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Digital Library Interoperability,
Best Practices and Modelling Foundations

# The DL.org Reference Model for Digital Libraries


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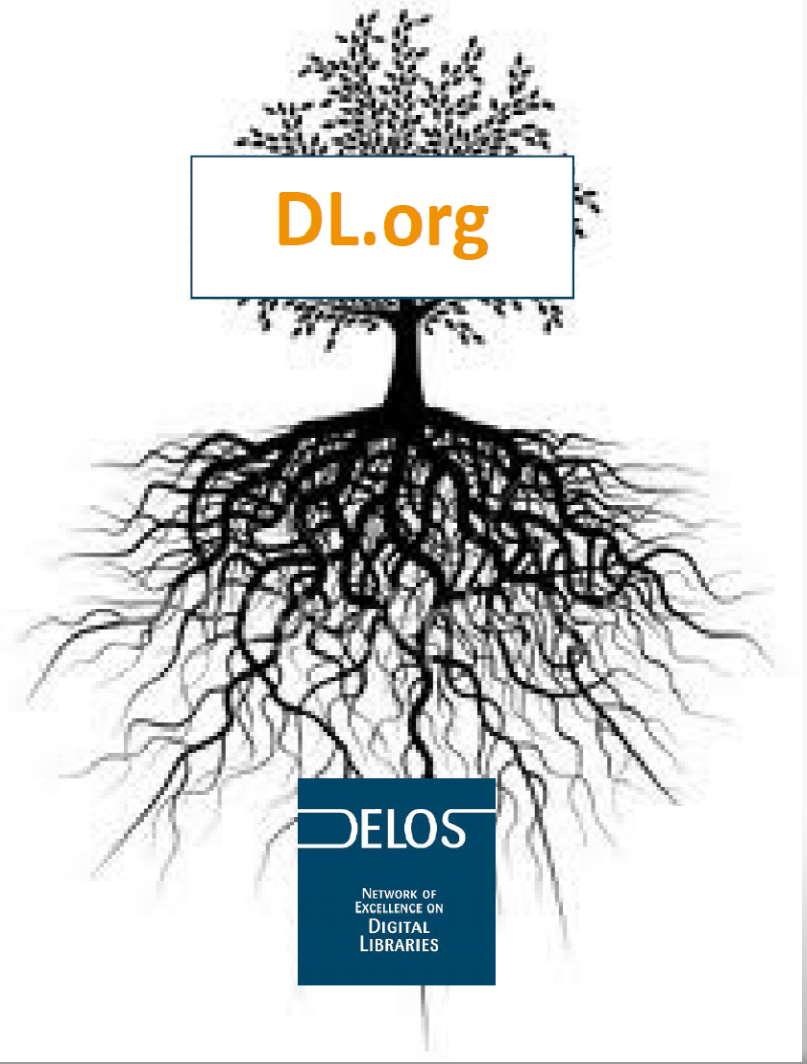
# DL.Org and DELOS



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# DELOS

The Network of Excellence on Digital Libraries

Define and conduct a **joint program of activities** in order to integrate and coordinate the on-going research activities of the major European research teams in the field of **digital libraries** for the purpose of developing the next generation digital library technologies

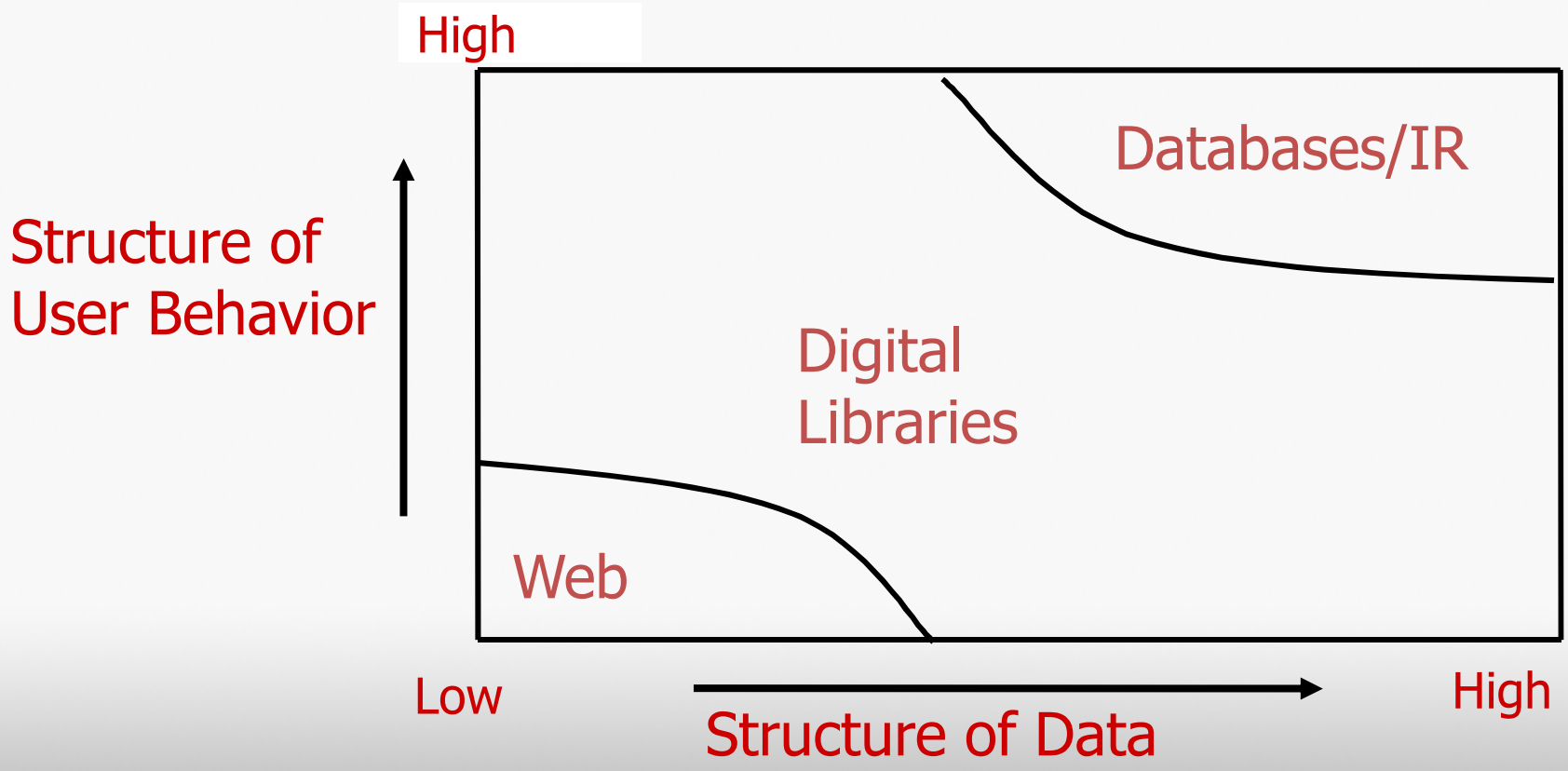
# DELOS – Grand Vision #1

Digital libraries should enable any citizen to access all human knowledge anytime and anywhere,in a friendly, multi-modal, efficient, and effective way, by overcoming barriers of distance, language, and culture and by using multiple Internet-connected devices

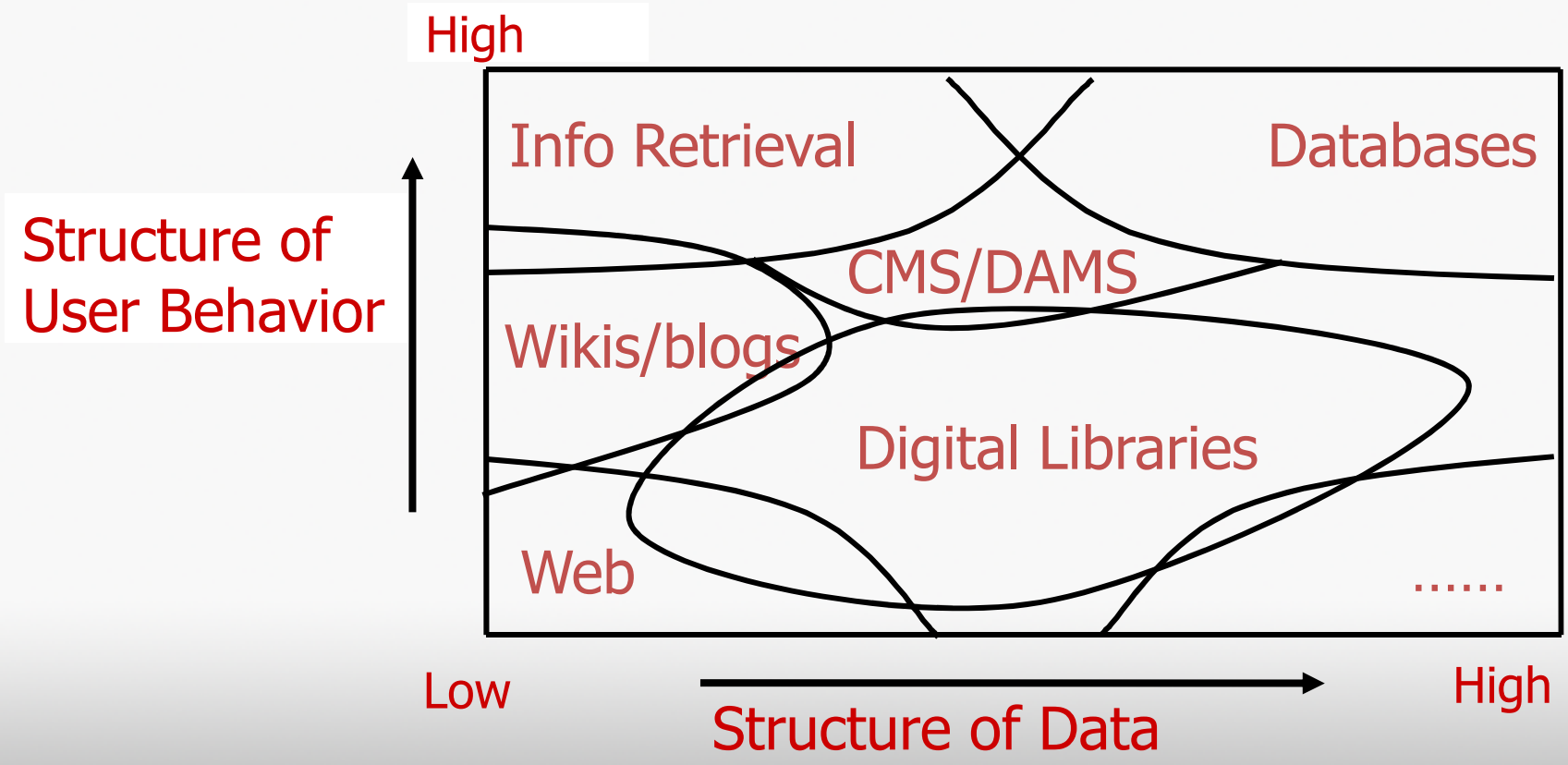
# DELOS – Grand Vision #2

The potential exists for digital libraries to become the universal knowledge repositories and communication conduits for the future, a common vehicle by which everyone will access, discuss, evaluate, and enhance information of all forms

