Terminology Services in Support of Healthcare Interoperability

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Outline

- Why Terminology
  - Importance of Terminologies
- Terminologies in Healthcare
  - Semantics of Healthcare Terminologies
- Terminology Services
  - Intent
  - HL7 CTS / CTS 2

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Health Care Is An Information Intensive Industry

- Control of Health Care Costs …
- Improved Quality of Care …
- Improved Health Outcomes …
- Appropriate Use of Health Technology…
- Compassionate Resource Management…

☞ … depend upon information

☞ … ultimately Patient Data

☞ … increasingly augmented by genomic data

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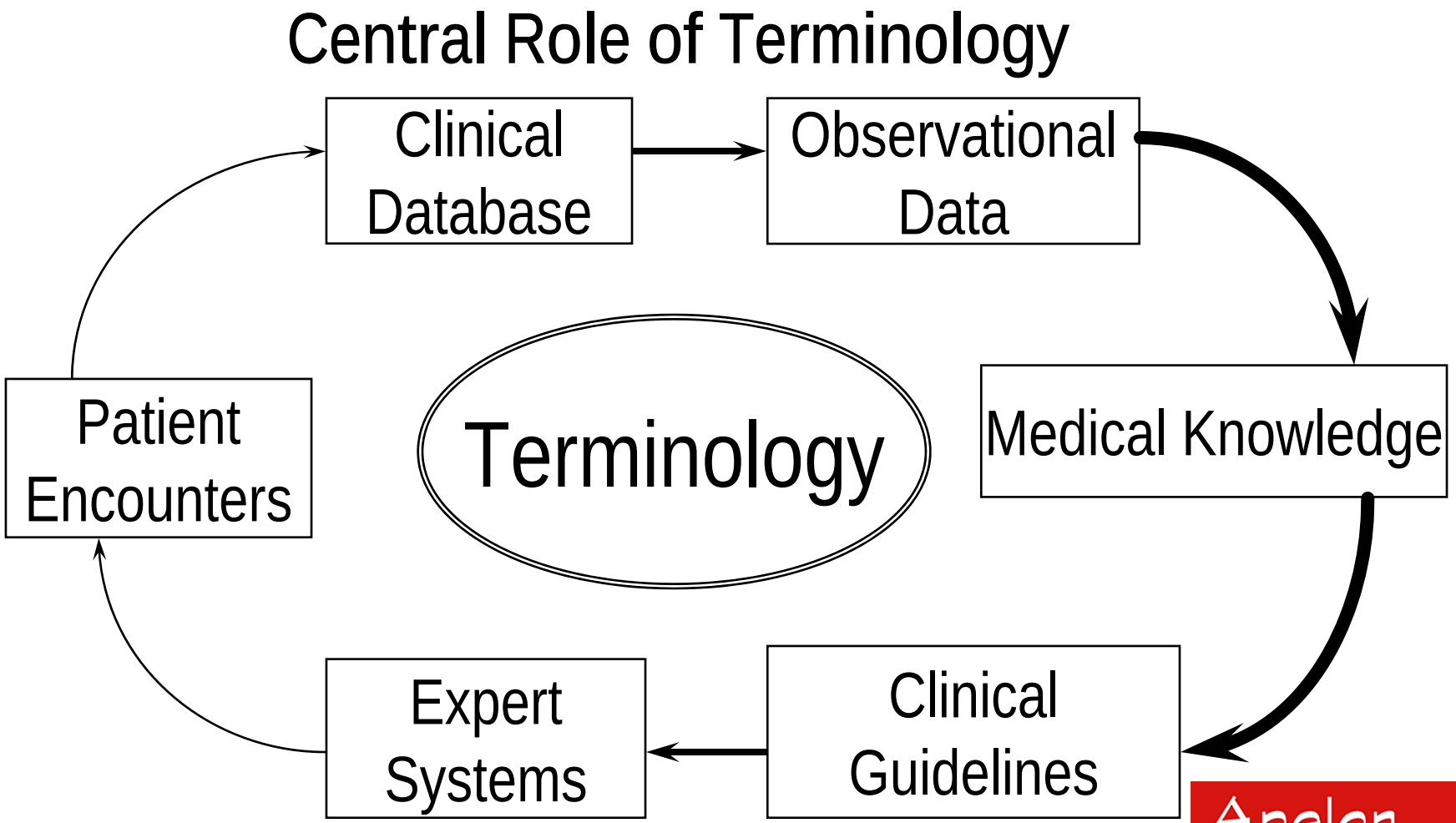
Understanding the Clinical Process



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Background - Terminology

- Terminologies (and ontologies, sort of...) have been around for a long time in the healthcare domain.
  - Coding / classification / query is an integral part of the practice of medicine
  - Shared electronic records is an emerging need
    - PMR
    - Genetic query needs the power of many communities
- Defines the meaning of data – i.e. changes data to information through instantiation of semantic rules

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Why Code Data? (translation and understanding)

- Cold
  - February is a 45893009.
  - She met his gaze with a 285846001 stare.
  - Julia is in bed with a 82272006.

