The Stanford Digital Repository

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Agenda

- Purpose of PASIG
- Stanford Use Cases
- Stanford Ecosystem
- SDR 2.0 - Preservation Core
- Observations, lessons, next steps
Why PASIG?

- A practical forum for practitioners in the preservation & archiving space
- Exchange of requirements, designs, specifications, architectures & practices
- Cross-pollination of technology industry experts and preservationists
SDR is...

- in production since Dec 2006
- a second generation preservation system
- one component in a larger ecosystem of digital library infrastructure
SDR today

- 92+ TB of unique content
- 300+ TB of managed data
- 200,000+ objects
- 62,000,000 files
- 7 content types: books, images, audio, video manuscripts, GIS data, software
- 5 storage migrations
Three Major Areas of Preservation Needs

- **Digital Library**
  - Legacy collections
  - Digitized collections
  - Licensed, locally loaded content
  - Born digital collections

- **Institutional Repository**
  - Research data,
  - Publications, dissertations,
  - Learning objects, university assets

- **External Depositors**
  - Publishers
  - Discipline-specific repositories
  - Reciprocal deposits with peer institutions

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**Preservation Needs (TeraBytes)**

- Google Books (’00s of TB)
- Manuscripts (75 TB)
- Media (50 TB)
- Geospatial Data (10 TB)
- ~30 other digi projects (15 TB)
- Purchased collections (25 TB)
E.g., Google-Scanned Books

Download, process and preserve 8 million volumes in SDR for...

- local indexing,
- text mining,
- selective delivery, and
- long-term access.
E.g., Monterey Jazz Festival

- Festival founded in 1958: longest running jazz festival in the world.
- Rich collection of recordings from inception, spanning over 50 years, in varying states of condition & decay.
- Archives held at Stanford’s Archive of Recorded Sound
- ~800 audio recordings, 1.6 TB audio files in SDR
- ~250 video recordings, 22 TB video files in SDR

Access:
- complete database of digital recordings online at collections.stanford.edu/mjf
- Access via in-site visit to ARS
- New commercial releases on MJF Records
E.g., National Geospatial Digital Archive

- Some 27,000 “at risk” geospatial objects
- TIFFs, GeoTIFFs, Shapefiles, Digital Elevation Models, Digital Orthophoto Quadrangle files
E.g., Preserving Virtual Worlds

Stanford University Libraries
Second Life Open House,
31 July 2009
E.g., Forensically Extracted Born Digital Files

- Digital Forensics lab extracting original computer files from legacy media
- Actively building pipeline from extraction to preservation store
- Support for both immediate and deferred archival processing & description
E.g., Electronic Theses and Dissertations

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Congratulations!
NSF Policy Position on Data Archiving

“NSF's policy position on data is straightforward: all science and engineering data generated with NSF funding must be made broadly accessible and usable, while being suitably protected and preserved.”

NSF and NIH Grants to Stanford

![Graph showing NSF and NIH Grants to Stanford from 2004 to 2010. The graph compares NSF Grants (blue bars) and NIH Grants (red bars) over the years.]
Preservation Is One Leg of a Stool

- Preservation without Access is pointless
  - Further, all signs point indicate that it is not economically viable

- Access without Preservation is myopic

- Robust Management services are prerequisite for accessioning, archiving and providing access to content
  - The “pre-ingest” phenomenon

Can one system handle it all? or
Stanford’s Digital Library Ecosystem

- SDR Preservation Core
- Digital Object Registry (DOR)
- EEMs
- ETDs
- SALT
- Digitization Workflow
- Google Books
- Symphony ILS
- SearchWorks
- Socrates
- "Digital Stacks" Delivery Systems
- Text
- Images
- Media
- Files
- Data
Three Spheres: Management, Preservation and Access

Digitization, Deposit & Management
- EEMs
- ETDs
- SALT
- Digitization Workflow
- Google Books
- Digital Object Registry (DOR)

Preservation
- SDR Preservation Core

Discovery & Delivery
- SearchWorks
- Socrates
- "Digital Stacks" Delivery Systems
- Text
- Images
- Media
- Files
- Data
SDR in Stanford’s DL Ecosystem

Specialty applications provide context-specific, user-facing deposit, and access services tailored to content types and disciplines

- **Library Management Applications**
  - EEMS (acquiring born digital content), digitization workflow, etc.

- **Institutional Repository**
  - ETDs, open access articles, faculty “papers”, research data, web sites, etc.

