The Yosemite Project

A Roadmap for Healthcare Information Interoperability

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SEE LATEST VERSION:

http://tinyurl.com/YosemiteRoadmap20150709slides

Outline

- Mission and strategy
- Semantic interoperability
  - Standards
  - Translations
- Roadmap for interoperability
- Cost

MISSION:

Semantic interoperability
of
all structured healthcare information

MISSION:

Semantic interoperability
of
all structured healthcare information

POSSIBLE

STRATEGY:

RDF as a
universal information representation

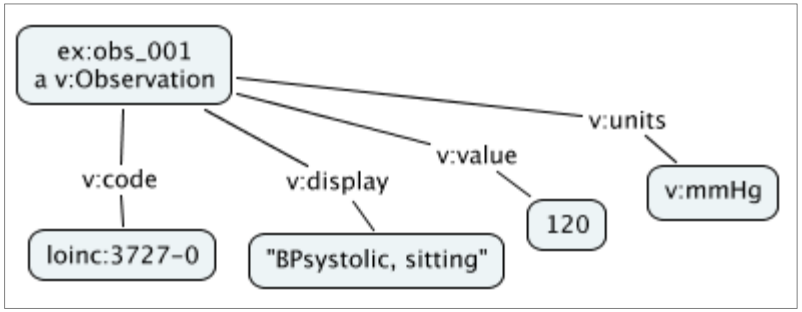
Universal information representation

- Q: What does instance data X mean?
- A: Determine its RDF information content

Instance data

```
<Observation
      xmlns="http://hl7.org/fhir">
   <system value="http://loinc.org"/>
   <code value="3727-0"/>
   <display value="BPsystolic, sitting"/>
   <value value="120"/>
   <units value="mmHg"/>
</Observation>
```

RDF



Why RDF?

"Captures information content, not syntax"

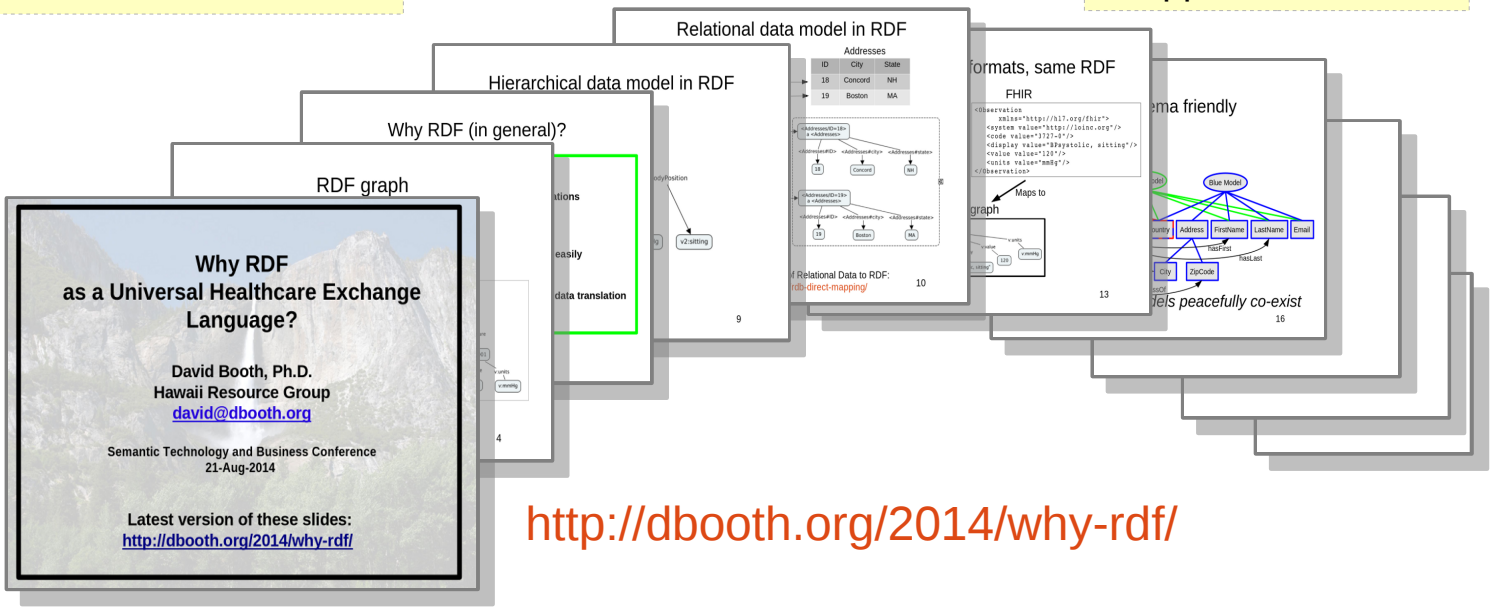
"Multi-schema friendly"

"Allows diverse data to be connected and harmonized"

"Allows data models and vocabularies to evolve"

"Good for model transformation"

"Supports inference"



http://dbooth.org/2014/why-rdf/

- Endorsed by over 100 thought leaders in healthcare and technology as the *best available candidate* for a universal healthcare exchange language
  - See http://YosemiteManifesto.org/

Semantic interoperability:

The ability of computer systems
to exchange data
with unambiguous, shared meaning.

– Wikipedia

Two ways to achieve interoperability

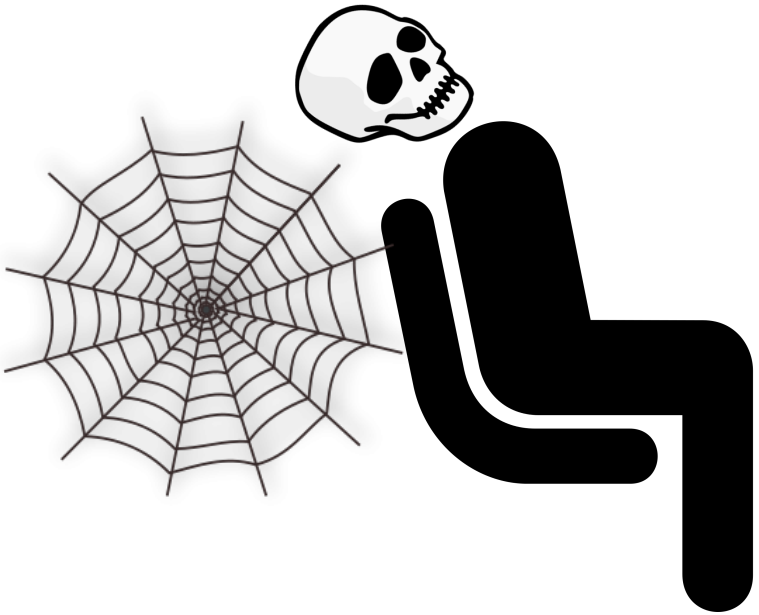
- Standards:
  - Make everyone speak the same language
  - I.e., same data models and vocabularies
- Translations:
  - Translate between languages
  - I.e., translate between data models and vocabularies

Obviously we prefer

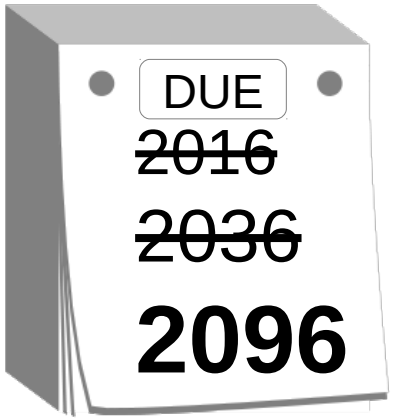
standards.

But . . . .

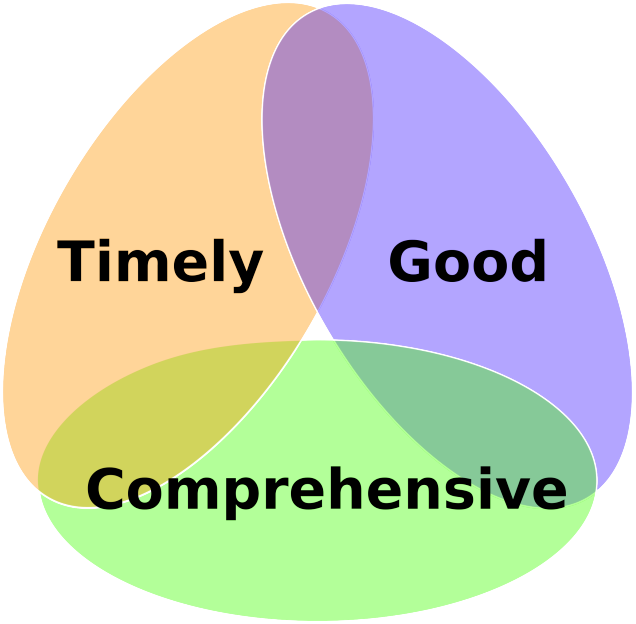
Standardization takes time



COMING SOON!
COMPREHENSIVE STANDARD

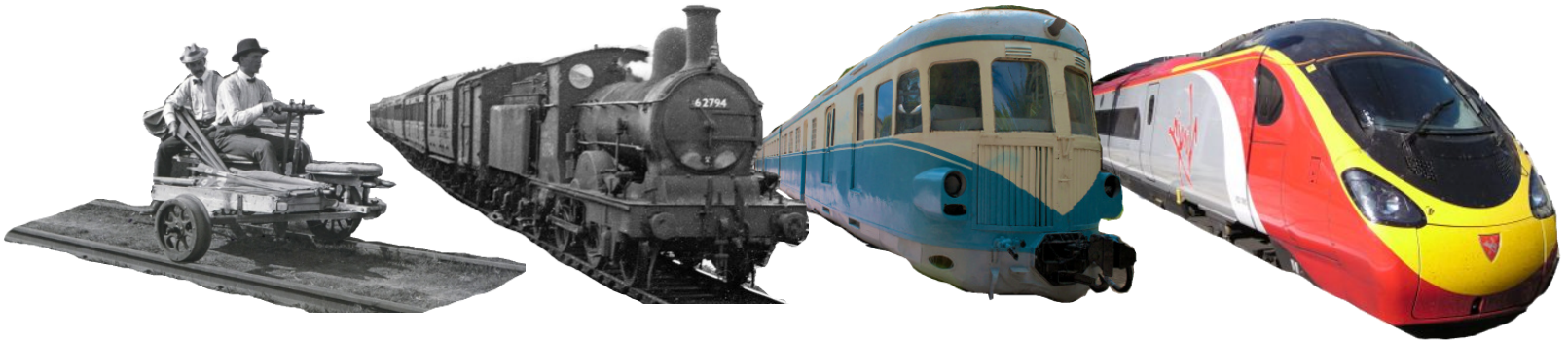


Standards trilemma: Pick any two



- **Timely**: Completed quickly
- **Good**: High quality
- **Comprehensive**: Handles all use cases

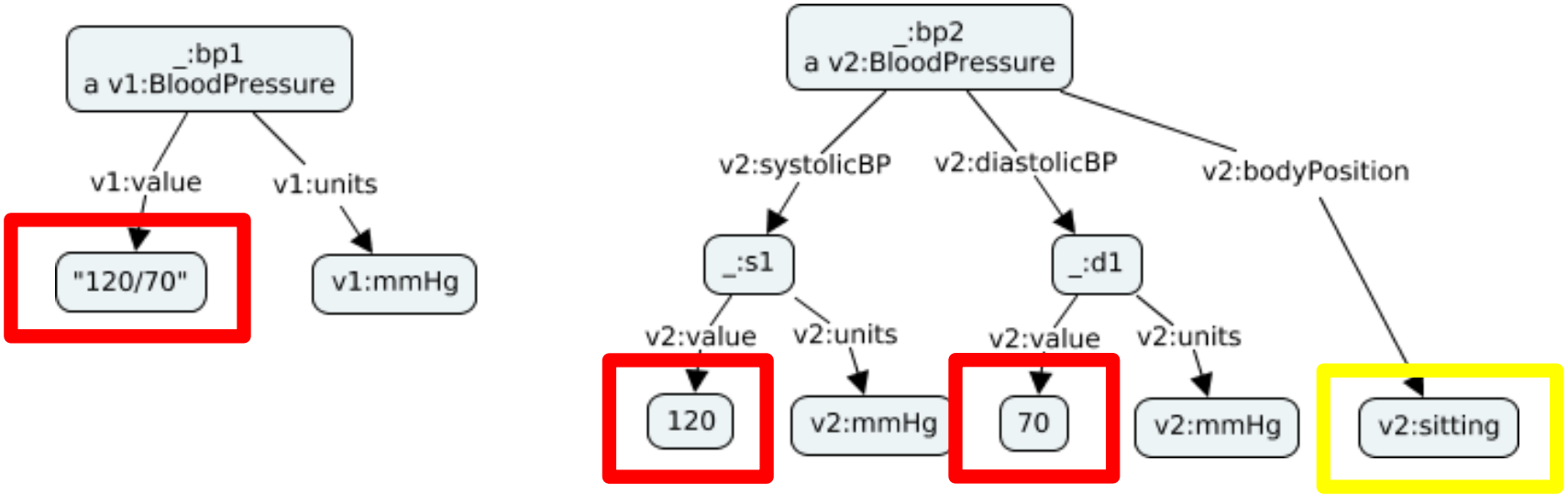
Modernization takes time



- Existing systems cannot be updated all at once

Diverse use cases

- Different use cases need different data, granularity and representations

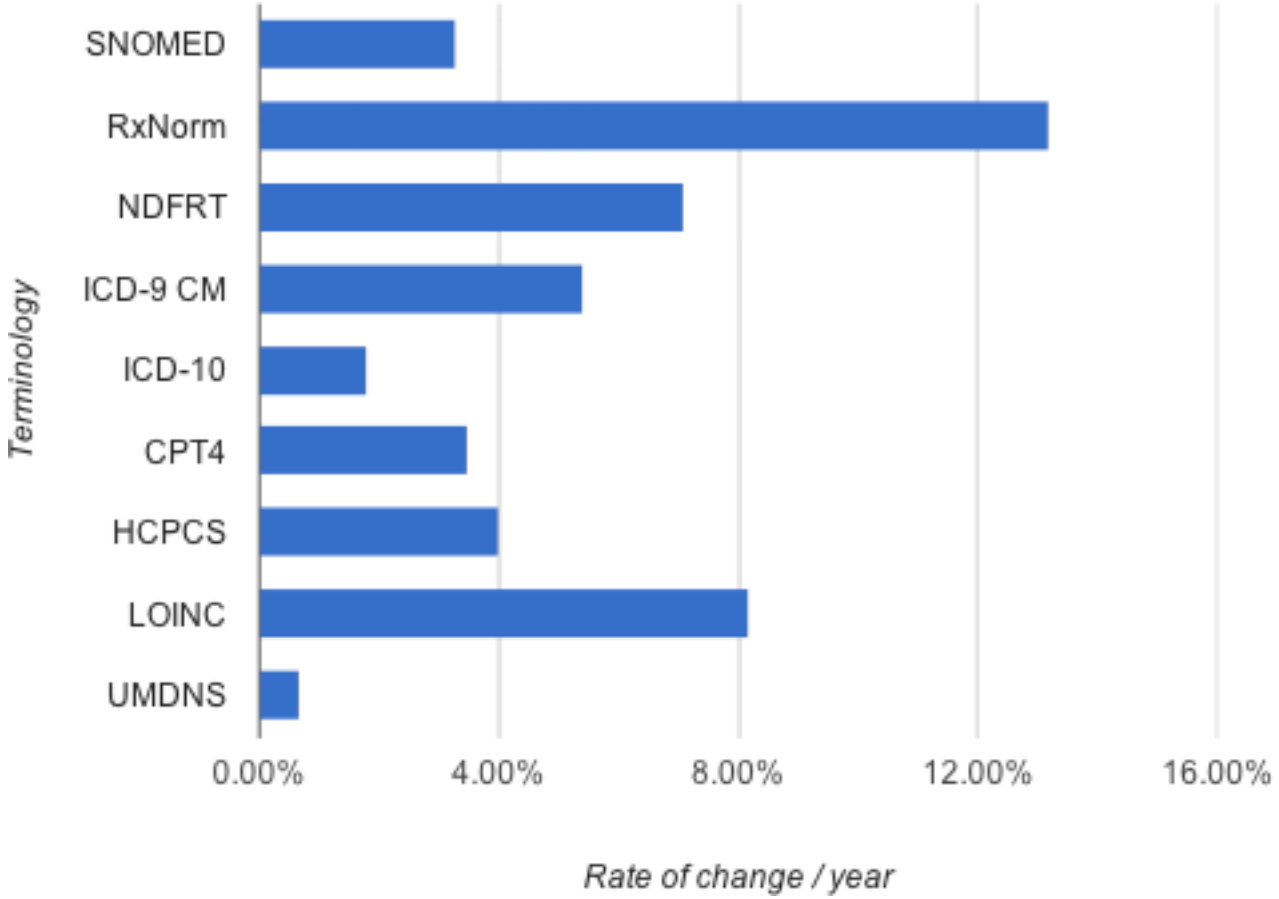


*One standard does **not** fit all!*

Standards evolve

- Version *n+1* improves on version *n*

Healthcare terminologies rate of change



Slide credit: Rafael Richards (VA)