  - February is a cold month.
  - She met his gaze with a cold stare.
  - Julia is in bed with a cold.

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Data Aggregation

Term	Description ID	Concept ID
myocardial infarction	37436014	22298006
cardiac infarction	37442013	22298006
heart attack	37443015	22298006
myocardial infarct	1784873012	22298006
MI - Myocardial infarction	1784872019	22298006
infarction of heart	37441018	22298006

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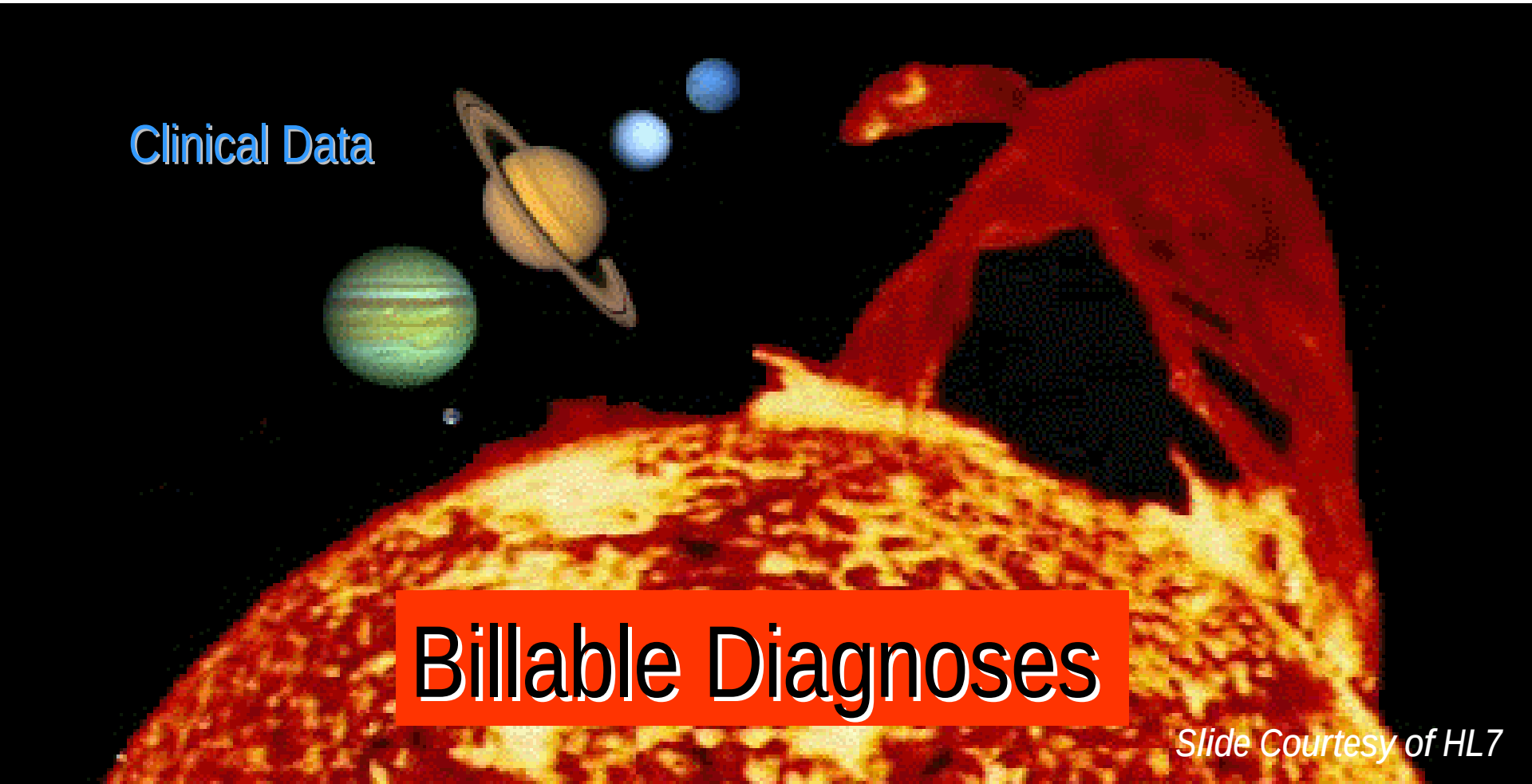
The Historical Center of the Health Data Universe

