Stanford University LIBRARIES &
ACADEMIC INFORMATION RESOURCES

Defining and Designing a Cyberinfrastructure for the Library of the Future

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Digital Library Systems & Services
Stanford University
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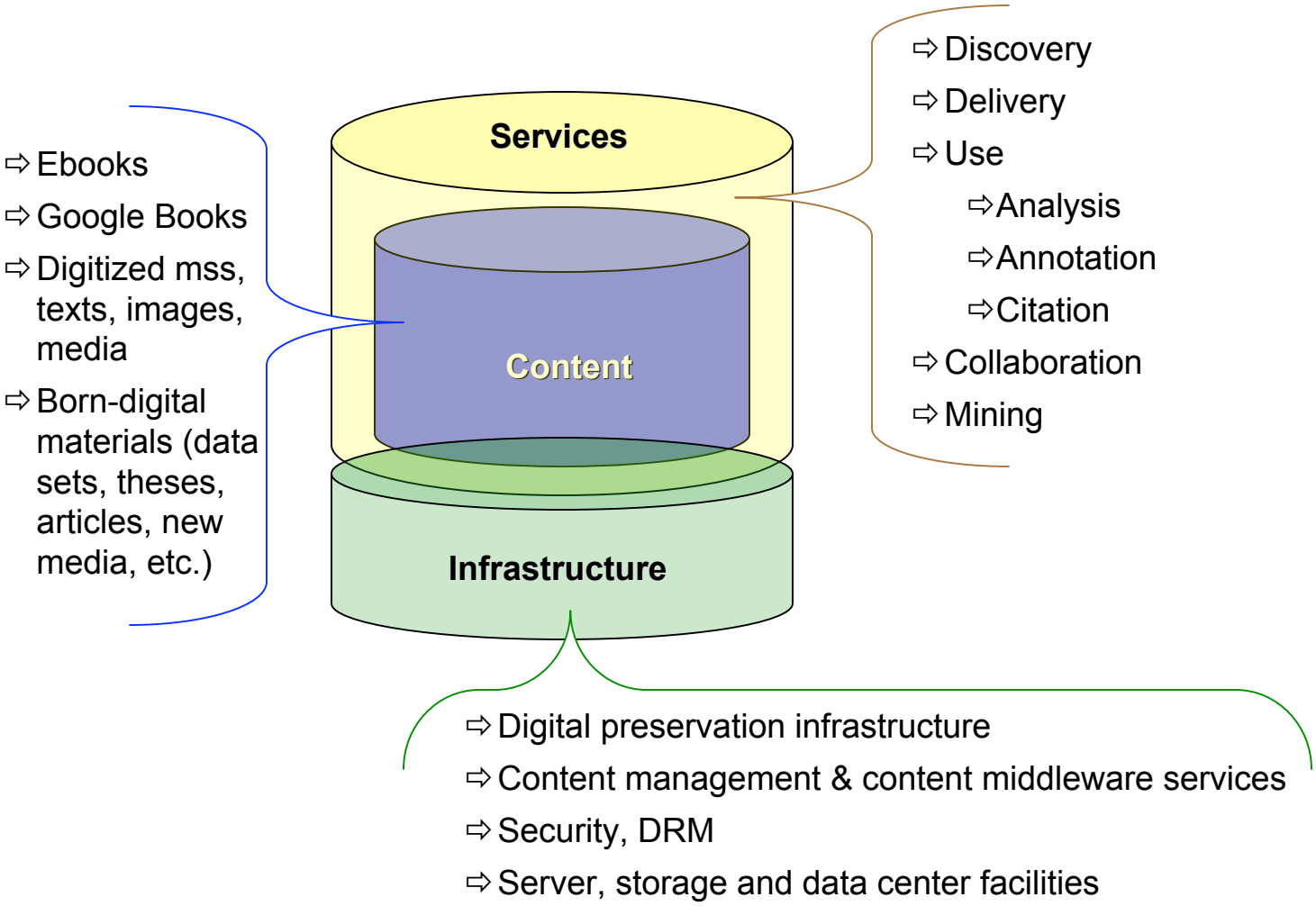
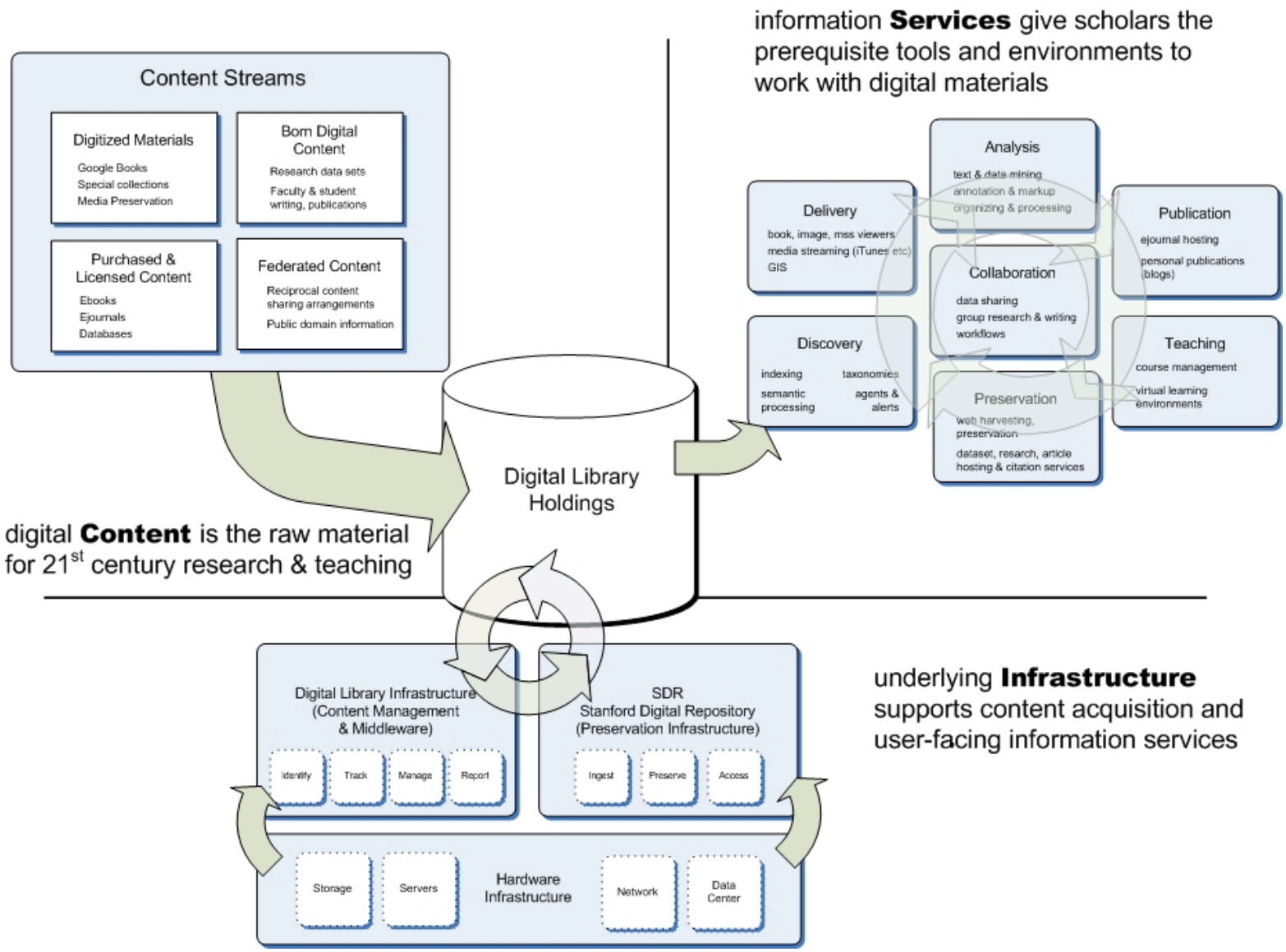
The Digital Library: Content, Services, Infrastructure



