Preservation and Archiving Special Interest Group Spring Meeting

San Francisco, 27-29 May 2008

Preservation Is Not A Location

Stephen Abrams
John Kunze

California Digital Library

Programmatic focus

- In order to be effective over any interesting period of time, preservation needs to be considered from a board programmatic orientation, as opposed to a more narrow project or systems focus
- Many other digital library services (e.g. high-volume end-user access) can benefit from features traditionally discussed only in a preservation context

Desiderata

- "Entities should not be multiplied beyond necessity"

  – William of Occam

- "The supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience" – Albert Einstein

- How simple can a preservation environment be and still be effective?

Digital preservation

- A set of intentions, activities, and (hopefully) outcomes aimed at the usability of authentic digital objects over time
- Intentions can be articulated in terms of desirable object- and service-centric values
- Activities can be articulated in terms of strategies designed to foster those values

Object-centric values and strategies

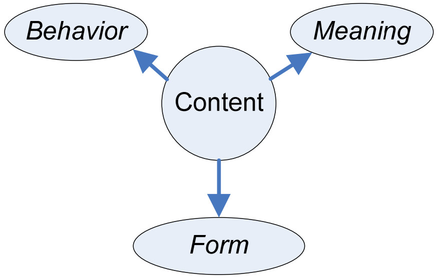
Value	*Justification*	*Strategy*
Identity	To distinguish an object from all others	Persistent naming
Viability	To recover an object from its medium	Redundancy, heterogeneity, media refresh
Fixity	To ensure that an object is unchanged from its accepted state	Redundancy, error correcting codes, message digests
Authenticity	To ensure that an object is what it purports to be	Cryptographically-secure signatures
Ontology	To understand the significant nature of an object	Syntactic, semantic, and pragmatic characterization
Visibility	To enable patrons to find objects of interest	Public discovery
Utility	To expose the underlying information content of an object	Behavior-rich delivery
Appraisement	To understand the consequences of the passage of time	Analysis and assessment
Timeliness	To know when a preservation value is threatened	Technology watch

Service-centric values and strategies

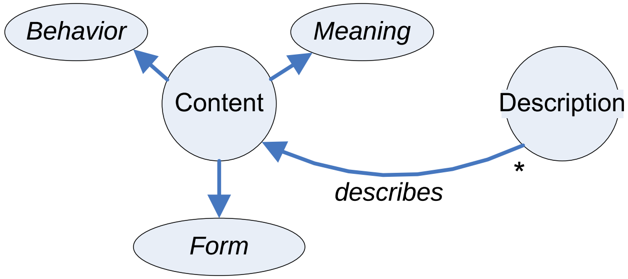
Value	*Justification*	*Strategy*
Availability	To provide access at the time of a patron's choosing	Redundancy, automated failover
Responsivity	To provide appropriate throughput in servicing requests	Redundancy, automated load balancing
Security	To enforce appropriate use of systems and content	Identity management, access control lists
Sustainability	To ensure ongoing access and use	Institutional commitment, financial cost-recovery, staff retention and education

- These strategies can be codified in terms of abstract services, which in turn can be implemented through
  - Human activities
  - Automated systems

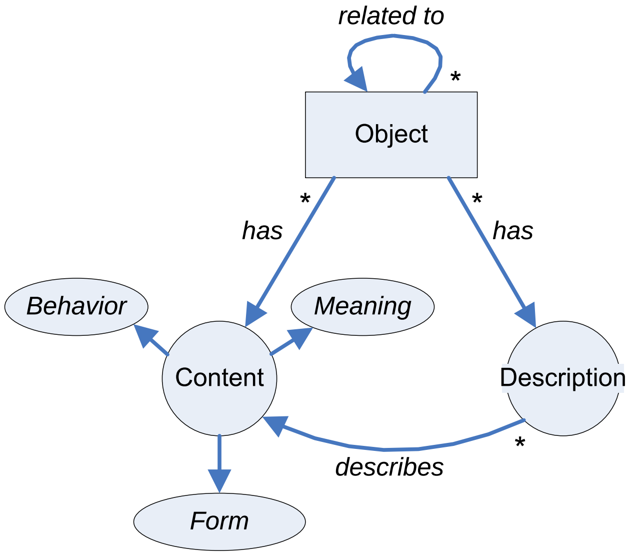
Preservation objects



Preservation objects



Preservation objects



Storage substrate

- Ideally, storage is provided as a ubiquitous commodity at a range of functional service levels (and, presumably, price points):

– Coherence	:	Unstructured	⇔	Structured
– Resilience	:	Unreliable	⇔	Dependable
– Permanence	:	Transient	⇔	Persistent
– Performance	:	Slow	⇔	Fast

- Object components should be assigned to the least functional, lowest cost storage than minimally meets their requirements at a point in time