Billable Diagnoses



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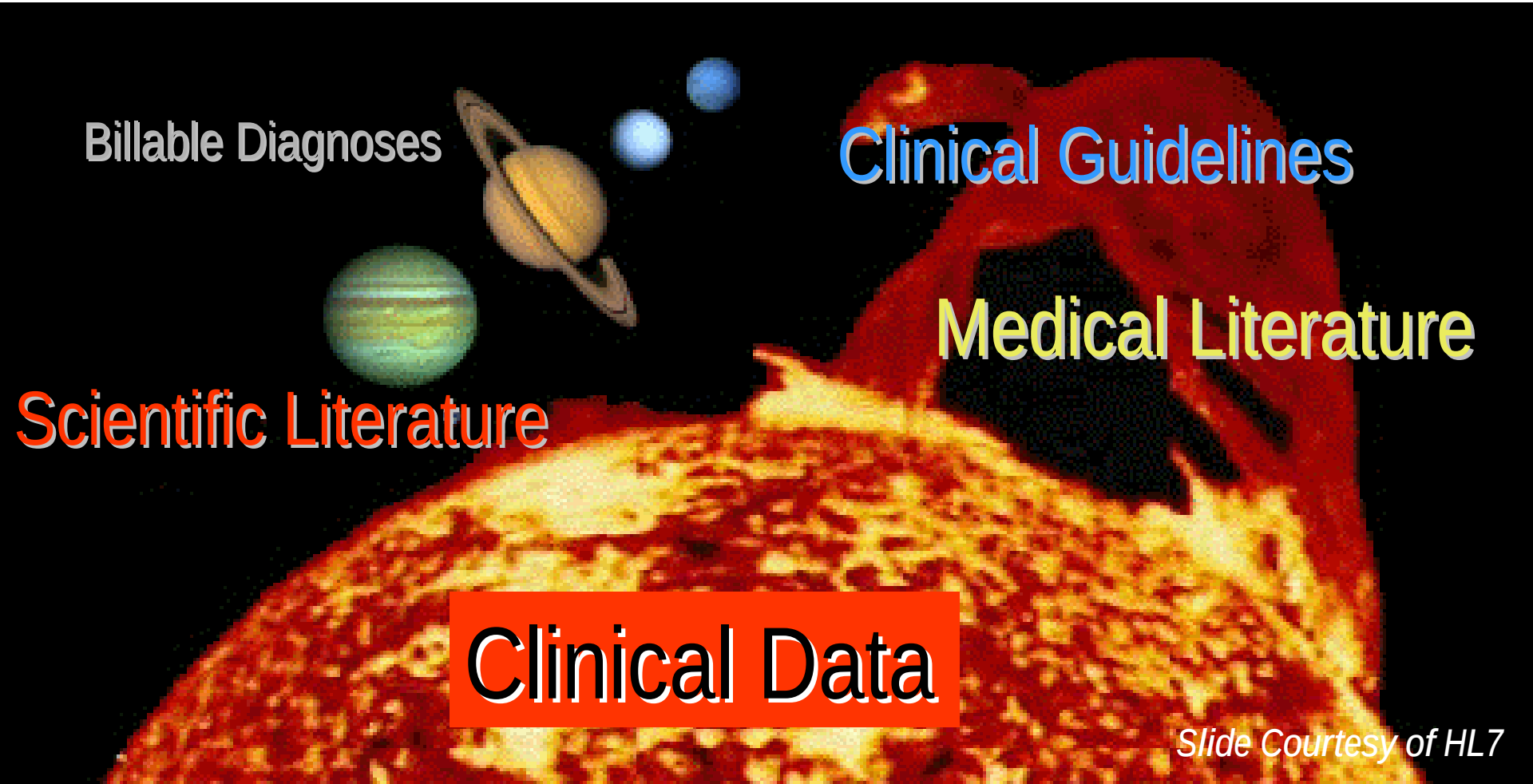
Copernican Healthcare

(Niklas Koppernigk)