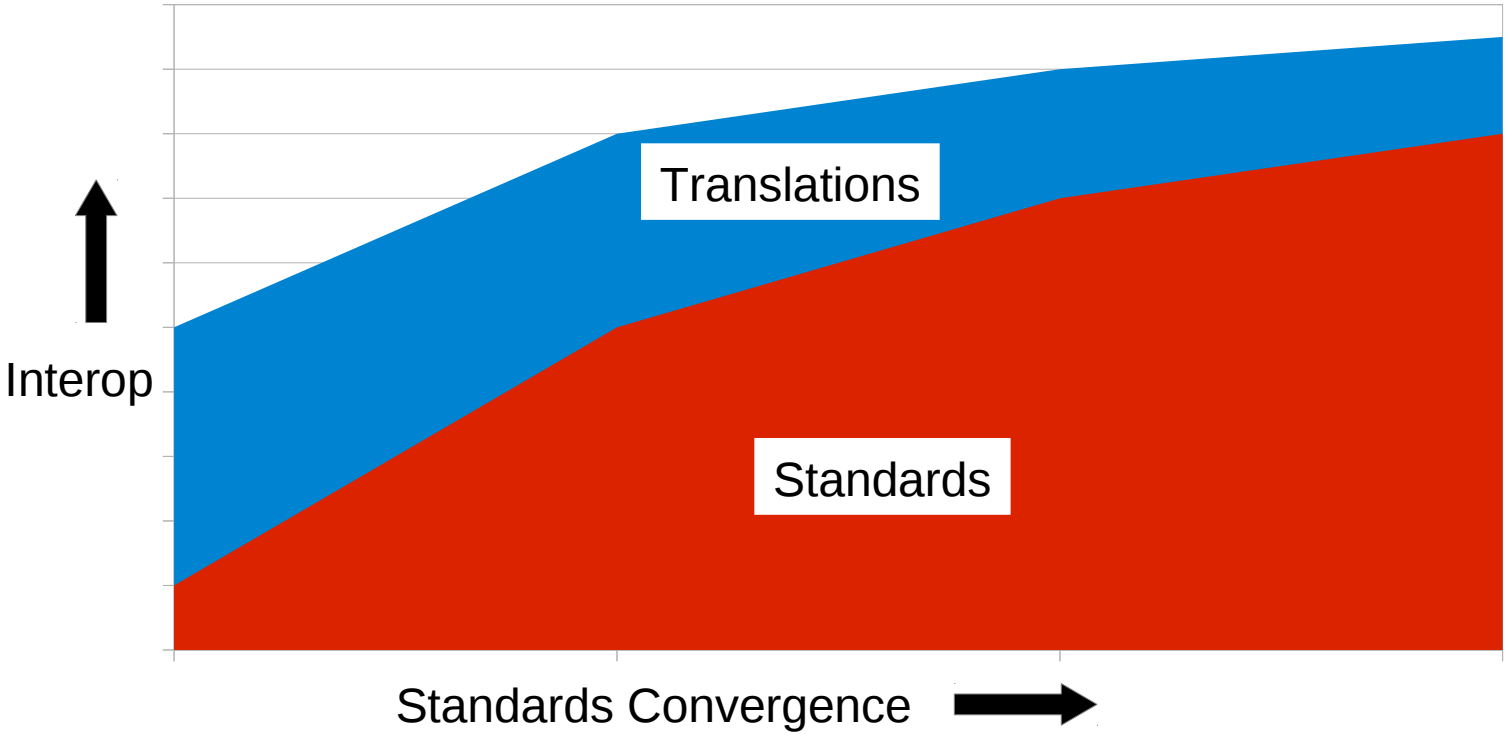
Translation is unavoidable!

- Standardization takes time
- Modernization takes time
- Diverse use cases
- Standards evolve

A realistic strategy for semantic interoperability must address both

standards and translations.

Interoperability achieved by standards vs. translations

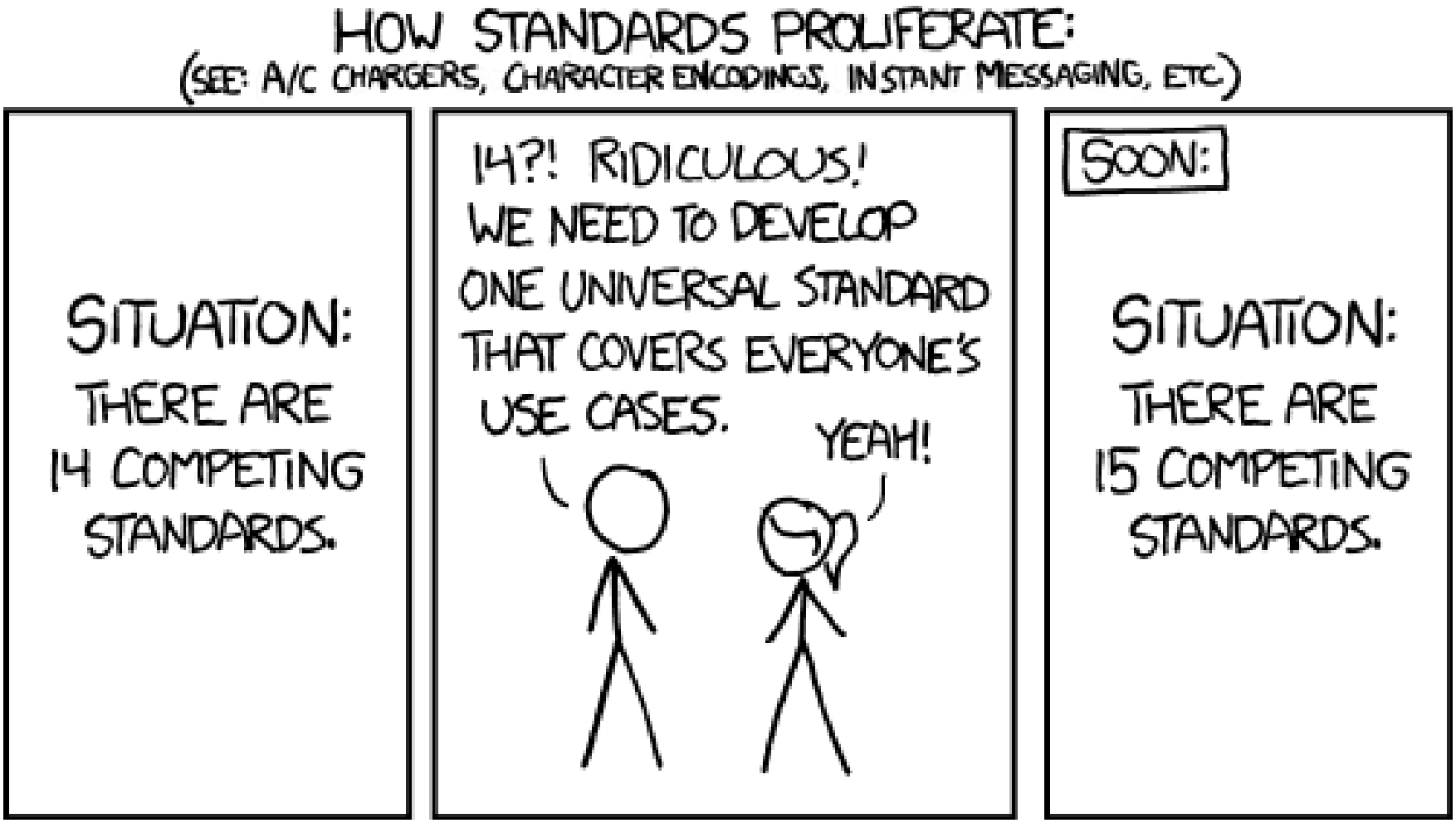


How RDF Helps Standards

Standard Vocabularies in UMLS

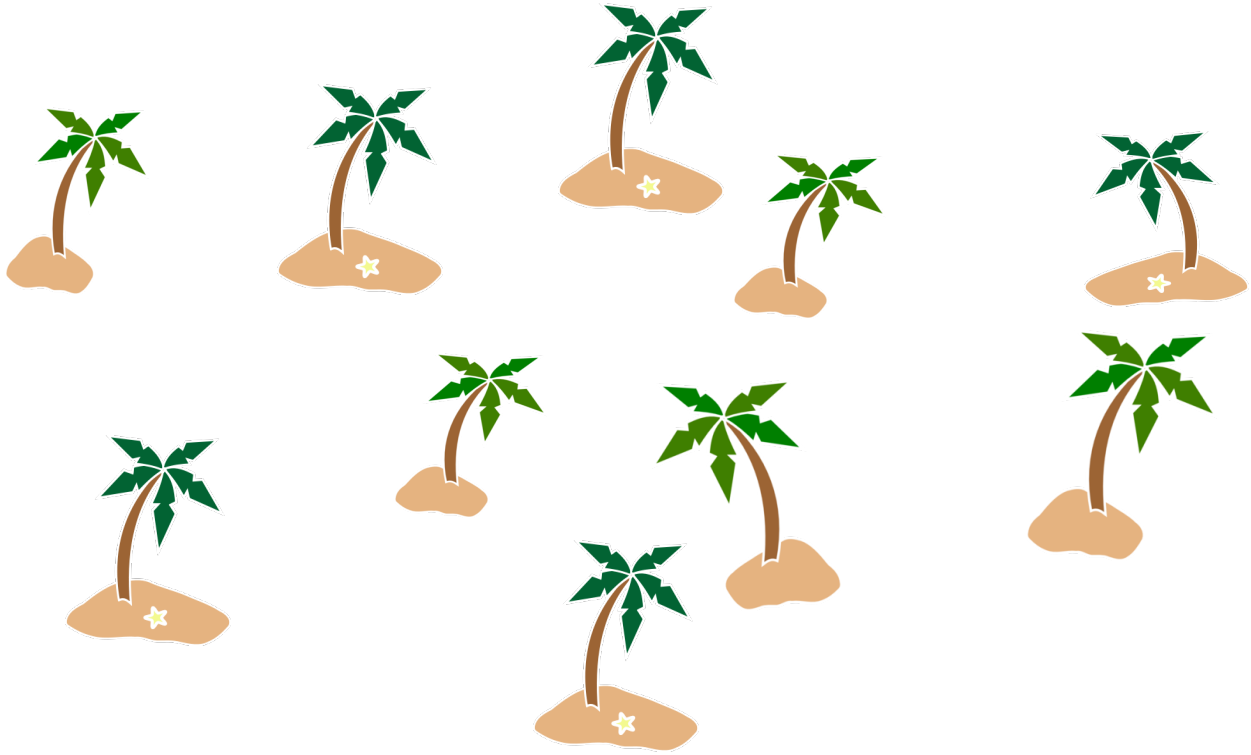
AIR ALT AOD AOT BI CCC CCPSS CCS CDT CHV COSTAR CPM CPT CPTSP CSP CST DDB DMDICD10 DMDUMD DSM3R DSM4 DXP FMA HCDT HCPCS HCPT HL7V2.5 HL7V3.0 HLREL ICD10 ICD10AE ICD10AM ICD10AMAE ICD10CM ICD10DUT ICD10PCS ICD9CM ICF ICF-CY ICPC ICPC2EDUT ICPC2EENG ICPC2ICD10DUT ICPC2ICD10ENG ICPC2P ICPCBAQ ICPCDAN ICPCDUT ICPCFIN ICPCFRE ICPCGER ICPCHEB ICPCHUN ICPCITA ICPCNOR ICPCPOR ICPCSPA ICPCSWE LAB LCH LNC_AD LNC_MDS30 MCM MEDLINEPLUS MSHCZE MSHDUT MSHFIN MSHFRE MSHGER MSHITA MSHJPN MSHLAV MSHNOR MSHPOL MSHPOR MSHRUS MSHSCR MSHSPA MSHSWE MTH MTHCH MTHHH MTHICD9 MTHICPC2EAE MTHICPC2ICD10AE MTHMST MTHMSTFRE MTHMSTITA NAN NCISEER NIC NOC OMS PCDS PDQ PNDS PPAC PSY QMR RAM RCD RCDAE RCDSA RCDSY SNM SNMI SOP SPN SRC TKMT ULT UMD USPMG UWDA WHO WHOFRE WHOGER WHOPOR WHOSPA

Over 100!



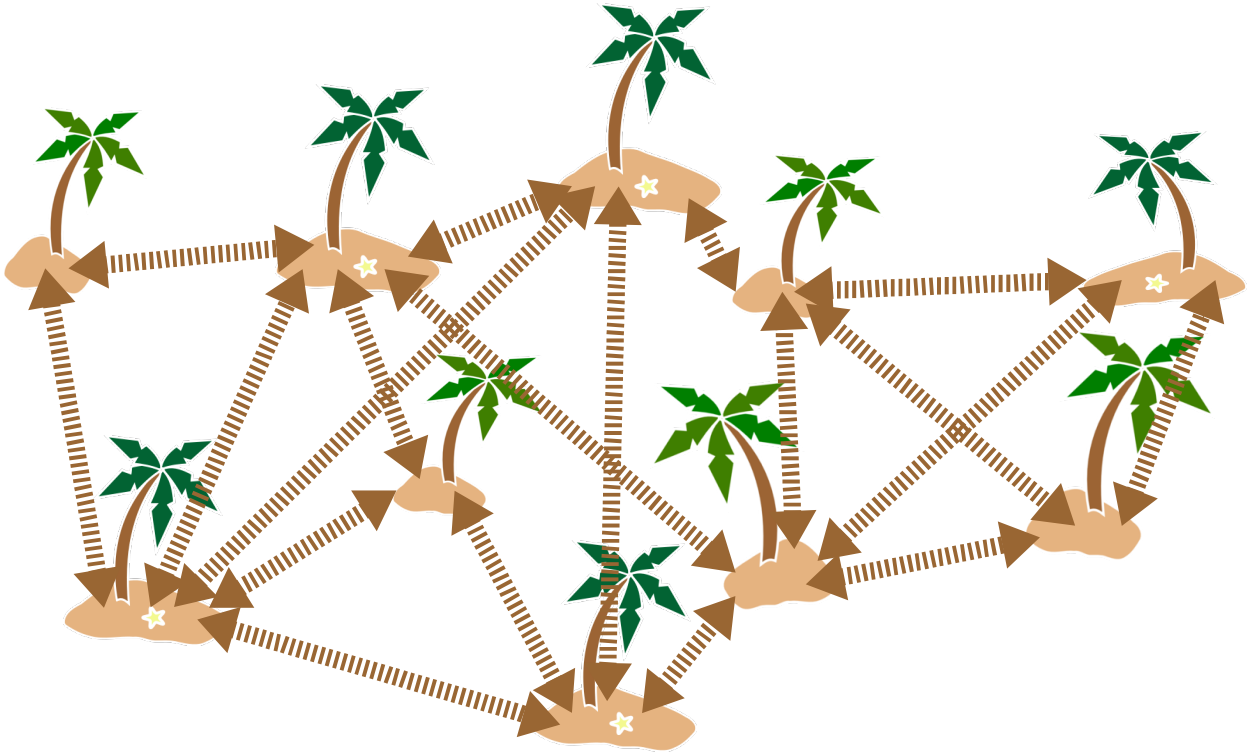
http://xkcd.com/927/
Used by permission

Each standard is an island



- Each has its "sweet spot" of use
- Lots of duplication

RDF and OWL enable semantic bridges between standards

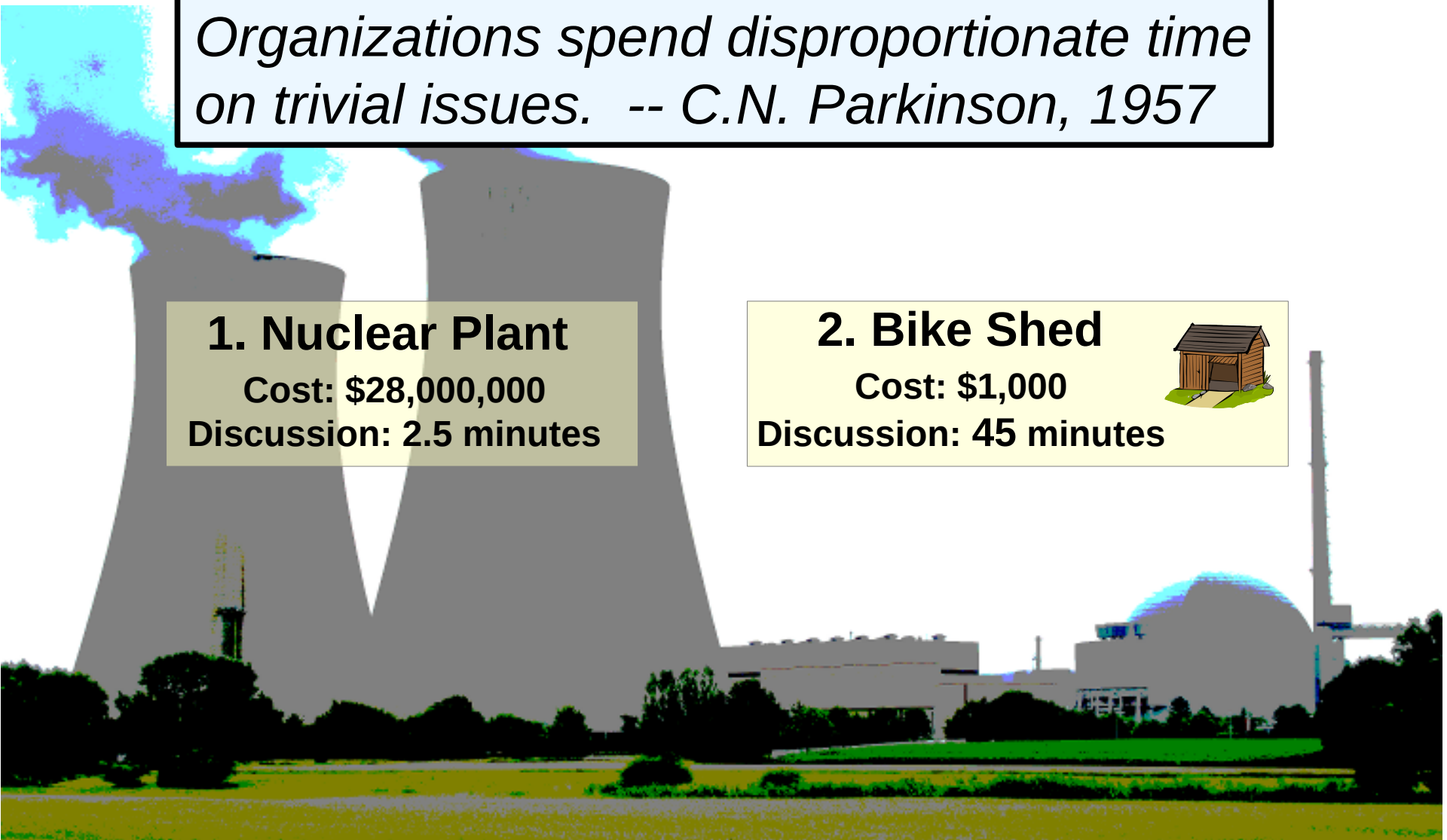


- Goal: a cohesive mesh of standards that act as a single comprehensive standard
- RDF also helps avoid the bike shed effect . . .

