A stethoscope is positioned diagonally across the right side of the slide, resting on a document. The document features a bar chart with several bars of varying heights and a pie chart with several slices. The background is a light, slightly blurred image of the same document and stethoscope.

The Logical Model Designer (LMD) – Binding Information Models to Terminology

Linda Bird, Hendry Wijaya, Teck Wei Chin - MOH Holdings
Balazs Banfai – B2i

25th October 2012
(10:45 – 11:30)

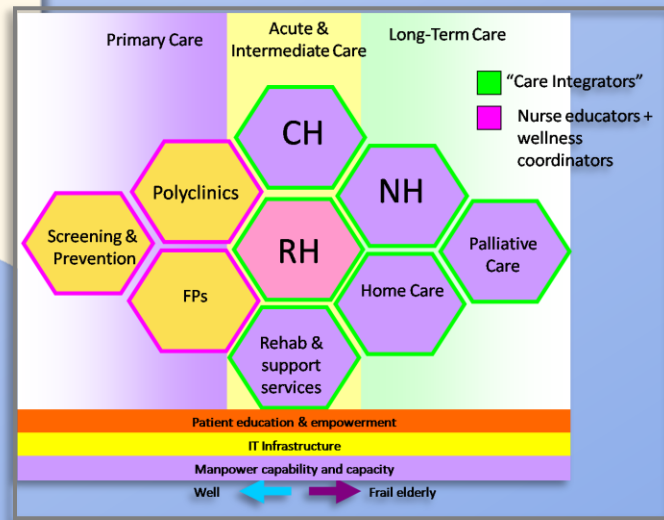
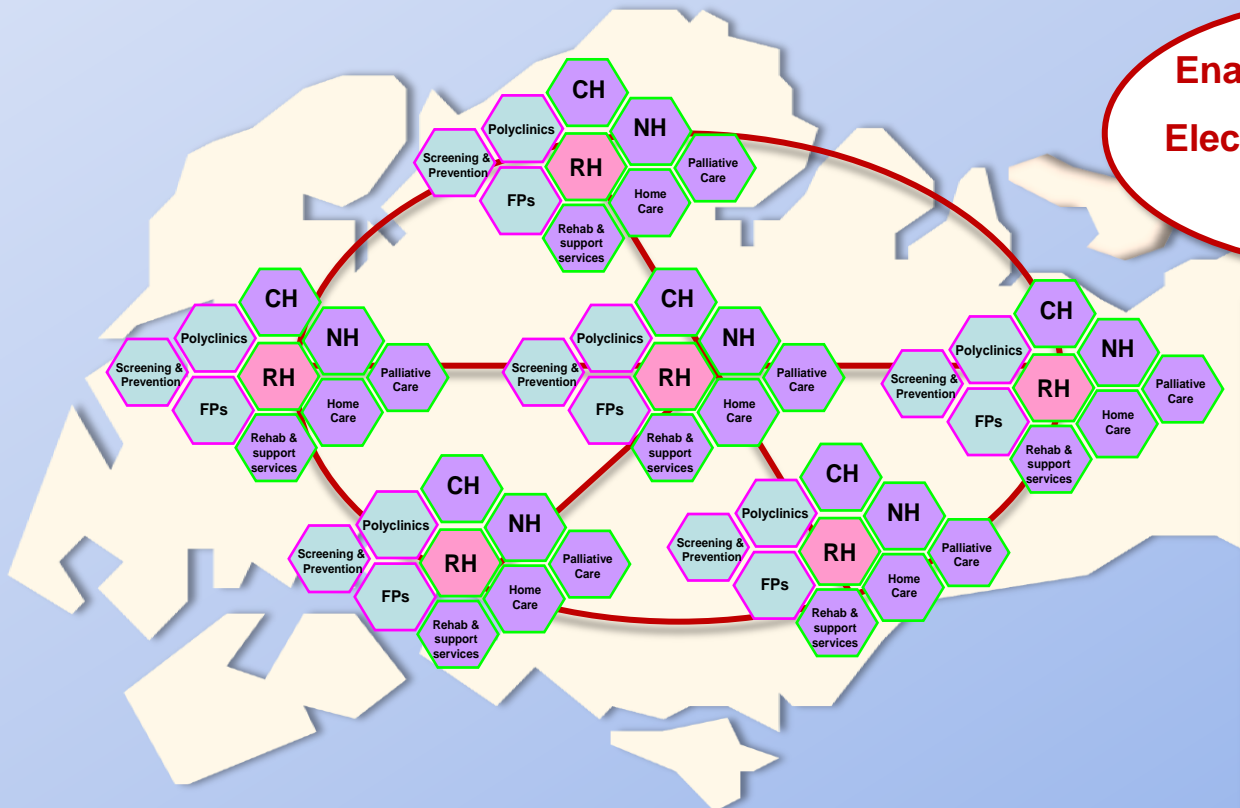
- Background
- Logical Information Model
- LMD Tooling
- Terminology Binding
- Demonstration
- Platform Software Architecture
- Project Timeline