Clinical Data



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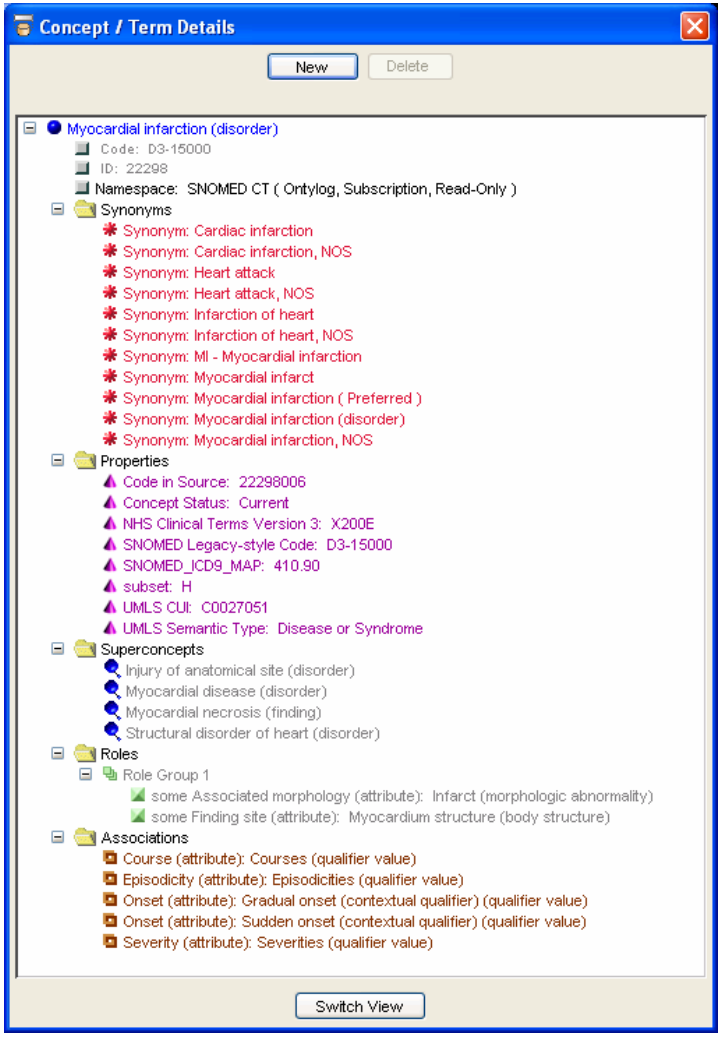
What is a Structured Terminology?



- A structured terminology is composed of *concepts* along with *synonymous terms*, *properties* and various relationships, especially a *taxonomy*
- *Relationships*
  - Taxonomy (is-a)
  - Partonomy (part-of)
  - Etiology (caused-by)
  - Therapy (treated-by)
  - Position (located-in)
  - …

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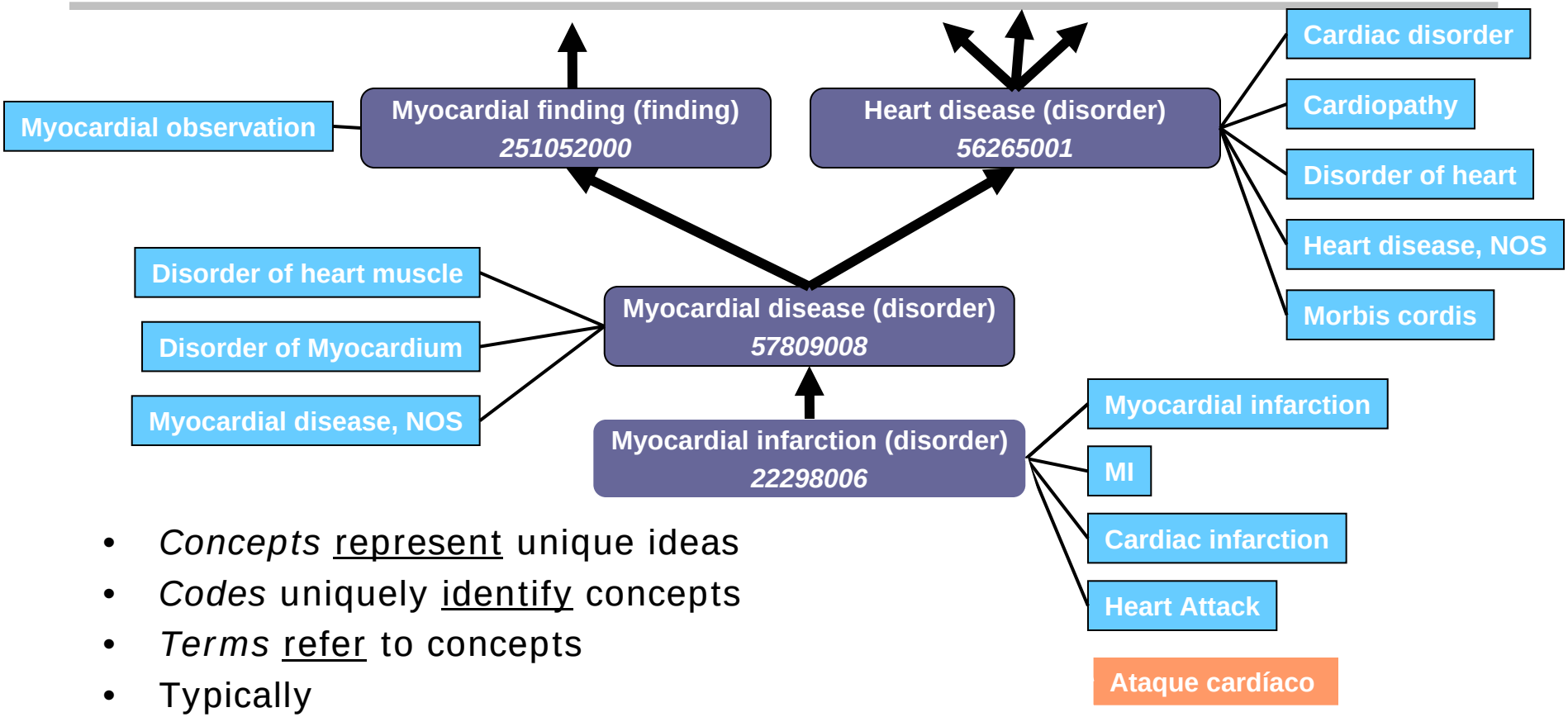
Terminology Elements