# Digital Libraries in the Information Space - 1



# Digital Libraries in the Information Space - 2



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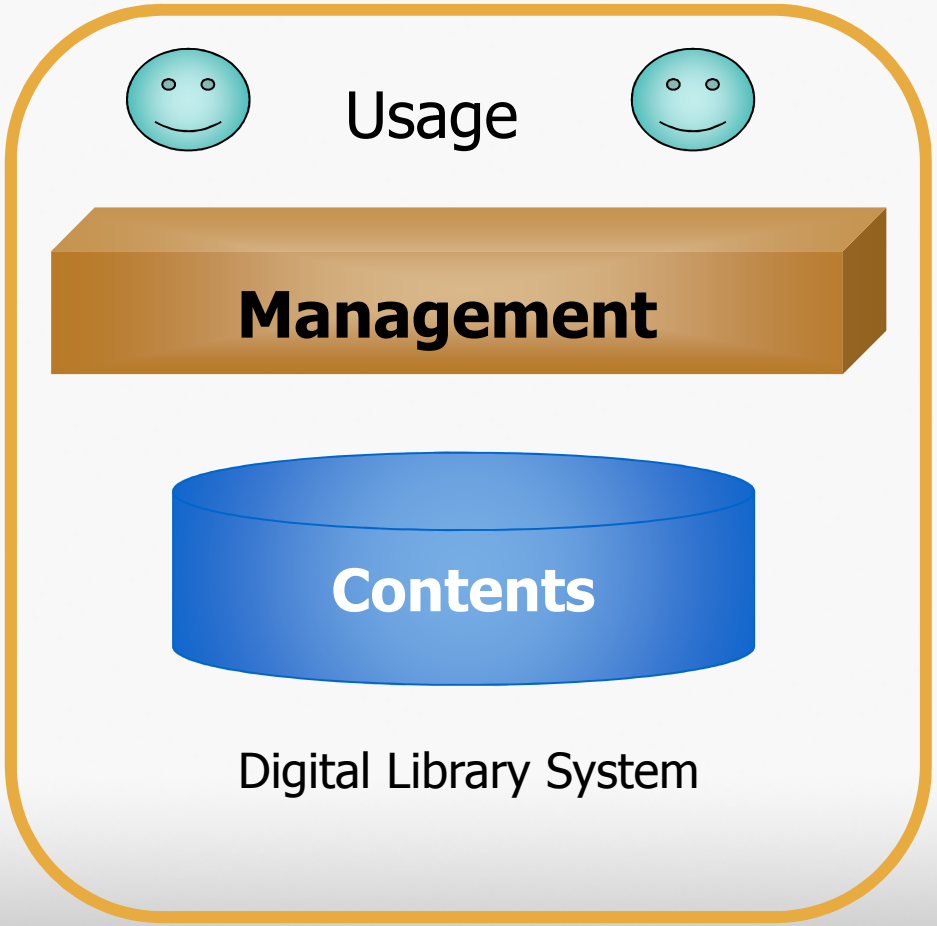
# Conceptual Framework



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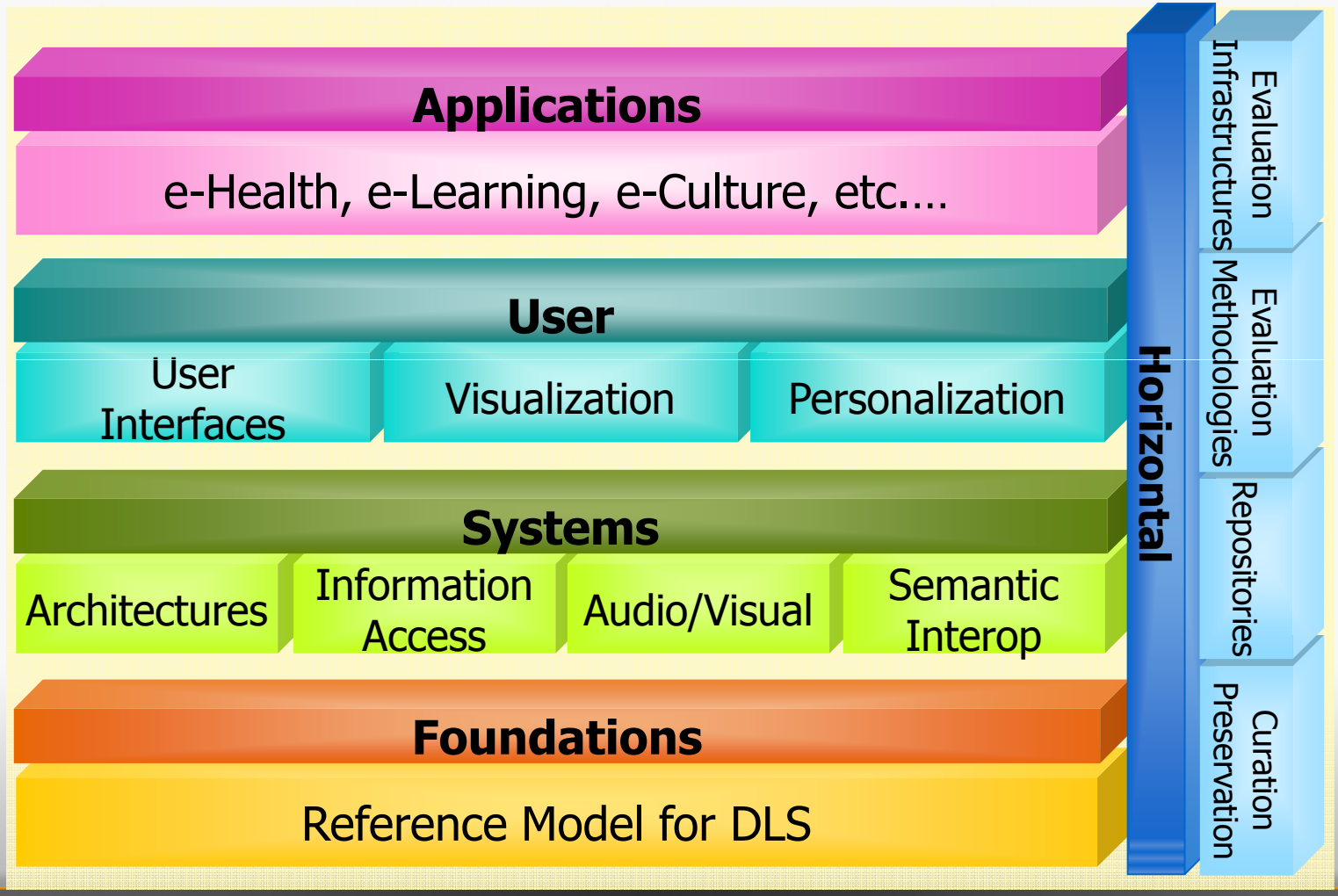
# Research Directions in Digital Libraries



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# What is a Digital Library ?

- A DL is the combination of “content and services”
- A Digital Library is a “tool” at the centre of intellectual activity having no logical, conceptual, physical, temporal, or personal borders or barriers on information
- A DL is an “entity” providing the functionality to mediate between information objects and information users in the context of distributed collections of information objects. This (external) functionality includes access, publish, delivery, preservation, personalization, etc.
- A Digital Library is an “institution” in charge of providing at least the functionality of a traditional library in the context of distributed and networked collections of information objects

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# Need for a Reference Model

- A reference model is an **abstract framework** for understanding significant relationships among the entities of some environment, and for the development of consistent standards or specifications supporting that environment
- A reference model is based on **a small number of unifying concepts** and may be used as a basis for education and explaining standards to a non-specialist
- A reference model **is not directly tied to any standards, technologies or other concrete implementation details**, but it does seek to provide a common semantics that can be used unambiguously across and between different implementations

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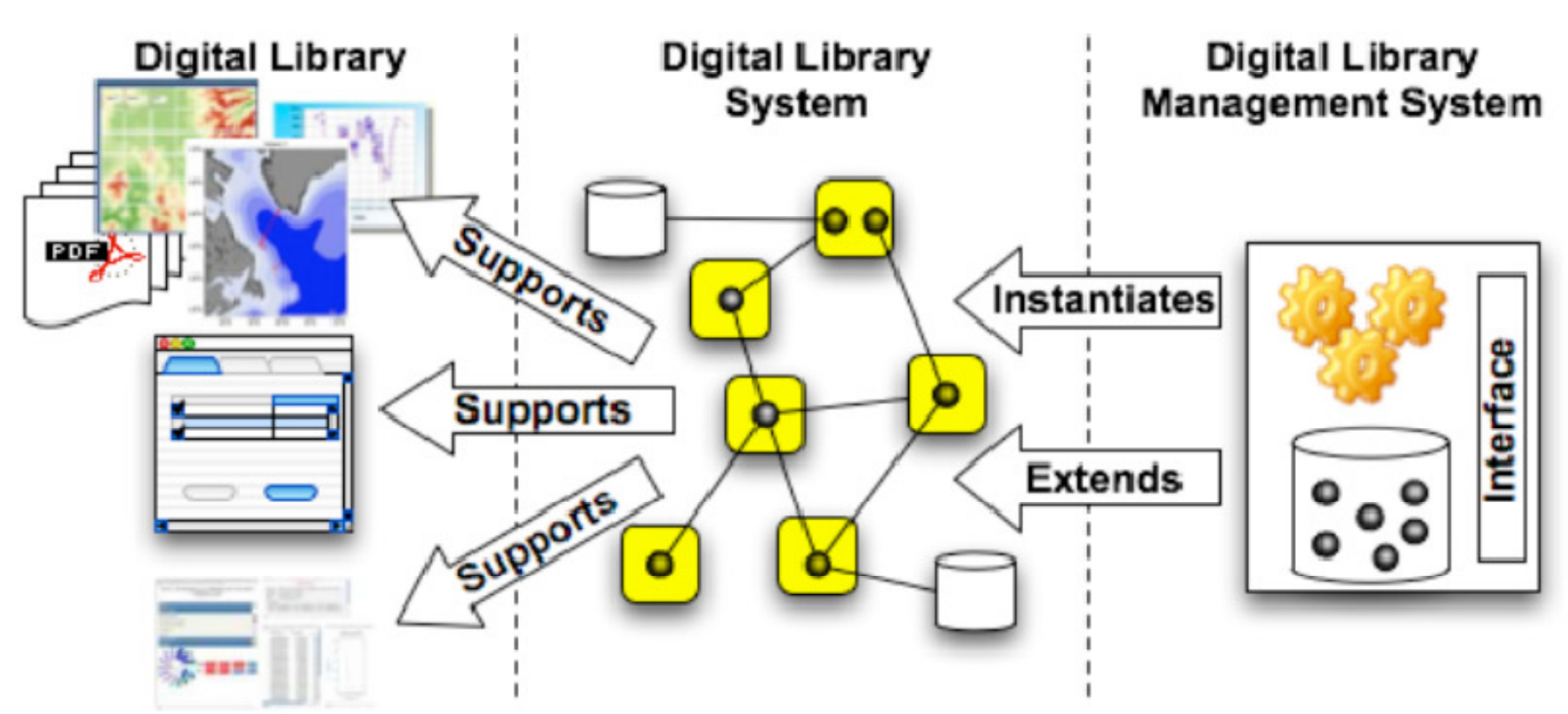
# A Three-Entity Framework