Bike shed effect

a/k/a Parkinson's Law of Triviality

Organizations spend disproportionate time on trivial issues. -- C.N. Parkinson, 1957



1. Nuclear Plant

Cost: $28,000,000

Discussion: 2.5 minutes

2. Bike Shed

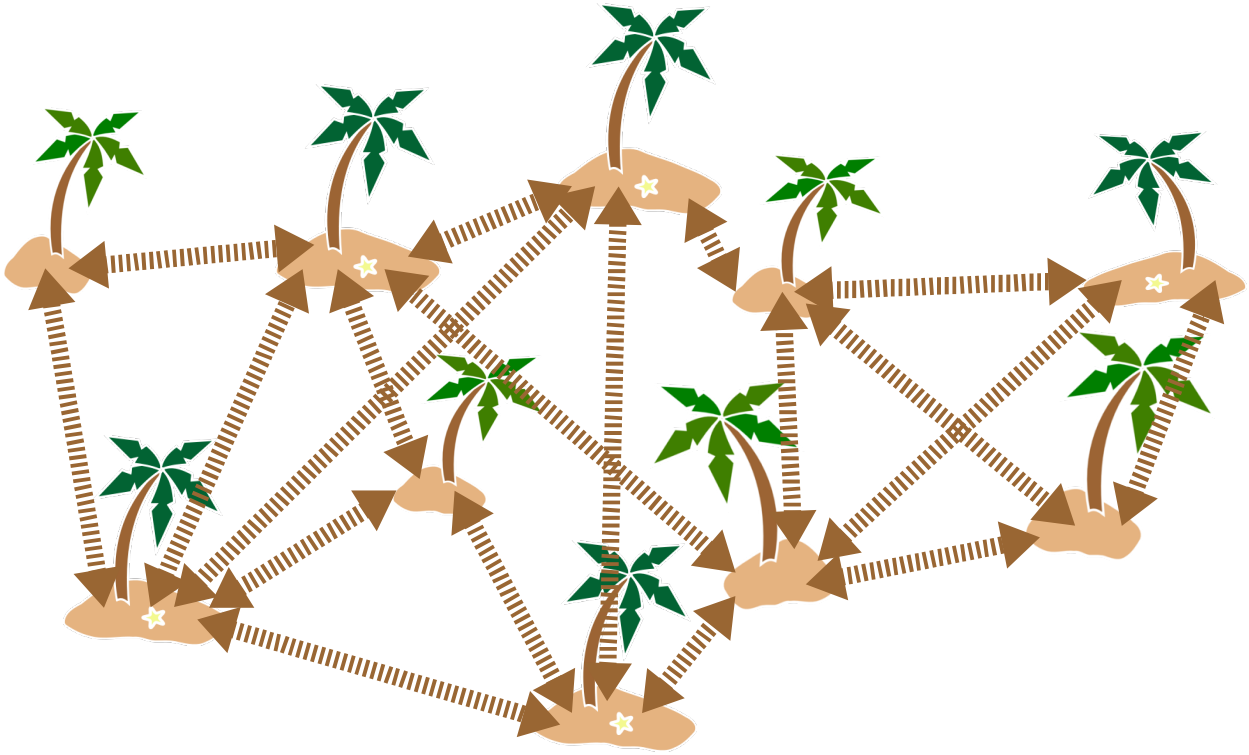
Cost: $1,000

Discussion: 45 minutes

Standards committees and the bike shed effect

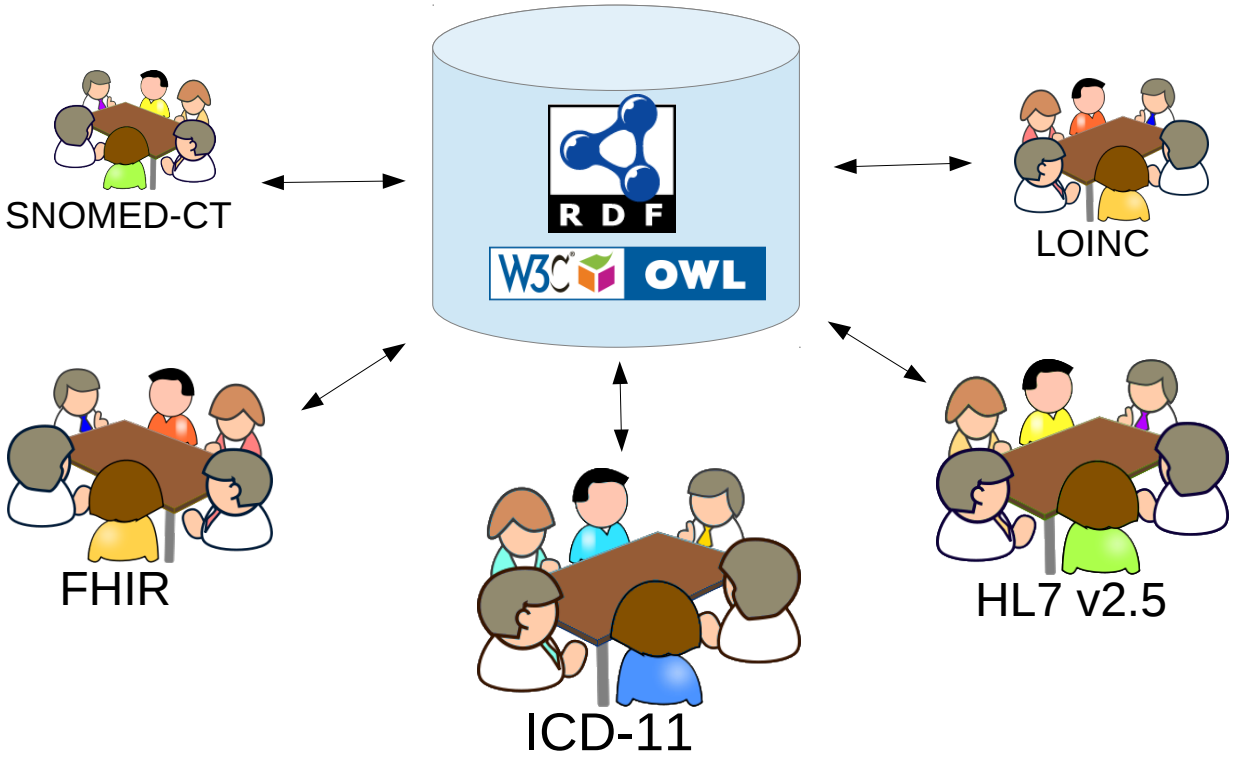
- Committees spend hours deciding on data formats, syntax and naming
  - Irrelevant to the computable information content

RDF helps avoid the bike shed effect



- Each group can use its favorite data format, syntax and names
- RDF can uniformly capture the information content

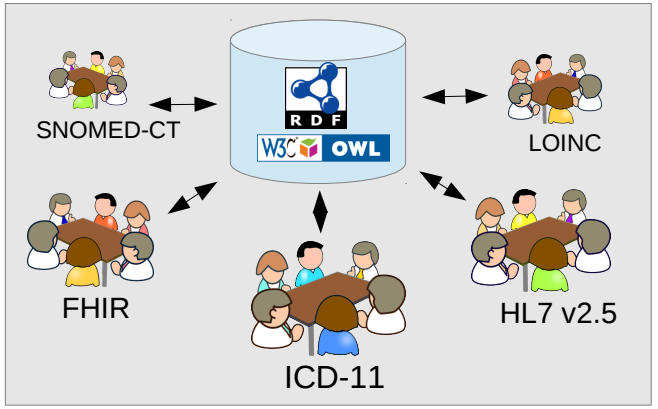
Needed: Collaborative Standards Hub



- A cross between BioPortal, GitHub, WikiData, Web Protege, CIMI repository, HL7 model forge, UMLS Semantic Network and Metathesaurus
  - Next generation BioPortal?

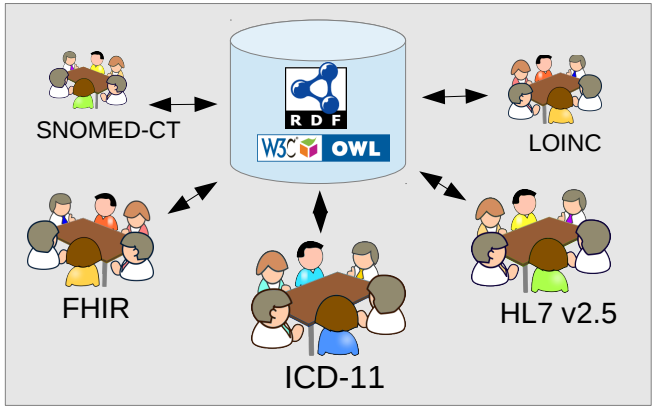
Collaborative Standards Hub

- Repository of healthcare information standards
- Supports standards groups and implementers



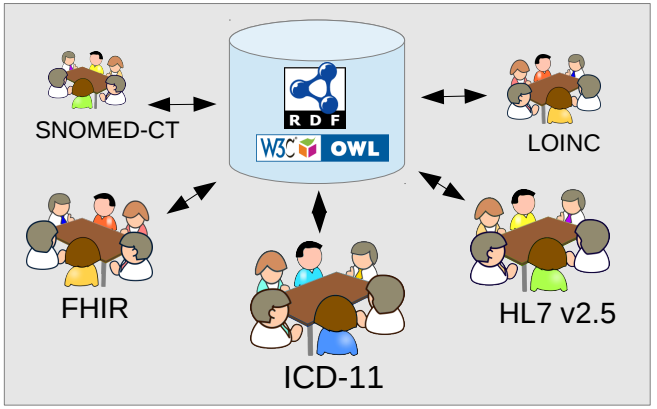
- Holds RDF/OWL definitions of data models, vocabularies and terms
- Encourages:
  - Semantic linkage
  - Standards convergence

Collaborative Standards Hub



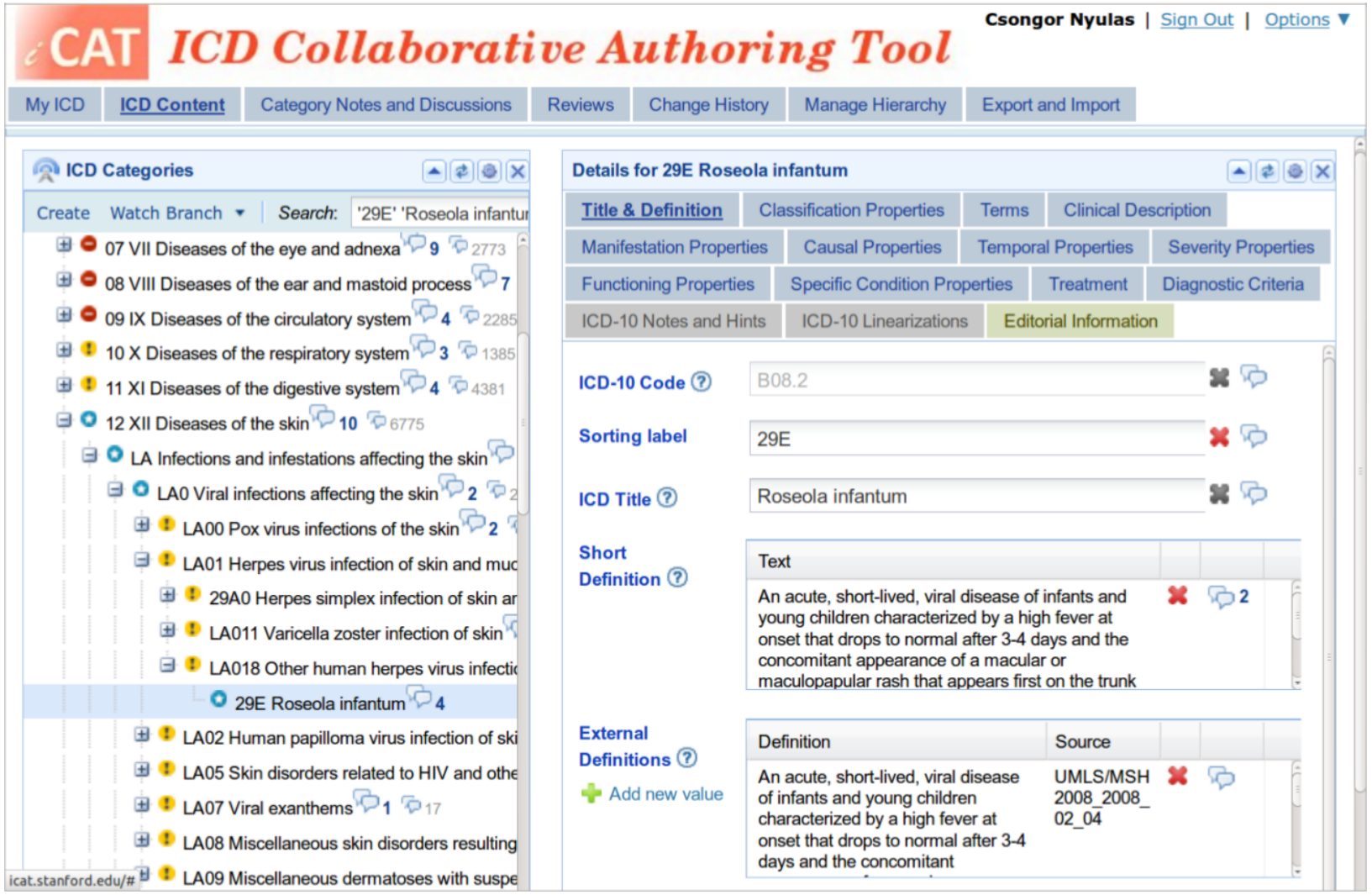
- Suggests related concepts
- Checks and notifies of inconsistencies – within and across standards
- Can be accessed by browser or RESTful API

Collaborative Standards Hub



- Can scrape or reference definitions held elsewhere
- Provides metrics:
  - Objective (e.g., size, number of views, linkage degree)
  - Subjective (ratings)
- Uses RDF and OWL under the hood
  - Users should not need to know RDF or OWL

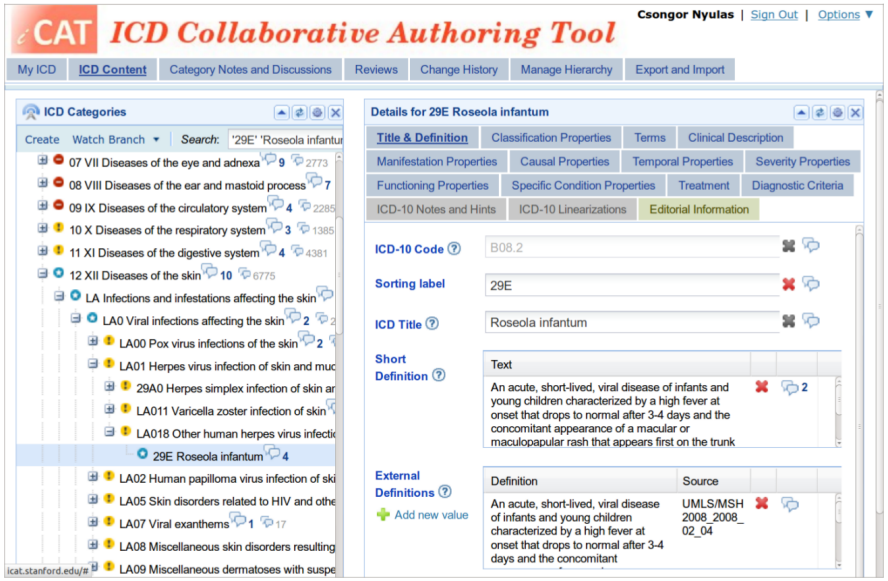
iCat: Web Protege tool for ICD-11



iCat development of ICD-11

In three years:

- 270 domain experts around the world
- 45,000+ classes
- 260,000+ changes
- 17,000 links to external terminologies