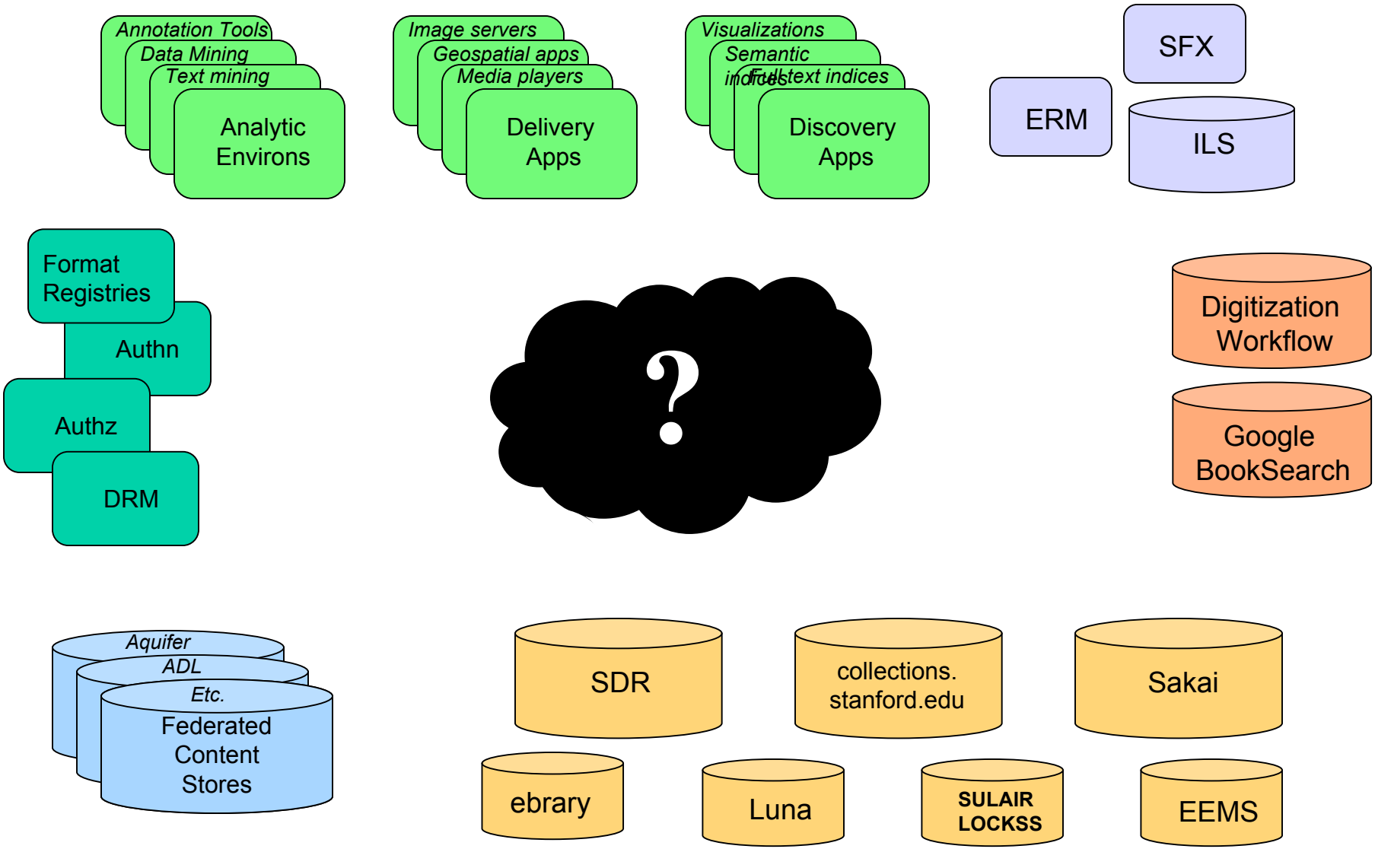
Another View of Underlying Infrastructure



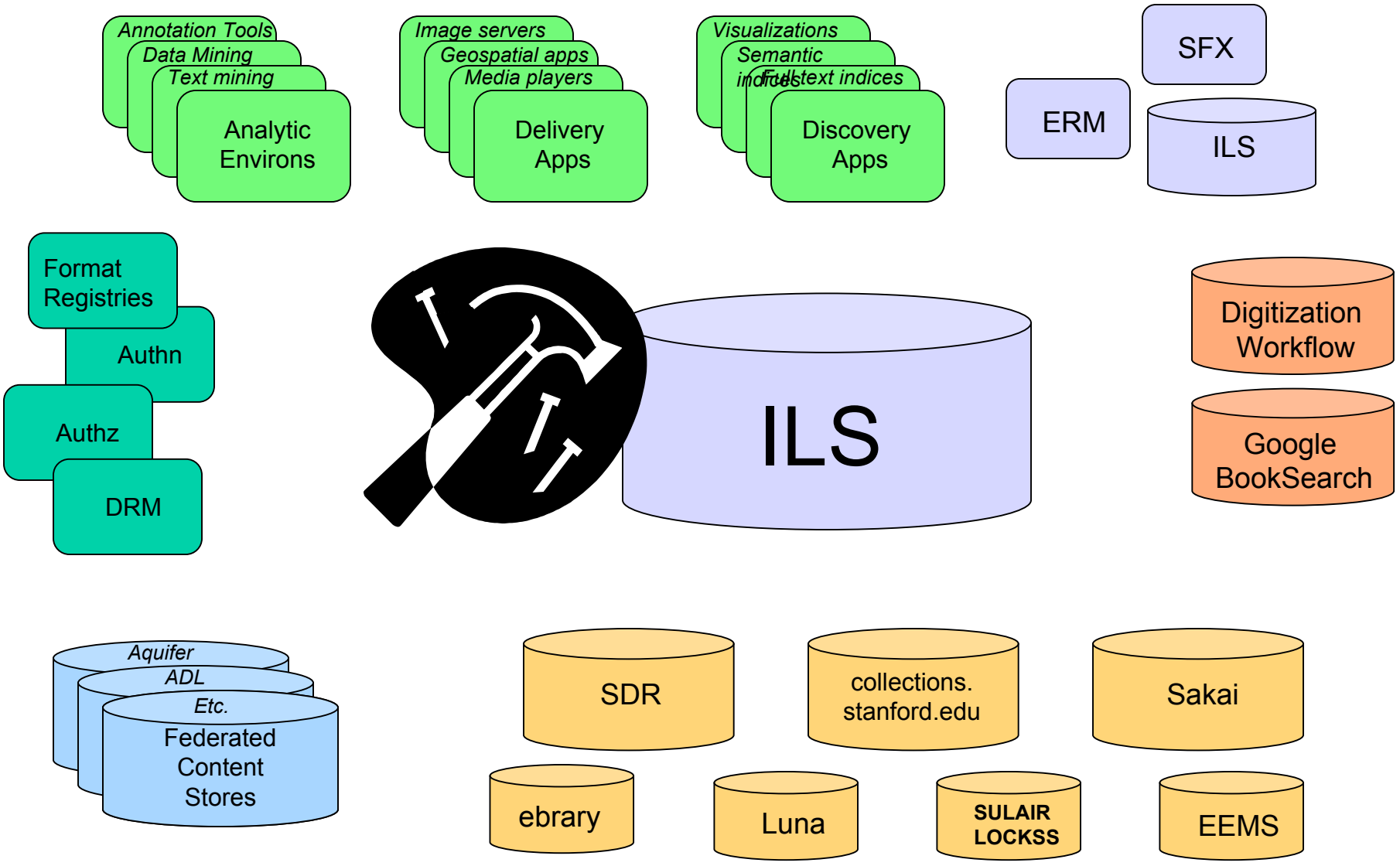
Environmental Scan at SULAIR

1. Digital preservation
   - SDR (the Stanford Digital Repository)
   - NGDA
2. Google Book Search scanning
3. Internal digitization
   - workflows, processing & delivery
4. Discovery
5. Content delivery
   - mss, image & book application environments
6. Ongoing process reengineering & optimization