Healthcare landscape of the future

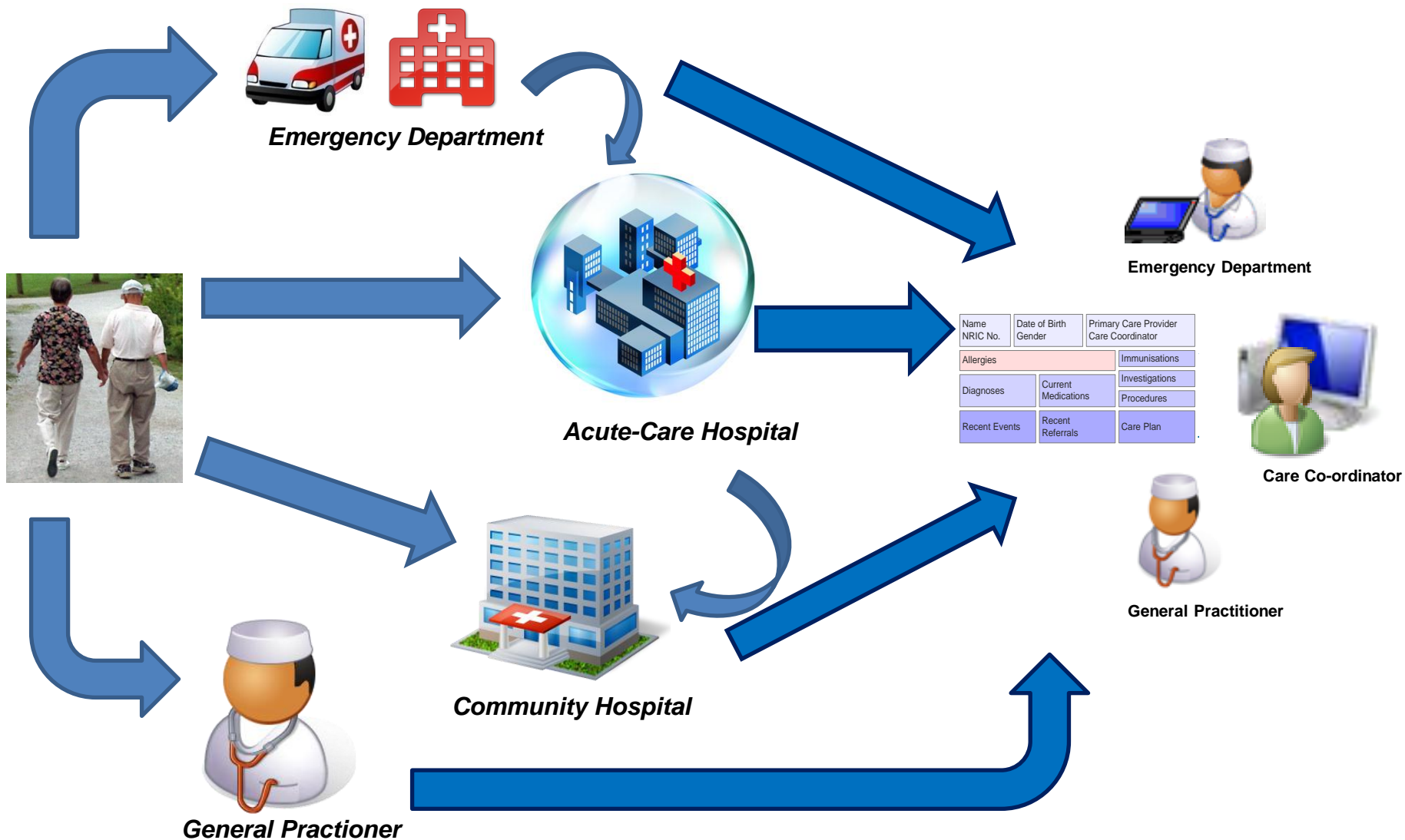
Strategic vision of patients moving seamlessly across the healthcare system, receiving coordinated patient-centric care at the most appropriate settings.



Enabled by the National Electronic Health Record (EHR)



Sharing Information Across Singapore

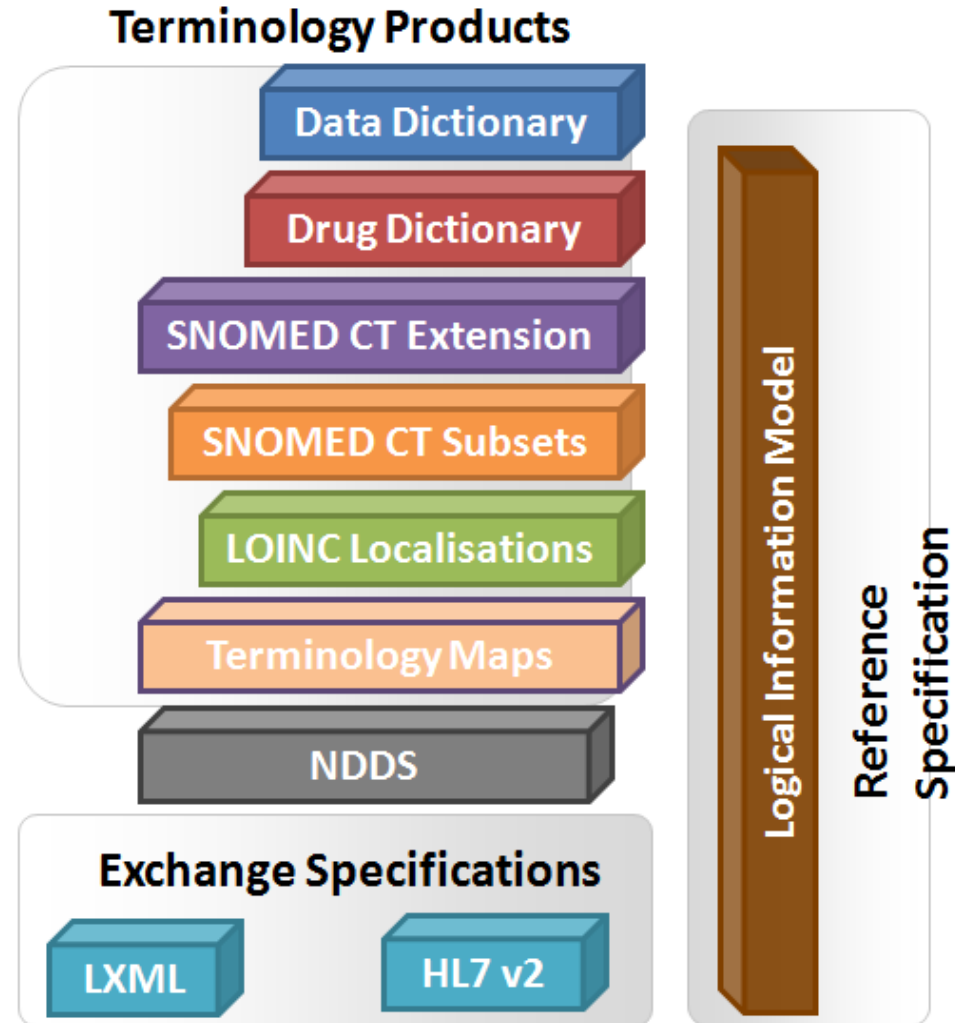


- **Messaging** – safe exchange of transactional data
- **Document Exchange** – safe exchange of documents
- **Persistence** – storing data in clinical systems
- **Interoperability** – ability to interpret semantics of data received from other clinical systems and store in native data stores
- **Querying & Analytics** – over multiple heterogeneous sources
- **Decision Support** – ability to define and apply decision support rules over shared data