FIBO development process

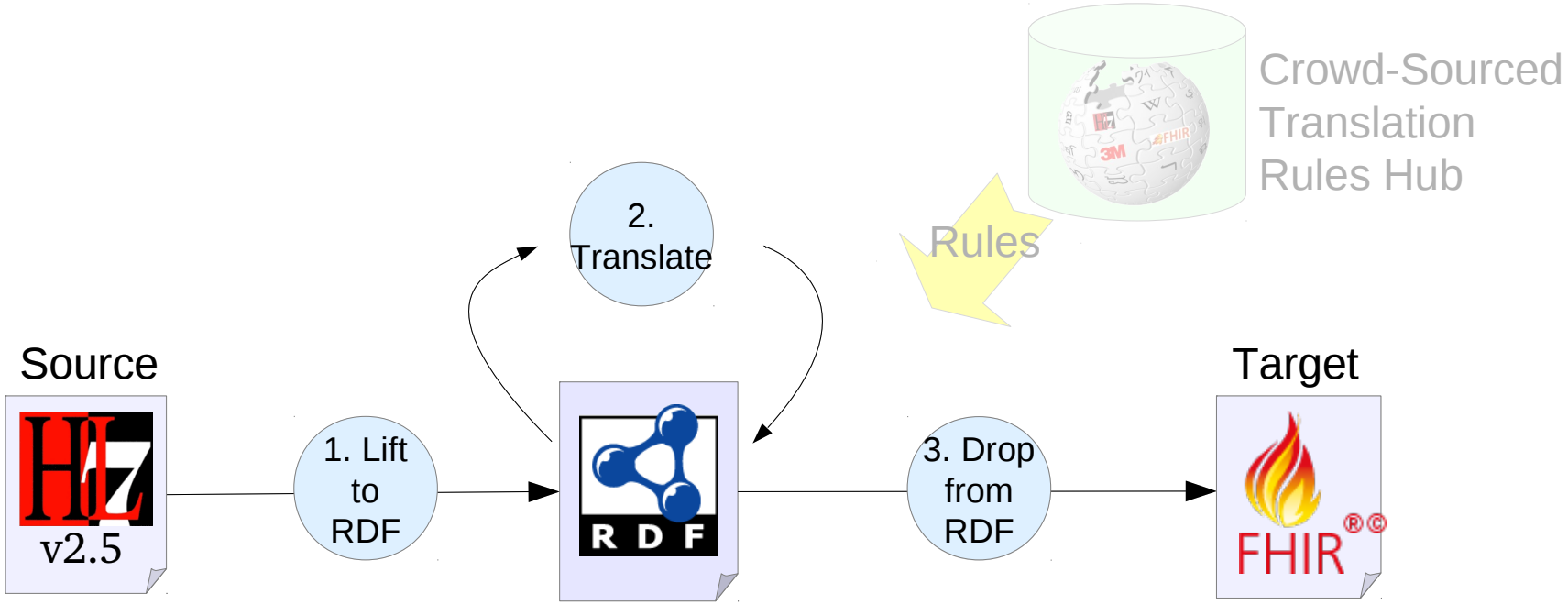
- Financial @@@ (FIBO) standards are developed in RDF/OWL
-

How RDF Helps Translation

How RDF helps translation

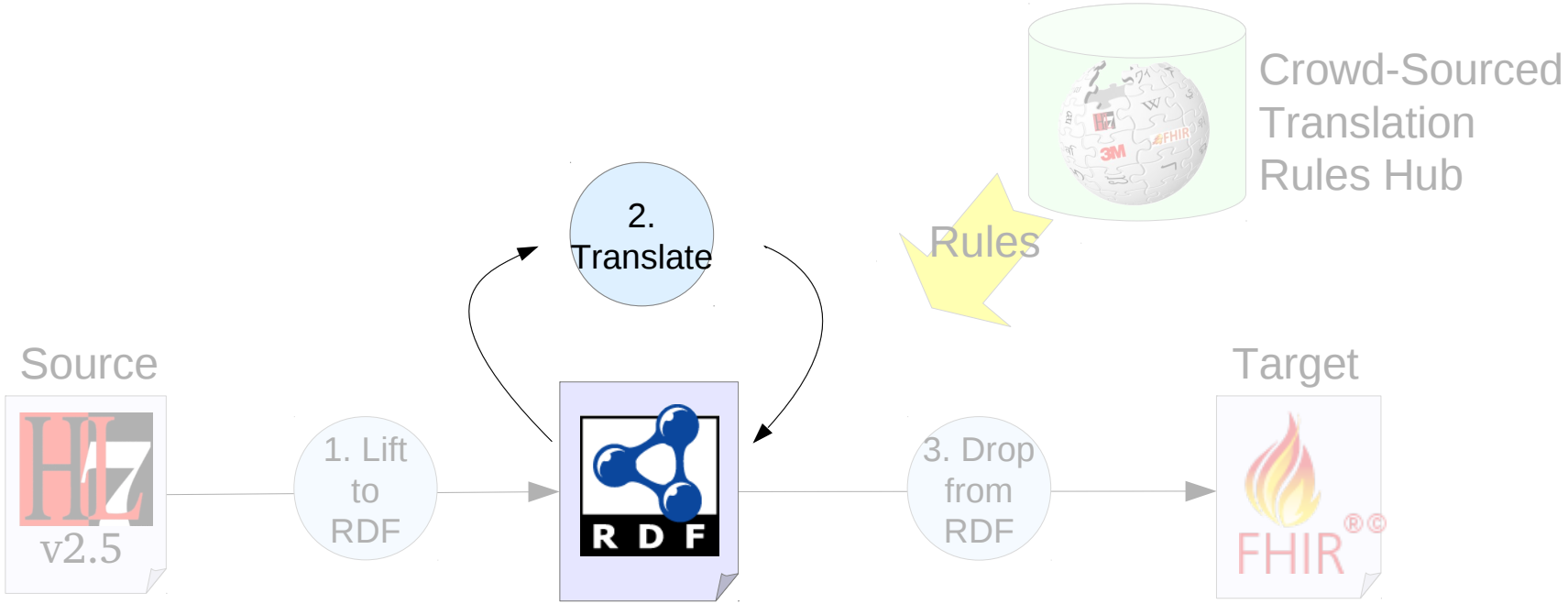
- RDF supports **inference**
  - Can be used for translation
- RDF acts as a **universal information representation**
- Enables data model and vocabulary translations to be **shared**

Translating patient data



- Steps 1 & 3 map between source/target syntax and RDF
- Step 2 translates instance data between data models and vocabularies (RDF-to-RDF)
  - A/k/a semantic alignment, model alignment

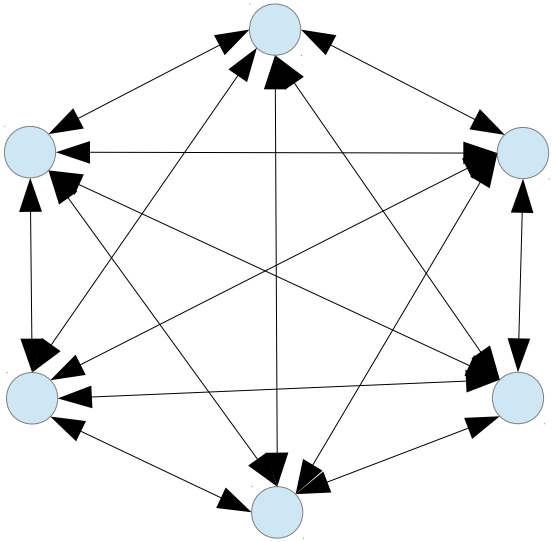
How should this translation be done?



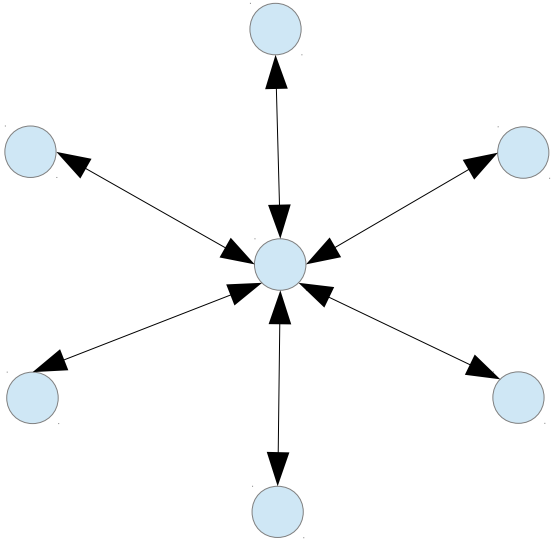
- Translation is hard!
- Many different models and vocabularies
- Currently done in proprietary, black-box integration engines

Translation strategies

Point-to-Point



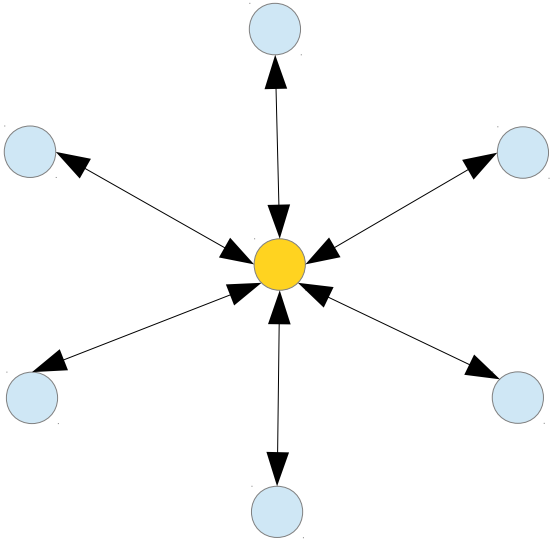
Hub-and-Spoke



- Point-to-point is easier/faster for each translation
- Hub-and-spoke requires fewer translations: O(n) instead of O(n^2)
- Hub-and-spoke requires a common data model
- Both strategies can be used!

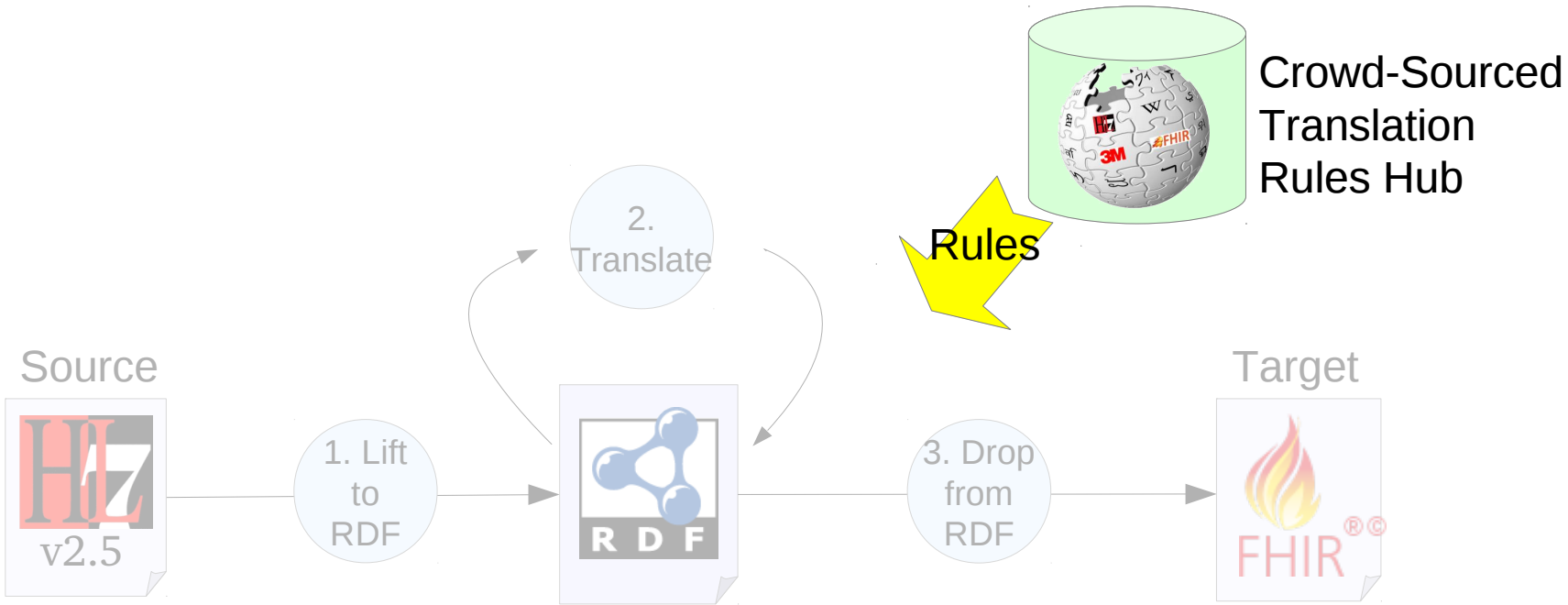
Which common data model?

Hub-and-Spoke



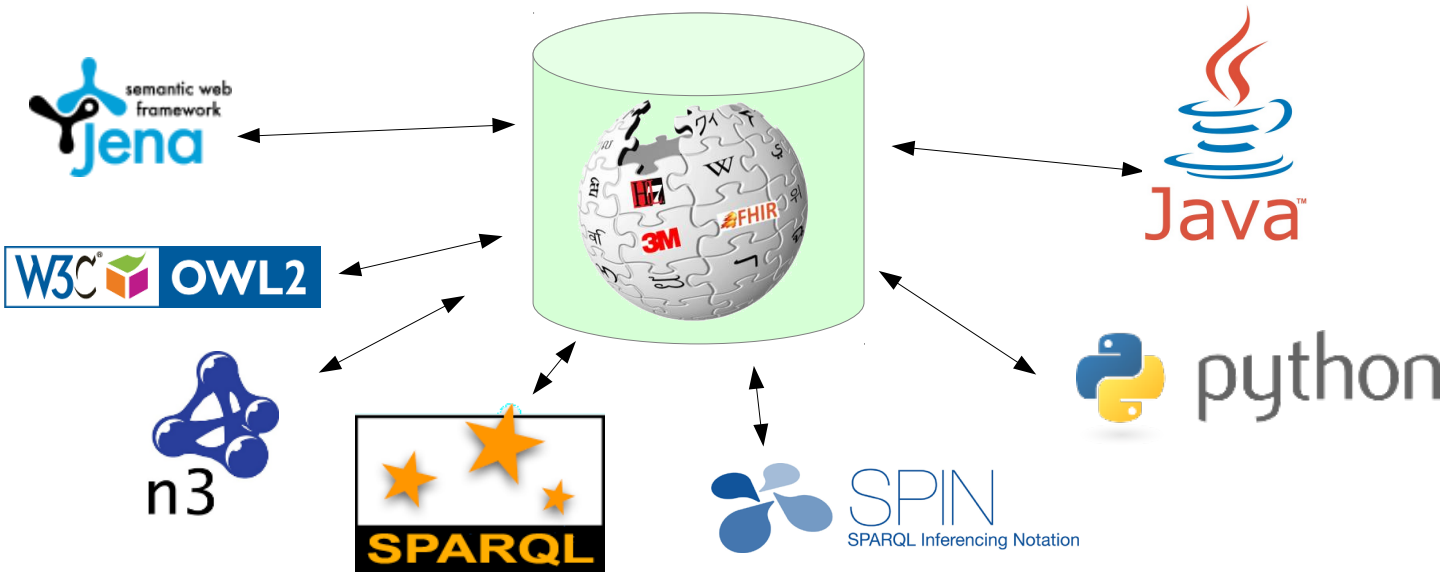
- Standardization may choose a common data model:
  - Moving target
  - Must be able to represent (but not require) the finest granularity needed by any use case
- Different use cases may use other data models, mapped to/from the common data model
  - Speeds standardization of common data model – **Avoids bike shed effect**

Where are these translation rules?