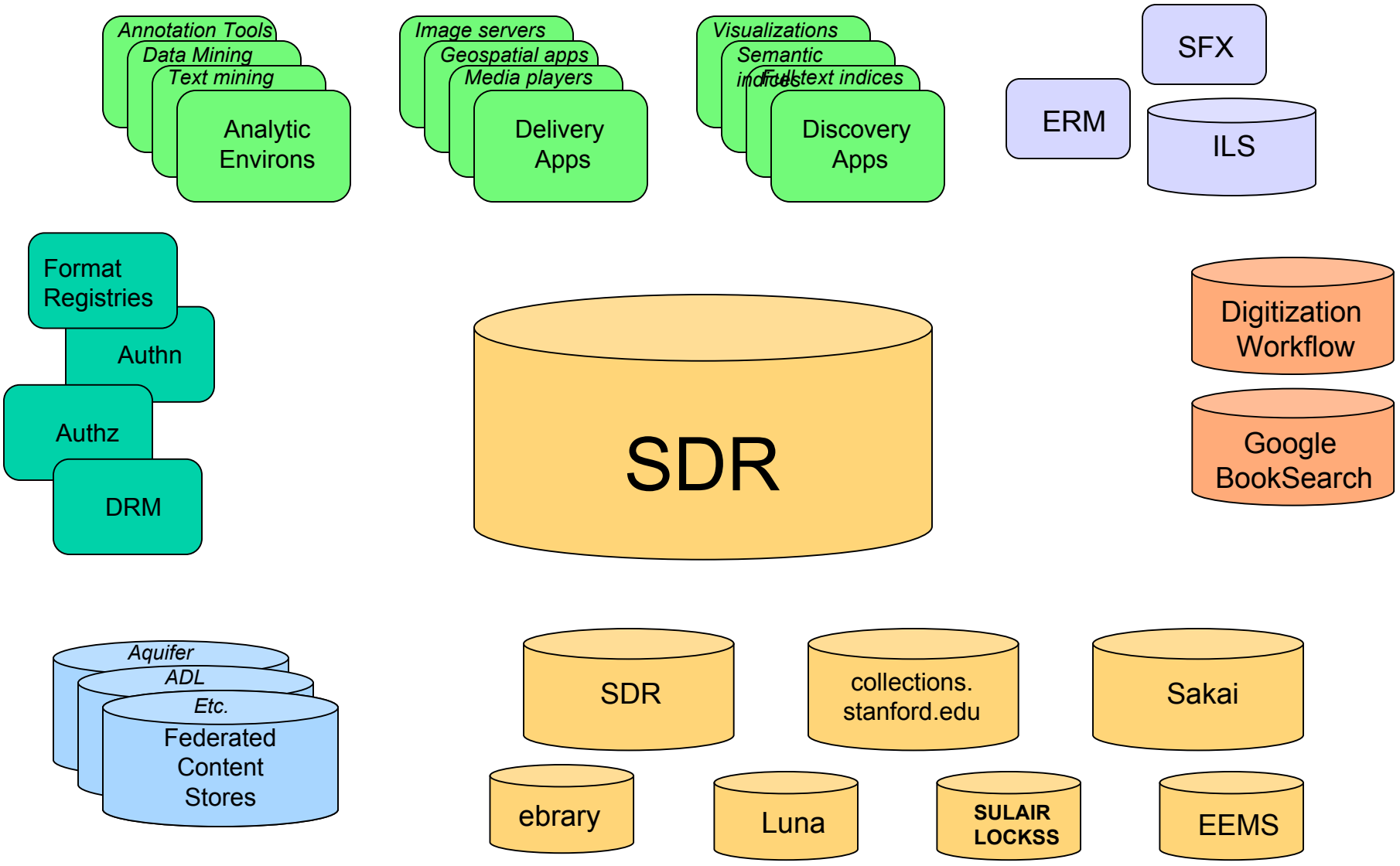
The Challenge



Strategy 1: Hardware Approach

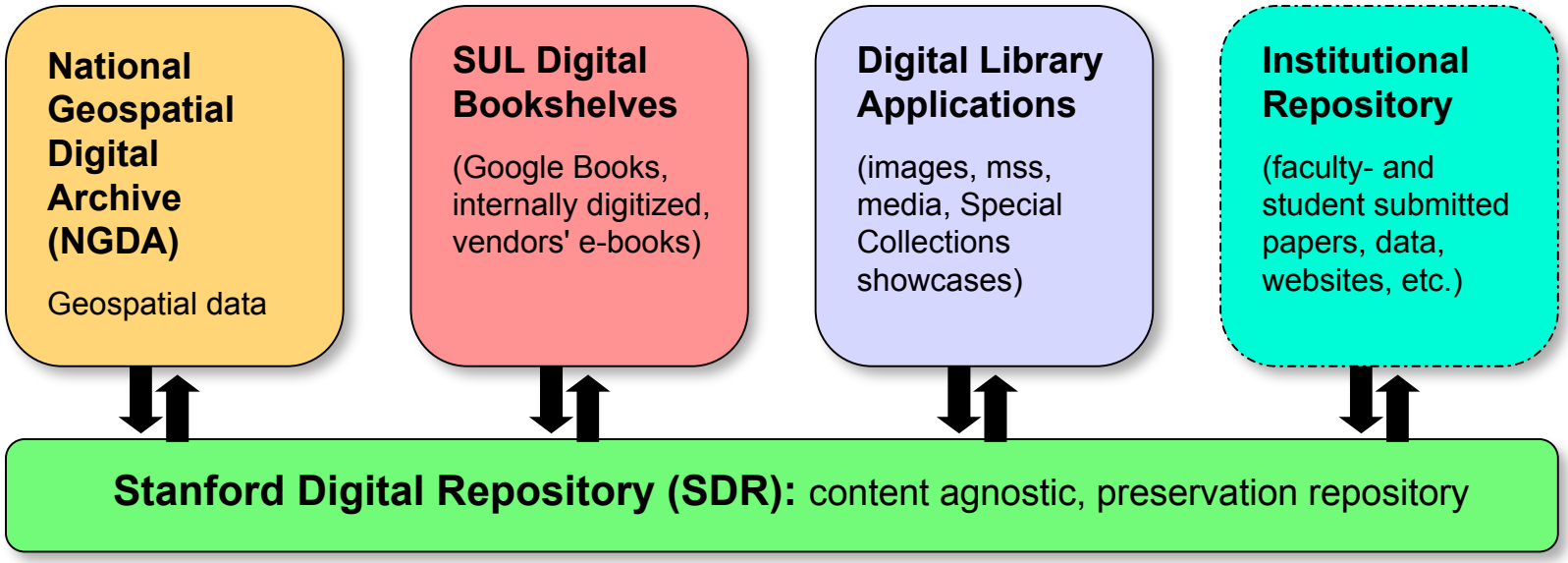


Strategy 2: Repository Centric

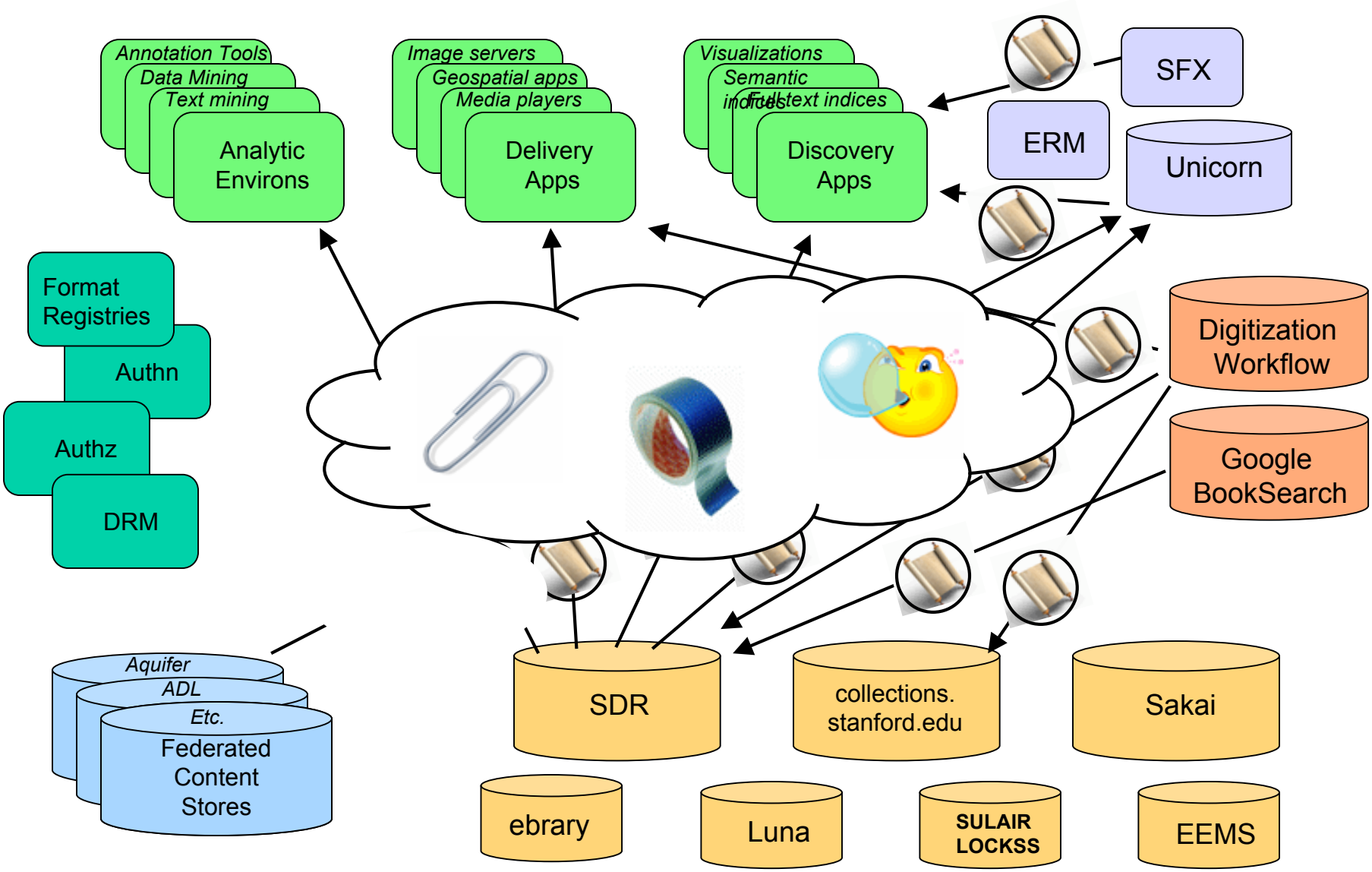


SDR Serves As Common Preservation Infrastructure

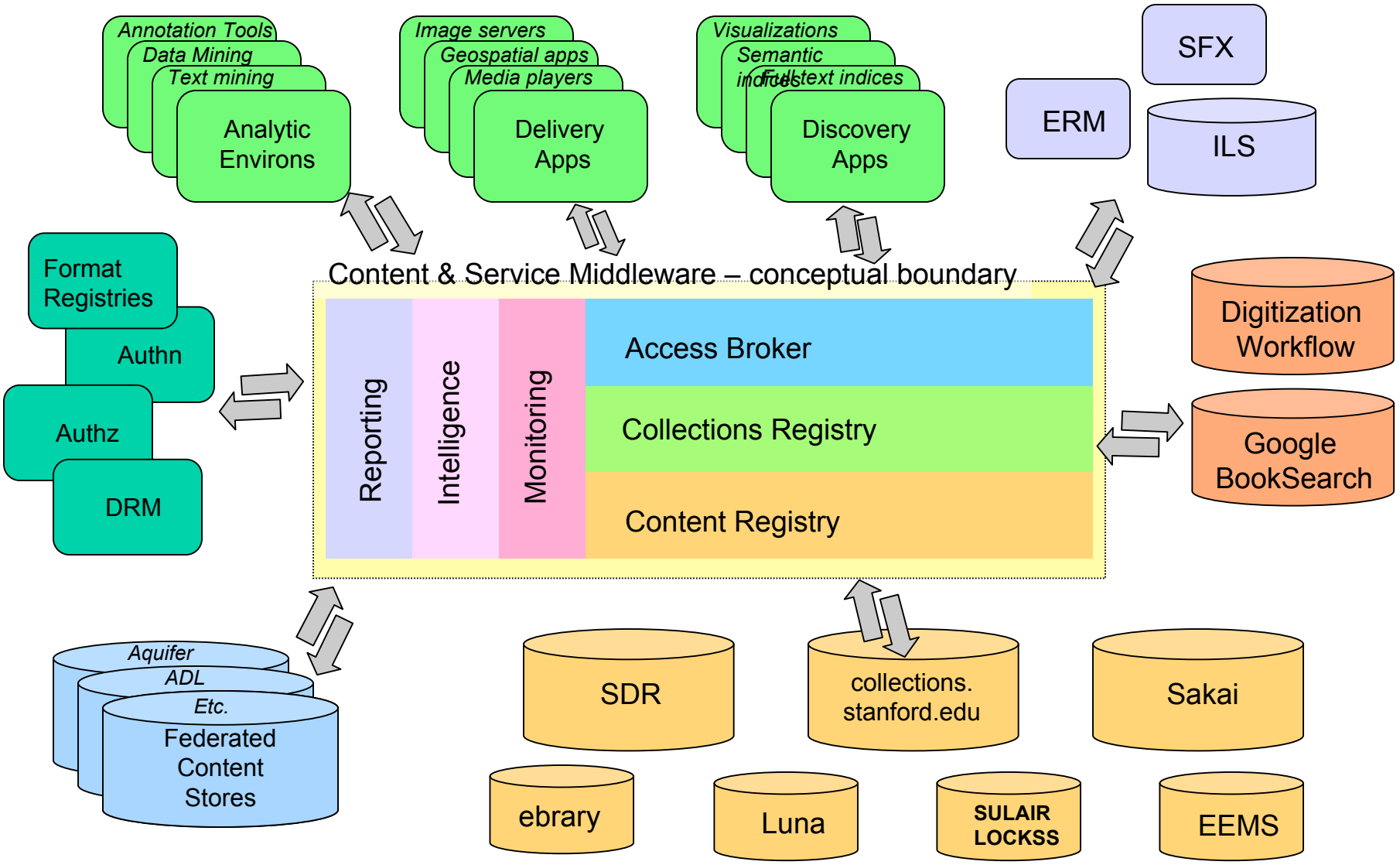
while specialty archives and applications provide focused digital content collection, access and value-added services