MOH Holdings Standards Products

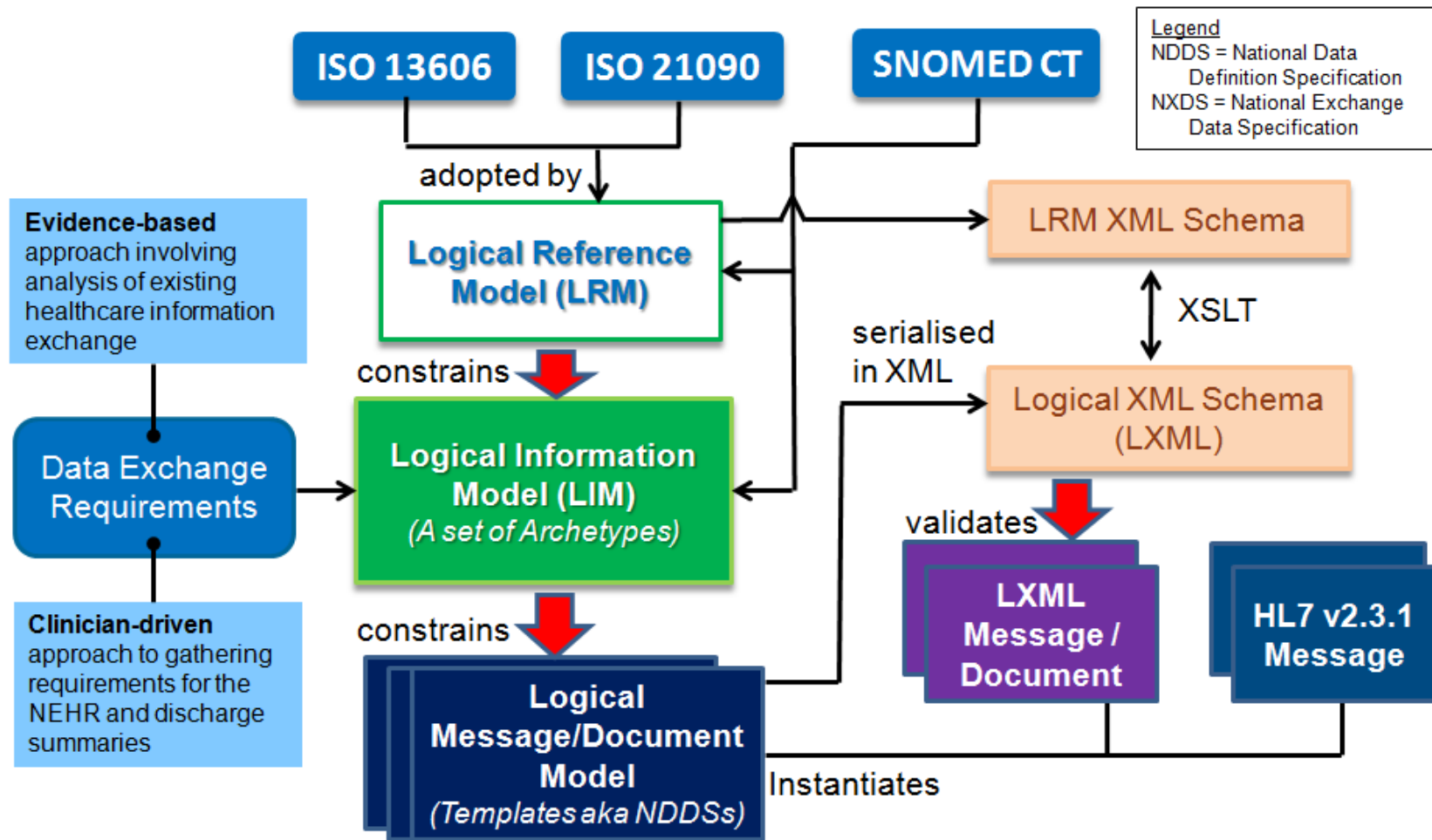
- **Diagnosis** - SNOMED CT*
- **Drugs** - Singapore Drug Dictionary (SDD)
- **Allergic Reactions** - SNOMED CT*
- **Allergens** - SNOMED CT* + SDD
- **Laboratory Results** - LOINC (TBD)
- **Data Dictionary** - MOHH Data Dictionary
- **Procedures** - TBD
- **Reason for visit** - SNOMED CT*
- **Symptoms and Problems** - SNOMED CT*
- **Laboratory Reports** - Smart SNOMED CT*
- **Laboratory Orders** - SNOMED CT*
- **Radiology Orders** - SNOMED CT*