- *Concepts* represent unique ideas
- *Codes* uniquely identify concepts
- *Terms* refer to concepts
- Typically
  - Humans communicate concepts using terms
  - Computers communicate concepts using codes
- Concepts are language independent; terms are dependent

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Interplay among Terminology Elements

- Humans and computers
  - select, apply and transform
    - concepts, codes and terms
  - Across human languages
  - Across contexts (geographic, medical specialty, etc.)
  - Across applications
- Example scenario
  1. English *term* entered by clinician
  2. *Term* is encoded in SNOMED
  3. *Code* is recorded in Electronic Health *Record*
  4. *Record* is retrieved
  5. *Record* is transmitted to another application in another institution
  6. *Code* is extracted
  7. *Term* is requested e.g.,
     - Spanish term
     - Consumer term
     - Spanish consumer term

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Why Standard Terminologies?

- Provide *consistent meaning*
- Promote *shared understanding*
- Facilitate *communication* with humans
- Enable *comparison* and *integration* of data
- Essential for *interoperation* among systems, applications and institutions
- Crucial for Electronic Health Record (EHR) *sharing* and *portability*
  - Regional Health Information Organization (RHIO)
  - National Health Information Network (NHIN)

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Significant Applications

- Structured terminologies are needed in healthcare for
  - Reimbursement
  - Data integration
  - Decision support
  - Clinical guidelines
  - Medical error reduction
  - Clinical trials
  - Public health surveillance

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Standard Terminologies

- Clinical (SNOMED CT)
- Reimbursement (ICD, CPT, HCPCS)
- Pharmaceuticals (FDB, RxNorm, NDF-RT, ...)
- Labs (LOINC)
- Nursing (ICNP, NIC, NOC, NANDA)
- Adverse events (MedDRA, COSTART, WHOART)
- Genetics (GO)
- ...

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Terminology is a Crucial Requirement

Without Terminology Standards...

- Health Data is *non*-comparable
- Aggregation is difficult if not impossible
- Health Systems *cannot* Interchange Data
- Secondary Uses (Research, Efficiency) are *not* possible
- Linkage to Decision Support Resources *not* Possible

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Terminology Services

- One of the fundamental goals of computerized medical information is that of precise, accurate and unambiguous communication.
- Structured terminologies provide the ***semantics*** of the concepts being conveyed in an electronic message or record (syntax is another discussion altogether).
- But…this is only half (ok, maybe ¾) of the story.

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Meaningful Communication…now what?

- Being able to predictably access terminological content is still necessary.
- Example
  - Need to receive a SNOMED-CT *disorder* code, and
    - Validate the code against the SNOMED-CT vocabulary
    - Query against properties of the code (determine the grouping or aggregation of the code, e.g. What type of disorder is this?)
    - What drugs can be used to treat this disorder
    - Translate this code for our insurance systems.
- Problem
  - How do we ensure that our operations with vocabulary are consistent across domains?

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Meaningful Communication…now what?

- External terminological resources vary considerably in both content and structure.

- User requirements of terminology differ (real time decision support, billing applications…)
- Storage formats may differ (relational database, XML, RDF, MIF…)

- This is where Terminology Services comes in.

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What is a Terminology Server?

A terminology server is

- a (networked) software component
- centralizes terminology content access and reasoning
- provides (complete, consistent and effective) terminology services for other network applications

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How is a Terminology Server Used?

- By informaticists

  to create, maintain, localize and map terminologies
- By clinical applications and their users

  to select and record standardized data
- By integration engines

  to facilitate mapping terminology elements between applications

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What are Terminology Services?

- The means by which applications (clinical) can
  - Define the common business functions for terminology applications
  - Utilize and interoperate among standard and local terminologies
  - Benefit from terminology model “knowledge”
- Are provided by terminology server software, which
  - Centralize or federate terminology content and represents it in a consistent format
  - Communicates with other network applications (e.g., to translate and normalize data elements)
- Provides a common platform for terminology updates
  - Provides tools to develop and maintain terminology content, including mappings that connect concepts in different terminologies, use-specific subsets, and local extensions to existing standards.
- Implement terminology as an *asset* of the organization (TAM)

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Examples of Terminology Services