Strategy 3: MacGyver It

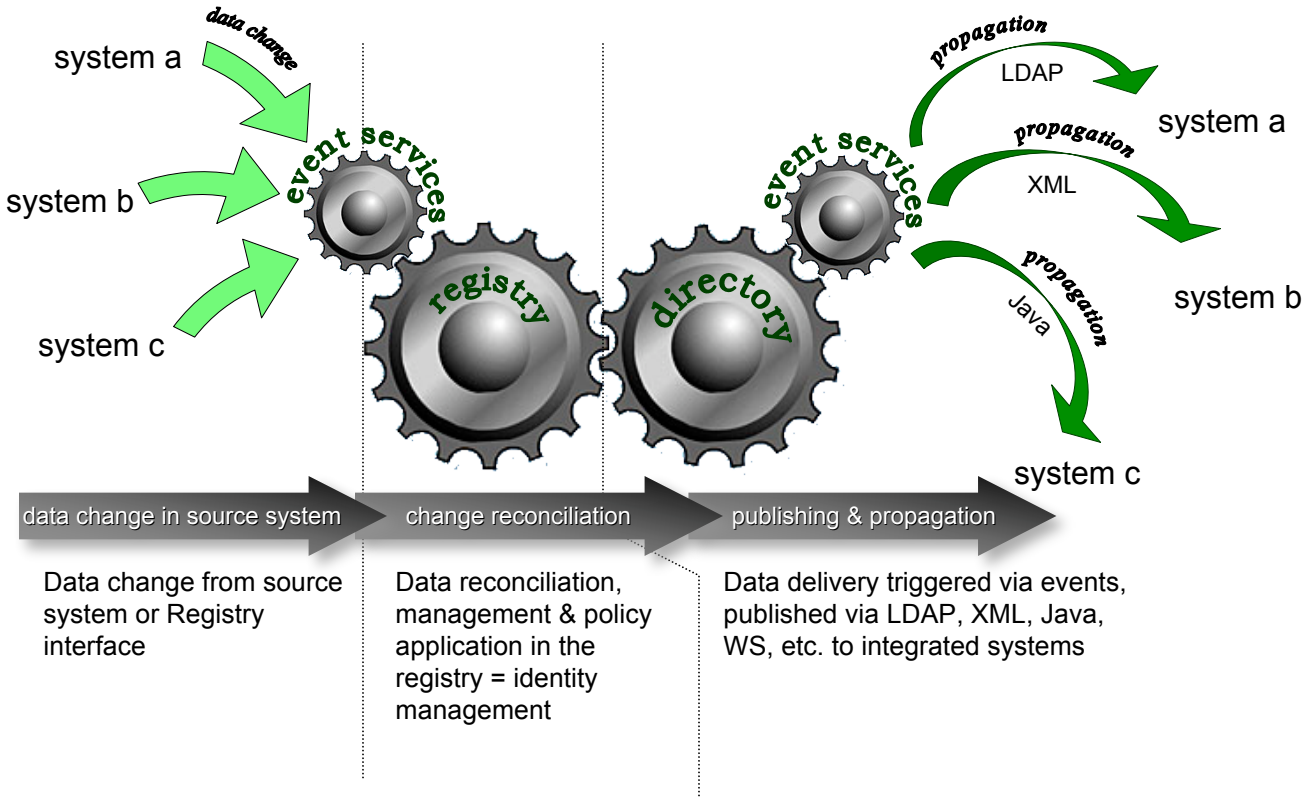


Strategy 4: Library Middleware



Parallels to Identity Management

In enterprise computing, the middleware that reconciles representations of entities (people, organizations, groups, etc.) across disparate systems, distributes this information across the infrastructure, and serves as the basis both for authentication and authorization (privilege assignment & management).



The process

1. Recognize need
2. Think through narratives
3. Identify parts
   - Applications
   - Services
   - Infrastructure
4. Assemble in an architecture
5. A diversion into ESB's
6. Validate concepts & find a name (still searching)

Narratives

1. Support for scholarly workflows
2. Personalized academic work environment
3. The DIY Library/Research Environment
4. Integrated, comprehensive content discovery
5. Creating, managing, publishing dynamic digital collections
6. Extend library infrastructure & workflows to already-digital content
7. Flexible digitization workflow
8. Library management, operations and reporting

1. Scholarly workflows

Support collaboration, research and publication through a full information and creative lifecycle.

- Research: raw data, to distilled, to published, to reference data.
- Scholar/author: notes, to drafts, to preprint, to published article, to archival version
- Faculty: preparing a course, to conducting a course, to materials added by students, to archiving the course
- Generically: transition from private to group to public
- Post publication lifecycle, e.g., continued access to post-project web sites

Capabilities

- Personal identity -- status, role, relationship to resources
- Collaborators -- roles, groups, rights
- Repository services -- data capture, backup, sharing, archiving
- Preservation -- archived data that's verifiable, citable, reusable
- Capture annotations, corrections, additions, versioning
- Transformation into publication formats

2. Personalized Academic Work Environment

Highly personalized services and resources based on persistent and intimate knowledge of the scholar's identity, roles, background, explicit choices, and implicit preferences.

- Endow all services with an awareness of personal identity, preferences and contributions
- Connect authors to their publications and citations
- Support consistent user tools & experience across UIs
- Preferences
  - Favorite resources (creating resource lists), ranked search results
  - Saved sources (citations), searches, ratings, tags and annotations
  - Language, delivery formats (accessibility)
  - Saved visibility settings (private, group-restricted, public)

3. The DIY Library/Research Environment

Enable scholars to use the tools of their choice to incorporate library data, metadata, and complementary services into their workspace

- Open access/APIs to content, metadata, library services
- Content extraction/delivery to local environment
- Support for syndicating & aggregating content
- Alerts
- Widgets interoperating via internally linked APIs a la iGoogle
- Metrics/usage profiles
- Backup and long term preservation

4. Comprehensive content discovery

Ability to discover across all content stores and deliver requested content regardless of location (local, licensed, federated, external).

- Integrated / federated search capabilities
  - across internal digitized collections (with unified metadata)
  - to external sources (via library supported access)
- Export and import of metadata (e.g., OAI data providers, harvesting)
- Common & interoperable data models
- Metadata flattening, translation
- Interoperable content delivery, API's
- Aware of community tagging

5. Creating, managing, publishing dynamic digital collections

The ability for librarians & scholars to create & curate their own digital collections by selectively collecting other digital collections, objects or their components, and remixing them into new collections for personal use, group use or publication.

- Fedora-like support for content disaggregation/reaggregation
- Open access/APIs to content, metadata, library services
- Ability to annotate objects/collections with new commentary
- Authn and authz services, plus application of DRM

6. Extend library infrastructure and workflows to already-digital content

Extensible framework to support simple (monolithic) datatypes and structured information through a full processing lifecycle -- receipt/capture, preservation, annotation, cataloging, indexing, delivery -- for information that is already in digital form.

- Workflow & rules, integrated with other workflows
- Track, manage, reconcile content
- Support for complex, structured objects -- web sites, wikis, blogs
- Web Forms (simplified/uniform UI layer, e.g., XForms)
- eCommerce/ePayment (departmental and personal)
- Digital Rights Management

7. Flexible digitization workflow

Support full range of individual patron requests to project-based collections to mass digitization initiatives, with a mix of formats & media types, metadata structures, and internal & external agents.

- Workflow & rules
- eCommerce/ePayment
- Track, manage, reconcile content
- Quality Control, e.g., format verification, tools for editing
- Location tracking, data moving
- Editing of archived material
- Scoping of front matter
- Scanning licenses

8. Library management, operations, reporting

Provide full administrative capabilities over all aspects of the digital library collections and processing flow to support management, analysis and reporting requirements needed for digital resources. Integrate these capabilities with information from the ILS to support a comprehensive view of Library assets,

- Report on what's held, what's preserved
- Track context (relationship, use) of materials/objects/collections
- Status of processing queues
- Vendor management
- License management & renewal
- Coordinate information about print and related e-content
- Flexible, distributed reporting

Five themes derived from narratives

1. Identity
2. Preservation
3. Personalization
4. Access
5. Management

Bound together in a common service infrastructure

Theme 1 -- Identity

- Identity Management
  - Unique work/resource
  - Editions, versions, manifestations, formats
  - Whole to parts; parts to whole
  - Rules, policies
- Extensible, multi-faceted
  - Base bibliographic record
  - Aggregated/sourced metadata
  - Formal and informal (community) tagging, commentary, annotations, etc.