SNOMED CT* includes Singapore Extension

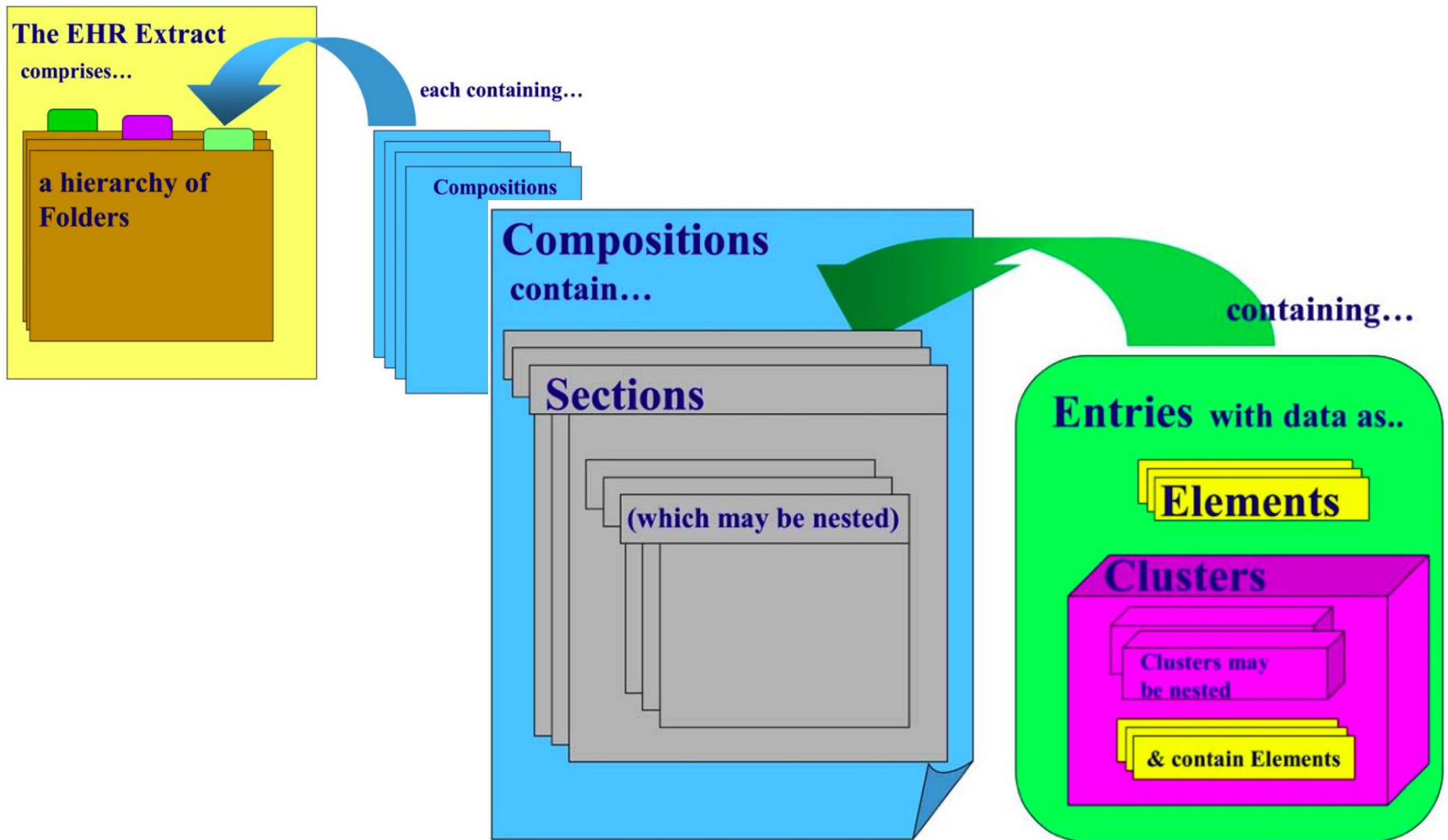


1. A common, implementation-independent model of all shared healthcare information in Singapore.
2. A 'single source of truth' that articulates our clinician and business information requirements
3. Implementation artefacts are generated from common semantics

LIM Development Process



Logical Reference Model



Archetypes

- Reusable clinical models
- Defined as a set of constraints on the reference model
- For example:
 - Observation, Diagnosis, Alert, Adverse Reaction, Investigation Result
- Can be further constrained – e.g. Heart rate, Microbiology Result

Templates

- Group together a set of archetypes for a specific use case
- Apply additional use-case specific constraints
- Can be used to standardise the elements, constraints and terminology for a given message type, user interface etc
- For example:
 - Discharge summary, Investigation Report, Prescription

Example Model

MOHH-LIM-ENTRY.INVESTIGATION.v0.2.0.lom MOHH-LIM-CD.CD.CWE.v0.0.0.lom

Archetype Editor

Hierarchy

- Information Provider
- Meaning
- Synthesised Flag
- Policy Identifiers
- Original System Audit
- Act Identifier
- Uncertainty Flag
- other_participation
- Performing Facility
- Reference Facility
- Consultant-In-Charge
- Reporting Clinician
- Other Participation
- item
- Investigation Item (Procedure Design Pattern)**
 - other_participation
 - archetype_id
 - name
 - orig_parent_ref
 - policy_id
 - sensitivity
 - link
 - original_system_audit
 - rc_id
 - translation
 - part
 - Investigation Name** **Business Data Element Name**
 - archetype_id
 - name
 - orig_parent_ref
 - policy_id
 - sensitivity
 - link
 - original_system_audit
 - rc_id
 - translation
 - null_flavour
 - value**
 - source
 - Additional Description

Complex Node

UID: 948f5ea3-ce33-41cb-abda-6c70e2283e39

Name: value

Node ID:

Defining Information

Base node:

Reference model attribute: value : ANY

Reference model type: CD **Data Type**

Flavour: CD.CWE

Constraints

Min. cardinality: 1 **Cardinality**

Max. cardinality: 1

Assumed value:

Default value:

Fixed value:

Other constraints

| Type | Description |
|------|-------------|
| | |
| | |
| | |

Add... Remove Edit...

Descriptive Information

Values

Constructor binding:

National Value Domain

Simple Investigation Name **Value Domain**

Terminology Challenges

Example: "Suspected Lung Cancer"

General Practice [X]

Problem/Dx

Prob/Dx: Cancer [v]

Body Site: Lung [v]

Status:

Suspected

Confirmed

Not found

OK Cancel

Polyclinic [X]

Problem/Diagnosis

Prob/Dx Name:

Suspected cancer [v]

Body Site:

Lung [v]

OK Cancel

Restructured Hospital [X]

Diagnosis

Name:

Suspected lung cancer [v]

OK Cancel

We need a consistent semantic representation.

