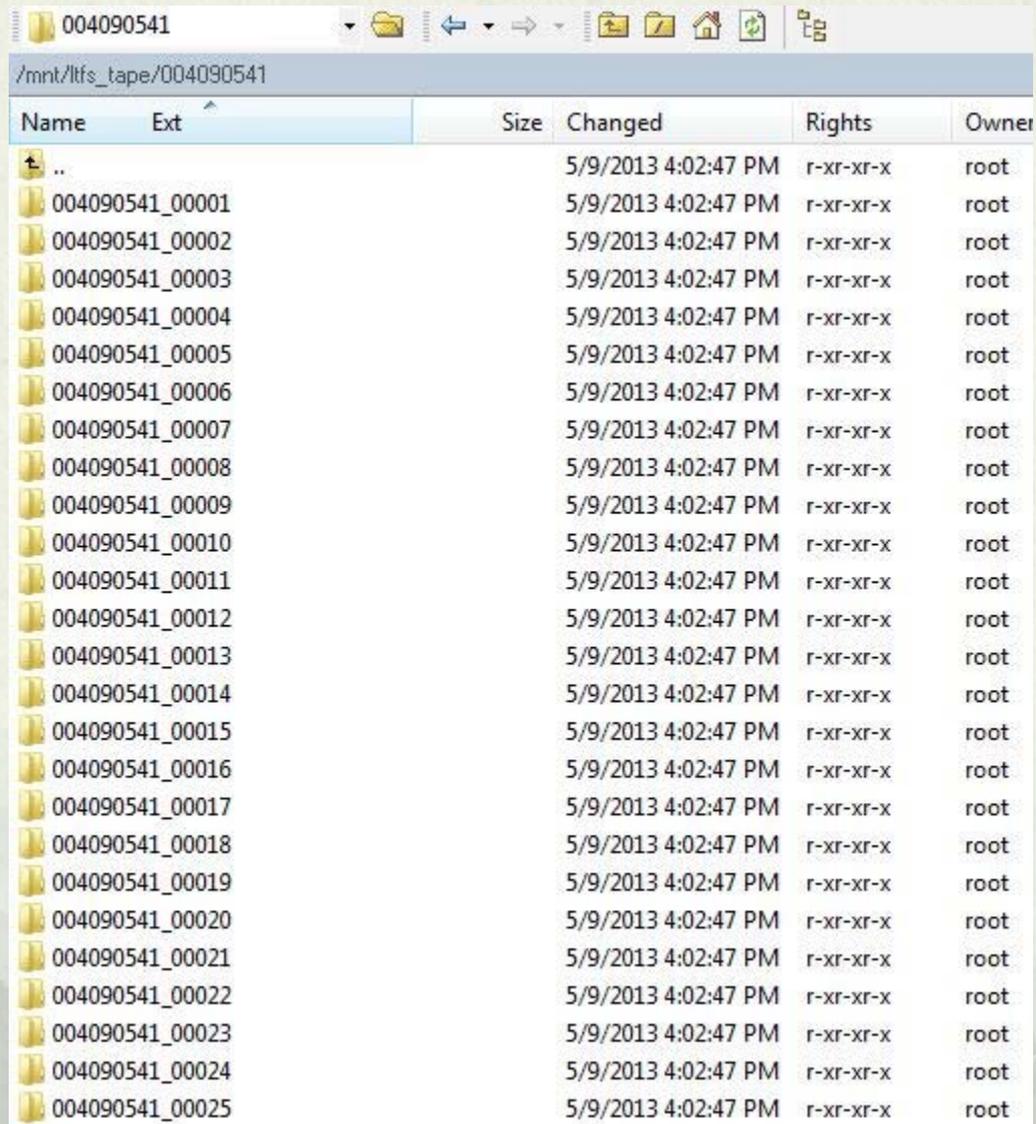
These are in LTFS volume



The screenshot shows a file manager window titled 'ltfs_tape' with the path '/mnt/ltfs_tape'. The window displays a list of directories with columns for Name, Ext, Size, Changed, Rights, and Owner. The list includes a '..' directory and 31 numbered directories from 004090261 to 004090562. All directories have 'r-xr-xr-x' permissions and are owned by 'root'. The 'Changed' column shows dates from 3/18/2013 to 5/9/2013.