Theme 2 -- Preservation

- **Ingest**
  - Extensive metadata
  - Risk analysis
  - Validation
- **Storage**
  - Archived masters and metadata
  - Safety, redundancy and permanence
  - Multi-generational timespan
  - Format migration

Theme 3 -- Personalization

- **User centric**
  - **Personal identity, connected to roles, status, authorship**
  - **Personalized experience (preferences)**
  - **Consistent across user experience**
- **Source and Resource centric**
  - **“Personal library”, favorites, ranking**
  - **Identity enrichment -- annotations, tags, corrections, commentary, reviews, etc.**

Theme 4 -- Access

- Discovery
  - Comprehensive across sources
  - Multiple search heuristics
  - Automated, programmatic, alerts, agents
  - Multi-faceted, ontologies, tags
- Presentation
  - Context sensitive, e.g., ranked results
  - Visualizations -- contexts, timelines, relationships
  - Interoperable with personal tools

Services, Infrastructure

- Services
  - Format and protocol conversions
  - Indexing and search
  - UUID assignment / Persistent URL
  - Link Resolution
- Infrastructure
  - Service Registry
  - Policy and Rules engine
  - Messaging
  - Workflow
  - Logging, statistics, metrics, diagnostics

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Bound together in a common service infrastructure

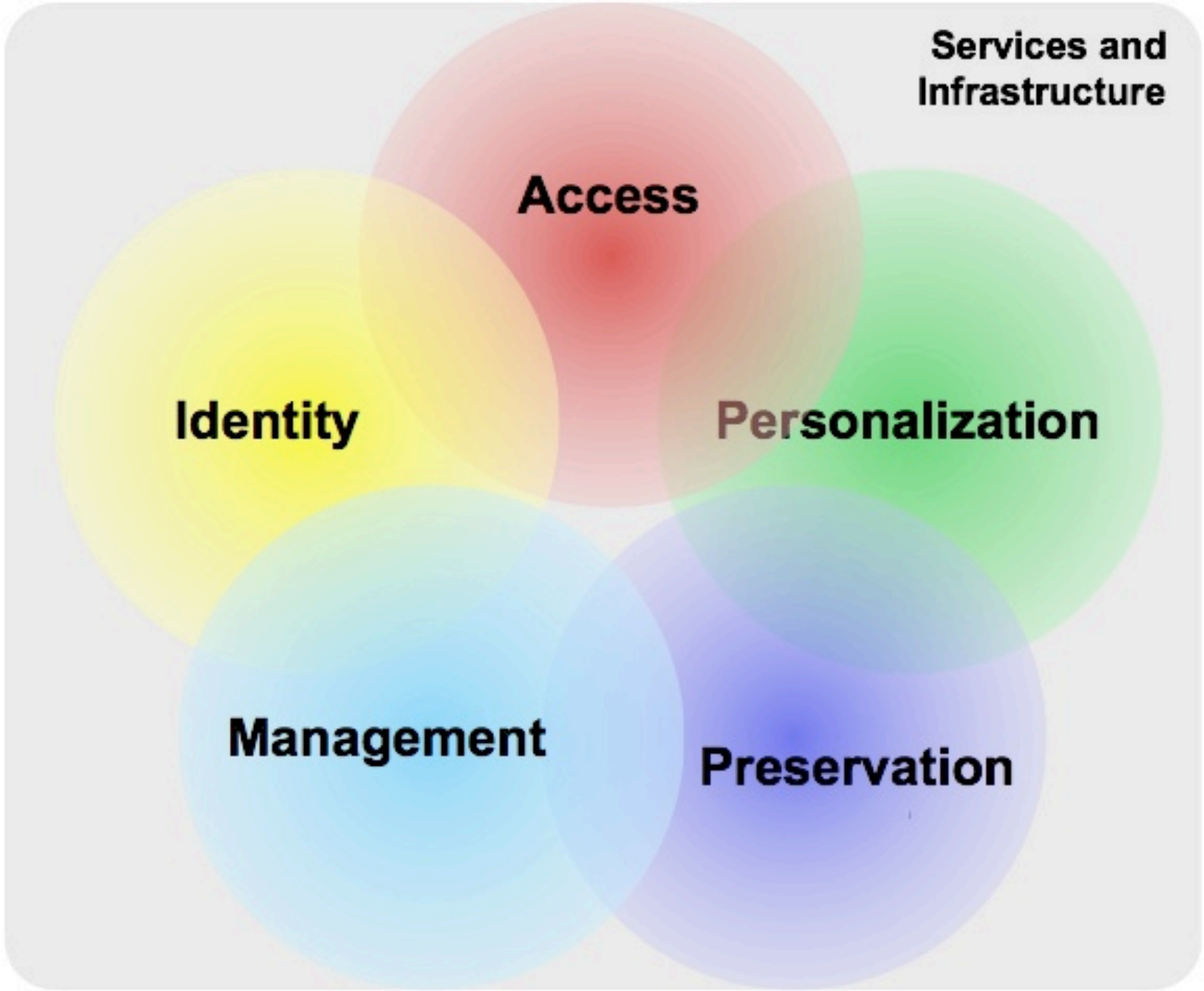
The **Identity** Equation

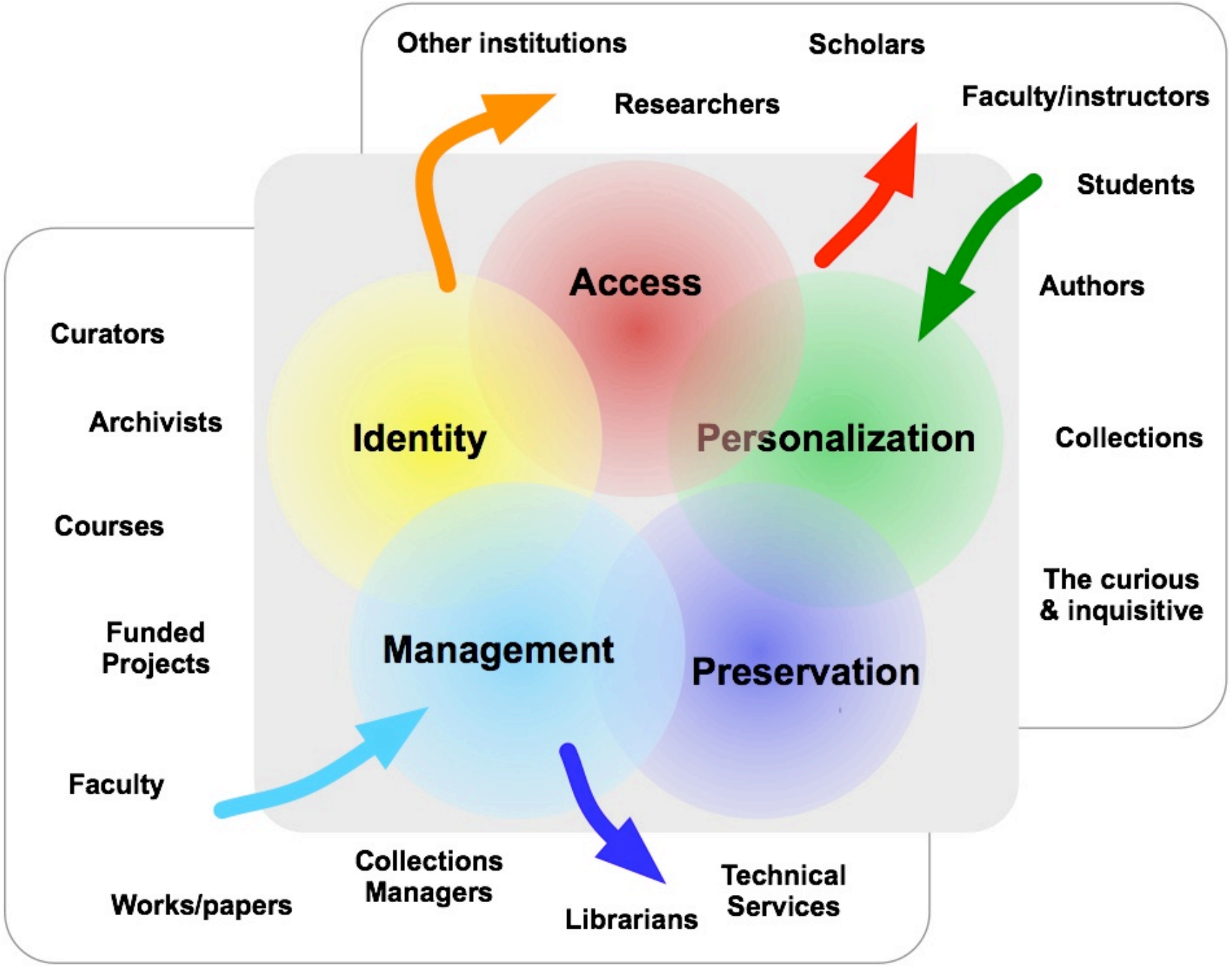
The **Preservation** Ultimatum

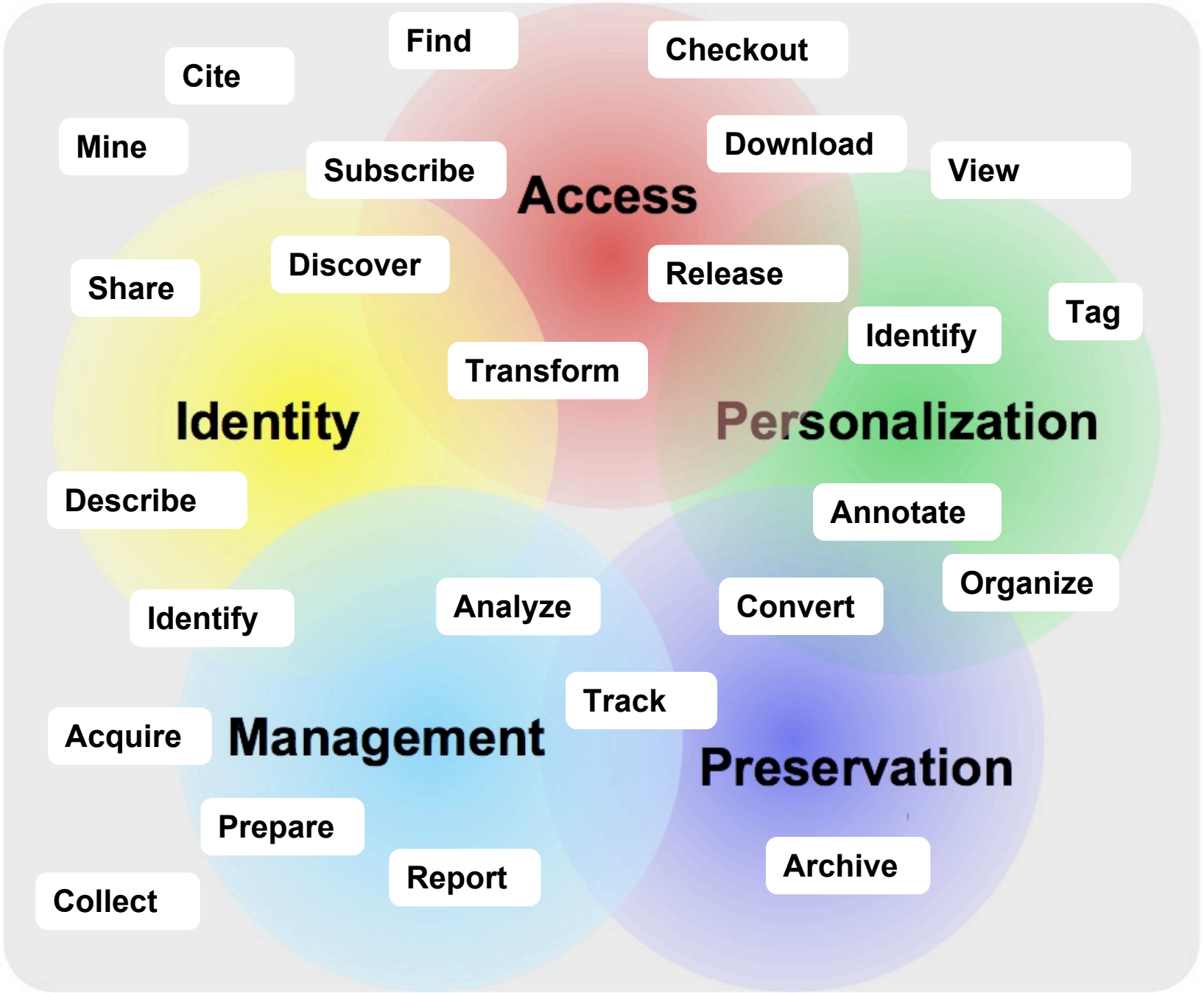
The **Access** Imperative

The **Personalization** Supremacy

The **Management** Sanction


Services and
Infrastructure
Access
Identity
Personalization
Management
Preservation