- By manipulating RDF data, rules can be mixed, matched and <u>shared</u>

Needed:
Crowd-Sourced Translation Rules Hub

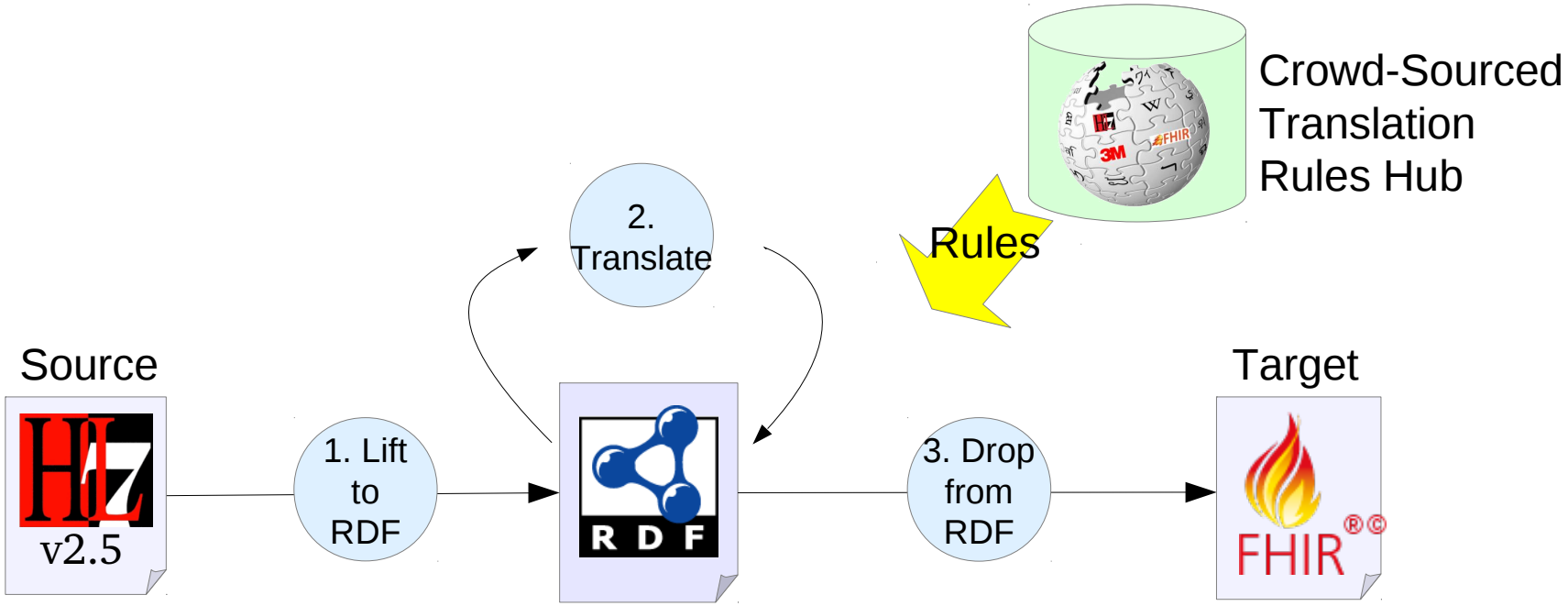


- Based on GitHub, WikiData, BioPortal, Web Protege or other
- Hosts translation rules
- Agnostic about "rules" language:
  - Any executable language that translates RDF-to-RDF (or between RDF and source/target syntax)

Translation rules metadata

- Source and target language / class
- Rules language
  - E.g. SPARQL/SPIN, N3, JenaRules, Java, Shell, etc.
- Dependencies
- Test data / validation
- License (free and open source)
- Maintainer
- Usage metrics/ratings
  - Objective: Number of downloads, Author, Date, etc.
  - Subjective: Who/how many like it, reviews, etc.
  - Digital signatures of endorsers?

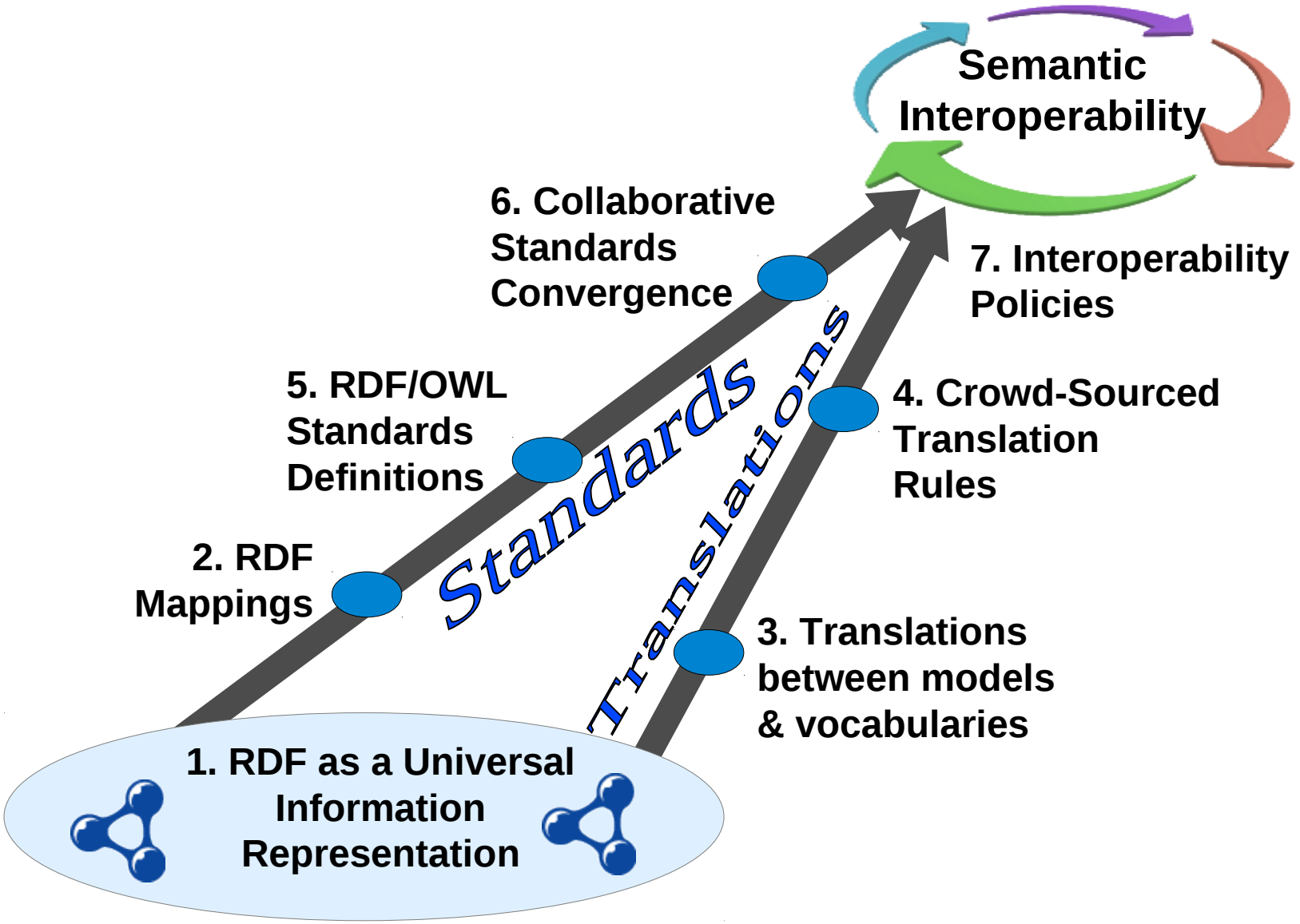
Patient data privacy



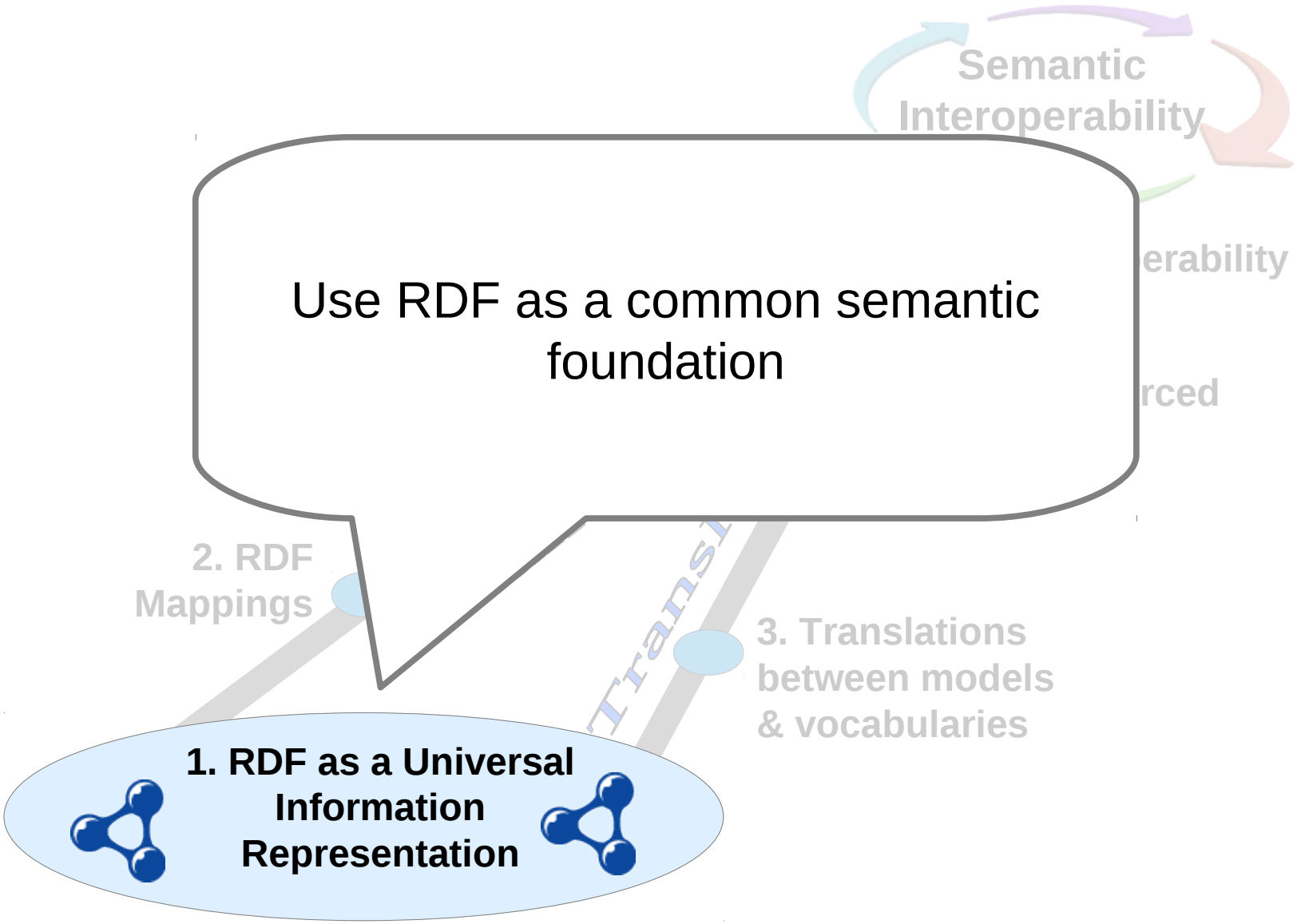
- Download translation rules as needed – plug-and-play
- Run rules locally
  - Patient data is not sent to the rules hub

Roadmap for Interoperability

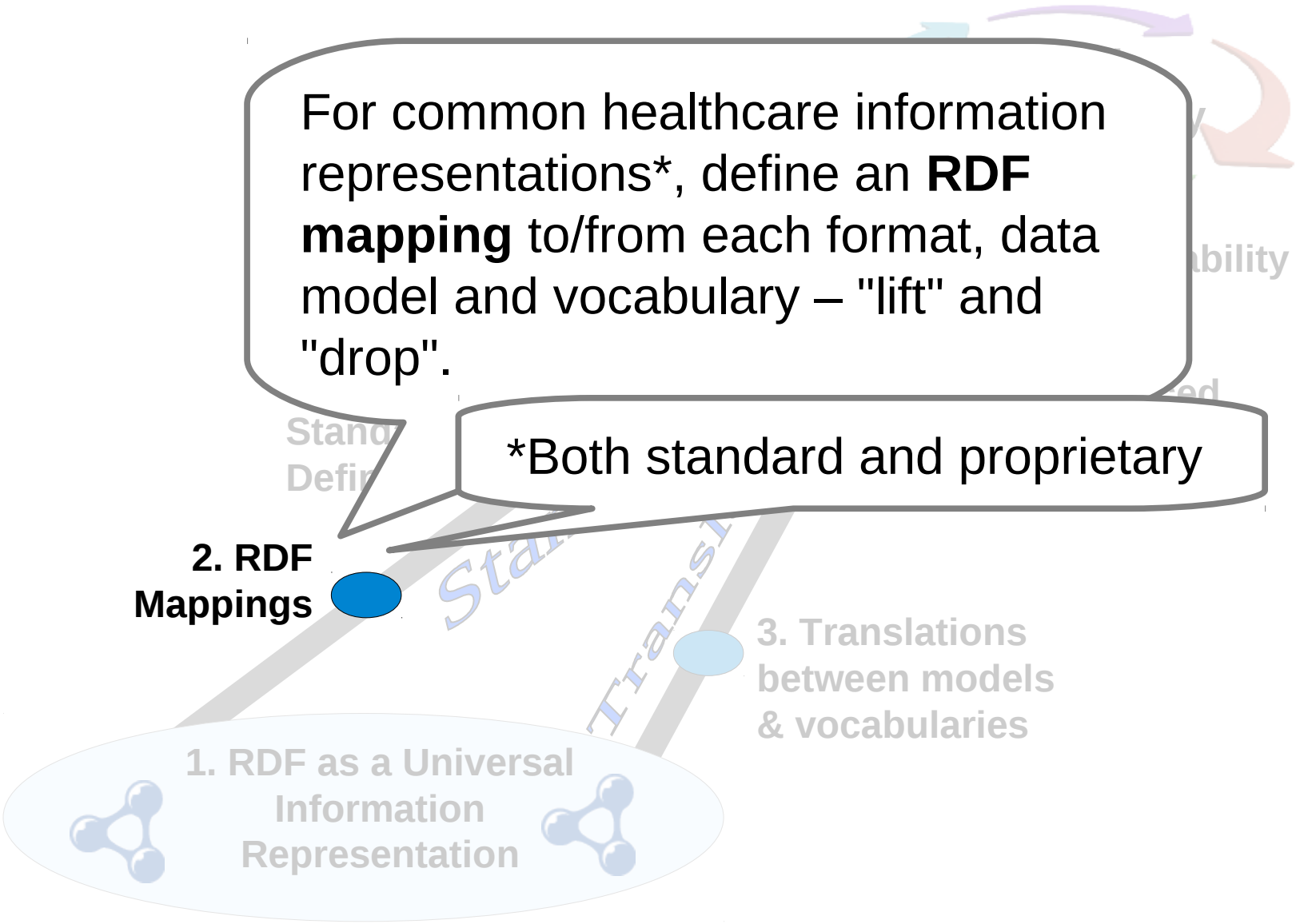
Roadmap


Semantic Interoperability
6. Collaborative Standards Convergence
7. Interoperability Policies
5. RDF/OWL Standards Definitions
4. Crowd-Sourced Translation Rules
2. RDF Mappings
Standards
Translations
3. Translations between models & vocabularies
1. RDF as a Universal Information Representation

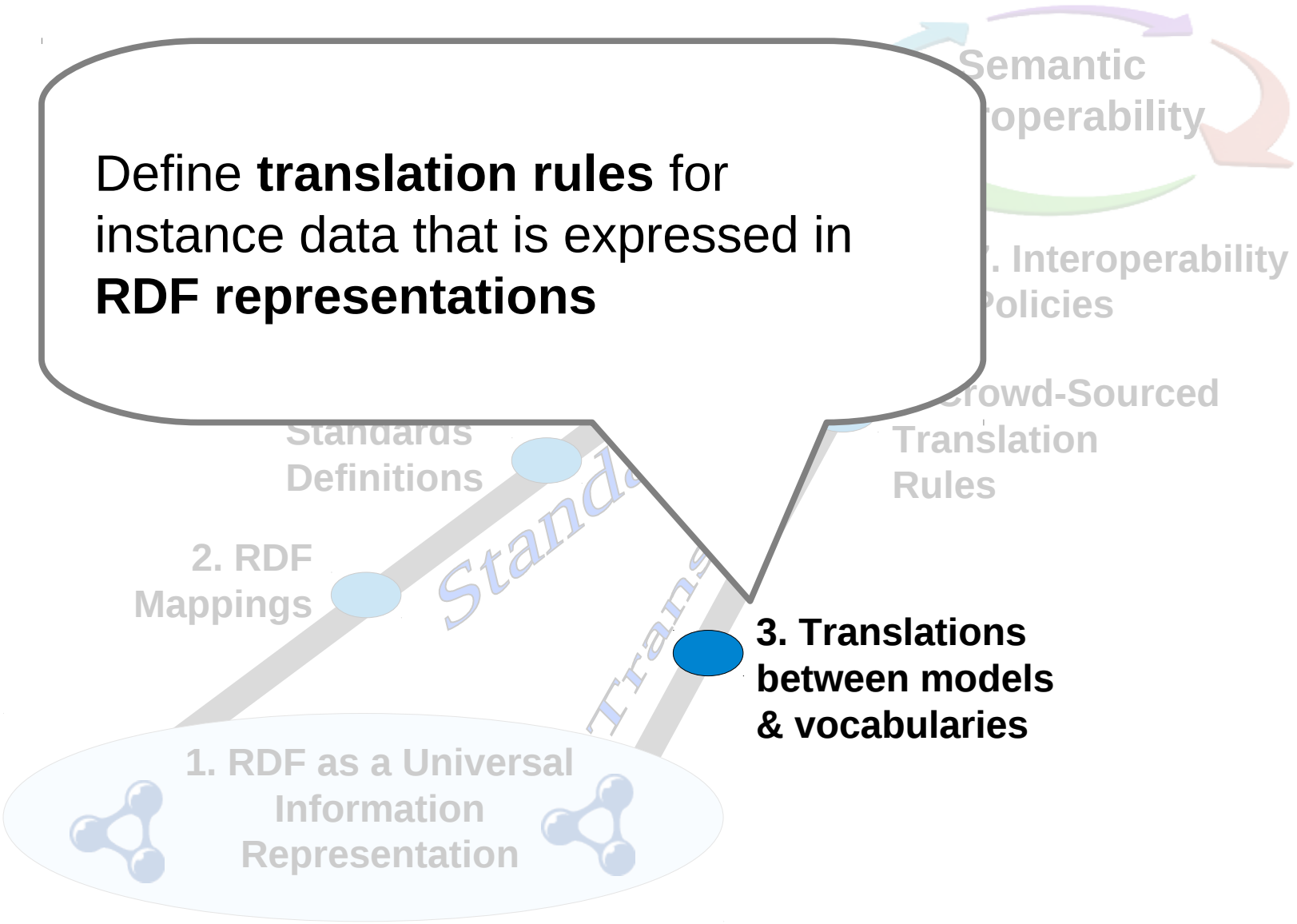
Roadmap - 1


Semantic
Interoperability
erability
rced
Use RDF as a common semantic foundation
2. RDF
Mappings
3. Translations
between models
& vocabularies
1. RDF as a Universal
Information
Representation