- Term/name normalization:
  What is the SNOMED CT name for *heart attack*?
  Myocardial Infarction
- Code translation:
  What is the ICD-9 code for Myocardial Infarction?
  410.9
- Grouping and aggregation:
  Is Myocardial Infarction a Cardiac Disease?
  Yes
- Clinical knowledge:
  What drug treats Myocardial Infarction?
  Streptokinase
- Local information:
  Add L227 as the local code for Serum Calcium.
  OK

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History of Terminology Services in the US

- YATN: yet another terminology service 1996
  - Mayo, Kaiser, Lexical Technology
- MetaPhrase – Lexical Technology 1998
- UC Davis JTerm Terminolgy service 1998
- LQS: Lexicon Query Services; 3M 1998
- Apelon DTS
- Mayo Autocoder: UI to YATN suite 2000
- CTS: Common Terminology Services 2003
  - HL7 balloted standard 2004 (CTS I)
  - Next version (CTS II) going into ballot as DSTU this fall
- LexGrid: superset CTS, ref. implementation – 04
  - http://informatics.mayo.edu
- CTS 2 – DSTU Ballot March 2009

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HL7's Common Terminology Services (CTS)

- What is CTS?
- An HL7 ANSI Standard interface specification for querying and accessing terminological content.
- The CTS identifies the minimum set of *functional* characteristics a terminology resource must possess for use in HL7.
- The functional characteristics are described as a set of Application Programming Interfaces (APIs) that can be implemented to suit.

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HL7's Common Terminology Services (CTS)

- Advantages to this functional approach
  - No need to force a common terminological structure on terminology developers.
  - Decouples *terminology* from the *terminology service.*
  - Terminology users can use whatever technology appropriate for their needs.
    - Legacy database
    - Institutional infrastructure
  - Provides a common interface and reference model for understanding
    - I know what you mean by Code System
    - I know what to expect when I execute the validateCode() method
- Client software doesn't have to know about specific terminology data structures and/or how to access them.
- Server software can plug and play with many clients

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Common Terminology Services API

- Allows Client Software to be Developed Independently from Service Server Software
- Allows Terminology Plug-and-Play
- Allows Client Plug-and-Play
- Defines a “Functional Contract” between terminology users and providers.

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CTS Runtime Message API Examples

Function	Description
validateCode	Determine whether the supplied coded attribute (CD) is valid in this vocabulary domain and context.
validateTranslation	Determines whether the translation portion of the coded attribute is valid in this domain and context.
translateCode	Translate the input code into a form that is valid in the target contexts.

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CTS Runtime Message API Examples

Function	Description
fillInDetails	Fill in the details for the coded attribute, including all code system names, versions and display names.
subsumes	Determine whether the parent attribute subsumes the child.
areEquivalent	Determine whether attribute value 1 and 2 are logically equivalent
lookupValueSetExpansion	Return a hierarchical list of selectable concepts for the vocabulary domain and context

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CTS Runtime Vocabulary API

Function	Description
lookupCodeSystemInfo	Return detailed information about the named code system
isConceptIdValid	Determine whether the concept code is valid in the code system.
lookupDesignation	Determine whether the relationship exists between the source and target code

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Additional CTS API's

- CTS Message Browsing API
  - Used by HL7 Modelers
- CTS Vocabulary Browsing API
  - Used by Terminology Authors and Value Set Building
- CTS Mapping API
  - Used to translate concept codes from one system to another

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Limitation of CTS

- Purposely limited functional scope:
  - read only
  - terminology access APIs for HL7 (much carryover to other terminologies)
  - basic terminology mapping
  - no versioning support

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CTS 2

- Project of the HL7 Vocabulary Workgroup
  - Developed under the Service Oriented Architectures (SOA) Healthcare Service Specification Project (HSSP) framework
  - Expand the scope of functionality to include
    - Administrative functions
    - Expanded search capability
    - Mapping functionality
    - Authoring / Maintenance
    - Conceptual model for terminology

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CTS 2 Process

- Formalize Actors
- Behavioral/Conceptual Model
- Business Scenarios (Use Cases)
- Detailed Models
- Profiles
  - Functional
  - Semantic
  - Conformance