Other institutions
Scholars
Researchers
Faculty/instructors
Students
Access
Authors
Curators
Archivists
Identity
Personalization
Collections
Courses
The curious & inquisitive
Funded Projects
Management
Preservation
Faculty
Collections Managers
Technical Services
Works/papers
Librarians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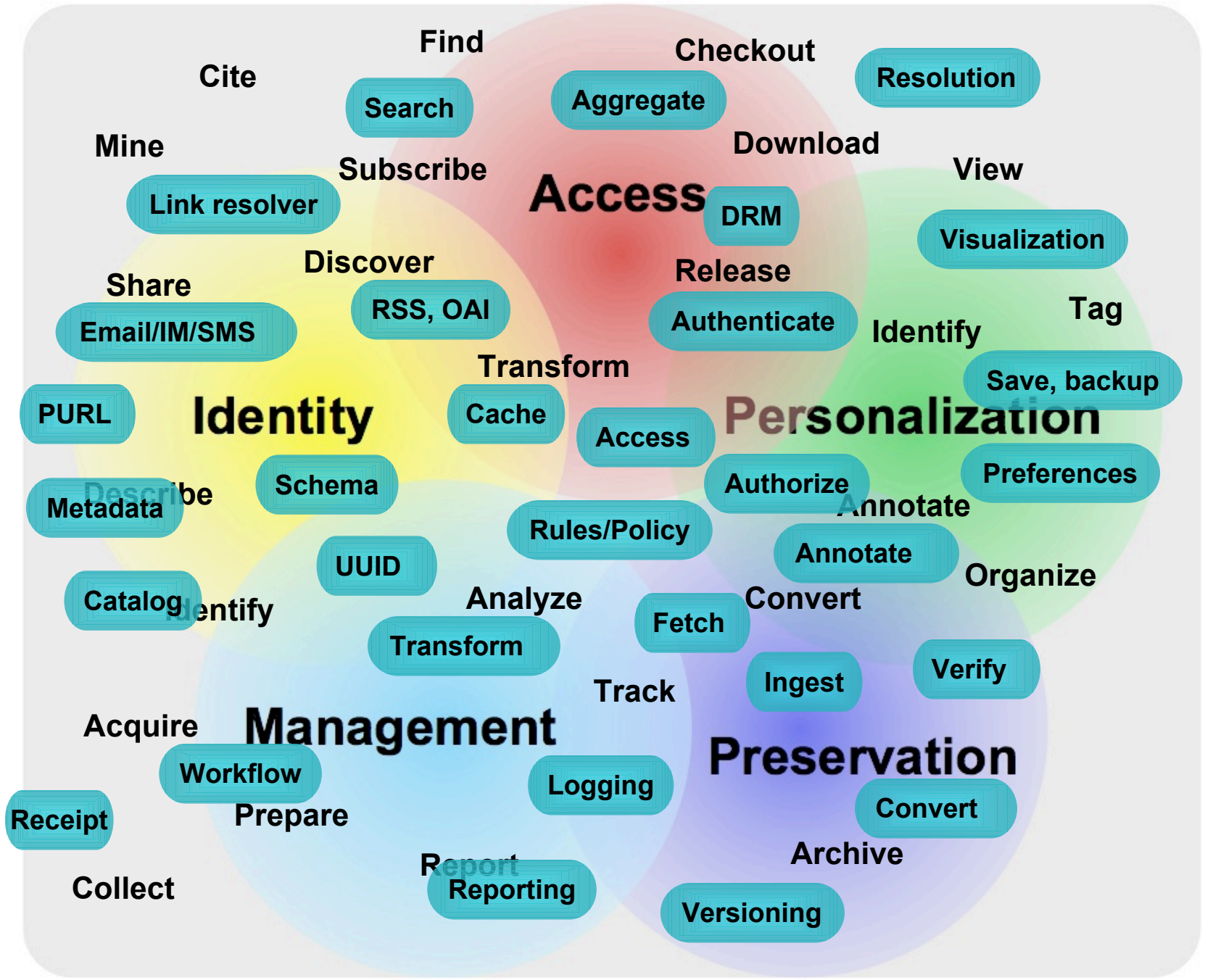
Analyze
Convert
Track
Acquire
Management
Preservation
Prepare
Archive
Report
Collect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Identify
Transform
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Identity