# The three Entities

- **Digital Library**
  - An organization, which might be virtual, that comprehensively collects, manages, and preserves for the long term rich **digital content**, and offers to its **user** communities specialized **functionality** on that content, of measurable **quality** and according to codified **policies**
- **Digital Library System**
  - A software system that is based on a defined (possibly distributed) **architecture** and provides all functionality required by a particular Digital Library. Users interact with a Digital Library through the corresponding Digital Library System
- **Digital Library Management System**
  - A generic software system that provides the appropriate software infrastructure both (i) to produce and administer a Digital Library System incorporating the suite of functionality considered foundational for Digital Libraries and (ii) to integrate additional software offering more refined, specialized, or advanced functionality

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# Different types of DLMS

- **Extensible Digital Library System**
  - A complete Digital Library System that is fully operational with respect to basic/ foundational functionality required. It is based on an open software architecture, so that further software components can be incorporated on top of the ones already there with ease (DelosDLMS, GreenStone)
- **Digital Library System Warehouse**
  - A collection of software components that encapsulate the core suite of DL functionality and a set of tools that can be used to combine these components in a variety of ways (in Lego-like fashion) to create Digital Library Systems offering a tailored integration of functionalities. New software components can easily be incorporated into the Warehouse for subsequent combination with those already there (BRICKS, DILIGENT)
- **Digital Library System Generator**
  - A highly parameterized software system that encapsulates templates covering a broad range of functionalities, including a defined core suite of DL functionality as well as any advanced functionality that has been deemed appropriate to meet the needs of the specific application domain  Through an initialization session, the appropriate parameters are set and configured; at the end of that session, an application is automatically generated, and this constitutes the Digital Library System ready for installation and deployment (MARIAN)

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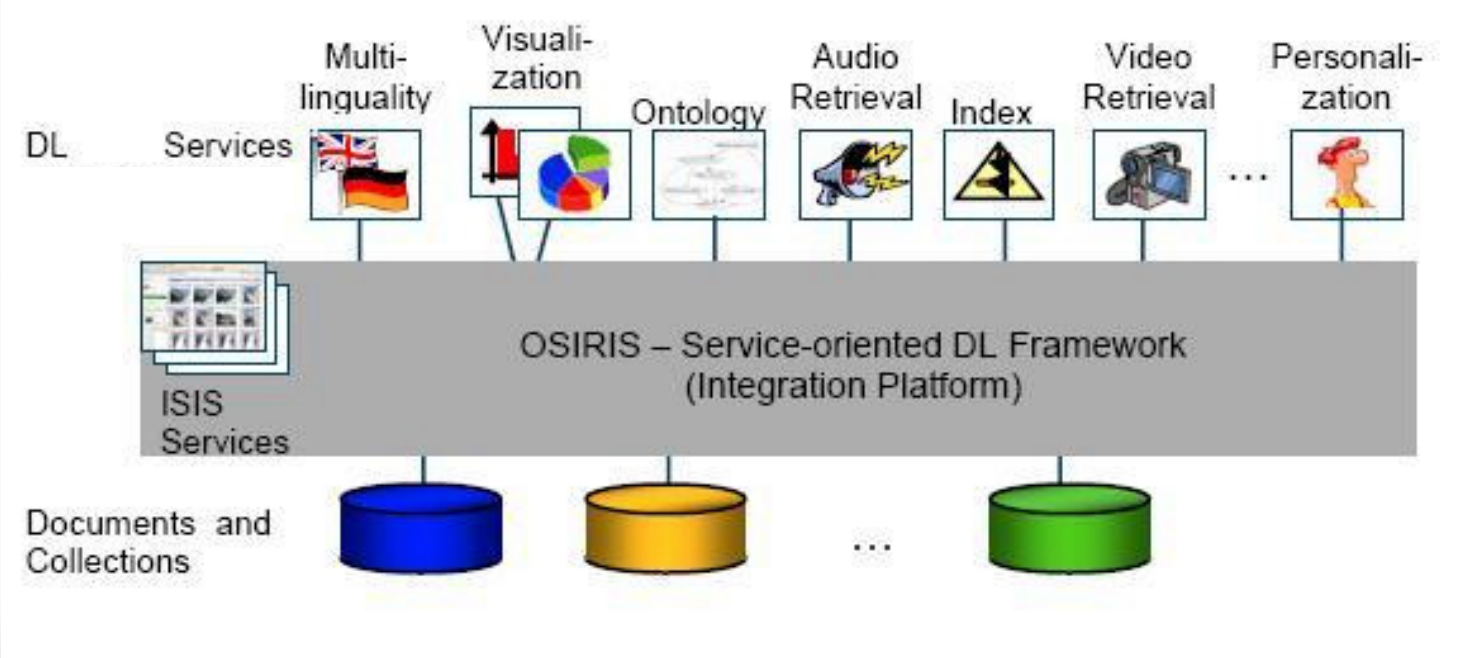
# DELOS DLMS



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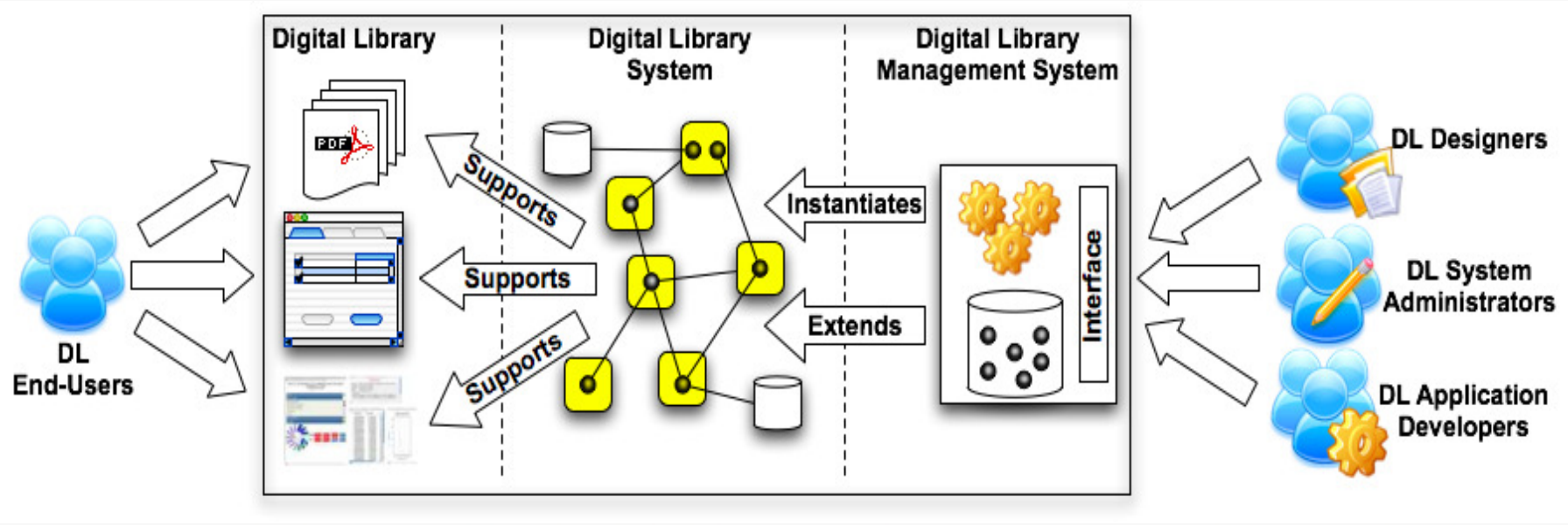
# Actors in the Digital Library



# Main roles of Actors (1)

- **DL End-Users**
  - They exploit the DL functionality for providing, consuming, and managing the DL Content as well as some of its other constituents  They perceive the DL as a stateful entity that serves their functional needs  The behaviour and output of the DL depend on its state at the time a particular part of its functionality is activated. DL end-users may be further partitioned into
    - Content Creators
    - Content Consumers
    - Librarians (end user)

- **DL Designers (Digital Librarian)**
  - They exploit their knowledge of the semantic of the application domain to define, customize, and maintain the Digital Library so that it is aligned with the information and functional needs of its end-users  To perform this task, they interact with the DLMS providing functional and content configuration parameters The values of these parameters, which can be modified during the DL lifetime, configure the specific DL perceived by the end-users because they determine the particular Digital Library System instance serving the Digital Library

# Main roles of Actors (2)

- **DL System Administrators (System Librarian)**
  - They select the software components necessary to create the Digital Library System needed to serve the required DL (as specified by the DL Designer) and decide where and how to deploy them  They interact with the DLMS by providing architectural configuration parameters, such as the selected software components, the hosting nodes, and the components allocation.  The value of the architectural configuration parameters can be changed over the DL lifetime Any change of these parameters may result in the provision of different DL functionality and/or different quality

- **DL Application Developers**
  - They develop the software components of DLMSs and DLSs, implementing the necessary functionality

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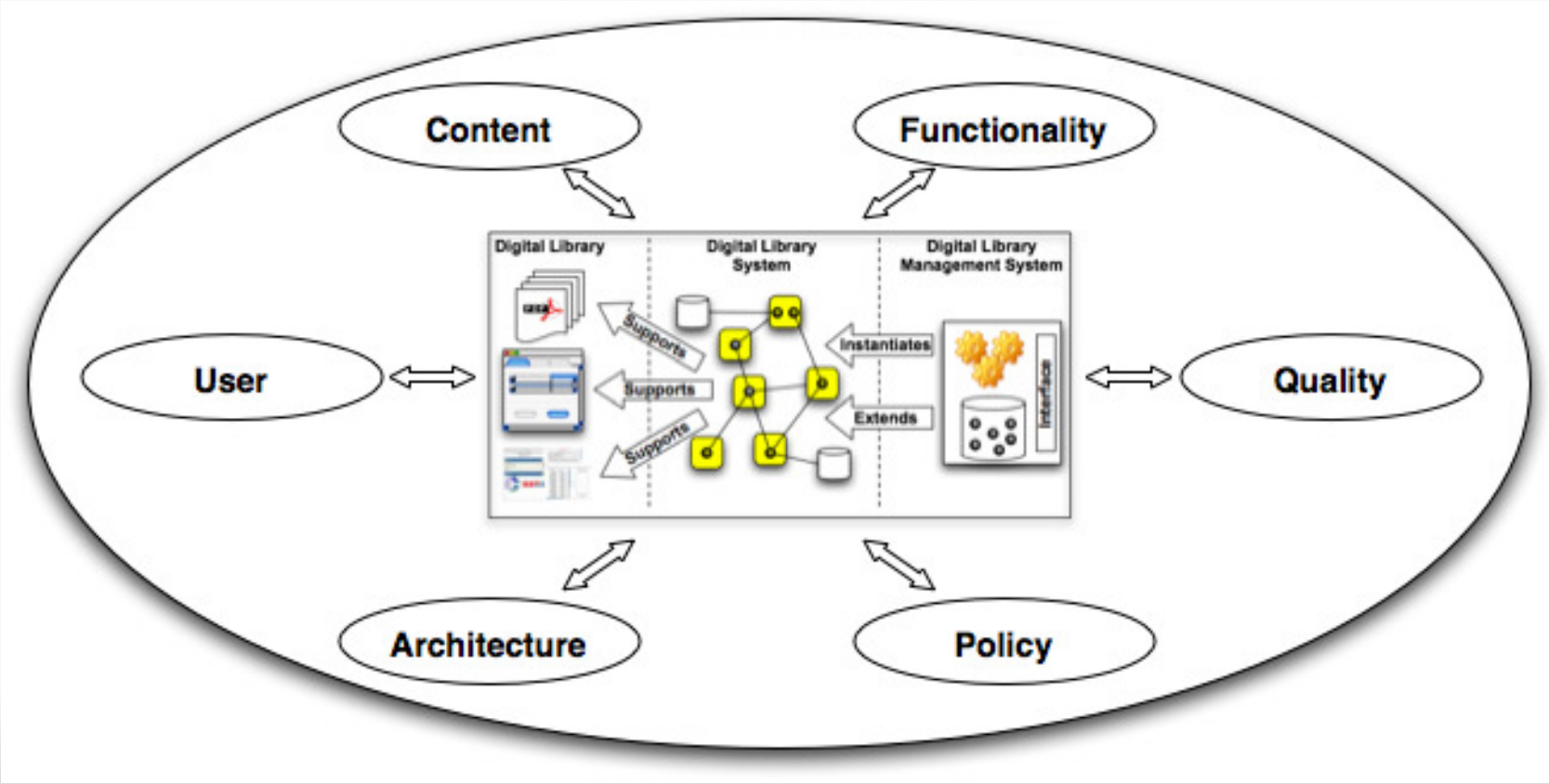
# Main concepts (1)