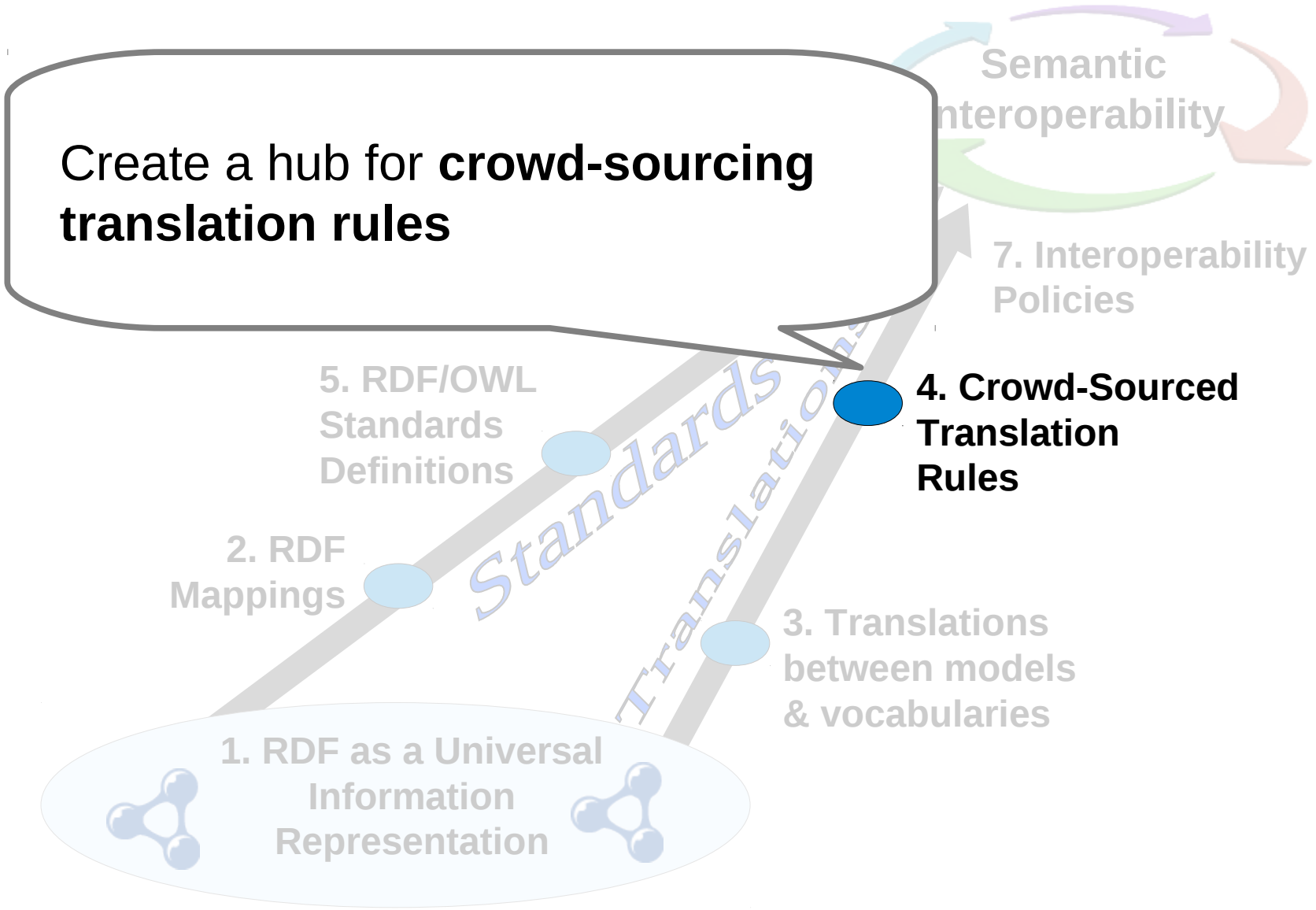
Roadmap - 2


For common healthcare information representations*, define an **RDF mapping** to/from each format, data model and vocabulary – "lift" and "drop".
*Both standard and proprietary
2. RDF Mappings
3. Translations between models & vocabularies
1. RDF as a Universal Information Representation

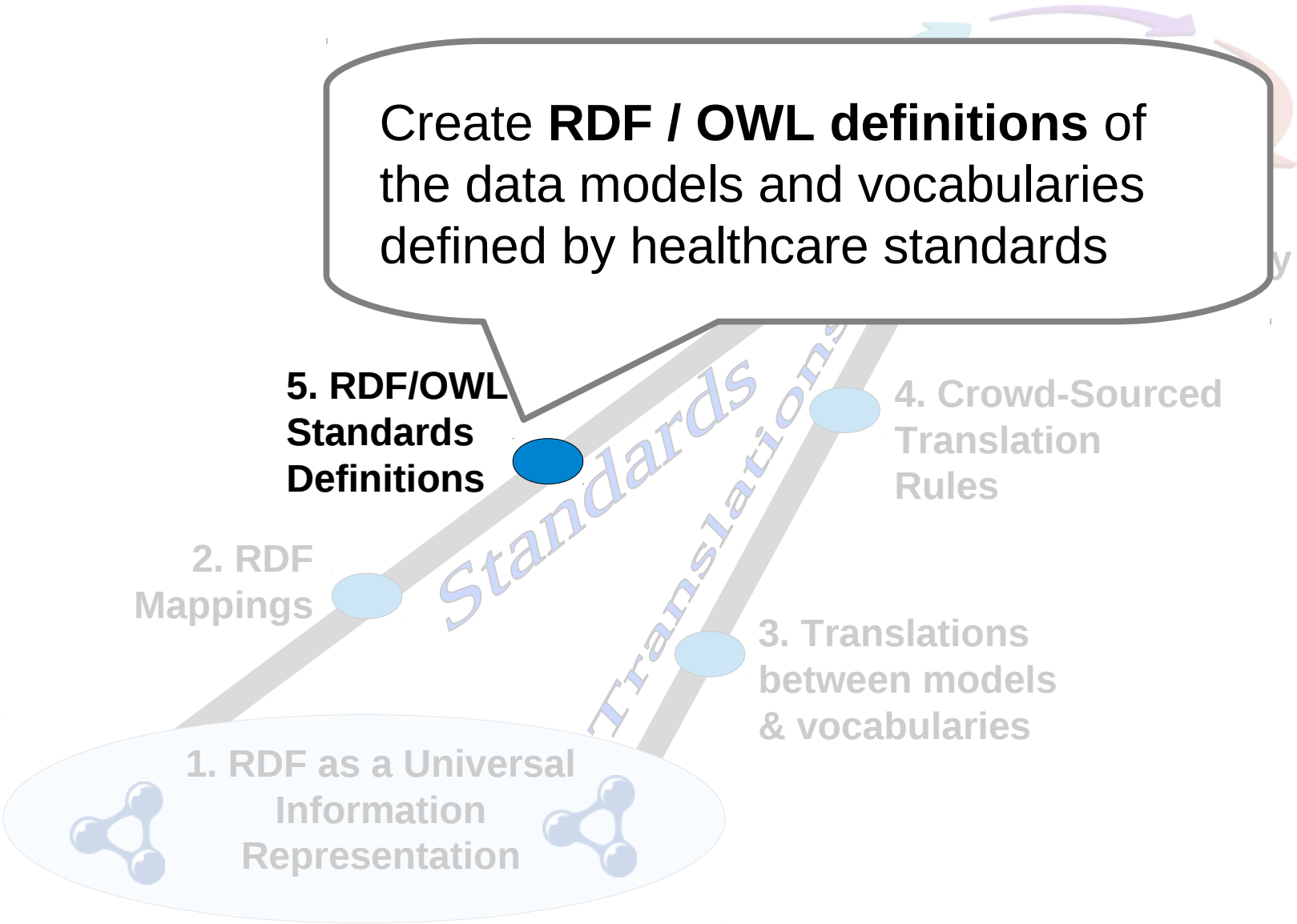
Roadmap - 3


Define **translation rules** for instance data that is expressed in **RDF representations**
Semantic
operability
. Interoperability
olicies
rowd-Sourced
Translation
Rules
Standards
Definitions
2. RDF
Mappings
3. Translations
between models
& vocabularies
1. RDF as a Universal
Information
Representation

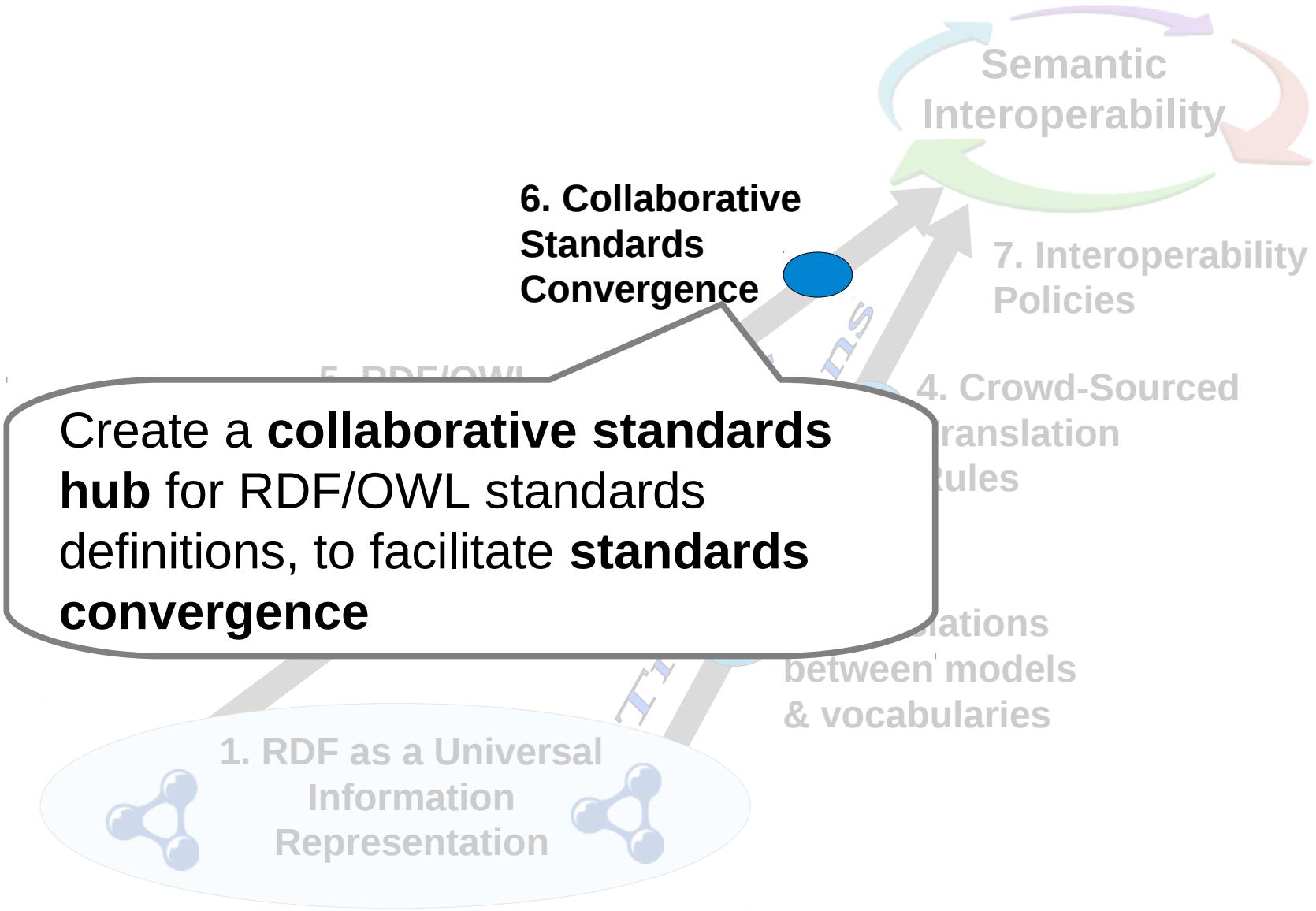
Roadmap - 4


Create a hub for **crowd-sourcing translation rules**
Semantic Interoperability
7. Interoperability Policies
4. Crowd-Sourced Translation Rules
5. RDF/OWL Standards Definitions
2. RDF Mappings
3. Translations between models & vocabularies
1. RDF as a Universal Information Representation
Standards
Translation

Roadmap - 5

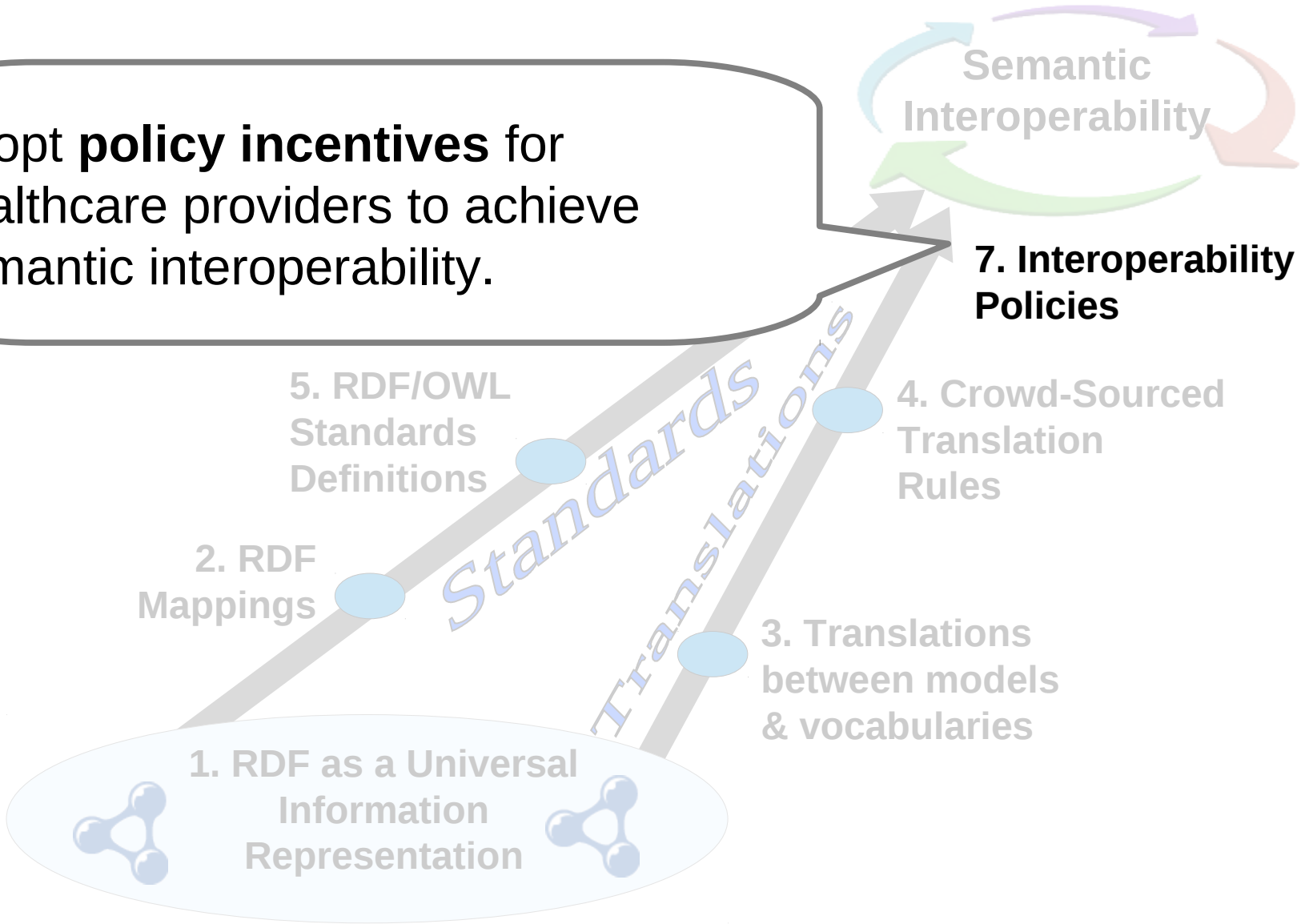

Create **RDF / OWL definitions** of the data models and vocabularies defined by healthcare standards
5. RDF/OWL Standards Definitions
4. Crowd-Sourced Translation Rules
2. RDF Mappings
3. Translations between models & vocabularies
1. RDF as a Universal Information Representation
Standards
Translations

Roadmap - 6


Semantic Interoperability
6. Collaborative Standards Convergence
7. Interoperability Policies
4. Crowd-Sourced
ranslation
ules
lations
between models
& vocabularies
1. RDF as a Universal Information Representation
Create a **collaborative standards hub** for RDF/OWL standards definitions, to facilitate **standards convergence**

