An Emergent Micro-Services Approach to Digital Curation Infrastructure

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The new curation landscape

Increasing number, size, and diversity of content, and content producers and consumers

– More stuff, smaller budget

Inevitability of disruptive changes in technology, user expectation, and institutional mission and resources

– “My grant requires a data sustainability plan”
– “I know I should be doing something more to protect my stuff, but I don’t know what”
– “I don’t want to preserve my stuff, just store it forever”
Assumptions

Curated content gains
- Safety through redundancy
- Meaning through context
- Utility through service
- Value through use

Decentralized curation can be as effective as centralized

Curation stewardship is a relay
Imperatives

Do more with less
Enable curation at the point of use
Plan for change

– Focus on content, not the systems in which that content is managed

– Ockham’s Razor and Murphy’s Law suggest
  ✓ Favor the small and simple over the large and complex
  ✓ Favor the proven over the (merely) novel
Curation micro-services

Devolve curation function into a granular set of independent, but interoperable micro-services

– Since each is small and self-contained, they are collectively easier to develop, deploy, maintain, and extend

– Since the level of investment in and commitment to any given service is small, they are easier to replace when they have outlived their usefulness

– Although the scope of each service is limited, complex behavior *emerges* from the strategic composition of individual, atomistic services
## Curation micro-services

<table>
<thead>
<tr>
<th>Curation</th>
<th>Value</th>
<th>Service</th>
<th>Context</th>
<th>Protection</th>
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- **Value**
  - “Lots of uses keeps stuff valuable”
- **Service**
  - “Lots of services keeps stuff useful”
- **Context**
  - “Lots of description keeps stuff meaningful”
- **Protection**
  - “Lots of copies keeps stuff safe”
Curation lifecycle
Design principles

Model the major conceptual entities embodying a given service

- Defined in terms of state properties and behaviors that can access and manipulate that state

Assertions of persistence of curation function are made relative to interfaces

- Underlying implementation can and will evolve over time without invalidating interface service “contract”

Defer implementation decision-making until needs and outcomes are well understood
Storage service

Service
– Central broker to an arbitrary number of storage nodes

Node
– Object store encapsulating a particular technology, policy regime, or administrative scope

Object
– Digital representation of a coherent unit of abstract content

Version
– Set of files representing a discrete object state

File
– Named, *but not typed*, byte stream
Storage service

- Help
- Get-service-state
- Get-node-state
- Get-object-state
- Get-version-state
- Get-file-state

- Get-object
- Get-version
- Get-file
- Add-version
- Delete-object
- Delete-version
## Storage service

**METHOD Get-file-state**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Type</th>
<th>Obligation</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Node</td>
<td>Identifier</td>
<td>Mandatory</td>
<td>Storage node</td>
</tr>
<tr>
<td>Object</td>
<td>Identifier</td>
<td>Mandatory</td>
<td>Object identifier</td>
</tr>
<tr>
<td>Version</td>
<td>Identifier</td>
<td>Mandatory</td>
<td>Version identifier</td>
</tr>
<tr>
<td>File</td>
<td>Identifier</td>
<td>Mandatory</td>
<td>File identifier</td>
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<tr>
<td>Form</td>
<td>Enum</td>
<td>Optional</td>
<td>Response form</td>
</tr>
</tbody>
</table>

**RETURN**

| State | Mandatory | File state |

**SIDE EFFECTS**

*Not applicable*

**ERRORS**

...   

GET `/fileState/node/object/version/file` HTTP/1.1
Accept: application/json

% store getFileState node object version file -f json

File.getState(node, object, version, file, Form.JSON);
Storage service

The general principles of granularity and orthogonality continue to apply to subsidiary specifications and conventions

- Content Access Node (CAN)
- Pairtree
- Dflat / Dnatural
- Checkm
- Reverse Directory Deltas (ReDD)
- Namaste (Name-as-text)

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Storage service

Rely on the file system as the paradigmatic storage abstraction

- Modern file systems exhibit excellent scaling properties
  - Constant read/write time independent of number and size
  - Traversal time scales linearly with number and size

- The file system holds the “copy of record” of object metadata

- A duplicated subset of metadata is managed in the higher-level Inventory service as an optimization for routine administrative and curatorial queries
Storage service
## Development milestones

<table>
<thead>
<tr>
<th>First wave</th>
<th>Second wave</th>
<th>Third wave</th>
<th>Fourth wave</th>
<th>Fifth wave</th>
<th>Sixth wave</th>
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</thead>
<tbody>
<tr>
<td>Identity</td>
<td>Inventory</td>
<td>Index</td>
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<tr>
<td>Storage</td>
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<td>Fixity</td>
<td>Replication</td>
<td>Characterization</td>
<td>Transformation</td>
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<td>Object and collection modeling</td>
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<td>Authentication and authorization</td>
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<td>Policy and business model development</td>
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</table>
Summary

• Provide for
  – Safety through redundancy
  – Meaning through context
  – Utility through service
  – Value through use

• Decentralization of applicability

• Granularity and orthogonality of service

• Complexity through composition, not addition

• Persistent interfaces, evolving implementations

• Reliance on the file system
Questions?

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