Name	Ext	Size	Changed	Rights	Owner
..			3/18/2013 12:19:13...	rwxr-xr-x	root
004090261			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090530			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090531			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090533			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090536			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090537			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090547			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090548			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090549			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090550			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090551			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090552			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090553			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090554			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090555			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090556			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090557			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090558			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090559			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090560			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090561			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090562			5/9/2013 4:02:47 PM	r-xr-xr-x	root

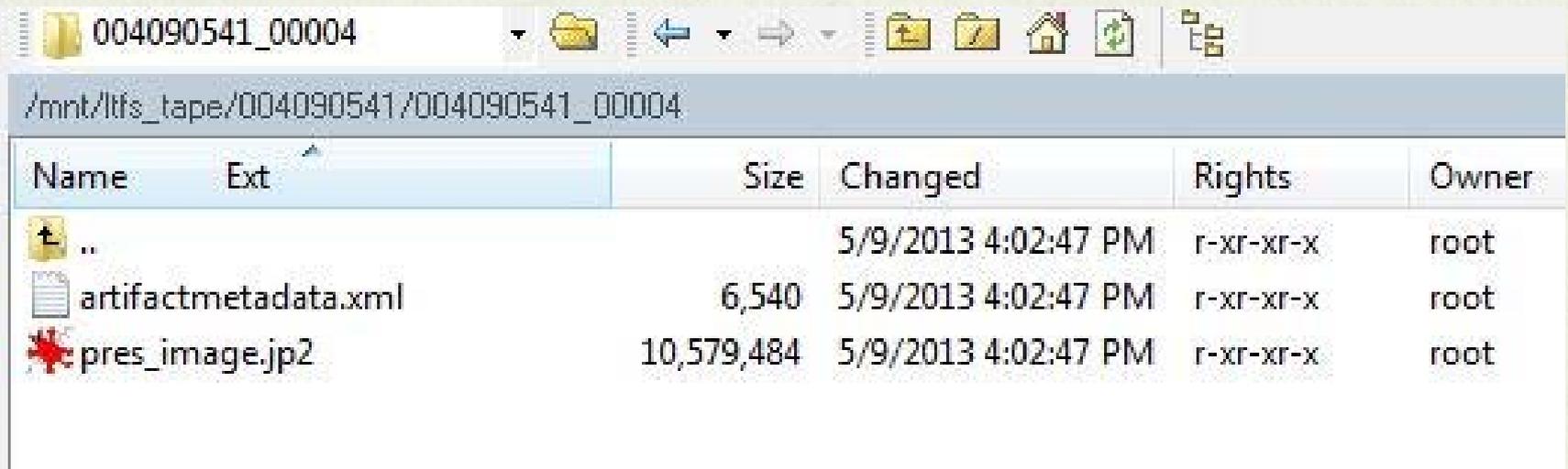
A List of Artifact Subdirectories



The screenshot shows a file explorer window with the address bar set to `/mnt/lfs_tape/004090541`. The window displays a list of subdirectories, each with a yellow folder icon. The columns are labeled: Name, Ext, Size, Changed, Rights, and Owner. The 'Name' column contains the subdirectory names, 'Ext' is empty, 'Size' is empty, 'Changed' shows the date and time '5/9/2013 4:02:47 PM', 'Rights' shows 'r-xr-xr-x', and 'Owner' shows 'root'.

Name	Ext	Size	Changed	Rights	Owner
..			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00001			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00002			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00003			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00004			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00005			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00006			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00007			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00008			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00009			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00010			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00011			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00012			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00013			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00014			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00015			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00016			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00017			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00018			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00019			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00020			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00021			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00022			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00023			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00024			5/9/2013 4:02:47 PM	r-xr-xr-x	root
004090541_00025			5/9/2013 4:02:47 PM	r-xr-xr-x	root

Example of Artifact Directory



Name	Ext	Size	Changed	Rights	Owner
↑ ..			5/9/2013 4:02:47 PM	r-xr-xr-x	root
artifactmetadata.xml		6,540	5/9/2013 4:02:47 PM	r-xr-xr-x	root
pres_image.jp2		10,579,484	5/9/2013 4:02:47 PM	r-xr-xr-x	root

Thank you!