Roadmap - 7

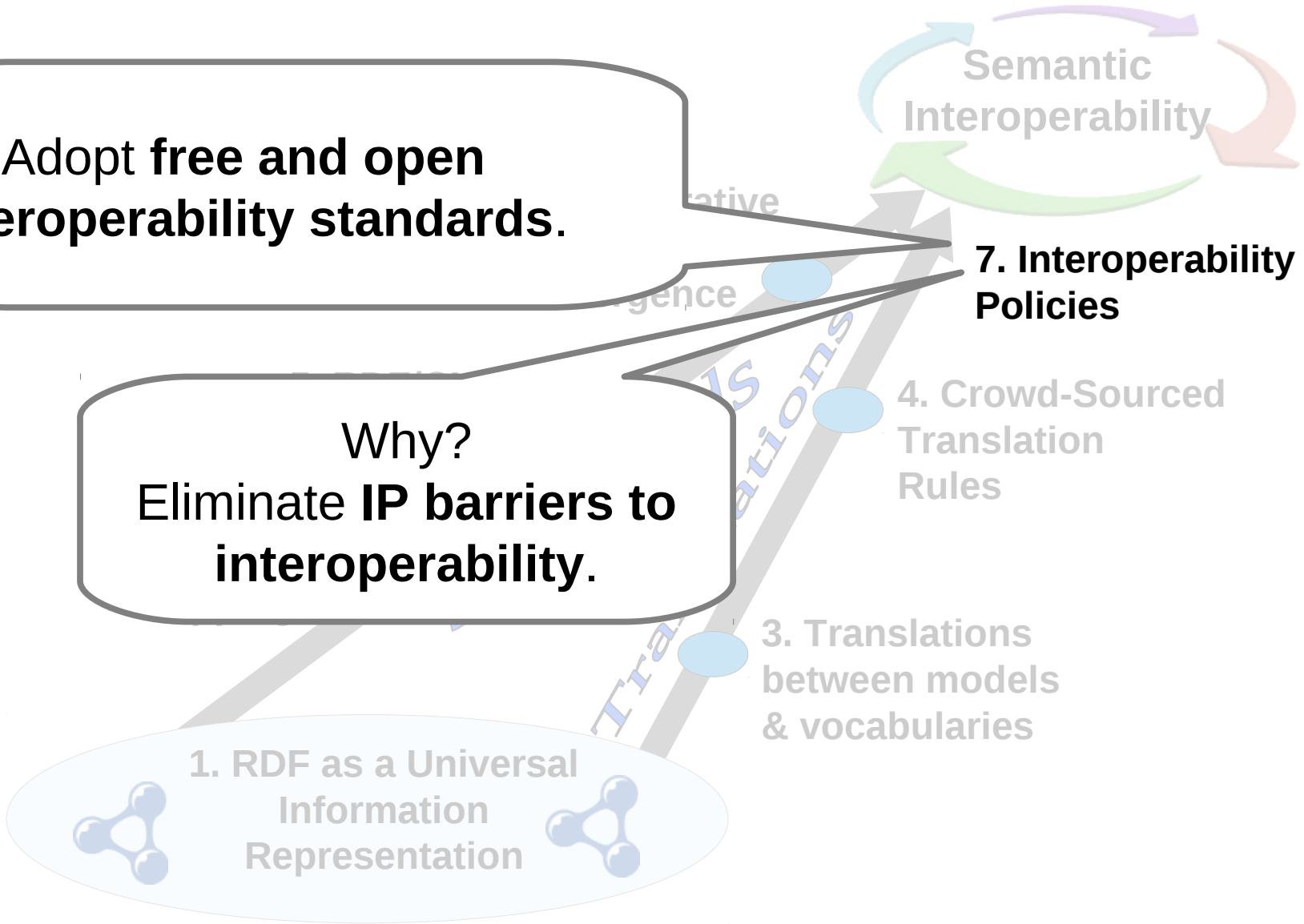
Adopt **policy incentives** for healthcare providers to achieve semantic interoperability.



Roadmap - 7

(a) Adopt **free and open interoperability standards**.

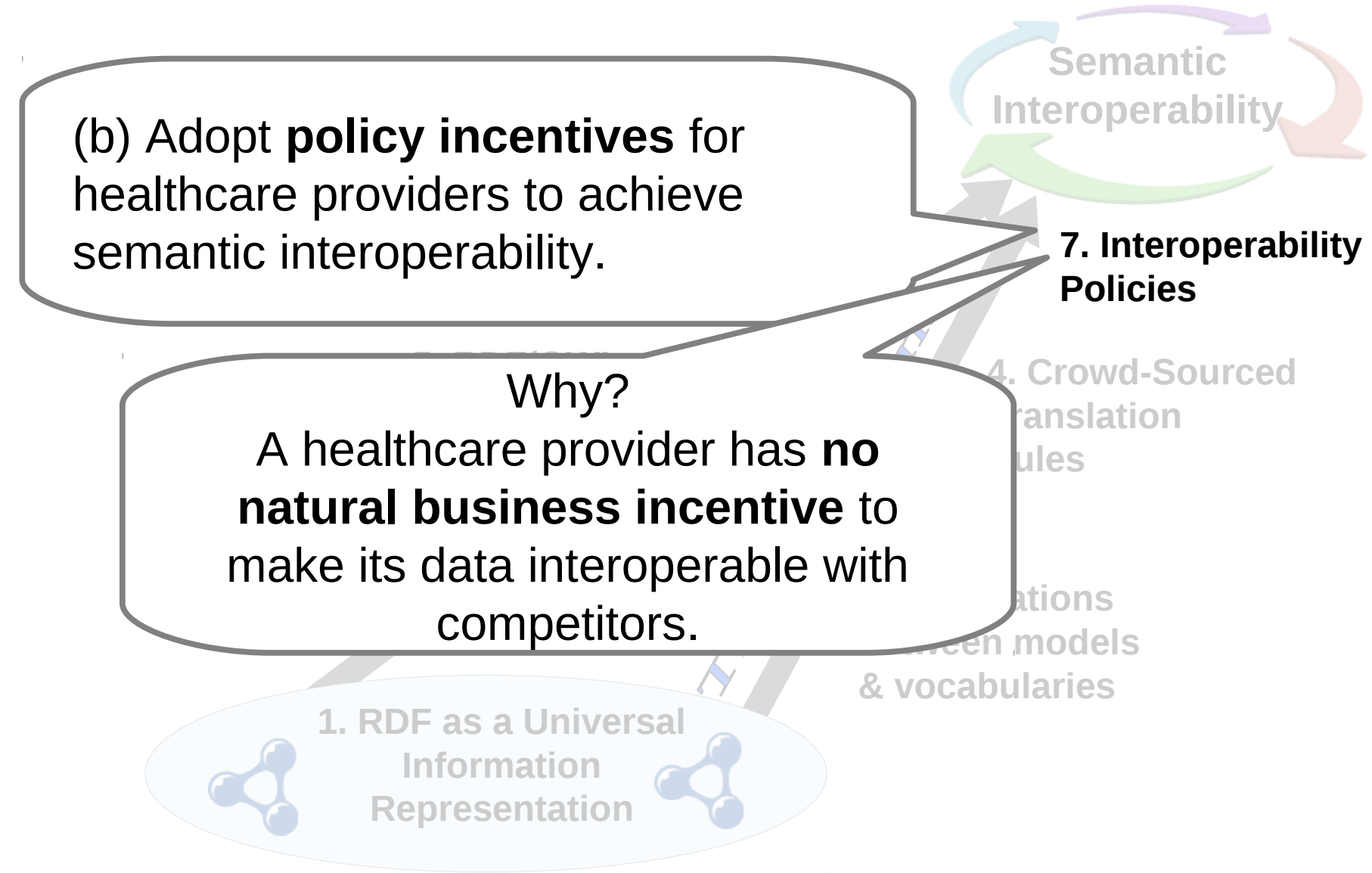
Why?
Eliminate **IP barriers to interoperability**.



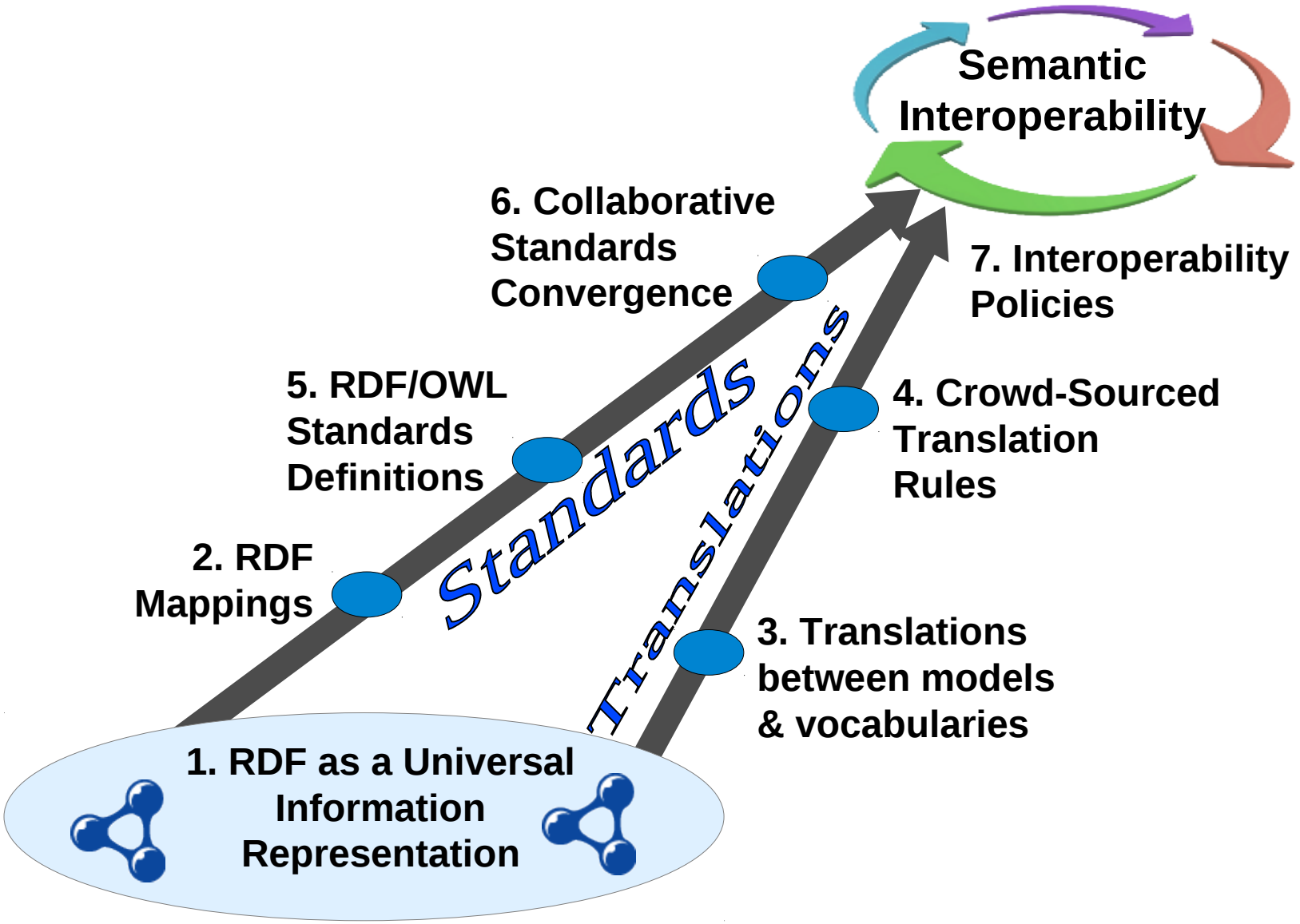
Roadmap - 7

(b) Adopt **policy incentives** for healthcare providers to achieve semantic interoperability.

Why?
A healthcare provider has **no natural business incentive** to make its data interoperable with competitors.



Roadmap


Semantic Interoperability
6. Collaborative Standards Convergence
7. Interoperability Policies
5. RDF/OWL Standards Definitions
4. Crowd-Sourced Translation Rules
2. RDF Mappings
Standards
Translations
3. Translations between models & vocabularies
1. RDF as a Universal Information Representation

What will semantic interoperability cost?

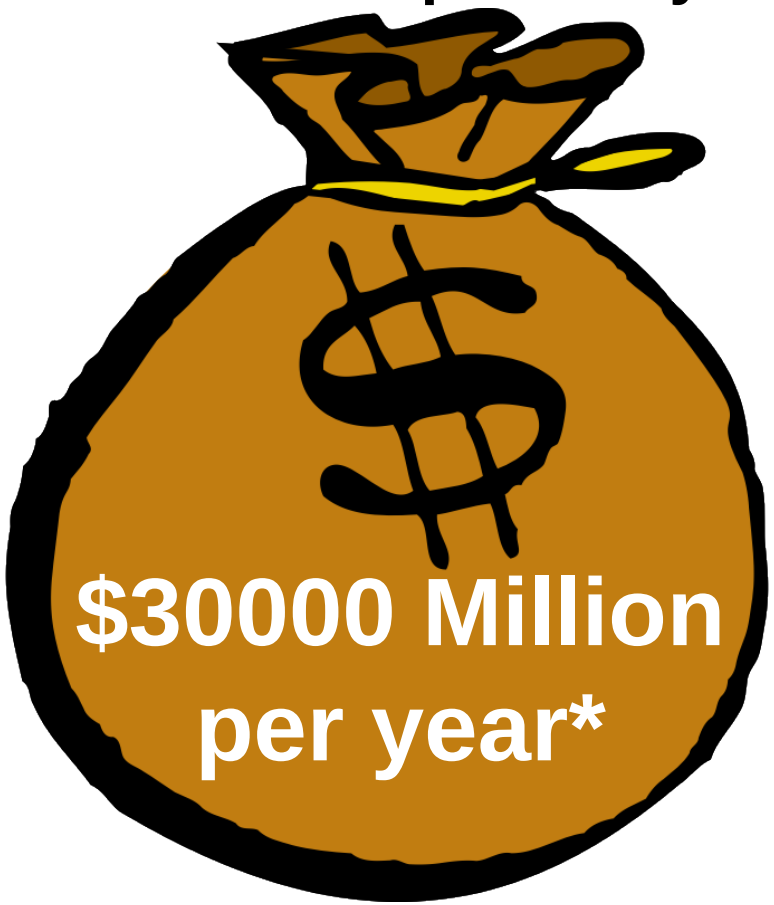
My guesses . . .

	Initial	Ongoing
Standards	$40-500M	+ $30-400M / year
Translations	$30-400M	+ $20-300M / year
Total	**$60-900M**	**+ $50-700M / year**

What are yours?

Opportunity cost

Non-interoperability

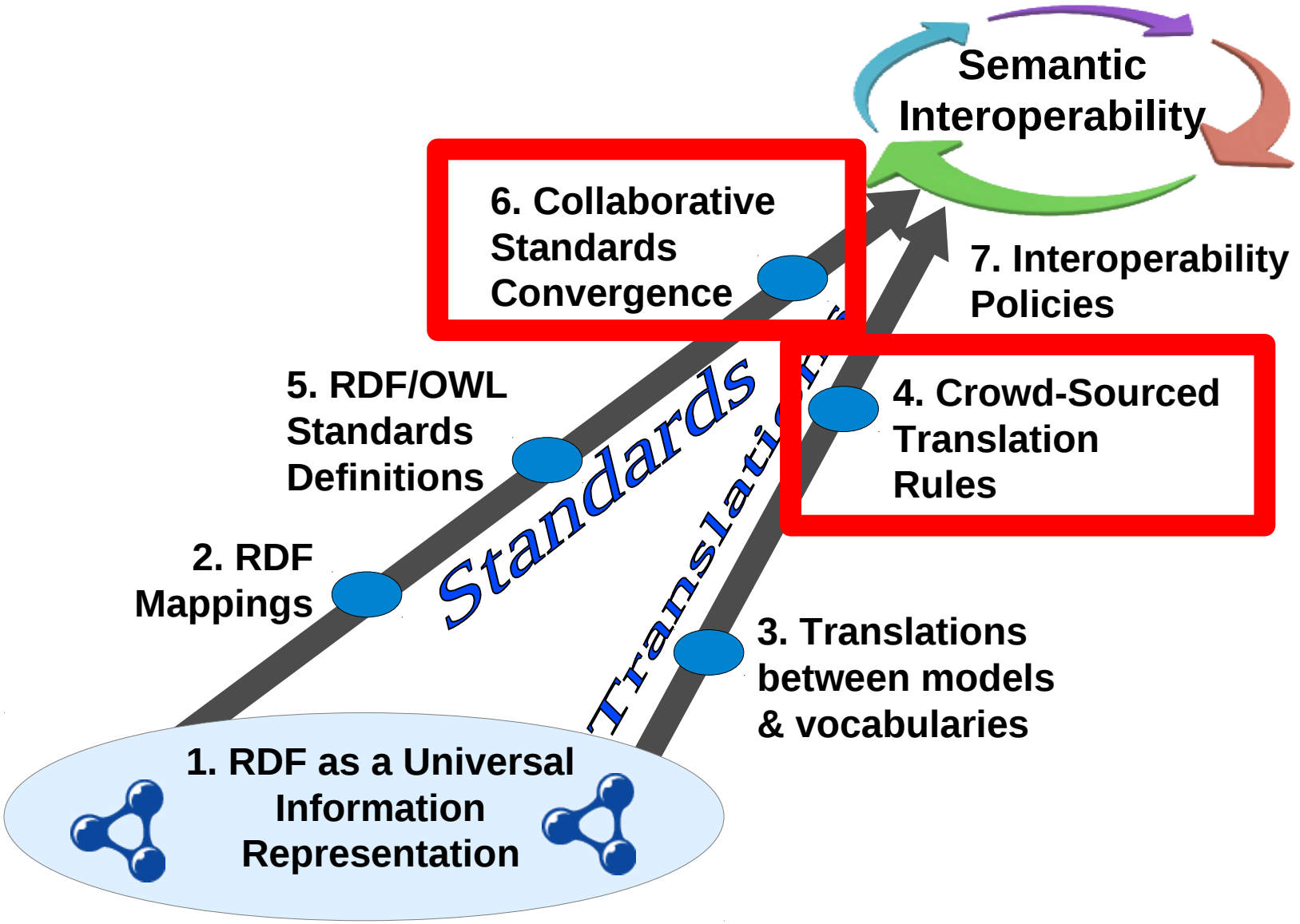


Interoperability

$700 Million
per year?