Preservation services

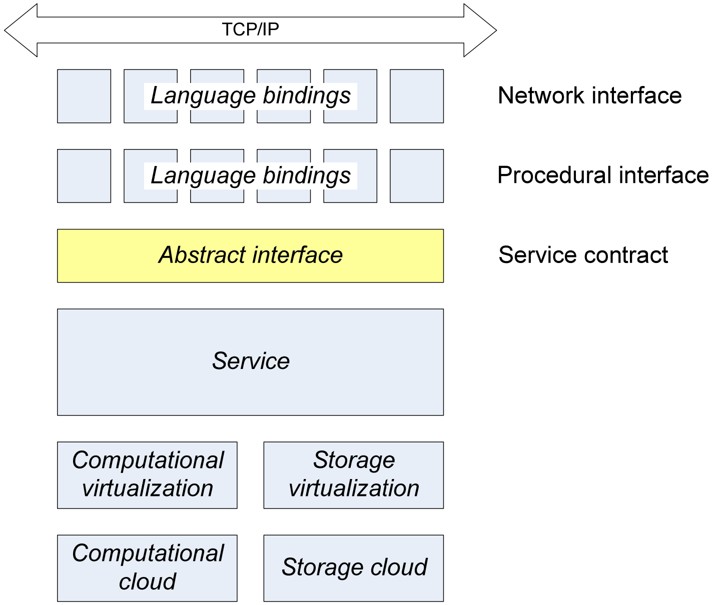
- A set of simple, orthogonal services whose invocation can be requested or scheduled
  - Ingest
    - Characterization
    - Normalization
    - Enrichment
    - Naming
  - Archival storage
    - Fixity
    - Replication
  - Data Management
    - Indexing
    - Querying
    - Logging
    - Reporting
  - Access
    - Discovery
    - Request
    - Packaging
    - Delivery

Technological invariance

- 1988
  - FTP
  - POSIX command shell and file system interface
  - RDMS / SQL
- 2028?
  - HTTP
  - URI
  - XML
- Due to their inherent abstract nature, protocols and interfaces last longer than systems

Preservation services

- Easily deployed in sufficient number and location to meet demand

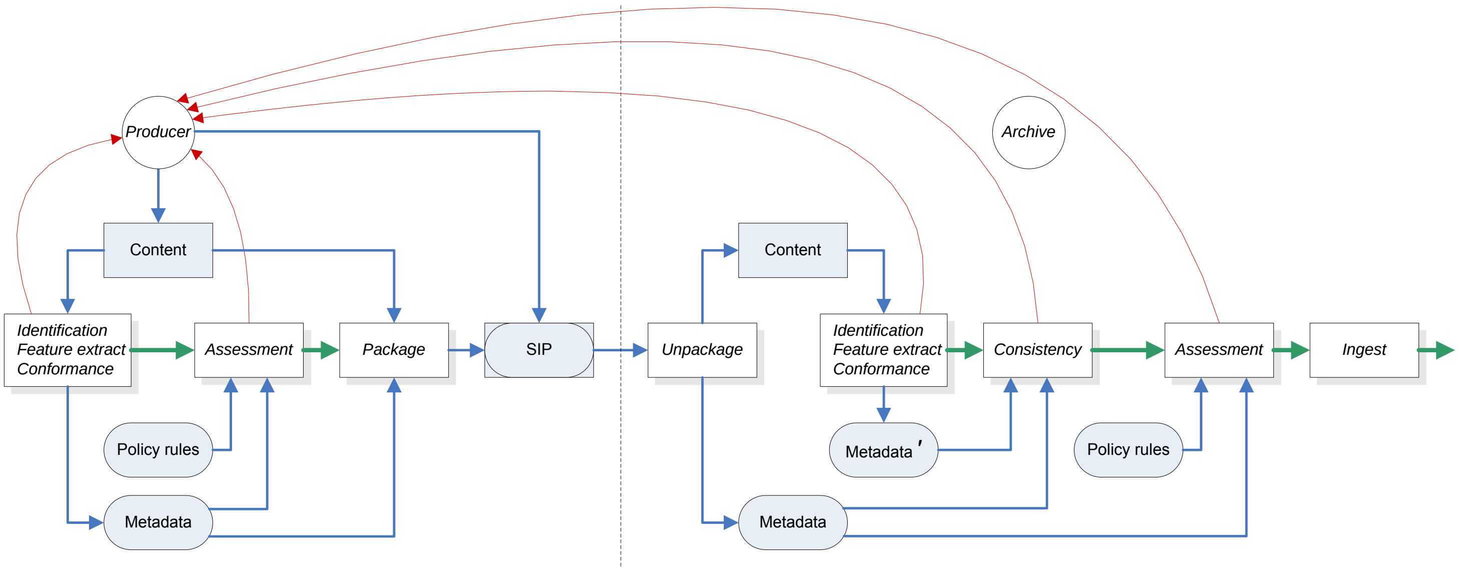


Preservation begins far upstream

- Born-archival objects
  - Easy, fast format characterization in hands of Producers
  - Early, cheap generation of identifiers suitable for persistent reference
  - Better metadata via heuristics (eg, GNU autoconf) and prompting
- Sharing – “preservation implies more than one location”
  - Common object substrate: Pairtree, Eflat
  - Object exchange: BagIt, GrabIt
  - Spreading the risk: format desiccation and diversification
- Transparency and simplicity help us focus on funding and cooperation