# Main concepts (2)

- **Content**
  - The Content concept encompasses the data and information that the Digital Library handles and makes available to its users. Content is an umbrella concept used to aggregate all forms of information objects that a Digital Library collects, manages, and delivers. It encompasses the diverse range of information objects, including such resources as objects, annotations, and metadata
- **User**
  - The User concept covers the various actors (whether human or machine) entitled to interact with Digital Libraries. Digital Libraries connect actors with information and support them in their ability to consume and make creative use of it to generate new information. User is an umbrella concept including all notions related to the representation and management of actor entities within a Digital Library. It encompasses such elements as the rights that actors have within the system and the profiles of the actors with characteristics that personalize the system's behaviour or represent these actors in collaborations
- **Functionality**
  - The Functionality concept encapsulates the services that a Digital Library offers to its different users, whether classes of users or individual users. While the general expectation is that DLs will be rich in capabilities and services, the bare minimum of functions would include such aspects as new information object registration, search, and browse Beyond that, the system seeks to manage the functions of the Digital Library to ensure that the functions reflect the particular needs of the digital library's community of users and/or the specific requirements relating to the Content it contains

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# Main concepts (3)

- **Policy**
  - The Policy concept represents the set (or sets) of conditions, rules, terms and regulations governing interaction between the Digital Library and users, whether virtual or real. Examples of policies include acceptable user behaviour, digital rights management, privacy and confidentiality, charges to users, and collection delivery
- **Quality**
  - The Quality concept represents the parameters that can be used to characterize and evaluate the content and behaviour of a Digital Library. Quality can be associated not only with each class of content or functionality but also with specific information objects or services Some of these parameters are objective in nature and can be automatically measured, whereas others are subjective in nature and can only be measured through user evaluations
- **Architecture**
  - The Architecture concept refers to the Digital Library System entity and represents a mapping of the functionality and content offered by a Digital Library onto hardware and software components There are two primary reasons for having Architecture as a core concept: (i) Digital Libraries are often assumed to be among the most complex and advanced forms of information systems; and (ii) interoperability across Digital Libraries is recognized as a substantial research challenge A clear architectural framework for the Digital Library System offers ammunition in addressing both these issues effectively

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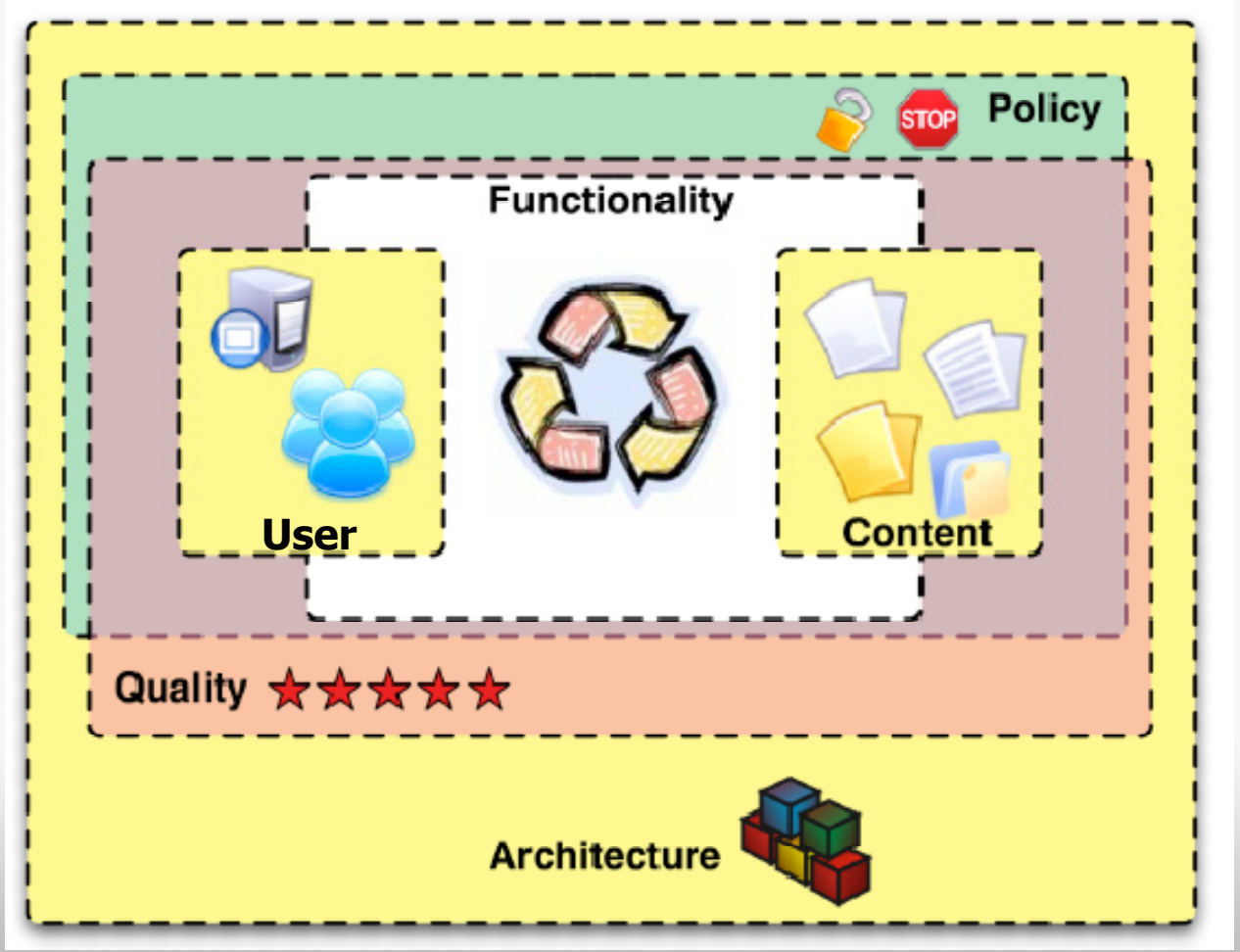
# The main concepts in perspective