IsoSemantic Models (example instances)

e.g. "Suspected Lung Cancer"

Model Hierarchy

General Practice

Polyclinic

Hospital

Problem Diagnosis

Problem Diagnosis Name

Location Details

Body Site

Laterality

Finding Context

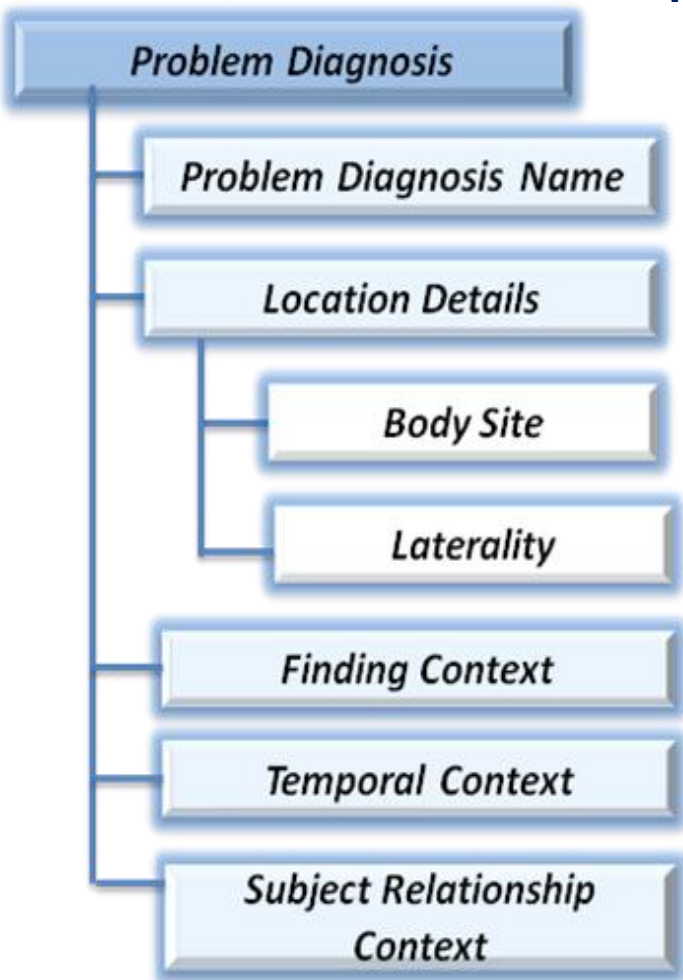
Temporal Context

Subject Relationship
Context

| | | |
|------------------|-----------------------------|----------------------------------|
| Cancer | Suspected Cancer | Suspected Lung Cancer |
| | | |
| Lung | Lung | |
| | | |
| Suspected | | |
| | | |
| | | |

IsoSemantic Models (constructor binding)

Model Hierarchy



Problem Diagnosis = \$ProblemDiagnosisName:
246090004 |associated finding| = (404684003|Clinical Finding|):

363698007 |finding site | = (**\$BodySite:**
272741003 |laterality| = **\$Laterality**),
246112005 |severity| = **\$Severity**),
408729009 |finding context | = **\$FindingContext**

GP Problem Diagnosis = 86049000 | **Cancer | :**

246090004 |associated finding| = (404684003 |Clinical Finding|
363698007 |finding site | = 39607008 |**Lung** |),
408729009 |finding context | = 415684004 |**Suspected** |

Polyclinic Problem Diagnosis = 162572001 | **Suspected cancer | :**

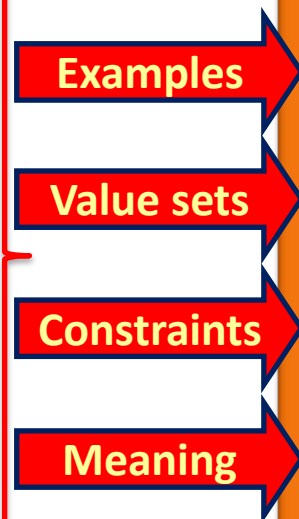
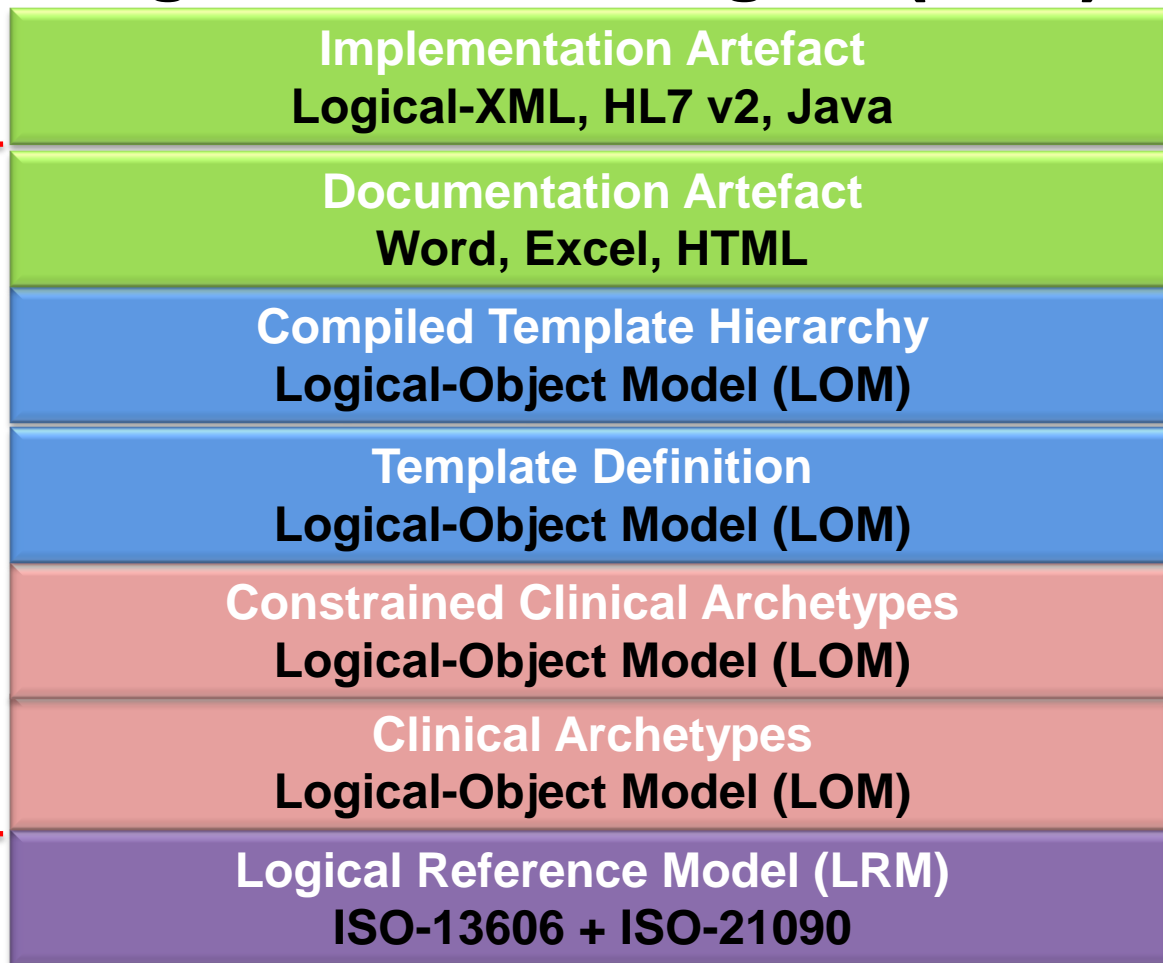
246090004 |associated finding| = (404684003 |Clinical Finding|
363698007 |finding site | = 39607008 |**Lung** |)