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Access
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Describe
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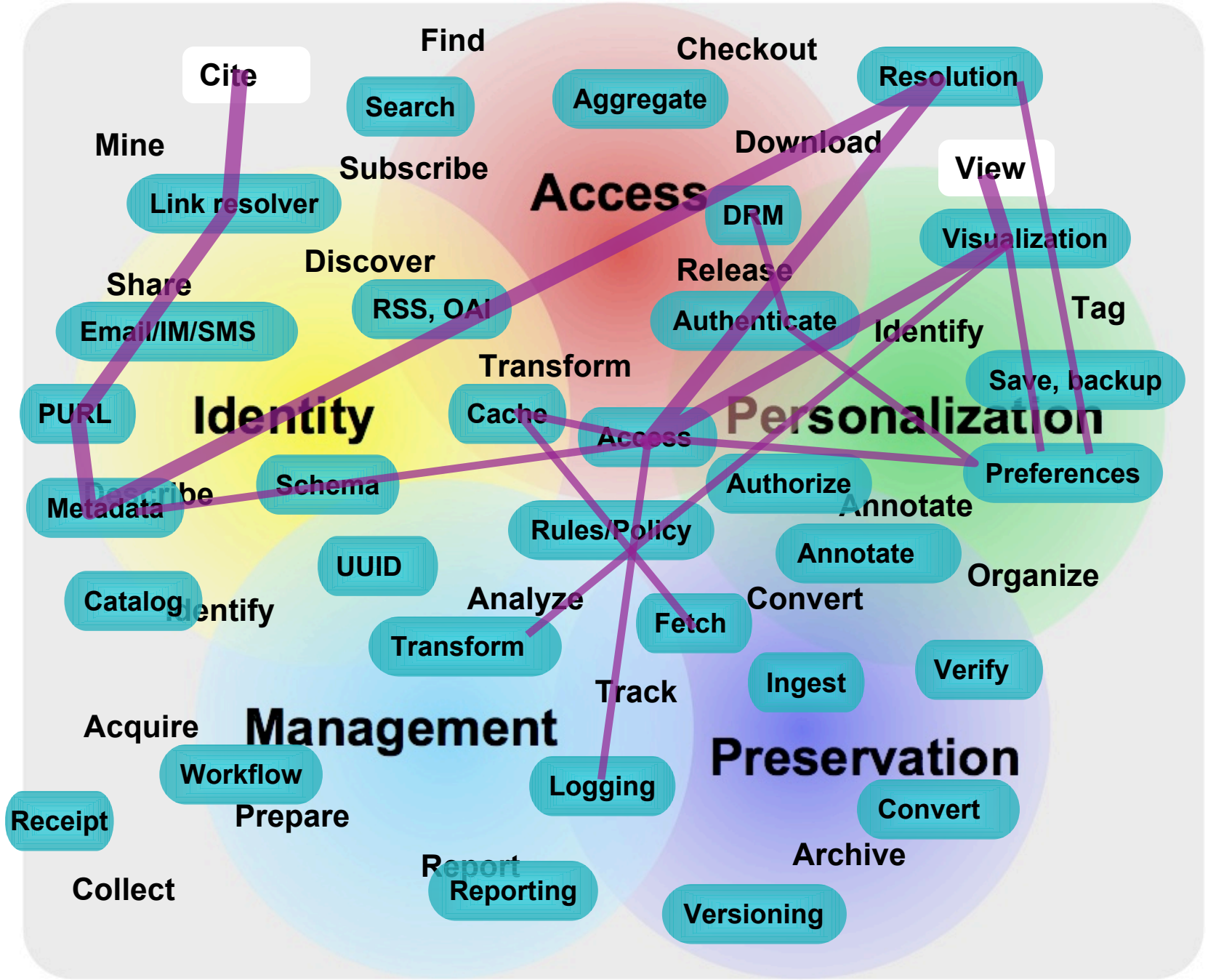
Report
Collect
Reporting
Versioning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Metadata
Rules/Policy
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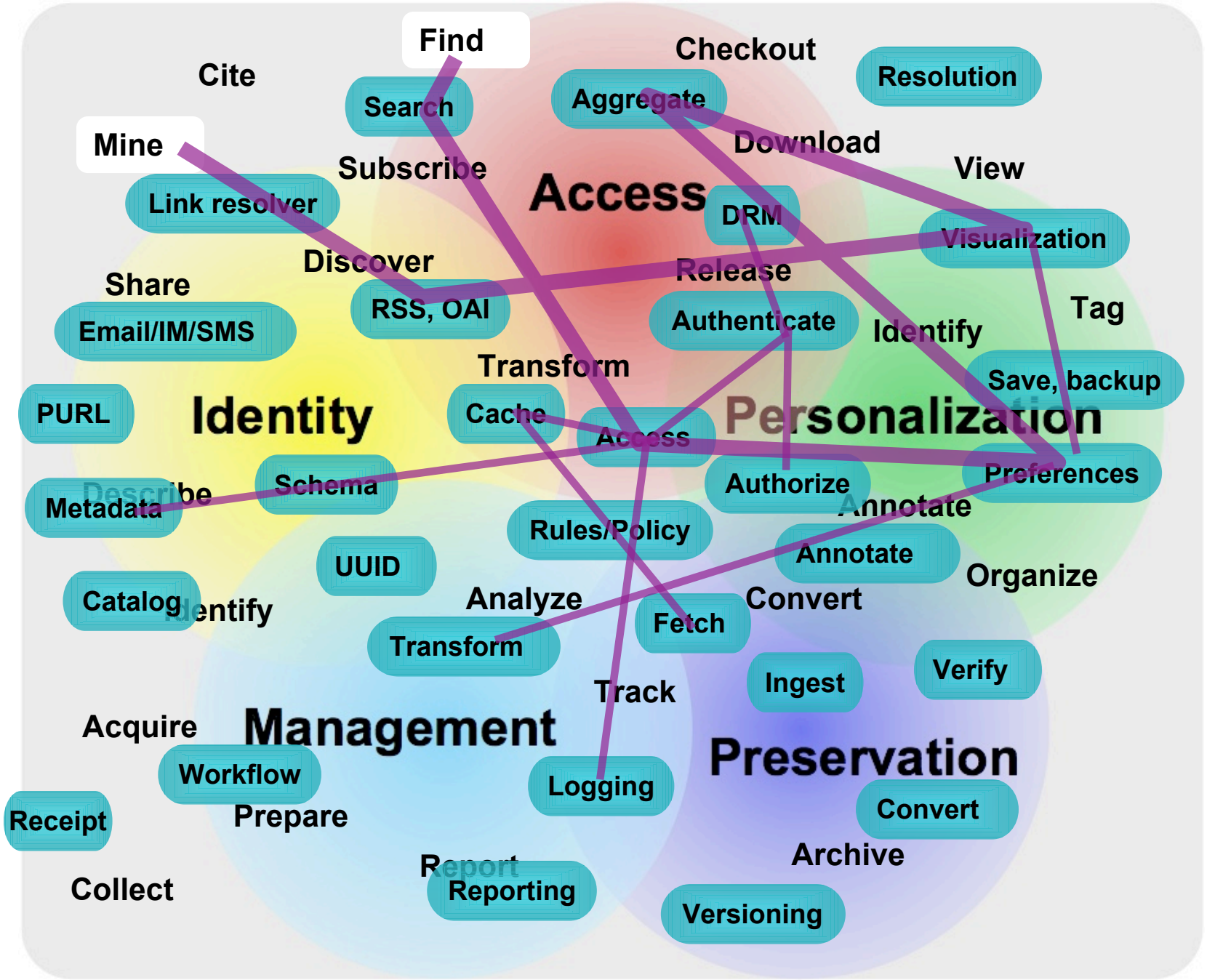
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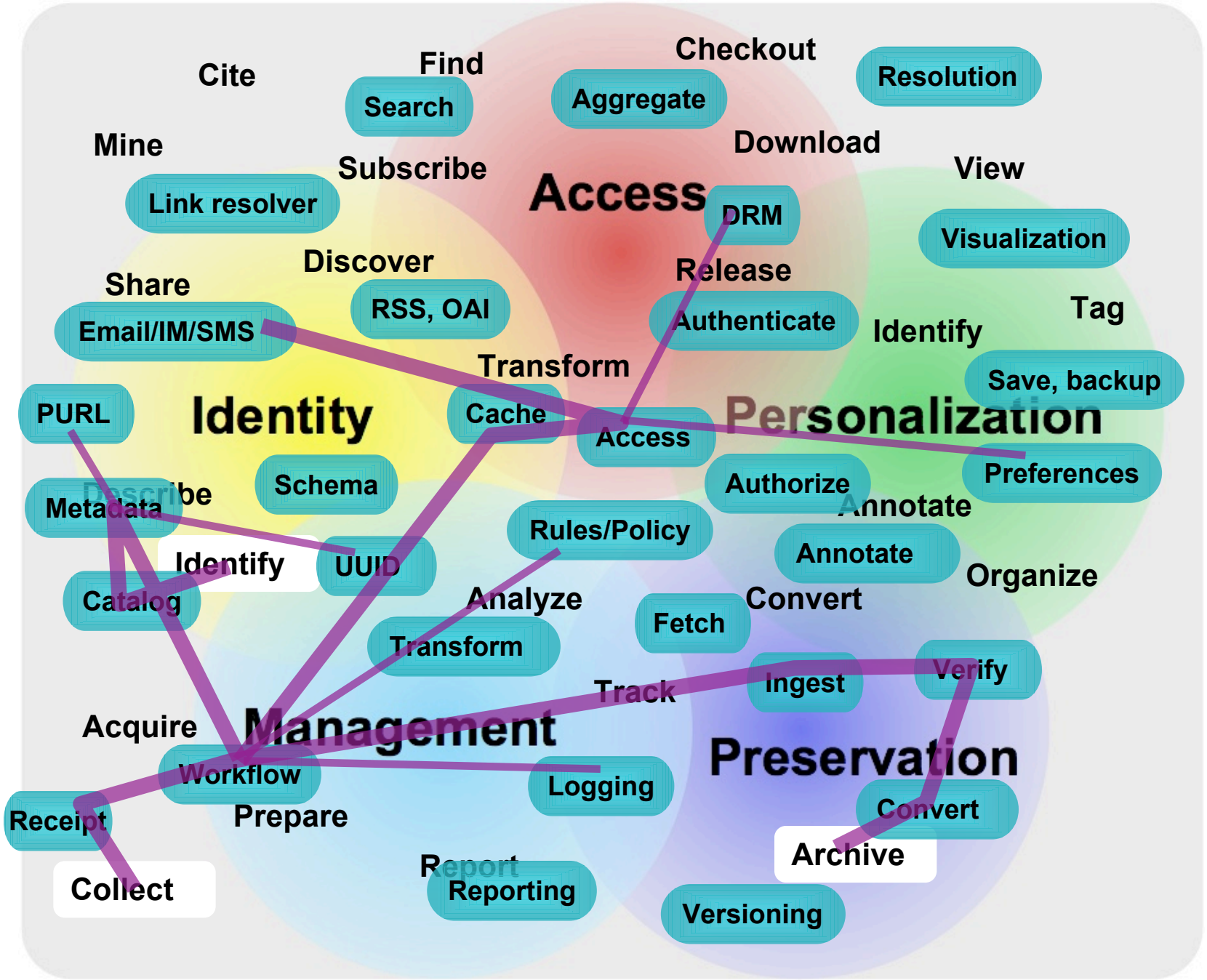
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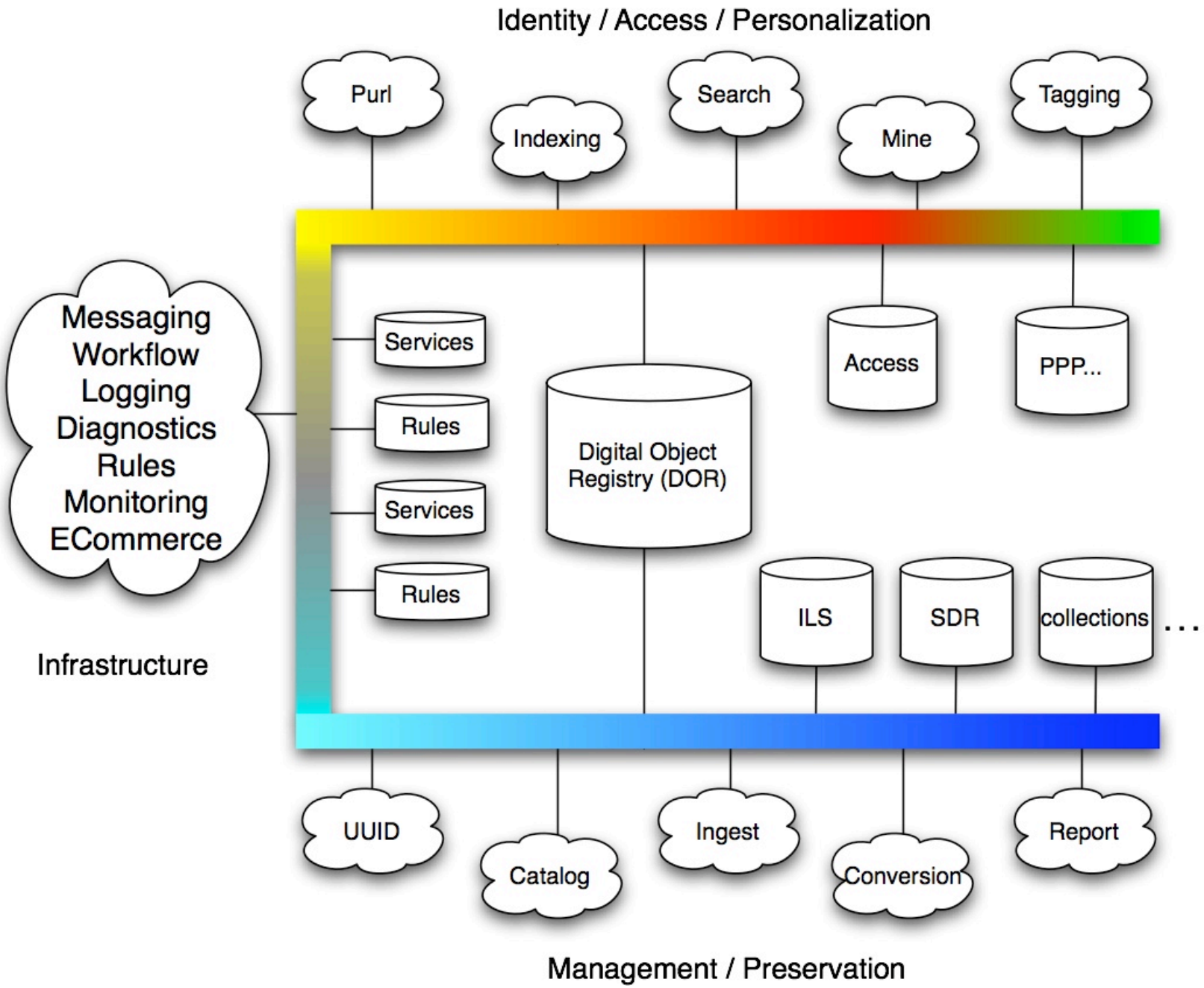
Translating function into architecture