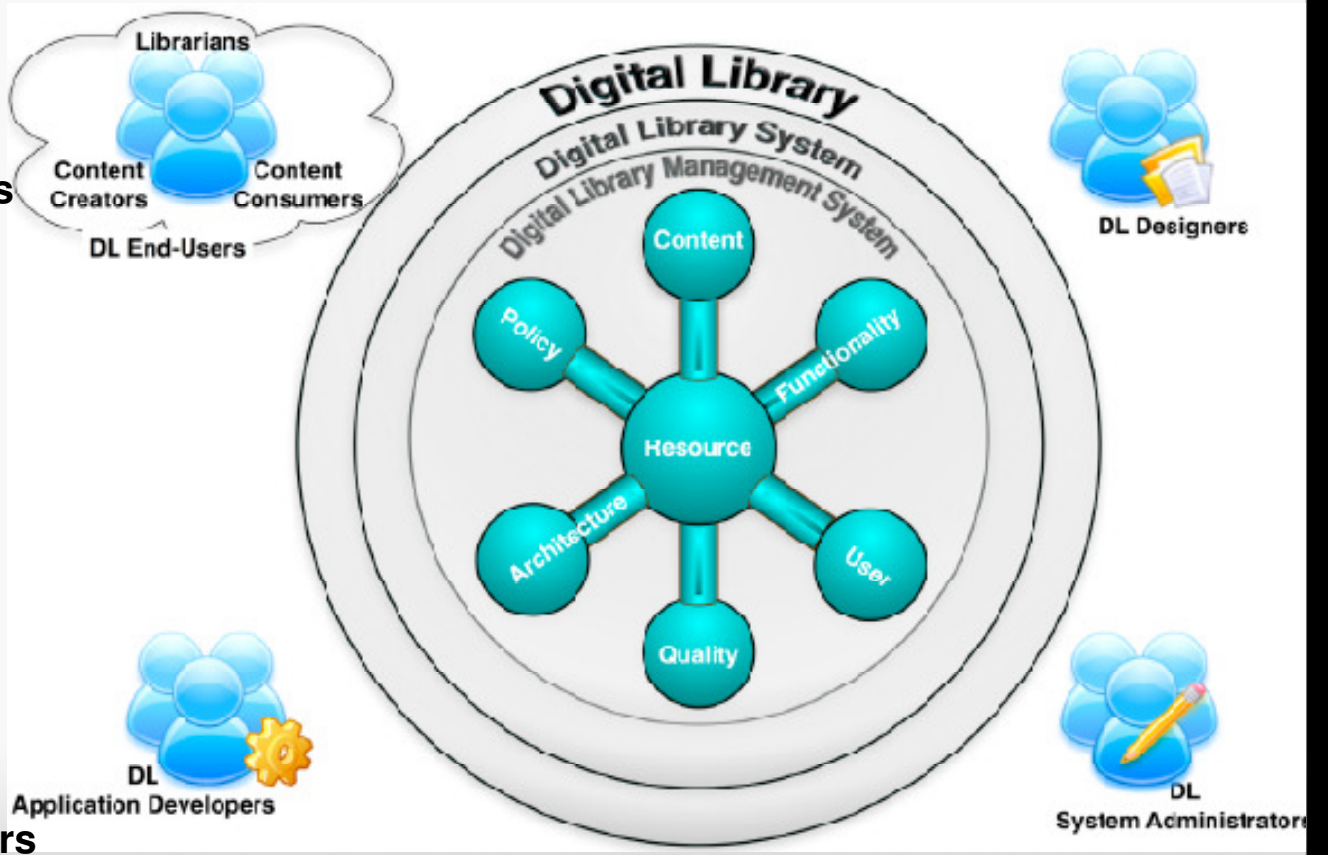


# The Digital Library Universe

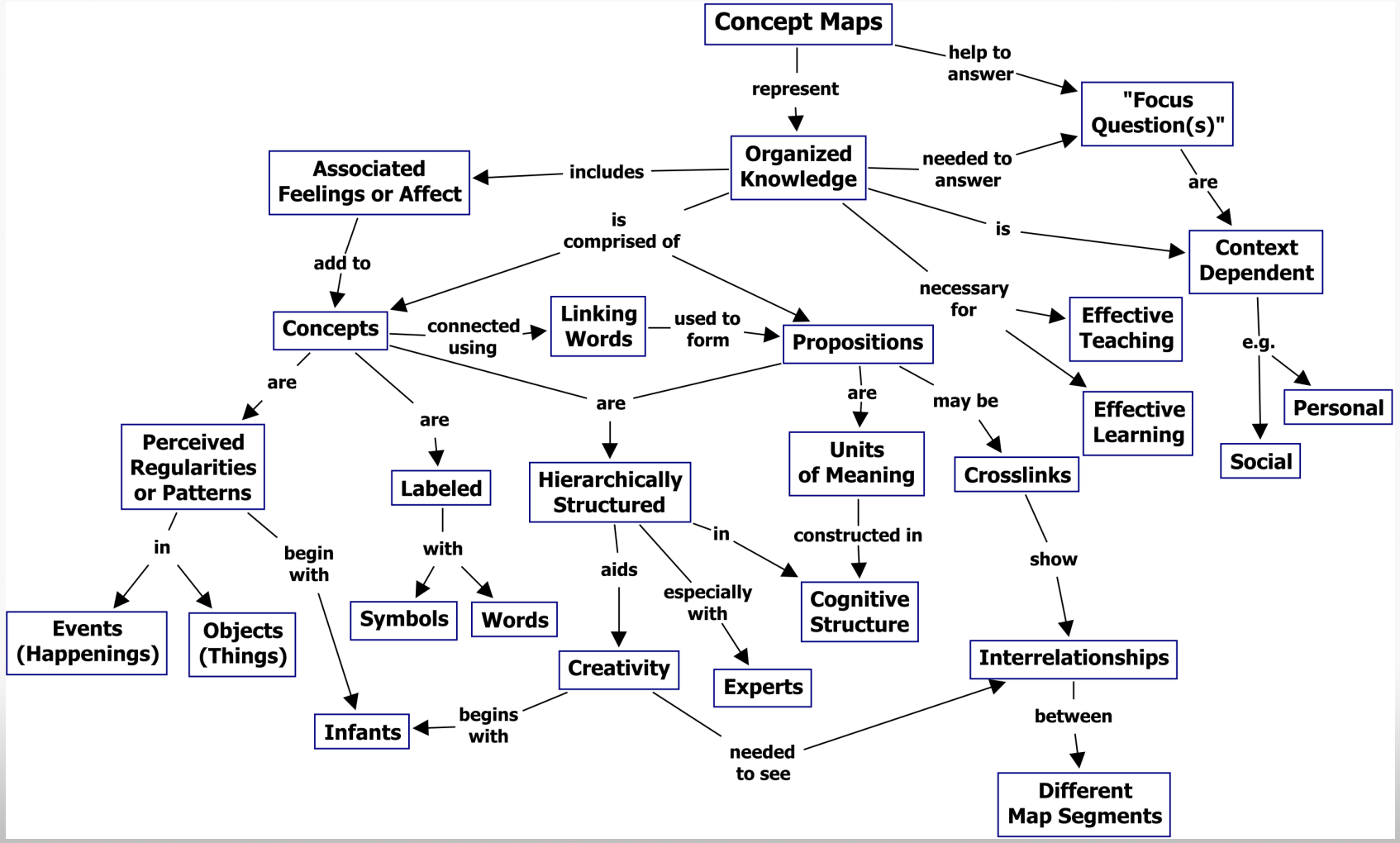
## 3 Types of systems
- DL
- DL System
- DL Management Systems