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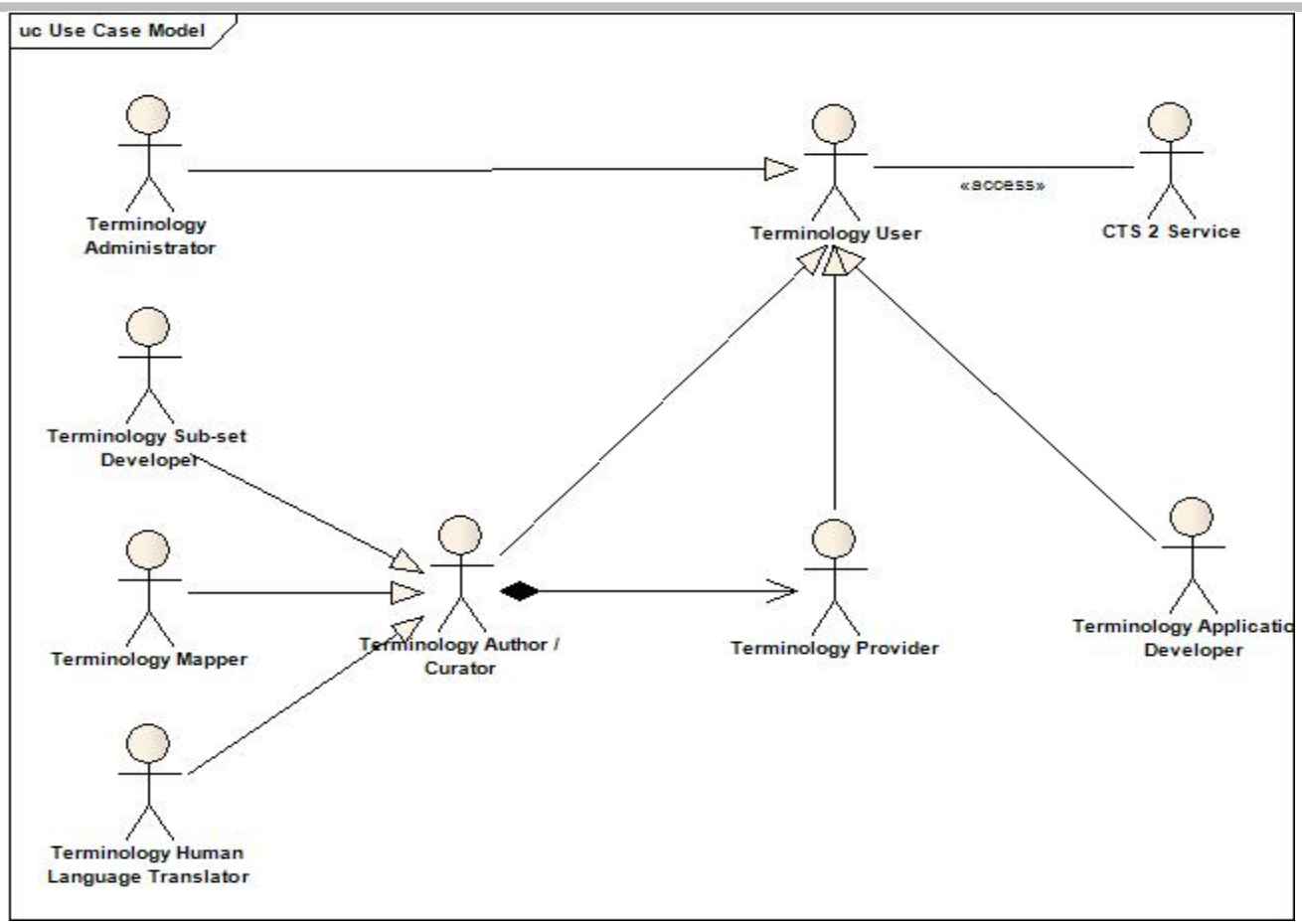
Formalize Actors



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Behavioral Model

- Terminologies are created for many purposes, and as such are often structured very differently
  - flat list of concepts,
  - complex poly-hierarchies.
- The attributes of the entities of code systems vary as well.
  - formats of the identifiers are different, meaningless identifiers/implied meaning.)
- The functional components of CTS 2 must be able to operate on this broad spectrum of terminology sources.
  - Specify a concept based terminology model that is capable of representing most varieties of structured terminologies.
  - Minimal necessary behavioral model for terminologies
  - Look to standards communities, industry, and academia