- **National Geospatial Digital Archive (NGDA)**
  - Geospatial data

- **SULAIR Digital Stacks**
  - Delivery for text, images, mss, media, data, & curated collections

**Stanford Digital Repository (SDR):** content agnostic, preservation repository

and SDR provides “back-office” preservation services: replication, auditing, migration, and retrieval in a secure, sustainable, scalable stewardship environment
E.g., Parker Manuscripts

- 559 Anglo-Saxon manuscripts, 200,000 pages

For each page:

- 22 MB JPEG2000 delivery surrogate
- 22 MB JPEG2000 delivery surrogate
- 110 MB submaster TIFF
- 220 MB master TIFF

Parker.stanford.edu:
Rich web application, tailored for general public, medievalists

SDR – Preservation Core
Separation of Concerns

- Scoped repository: differentiation between *preservation* (provided by SDR) and
  ...*content management* (provided by DOR)
  ...*access* (provided by the Digital Stacks apps)

- Implications:
  - Reduces pressure on SDR to be all things to all depositors, for all content
  - Reinforces need to provide managed & secure storage at scale
  - Reinforces requirement to focus on content integrity services
  - Emphasizes need to integrate SDR to management & access services through stable API’s
SDR 2.0: New Technical Architecture

Admin UI

Sedora (Fedora)
- identityMetadata
- contentMetadata
- provenanceMetadata
- workflow

DOR registered and accessioned

Access

Staging - secure transfer and storage pending preservation
- register
- checksum
- versioning
- store
- package
- assemble
- checksum
- fetch

Storage

SERVICES

workdo coordinates and tracks processes
processes invoke services
SDR 2.0: New Technical Architecture

• Adopt Fedora as a metadata management system
  – Clean mapping of new data model to Fedora content models
  – Reuse same design pattern, core technology as in DOR

• Support for parallelized & asynchronous operations
  – Multiple ingest streams to increase throughput
  – Decompose one process (e.g, “ingest”) into discrete, loosely coupled operations (“checksum”, “package”, “transfer”)

• Adopt a RESTful architecture & common workflow service
Management: Hydra-based Applications

ETD’s – Electronic Theses & Dissertations

SALT – Self-Archiving Legacy Toolkit

EEMs – Everyday Electronic Materials

Under Development...

• SDR’s Front End – Institutional Repository for Stanford
• Hypatia – Archival Arrangement, Description & Access
• SDR Preservation Core Administrative Application
Hydra for Repository Management

- Reusable application framework that sits on top of Fedora – providing CRUD (create, read, update, delete) apps
- Open source application with dozens of contributors
- Basis for Stanford’s user-facing (institutional) repository services (electronic theses, open access articles, data deposit, etc.)
- Interoperates with workflow, robot and web service framework for process orchestration
- Also the basis for an SDR administrative user interface (under development)
SDR 2.0: Revised Data Model

SDR 1.x’s METS-based SIP, AIP and DIP, had many issues:

- Each Transfer Manifest was content & collection specific → Doesn’t scale
- Transfer manifests require too much interpretation and analysis to change, augment
- Too complex: Stanford METS structure breaks apart related data across the object
- Wraps (somewhat dynamic) metadata with (mostly static) data files in same envelope
- Recursive nature of transfer manifest makes versioning self-referential, complex
- No one speaks METS natively: depositors, SDR & clients all forced to perform translation at handshakes
Content Structures and Flavors of Metadata

- Flexible data model can take any type of data, packaged in “bags”
  - A “bag” is a directory with standardized top-level structure and syntax

- Minimizes analysis & processing required on ingest

- Preserves options for future processing & transformations based on future needs

Each object has seven discrete metadata files:

- Identity metadata
- Descriptive metadata
- Content metadata (aka structural metadata)
- Technical metadata
- Rights metadata
- Source metadata
- Provenance metadata
SDR Deposits: Content Transfer via Bagit

druid
/bagit-info.txt

Stanford-Content-Metadata: data/metadata/contentMetadata
Stanford-Identity-Metadata: data/metadata/identityMetadata
Stanford-Provenance-Metadata: data/metadata/provenanceMetadata
/data
/metadata
/contentMetadata
descMetadata
/identityMetadata
/provenanceMetadata
/rightsMetadata
/sourceMetadata
/technicalMetadata
/content
/file1
/file2
:
Lessons Learned Over 5 Years

• Custom code, maintained by evolving & smaller team, was inefficient & unsustainable
  – Adopted Fedora for metadata management, Hydra for application framework
  – Shared technology & design patterns with rest of digital library ecosystem
  – API’s for management, ingest, retrieval, reporting

• Bottlenecks
  – Need to be quicker to add new content types & collections: simplify the data model, support “Zip & SIP”
  – Need to increase the throughput to the storage layer led to parallelization of processes

• Need to refine & hone the SDR service model
  – Need to deemphasize curation approach, shift away from “just in case” to a “just in time” mentality
Next Steps

- Scale to 1 PB
- Migrate legacy content and SDR 1 content to new environment
- Relate & manage preserved objects through RDF
- Develop robust administration and workflow management tools via Hydra
- More granular encapsulation of work into “robots” and web services
Growth in Disk and Computing at SULAIR