## 6 Domains + 1
- Content
- User
- Functionality
- Policy
- Quality
- Architecture
- + Resource

## 4 Roles of Actors
- DL end-Users
- DL Application Developers
- DL Designers
- DL Systems Administrators



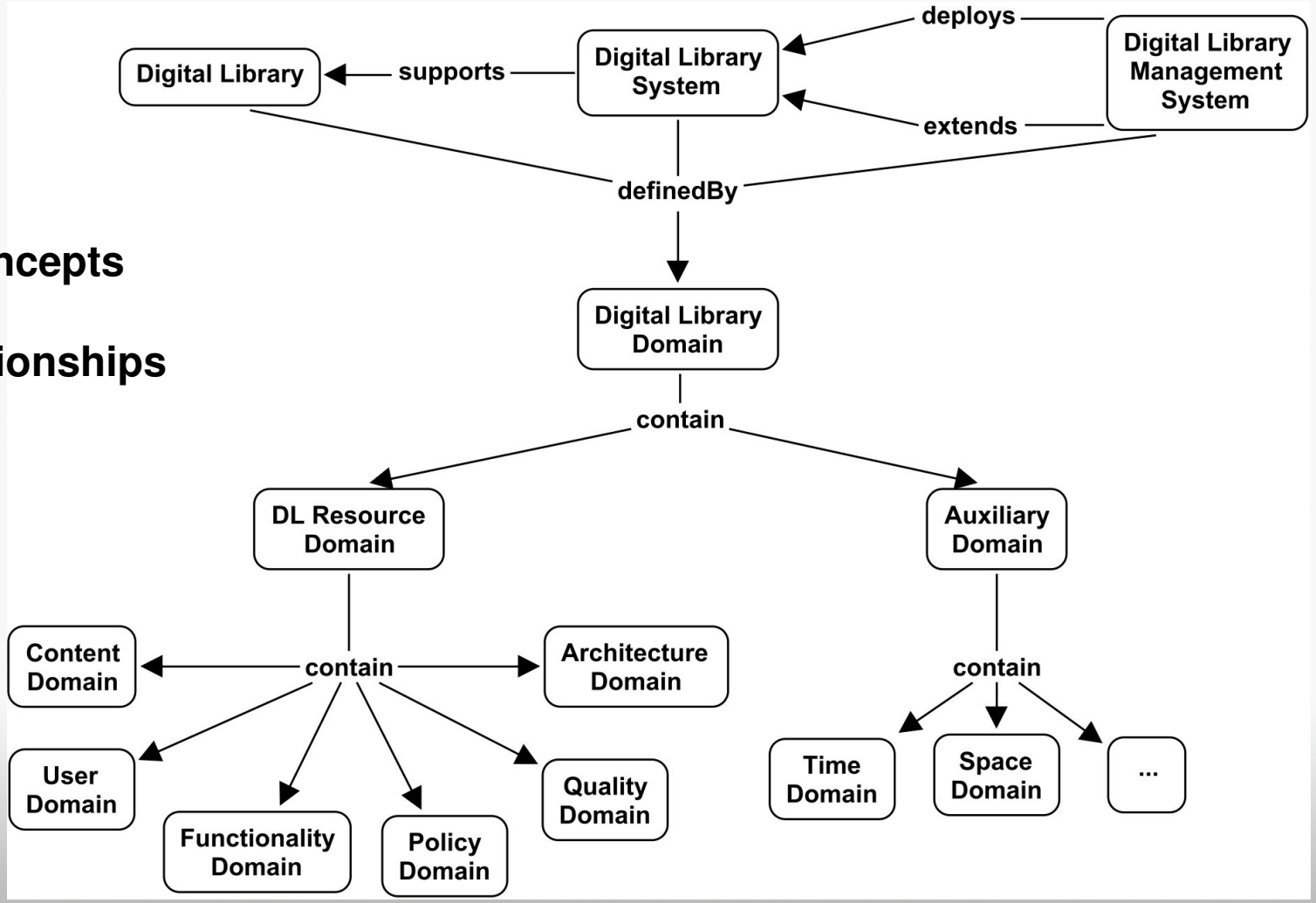
# Concept Maps



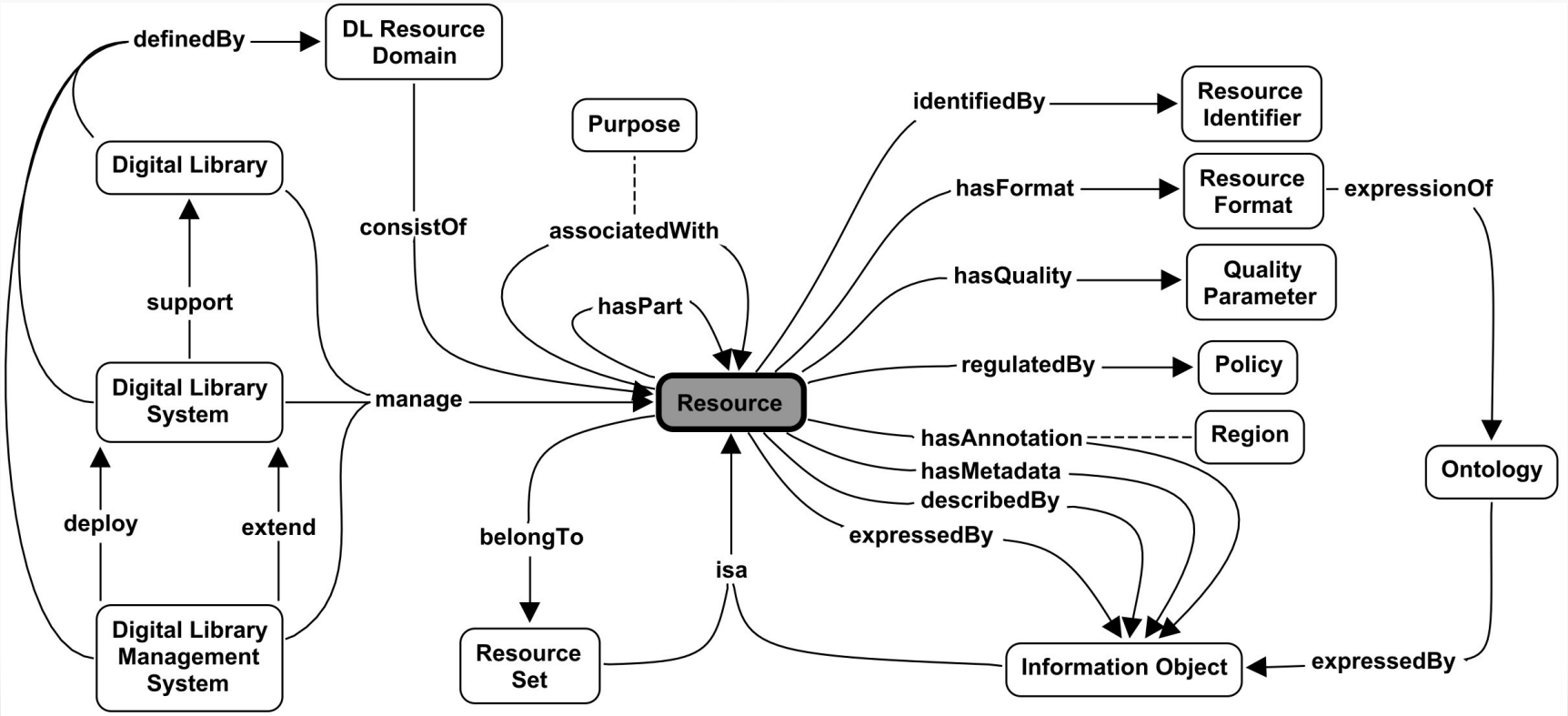
# Digital Library Domains

**218 concepts**

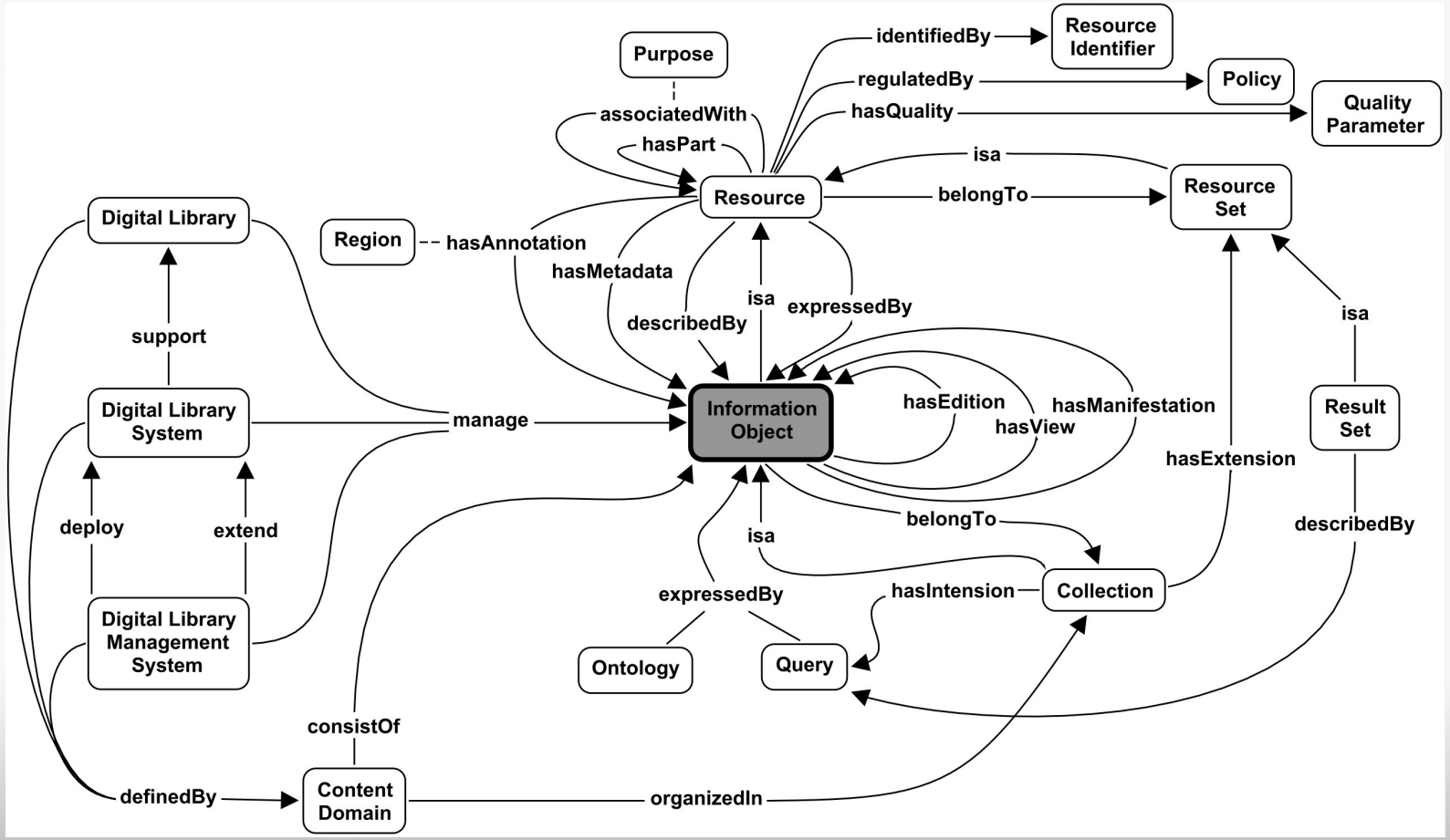
**52 relationships**



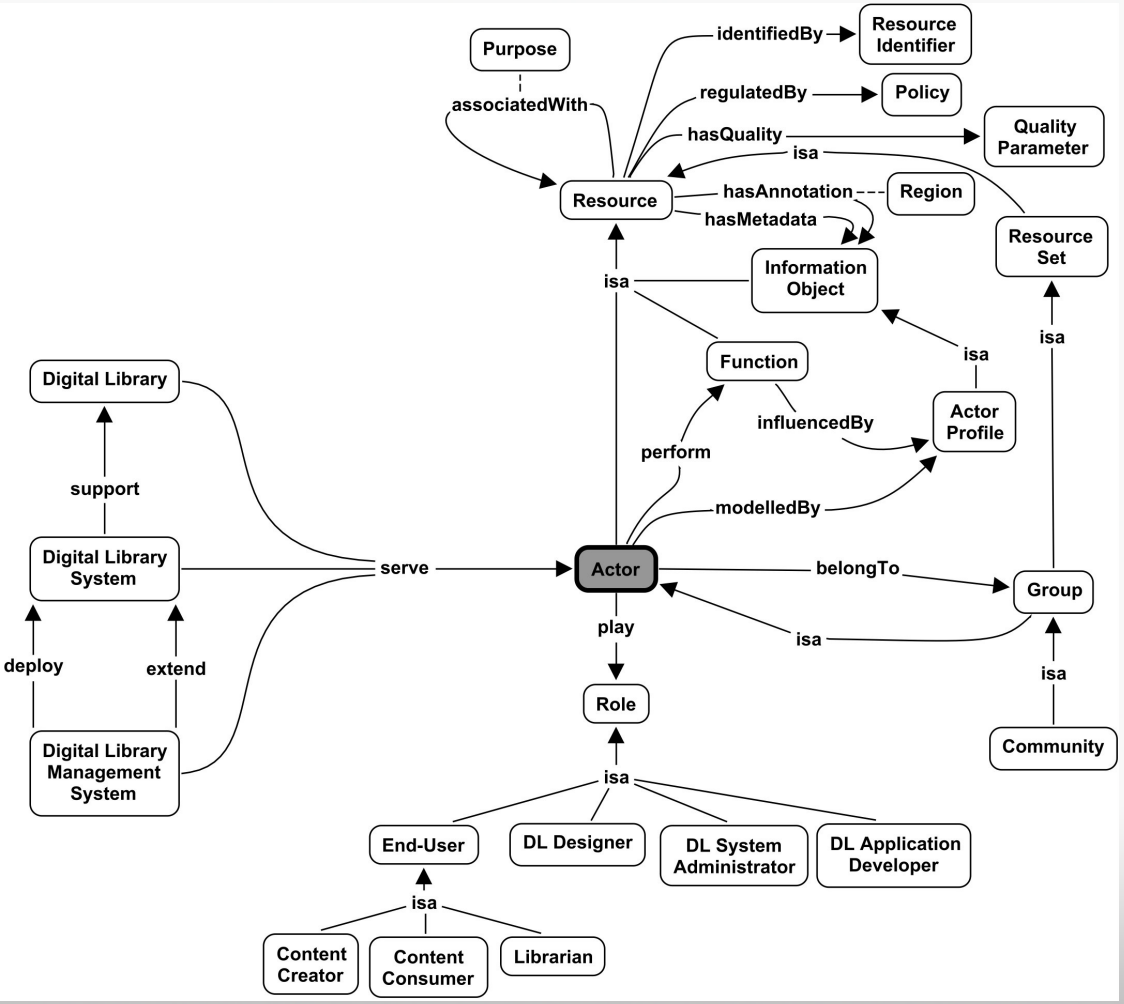
# The Resource Domain



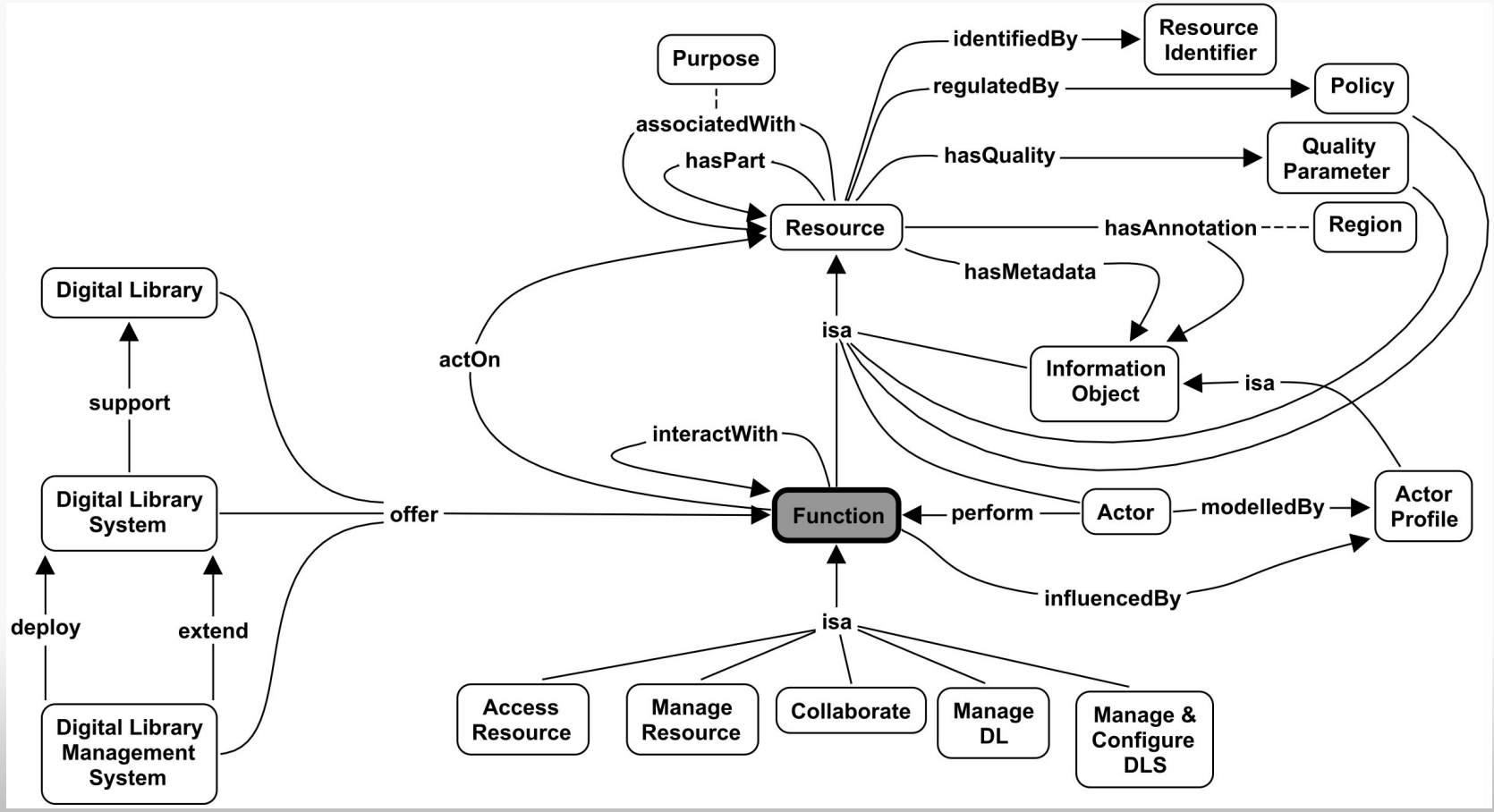
# The Content Domain



# The User Domain



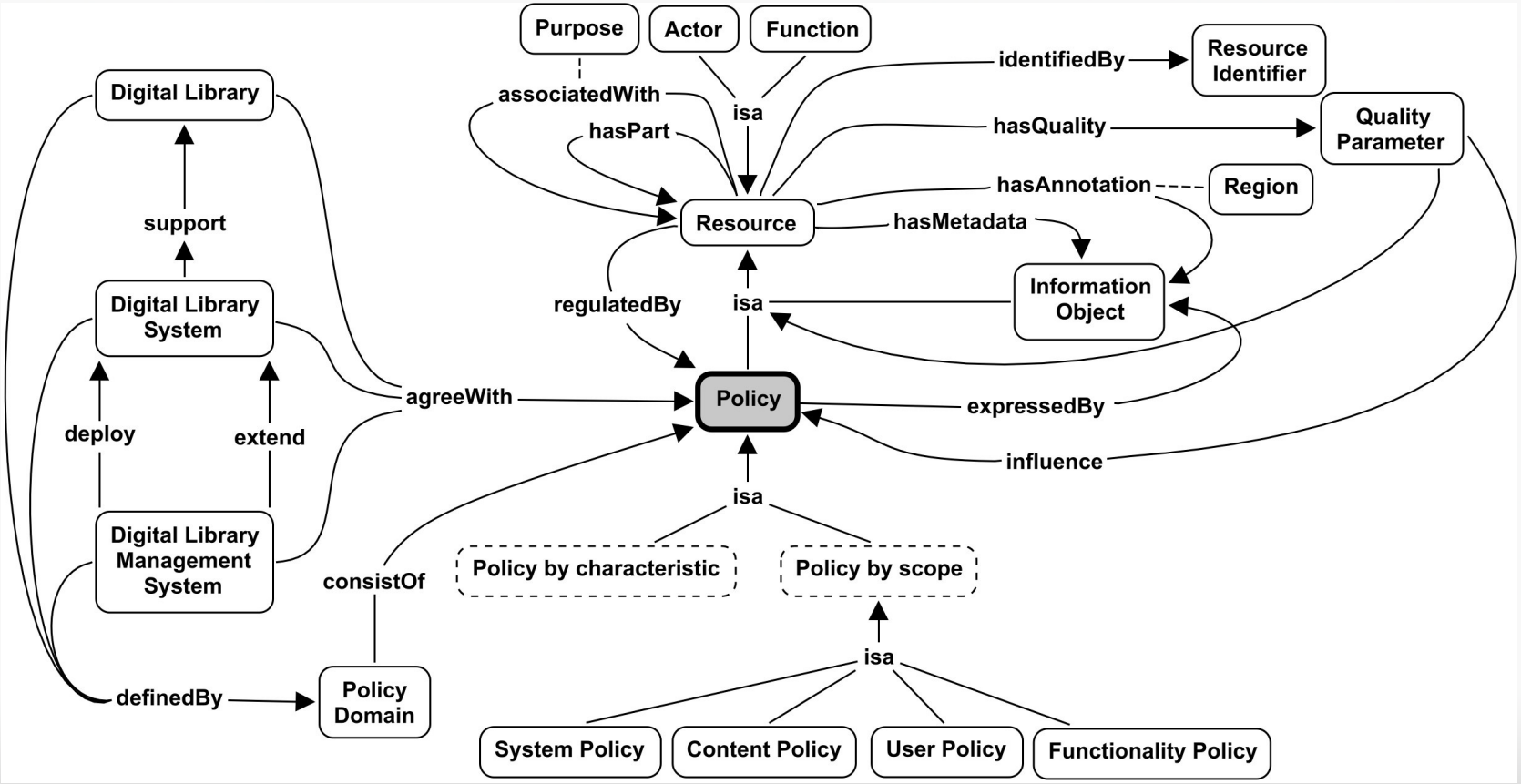
# The Functionality Domain



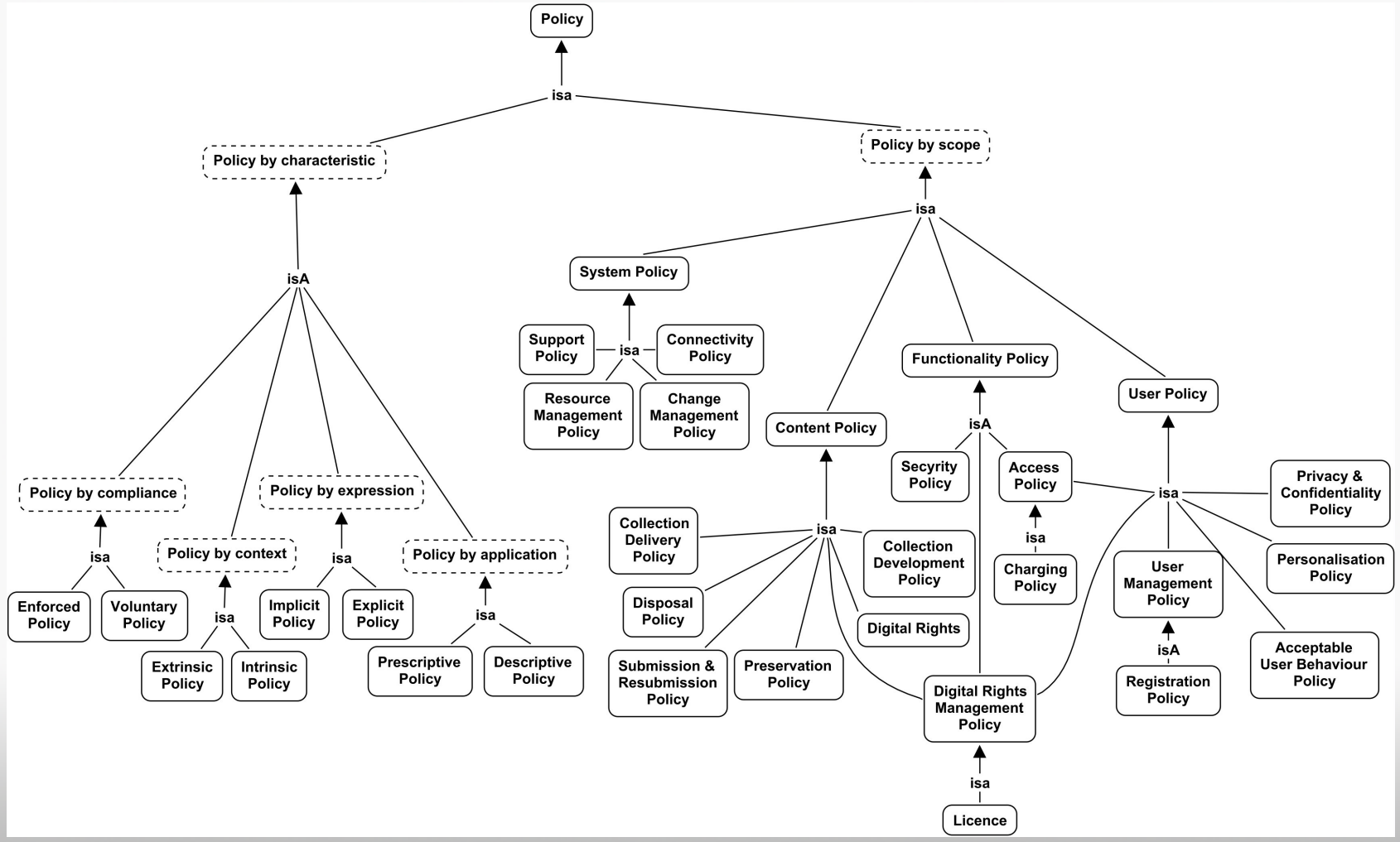
# Main functions

- C32 Access Resource
  - C33 Discover
    - C34 Browse
    - C35 Search
  - C36 Acquire
  - C37 Visualize
- C38 Manage Resource
  - C39 Create
  - C40 Submit
  - C41 Withdraw
  - C42 Update
  - C43 Validate
  - C44 Annotate
  - C45 Manage Inform Object
  - C64 Manage Actor
  - C71 Manage Function
  - C72 Manage Policy
  - C73 Manage Quality Parameter
- C74 Collaborate
  - C75 Exchange Information
  - C76 Converse
  - C77 Find Collaborator
  - C78 Author Collaboratively
- C79 Manage DL
  - C80 Manage Content
  - C85 Manage User
  - C90 Manage Functionality
  - C92 Manage Quality
  - C93 Manage Policy Domain
- C94 Manage & Configure DLS
  - C95 Manage DLS
  - C104 Configure DLS