*Source: http://www.calgaryscientific.com/blog/bid/284224/Interoperability-Could-Reduce-U-S-Healthcare-Costs-by-Thirty-Billion

Biggest payoff opportunities



Questions?

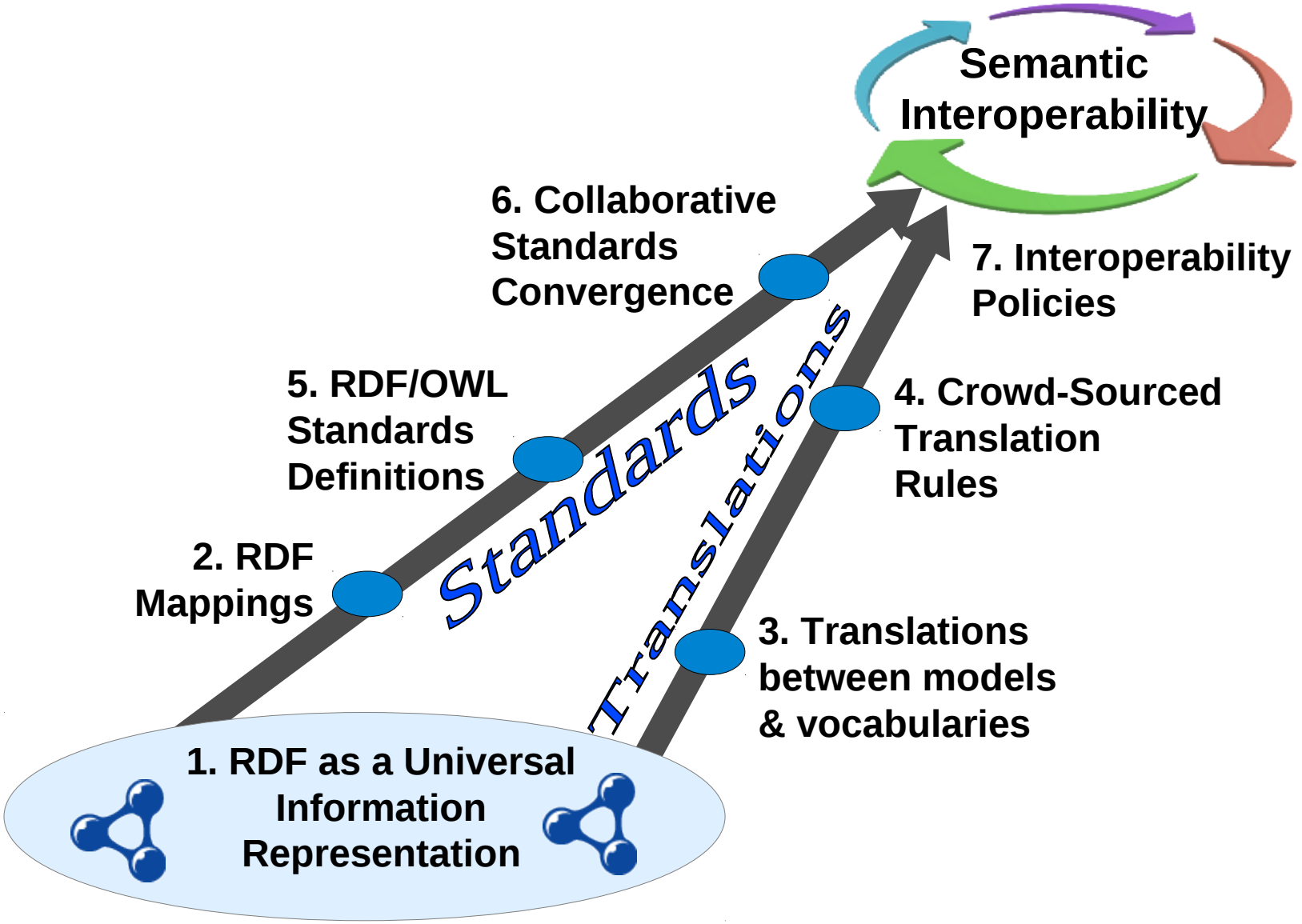
BACKUP SLIDES

Related Activities

- New HL7 group on "RDF for Semantic Interoperability": http://wiki.hl7.org/index.php?title=ITS_RDF_ConCall_Agenda
- ONC's "Interoperability Roadmap" (draft): http://tinyurl.com/mgtwwr8

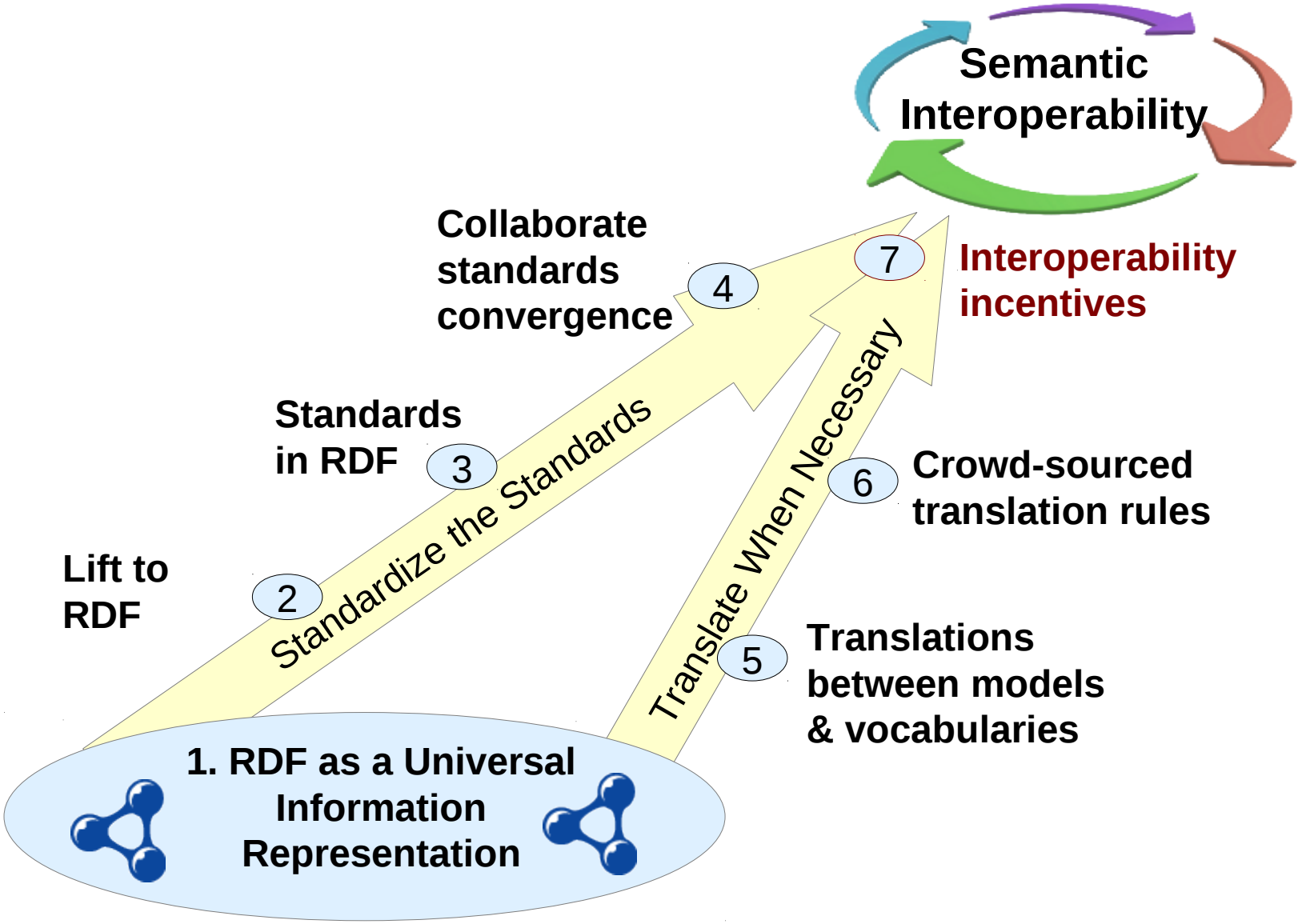
http://YosemiteProject.org/

A Roadmap for Healthcare Information Interoperability

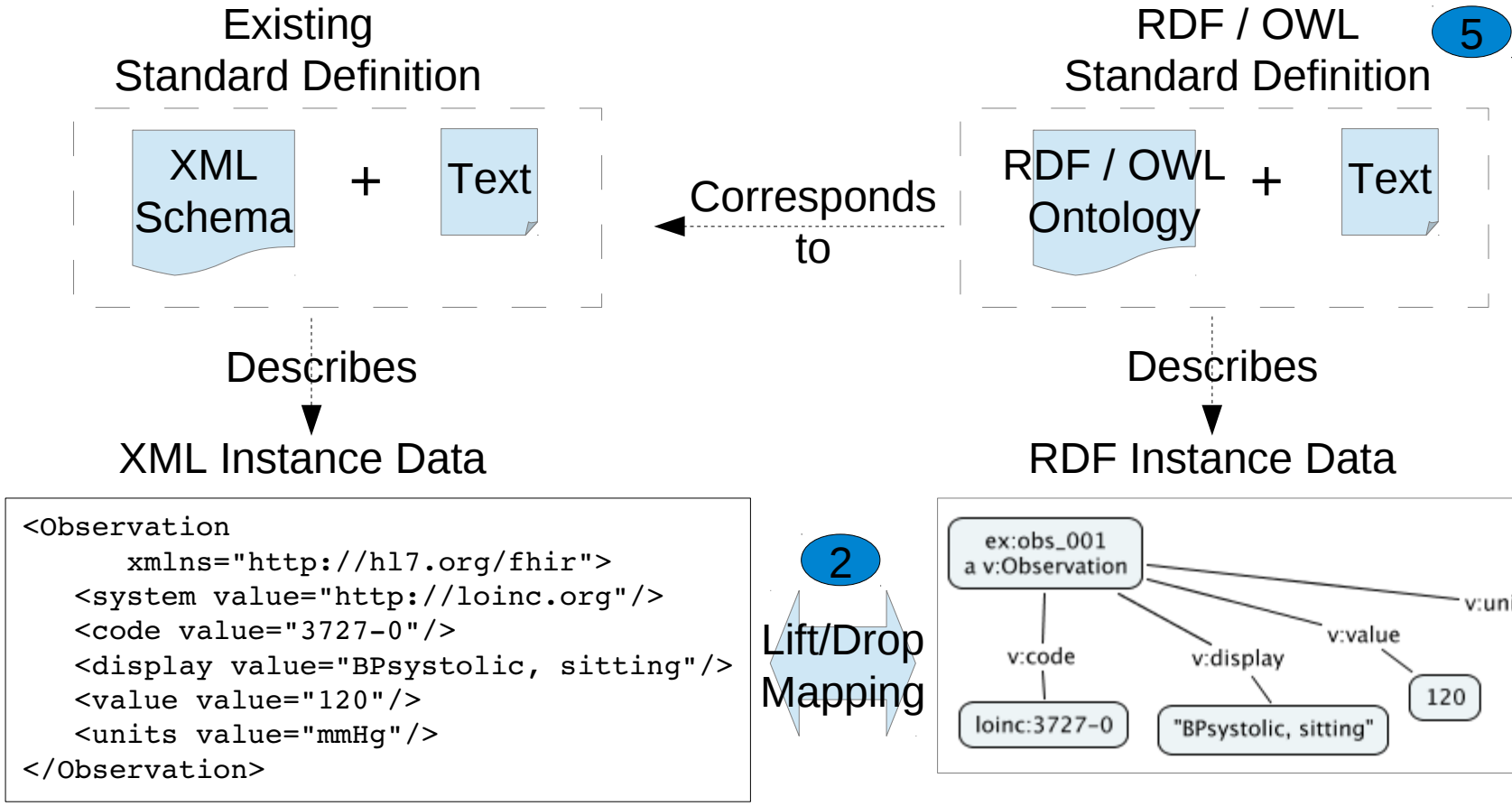


http://YosemiteProject.org/

A Roadmap for Healthcare Information Interoperability



Steps 2 and 5


Existing
Standard Definition
XML
Schema
+
Text
Corresponds
to
RDF / OWL
Standard Definition
5
RDF / OWL
Ontology
+
Text
Describes
XML Instance Data
Describes
RDF Instance Data
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<value value="120"/>
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2
Lift/Drop
Mapping
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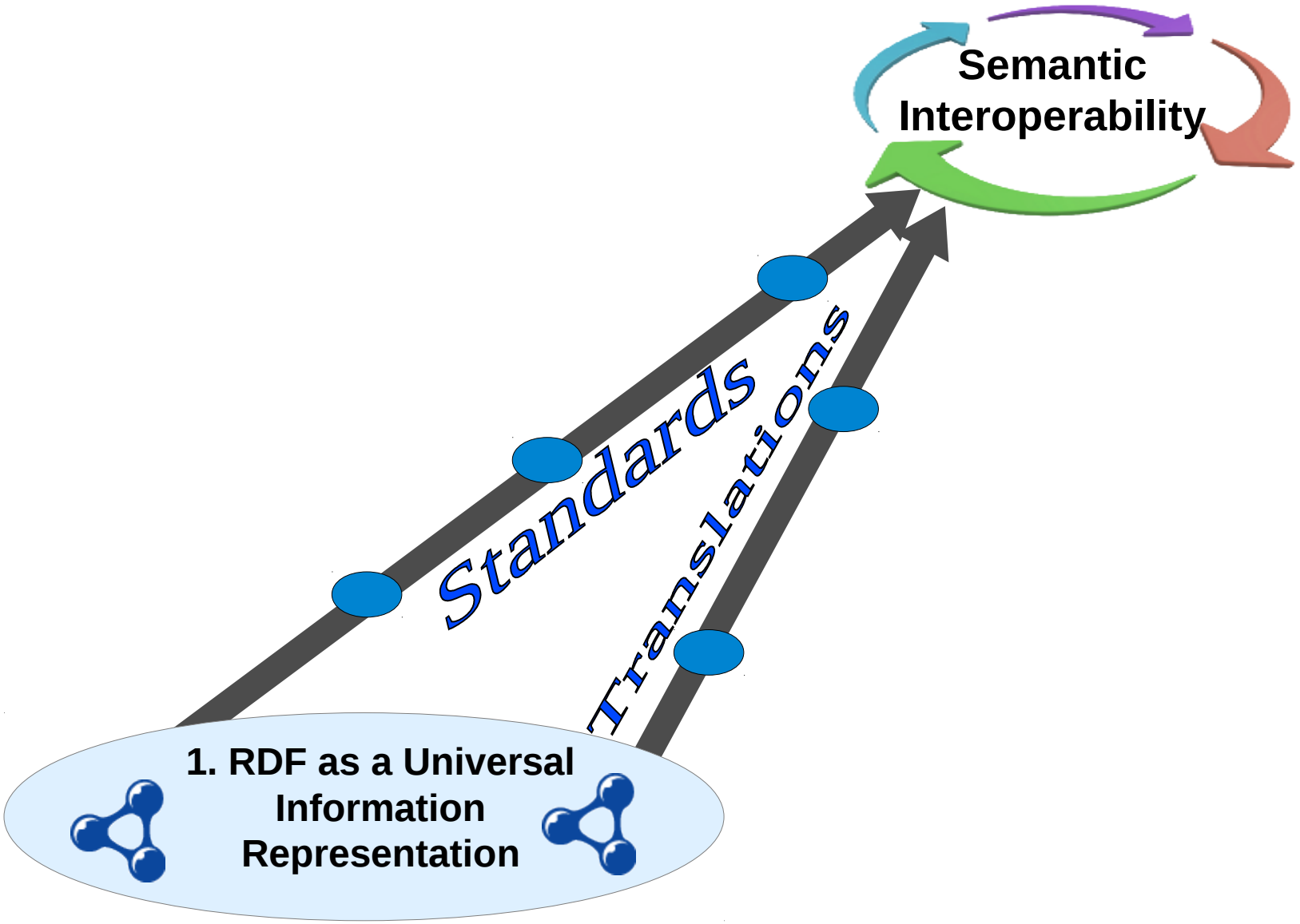
a v:Observation
v:units
v:value
v:code
v:display
v:mmHg
120
loinc:3727-0
"BPsystolic, sitting"

Roadmap


Semantic Interoperability
Standards
Translations
1. RDF as a Universal Information Representation