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Conceptual Model

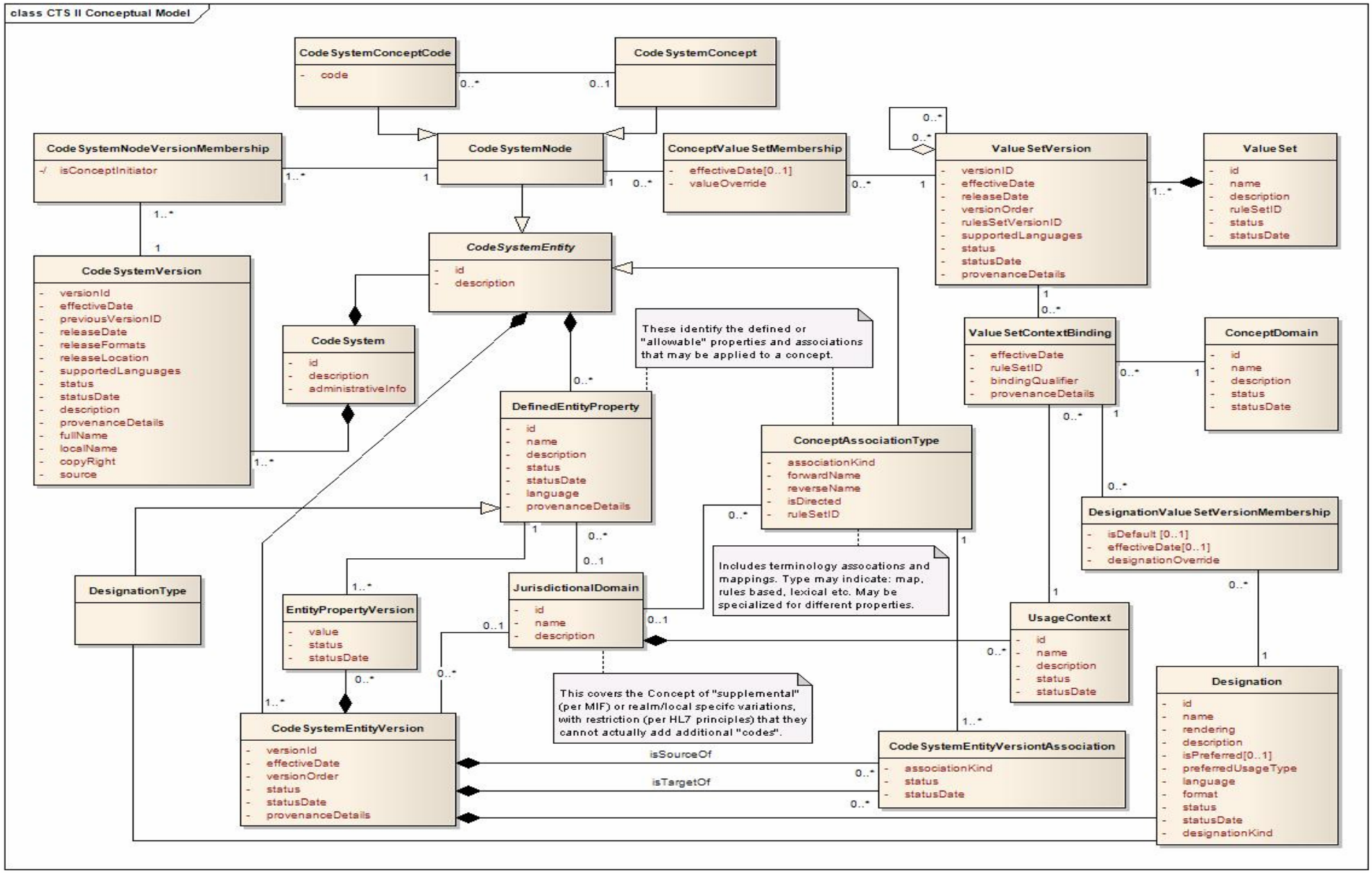

Figure 1 CTS 2 Conceptual Model

Business Scenarios (Use Cases)

- Based on the discussed terminology service criteria, define high level business scenarios that:
  - Cover the existing CTS functional capabilities
  - Extend the CTS functionality into other domains
    - Administrative functions
    - Expanded search capability
    - Mapping functionality
    - Authoring / Maintenance

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Profiles

- **A profile is a named set of cohesive capabilities that enables a service to be used at different levels, and allow implementers to provide different levels of capabilities in differing contexts.**
- **Service-to-service interoperability will be judged at the profile level and not the service level.**
- **A set of profiles may be defined that cover specific functions, semantic information and overall conformance.**

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CTS 2 Query Profile

- The CTS 2 Query Profile specifies the minimal functional coverage necessary for a service to declare itself as being a conformant CTS 2 service.

- The CTS 2 Query includes capabilities for searching and query terminology content, representing terminology content in interoperable datatypes and structuring terminology content appropriately.

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Terminology Administration Profile

- The Terminology Administration profile is intended to provide the functional operations necessary for terminology administrators to be able to access and make available terminology content obtained from a Terminology Provider.

- Terminology Administrators are required to interface with Terminology Provider systems in order to obtain the terminology content, then load that terminology content on local Terminology Servers.

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Functional Profiles
Terminology Authoring Profile

- Terminology authors require the capability to robustly query and access terminology content, as well as directly modify the terminology content.

- The Terminology Authoring profile is intended to provide the functional operations necessary for terminology authors to analyze and directly edit the existing terminology content.

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Status

- The CTS 2 SFM went to ballot as Draft For Comment for the May 2009 ballot Cycle at HL7
- Resolve and integrate comments and ballot as DSTU this May
- Meet with OMG (yesterday) to discuss/draft initial RFP

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Summary

- Terminologies play a crucial role in enabling semantic interoperability by defining the meaning of data being communicates
- Healthcare has been a leader in the development of terminologies for use in classifying and aggregating clinical data.
- Terminology Services can be deployed to provide consistent access to terminology resources across organizations.

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Thank You?

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