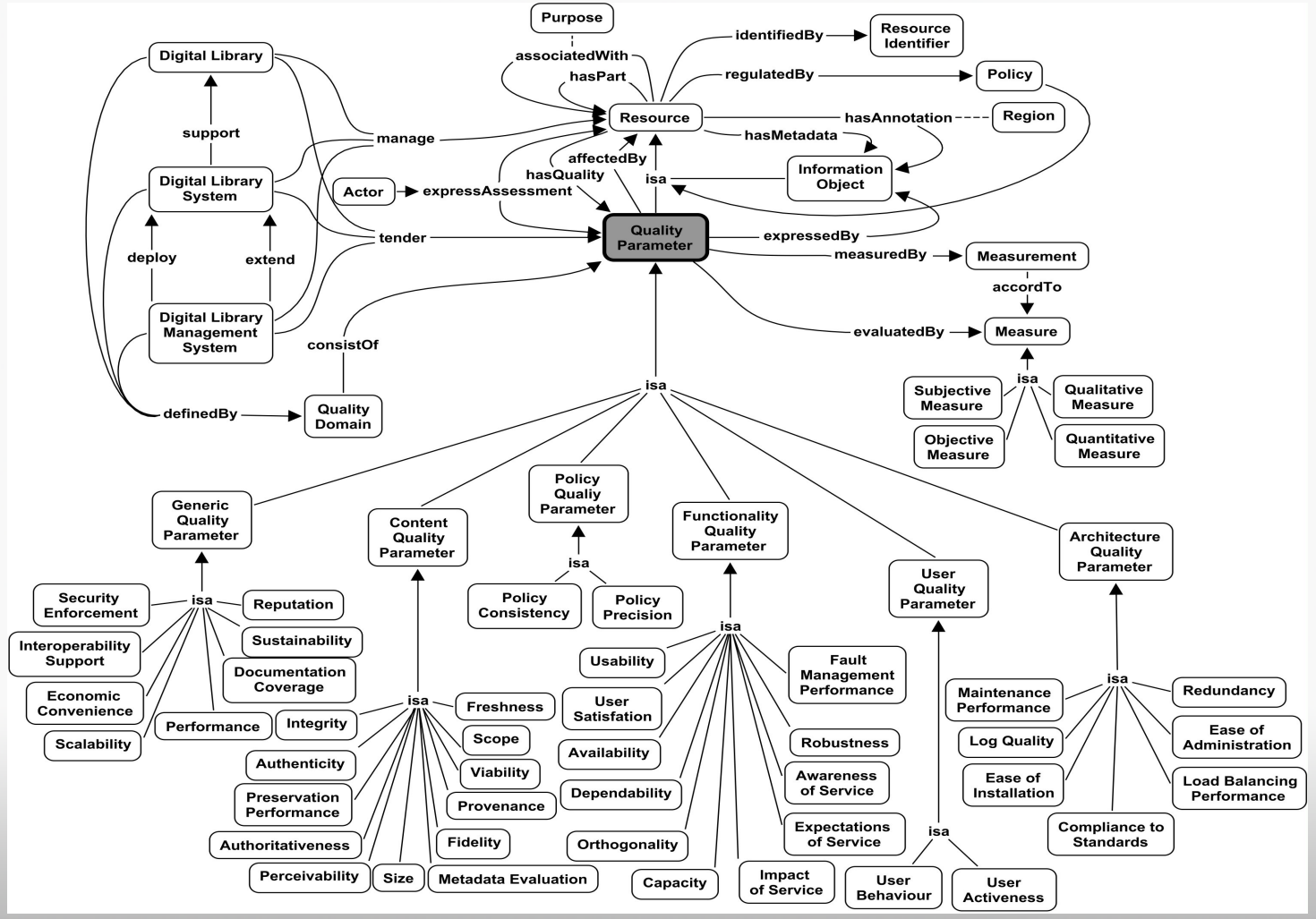
# The Policy domain



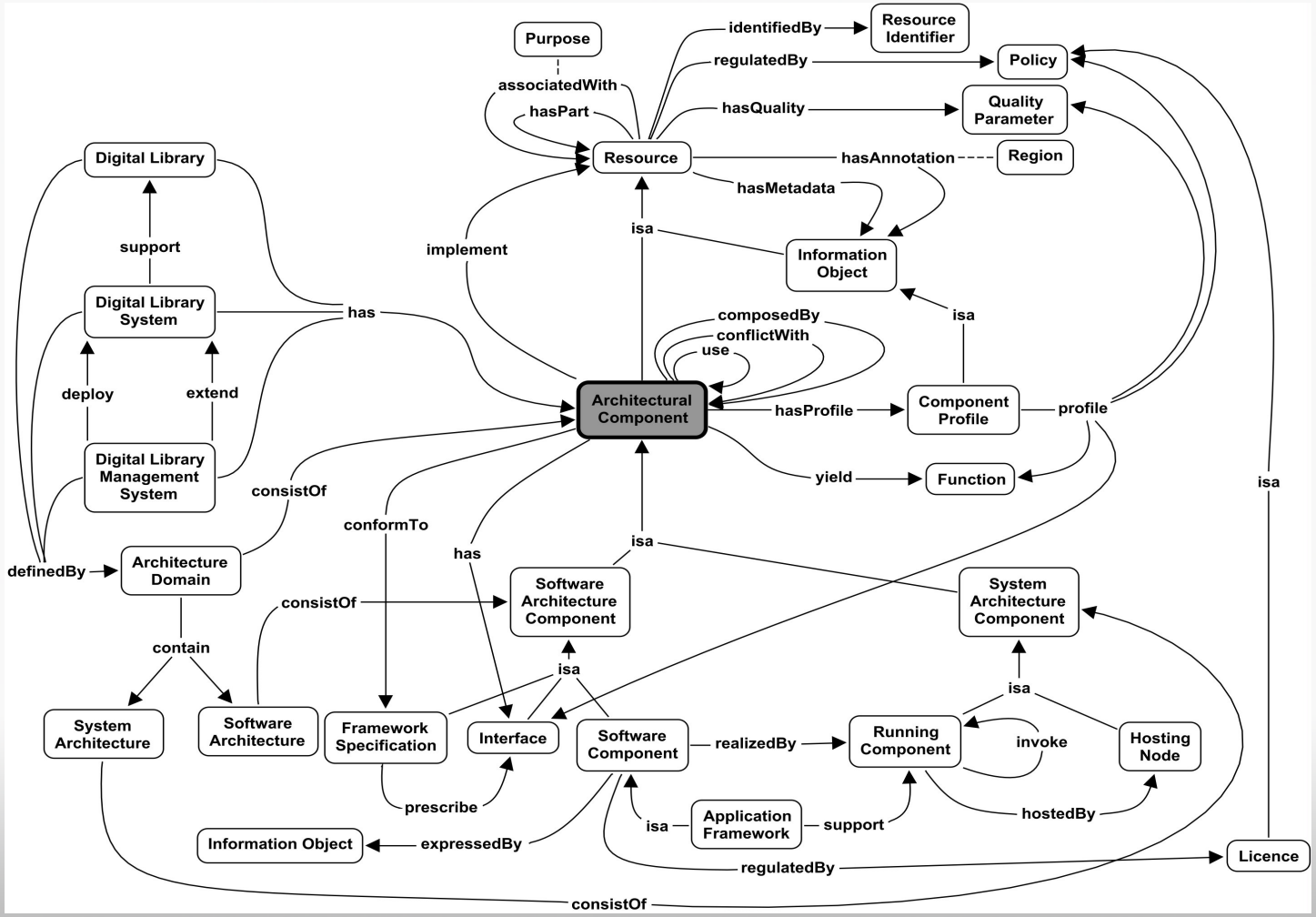
# Categorization of Policies



# The Quality Domain



# The Architecture Domain



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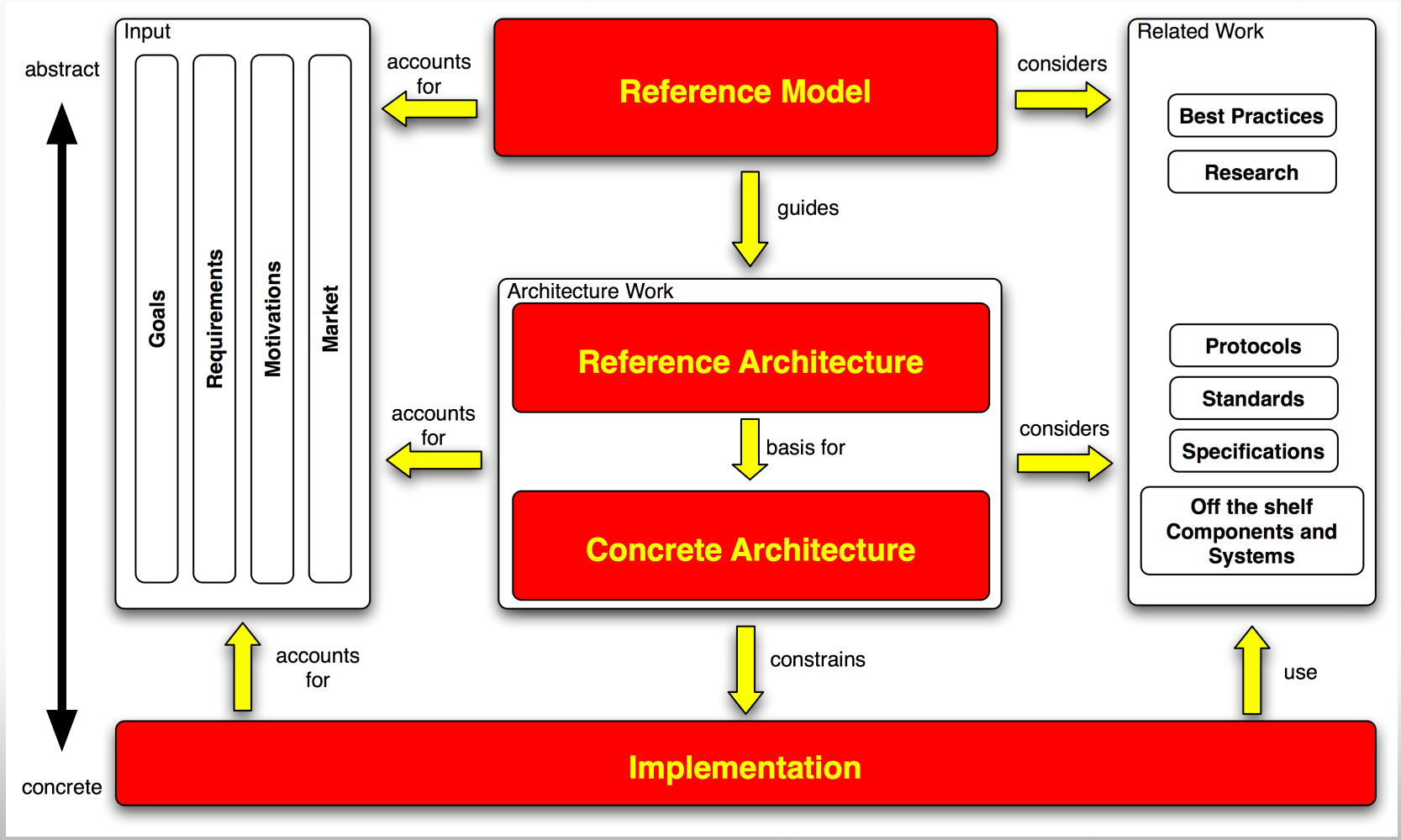
# The Digital Library Development Framework



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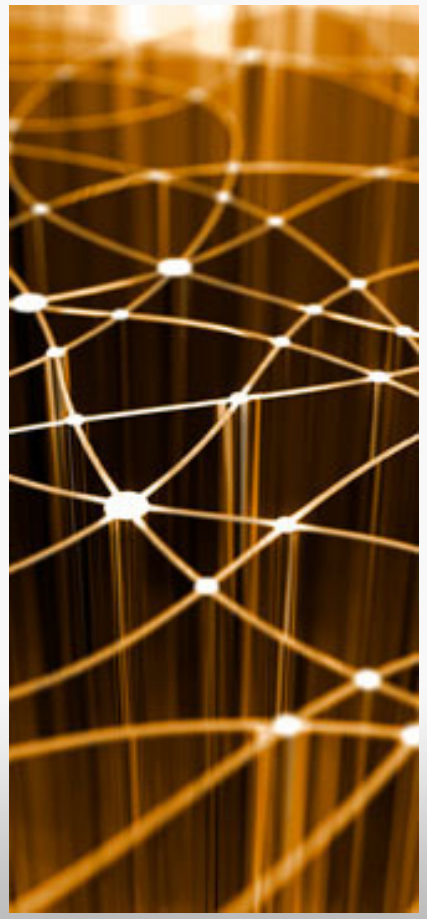

# Thank you

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