RH Problem Diagnosis = 162573006 | **Suspected lung cancer |**

Benefits of the LIM

- Common model
 - shared healthcare information in Singapore
- Common queries
 - Provides a common vocabulary for querying multiple data sources
- Common meaning
 - Each clinical meaning is represented just once and reused many times
- Consistent terminology
 - National reference terminology bound to a clinical meaning
- Implementation independent
 - Information model independent of exchange format and proprietary information models
- Machine processable model
 - Allows information to be defined once, and used many times (consistently)
- Conformance Testing
 - Enables the automation of Conformance Testing to ensure quality of data

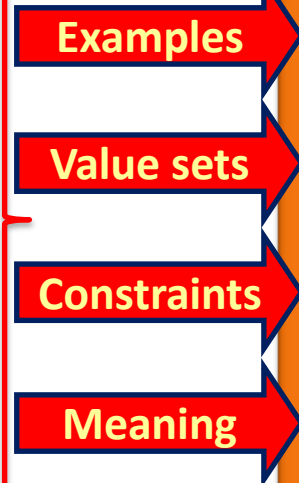
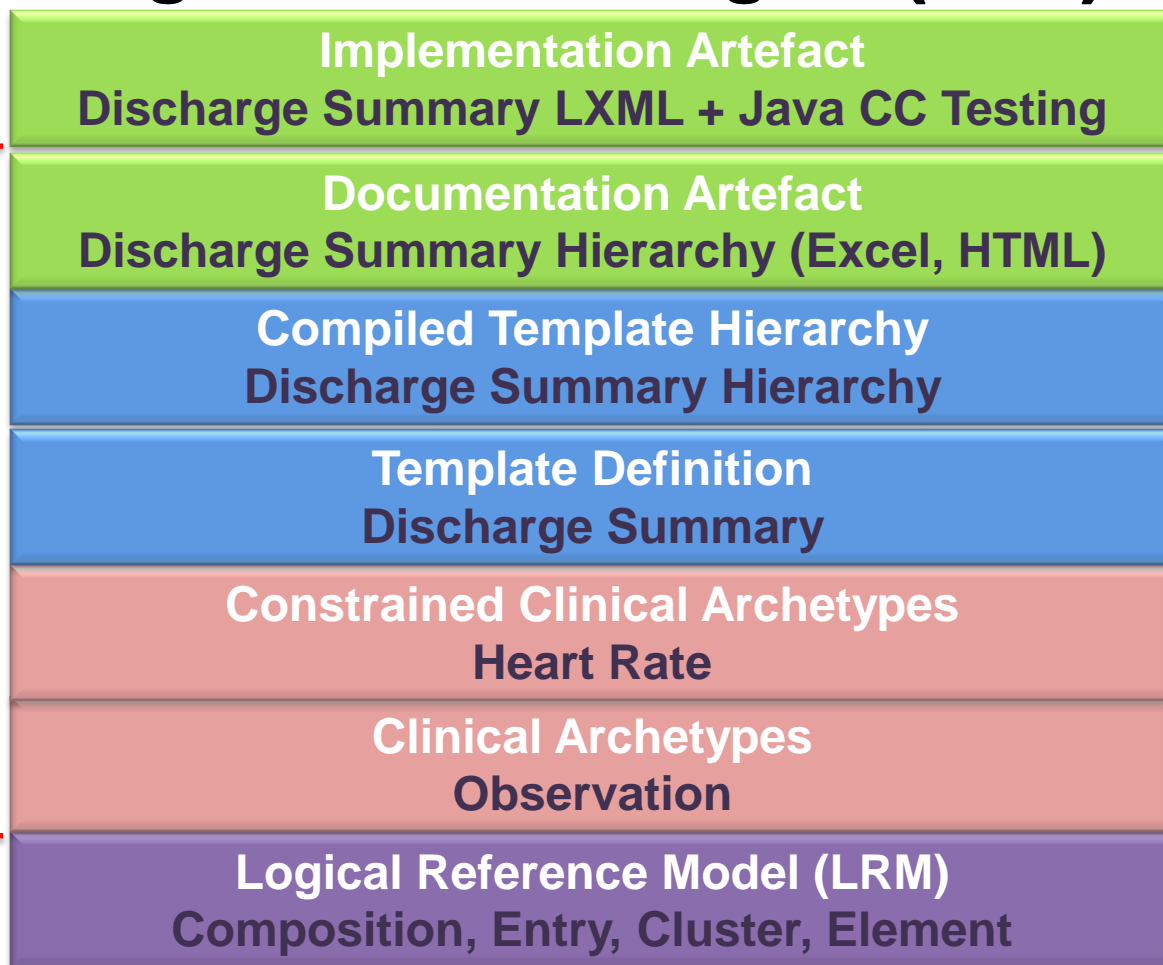
Logical Model Designer (LMD)



Snow Owl



Logical Model Designer (LMD)