Identity / Access / Personalization
Purl
Indexing
Search
Mine
Tagging
Messaging
Workflow
Logging
Diagnostics
Rules
Monitoring
ECommerce
Services
Rules
Services
Rules
Digital Object Registry (DOR)
Access
PPP...
ILS
SDR
collections
. . .
Infrastructure
UUID
Catalog
Ingest
Conversion
Report
Management / Preservation

Content management

- Data/metadata stores:
  - Content Registry -- Digital Object Registry (DOR)
  - Personalization (PPPPPPPP …)
  - Fedora
  - Collections -- DCR
  - Rights registry
  - Service registry
  - Schema registry
- Data/content sources
  - Preservation Repository -- SDR
  - collections.stanford.edu
  - NGDA
  - ILS

Services -- Preservation & Management

- Format conversion
- Purl service
- Link reassigner
- Loading records into DOR
- Data source CRUD
- Content mover
- Link checker
- Checksum validation
- Encrypt/decrypt
- JHOVE2/DROID
- Repository ingest
- Reporting
- Monitoring
- Logging
- alert
- scheduling

Services -- Access/Identity/Personalization

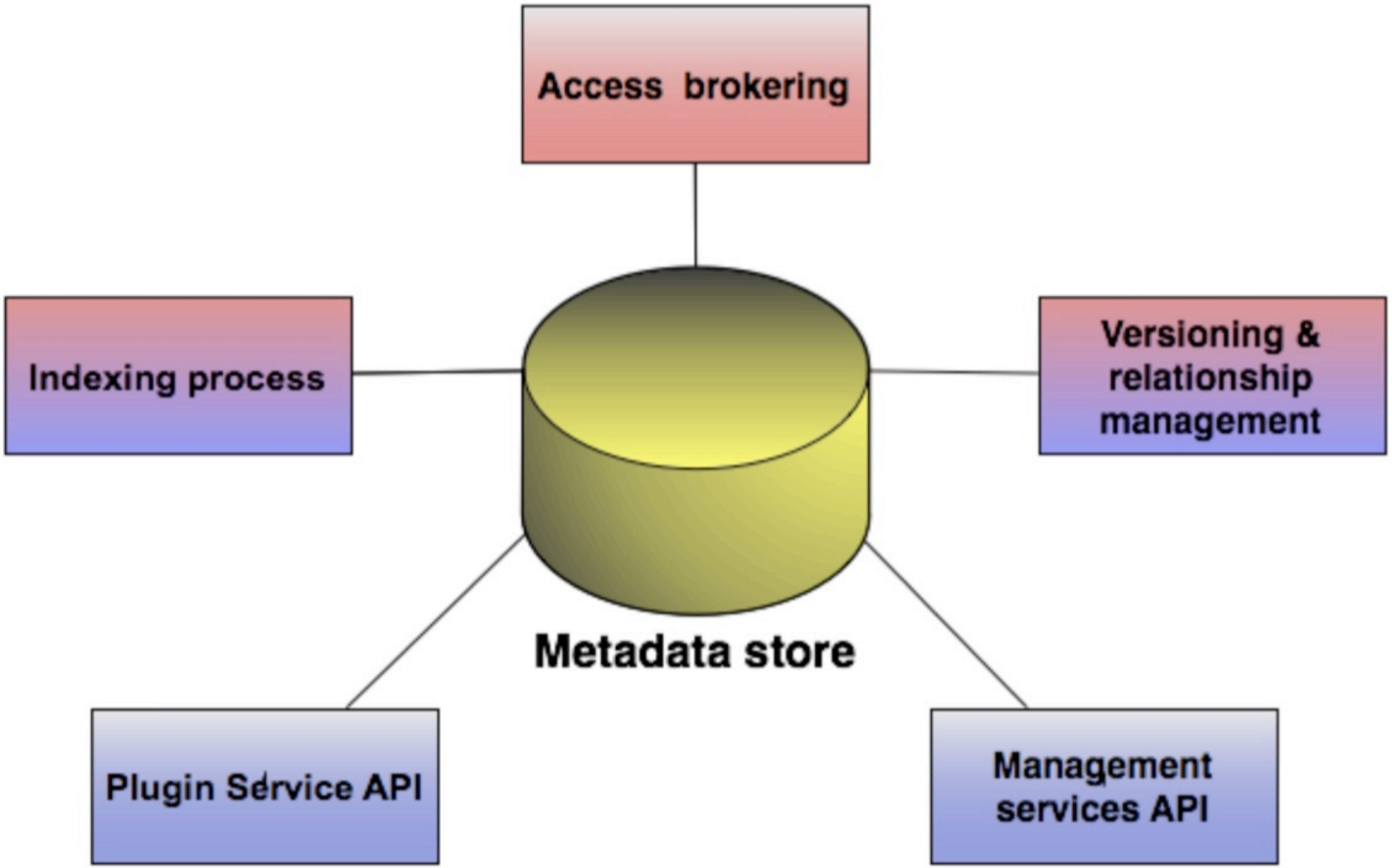
- Schema converter
- Link resolver
- Digital signature
- Alert/update
- Data mining
- Preferences api
- Licensing
- Rights
- OAI dp
- SRU/SRW
- authn
- authz
- ecommerce

Infrastructure services

- Service registry
- logging
- workflow
- monitoring
- diagnostics
- rules engine
- messaging
- Ecommerce

- Connections to campus infrastructure
  - Directory/LDAP lookups
  - Calendars
  - Lists
  - File services
  - Groups
- Connections to other infrastructure (e.g., Higher Ed)

Services are associated with core data stores



What's In A Name?

'Digital Library Management System'

'Content Management System'

'Content Middleware'

'Library Cyberinfrastructure'

'Libra-infrastructure'

'Lyberinfrastructure'

'Lyberstructure'

'Lybermanagement'

'Lyberware'

- Information Architecture
- Library
- Infrastructure
- Management
- Cyber/digital
- Middleware