Easy, fast object characterization

- Producer-side validation
  - Push characterization operations as far up-stream as possible
  - Early detection of anomalous or problematic data facilitates efficient remediation
  - Requires combination of tools and education



Early, cheap preservation-ready identifiers

- Identifiers with decent chances of persistent reference are usually assigned very late
  - Strangely, objects are often renamed at peak of valuation
- Can we freely give out preservation-ready IDs, even if only a fraction ever return attached to “valued” objects?
  - Lightly-controlled “minting” services, e.g. like tinyurl
  - Requires combination of tools and education

Better object description via heuristics

- Metadata won’t go away, but collecting it is a pain
  - Who, what, when, where, …, <technical metadata>
  - Some metadata is easy to generate, some is not worth generating
- Tool to generate good guesses with user prompt to correct
  - Think GNU “autoconf”, to poke around a computer to develop very sophisticated system metadata guesses
  - Could be applied at multiple life-cycle stages

Preservation implies more than one location

Pairtree: thinnest possible smear on top of a file system to make an object system

cyocum

- Platform-independent file hierarchy that factors the scarily-hard repository into
  - Easy, powerful names
  - The stuff that’s merely hard
- Common substrate for simple or complex access and preservation systems

What a pairtree gives you

- A file system hierarchy mapping an ID string to a unique object directory using pairs of characters

  `abcdefg` ⇒ `ab/cd/ef/g/`

  - There there: all the object's files and nothing but the object's files
- Import a pairtree and, knowing *nothing* about objects' nature, reliably
  - Enumerate all objects and their identifiers
  - Produce any object by requested ID
  - Maintain and back it up with ordinary OS tools
  - Rebuild the collection in case of database corruption simply by walking the filesystem

Where pairtree leaves off

Inside object is another story, such as, “*eflat*”

```
object/
 |  meta.txt
 |  files.txt
 |  data/
 |  v001/ . . . v004/
 |  meta/
 |  m001/ . . . . . . . m039/
 |  annotations/
 |  audits/
 |  config/
 |   . . .
 |  pairtree…
```

Object exchange with BagIt and GrabIt

- Need: to move *lots* of files from CDL to Library of Congress
  - *BagIt* file package format
  - *GrabIt* exchange protocol
- Informed by lessons from
  - AIHT transfer test
  - ARC file format, and
  - “Enclose and Deposit” (Tabata and Sugimoto, IWAW 2005)

Sign on a Berkeley Ecology Center Recycling Truck

BagIt file package format

- A hierarchical file exchange package suitable for…
  - Generic content (no knowledge of bag payload required)
  - Disk- or network-based transfer
  - Possible bag return on a “rainy day”
  - Optional packing metadata & checksums
- Spec at http://www.ietf.org/internet-drafts/draft-kunze-bagit-01.txt

BagIt "bag" structure

- A "bag" reserves just enough file names to permit the safe enclosure of manifest, checksums, "tag" info, arbitrary payload, and optional "holes" for space/time efficiency

```
<bag_dir>/
 |   manifest-md5.txt   complete file list + checksums
 |   bagit.txt          declares this to be a "bag"
 |   package-info.txt   optional packing metadata
 |   fetch.txt          optional URL list completing bag
 \--- data/
         |    . . .          arbitrary payload files
```

GrabIt package exchange protocol

- Bag it, tag it, but don't ship it…
  - Instead, grab it, since a push is really a pull
- GrabIt is intended for moving large batches
  - When you have lots of bags (sent as "tarballs")
  - Or lots of other file sets, such as ARC containers
- Beats the tedium and error rate in emailing URL lists

Spreading the risk: data desiccation

- Generation of long-lived, perhaps feature-poor derivatives
  - Store derivatives along with originals
  - If original fails, desiccated version has better chance of survival and retains most of the original’s value
  - Should generated derivative close to height of format popularity, when implicit knowledge is tranferred

The Big Risks

- Transparency and simplicity help us *focus*, *cooperate*, and *regenerate*
- Must not be distracted from the Big Risks:
  - Political or financial loss (e.g., bankruptcy)
  - War, social upheaval, natural disaster
  - Power outage, disk failure, human error