Snow Owl



Types of Terminology Binding

- Value set binding
 - *National*: For national queries over heterogeneous data
 - *Local*: For generating conformance/compliance software for messages populated using local value sets (mapped to national)
- Constraint binding
 - Assumed, fixed and default values
 - OCL and ESCG constraints
- Semantic binding
 - Enables querying data using more general or specific meanings
 - Enables searching models, and identifying semantic overlap
- Relationship bindings
 - Defines meaning of relationship between parent to child node
 - Used to construct design pattern bindings (aka constructor bindings)
- Design pattern bindings (aka 'constructor bindings')
 - Extended compositional grammar expression with path-based slots
 - Used to normalise data that may either be precoordinated or postcoordinated in the structure, into a canonical form

- Uniform Resource Identifier (URI) standard:
 - Simple and extensible means for identifying a resource (ftp:, mailto:, news:, etc.), in this case terminology artefacts
 - Logical identifier of a resource, **without** specifying the physical location and the access mechanism
 - Both human and machine readable, with the syntax:
<scheme name>:<hierarchical part>[?<query>][#<fragment>]
 - Obtaining a representation of the resource is done by Resolvers
- Scheme for terminology binding:
terminology:<code system id>[:<version>]?<query type>= <query expression>[&<extension key>=extensionvalue]*
- SNOMED CT query types:
 - **concept, conceptlist, refset, refsetlist, escg, ocl**

Terminology Binding Examples

```
terminology:<code system id>[:version]?<query type>= <query expression>[&<extension key>=extensionvalue]*
```

Examples:

SNOMED CT

- terminology:2.16.840.1.113883.6.96:20110123?concept=284296006
- terminology:2.16.840.1.113883.6.96:20110123?refset=284296007&scope=A01324
- terminology:2.16.840.1.113883.6.96:20110123?escg=<<284296006

ATC

- Terminology:2.16.840.1.113883.6.3:20110123?code=A01

Singapore Data Dictionary

- terminology:data_dictionary_id?value_domain_id#code

SNOMED CT

CD

| | |
|------------------------|------------------------------------|
| Concept Id | → code :String [0..1] |
| 2.16.840.1.113883.6.96 | → codeSystem :Uid [0..1] |
| SNOMED CT | → codeSystemName :String [0..1] |
| 20110701 | → codeSystemVersion :String [0..1] |
| Preferred Term | → term :ST [0..1] |
| Description Id | → termId :String [0..1] |
| Assumed value: PT | → originalText :ST |
| RefSet Id | → valueSet :Uid [0..1] |
| RefSetVersion | → valueSetVersion :String [0..1] |

ICD-10

CD

Code

→ code :String [0..1]

2.16.840.1.113883.6.3

→ codeSystem :Uid [0..1]

ICD-10

→ codeSystemName :String [0..1]

2008

→ codeSystemVersion :String [0..1]

Description

→ term :ST [0..1]

→ termId :String [0..1]

Assumed value: Desc

→ originalText :ST

Value Domain Id

→ valueSet :Uid [0..1]

Value Domain Ver

→ valueSetVersion :String [0..1]

DD Value Domain

CD

Code

→ code :String [0..1]

DD OID

→ codeSystem :Uid [0..1]

MOH Data Dictionary

→ codeSystemName :String [0..1]

20120101

→ codeSystemVersion :String [0..1]

Description

→ term :ST [0..1]

→ termId :String [0..1]

Assumed value: Desc

→ originalText :ST

Value Domain Id

→ valueSet :Uid [0..1]

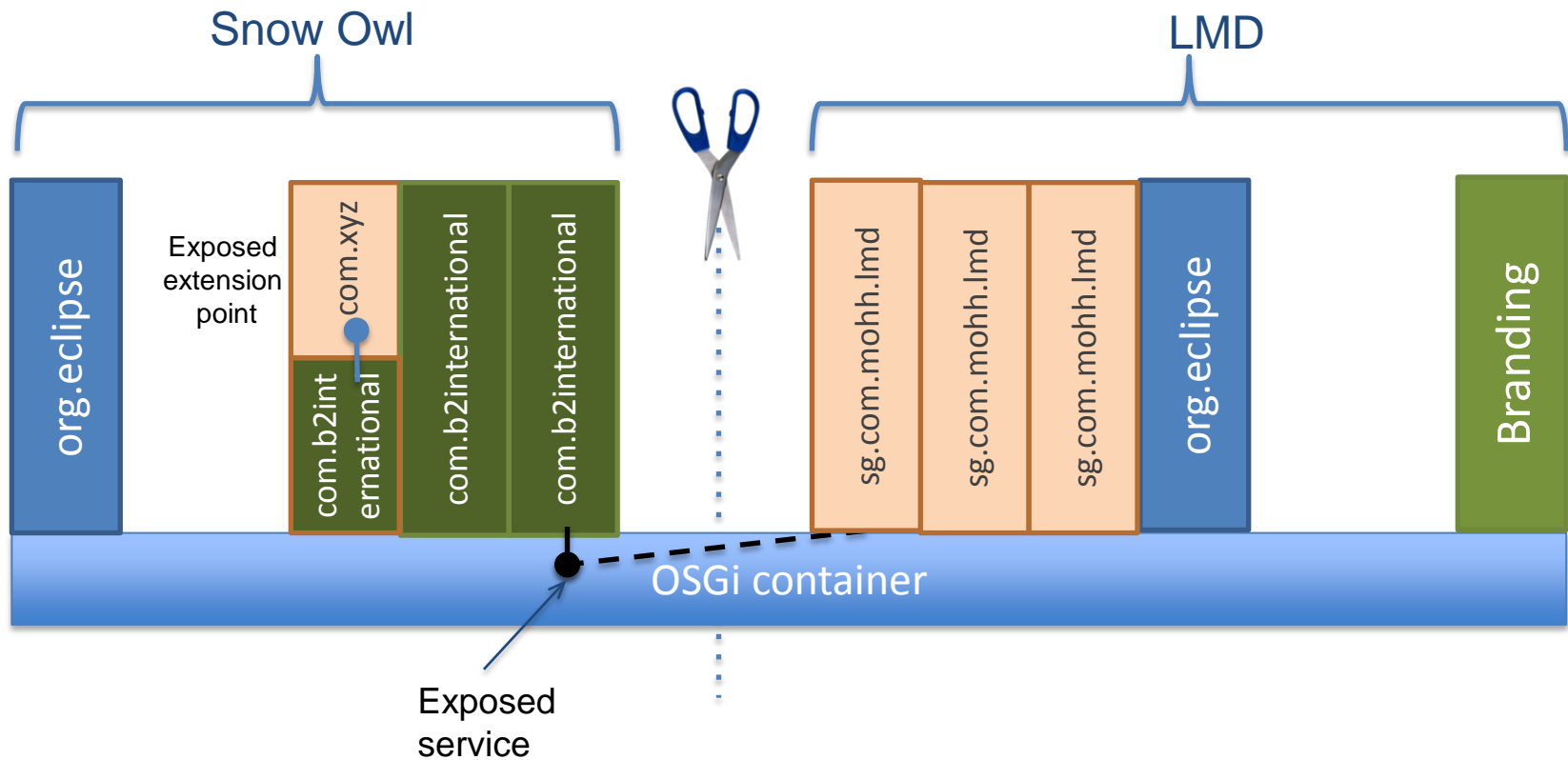
Value Domain Ver

→ valueSetVersion :String [0..1]

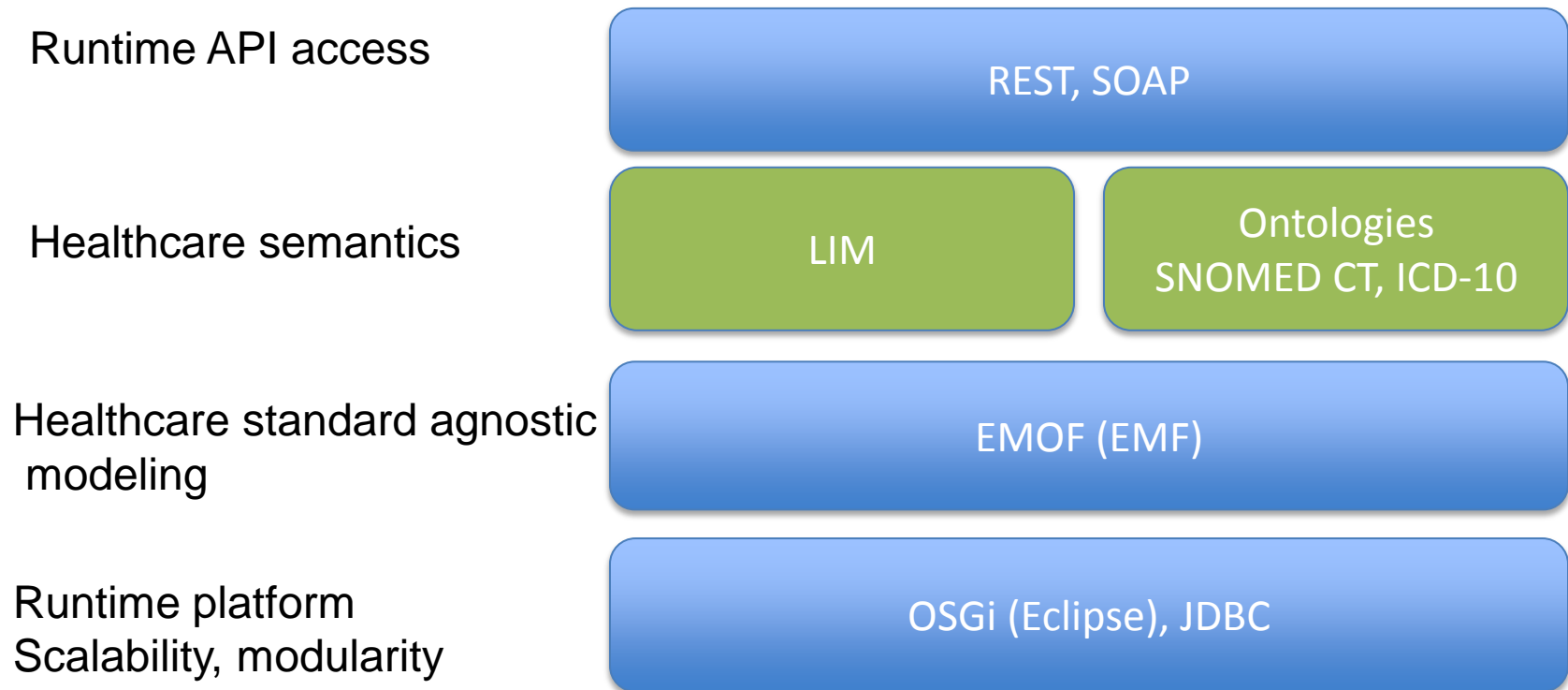
- Snow Owl
 - Reference sets and Extension concepts
- Logical Reference Model (LRM)
 - Editable view
- Archetype – Observation ENTRY
 - Add semantic and value domain bindings
 - Node meaning, relationship meaning, constraint & constructor bindings
- Constrained archetype – Heart rate ENTRY
 - Add semantic and value domain bindings
 - Confirm subsumption validation
- Compile template – Discharge summary (with heart rate)
 - Fill slot with heart rate archetype, and
- Model search
 - Search models using semantic bindings

- Built on the seasoned Eclipse tooling platform with wide industry adoption
 - Composed of bundles running within an OSGi (Eclipse) container
 - Bundles can be deployed depending the product definition (possible for both client and server side)
 - Help and branding information are in separate bundles
- Utilizes the services provided by the Snow Owl terminology platform
- Core domain objects are modeled via standard EMOF as opposed to be hard-coded

Modularity & extensibility



Platform Standards Stack



- 2012 April – LMD Project kick-off
- **V0.4: 2012 November 3 – current release**
 - Existing MOHH LIM artefacts import
 - Modelling artefacts browsing, searching and editing capabilities (archetype, constrained archetype, template, template hierarchy)
 - Validation framework
 - Terminology binding
 - Schema and instance generation
- V0.9: 2013 June 3 - Final release
 - Instance conformance & compliance
 - Mapping support
 - Logical query language support
 - Publication
 - ADL Support