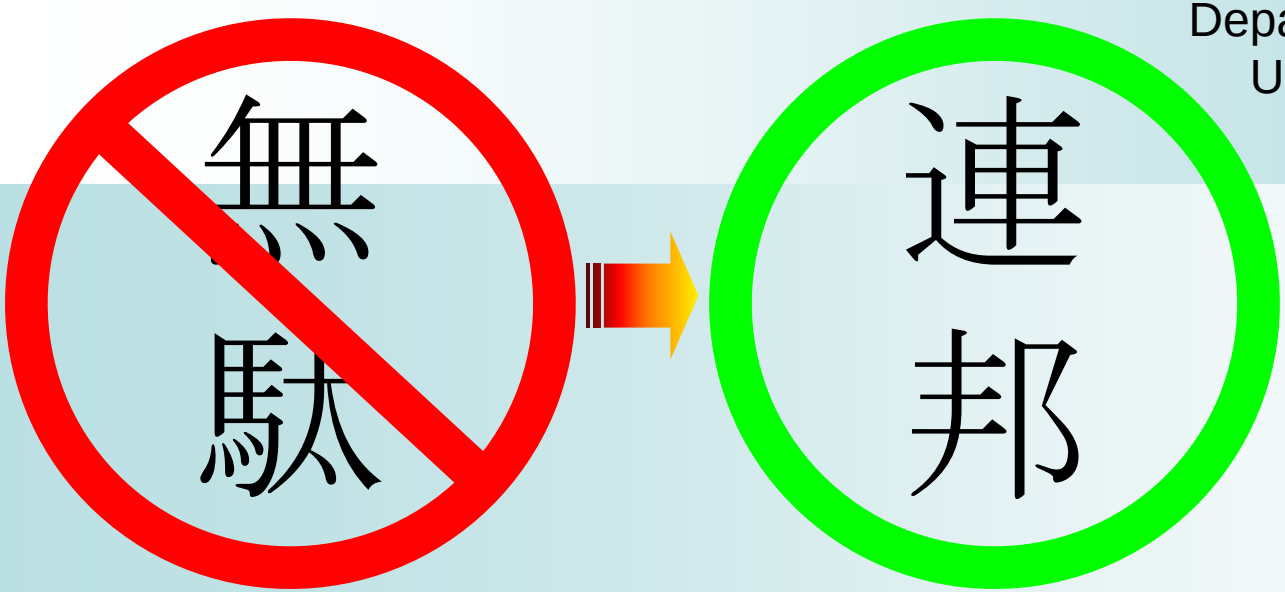
labinfotechsummit

The Federated Electronic Health Record (FEHR): *Getting Beyond HL7*

Ulysses J. Balis, M.D.
Director of Clinical Informatics
Co-Director, Division of Pathology Informatics
Department of Pathology
University of Michigan
ulysses@umich.edu

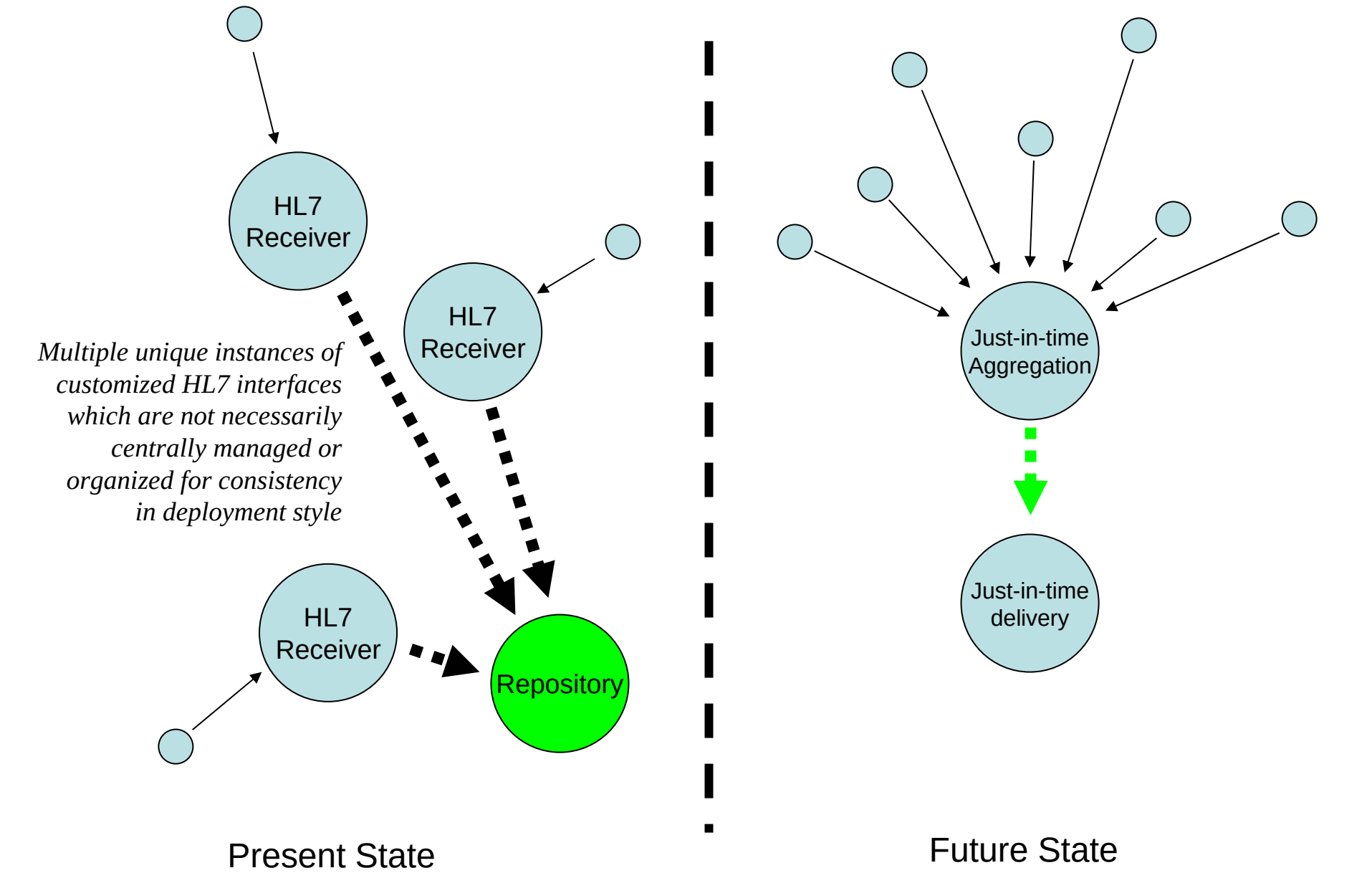


Overview

- Concepts are meant to be taken as thought-provoking and not dogmatic
- Comparison of current interface deployment strategies vs. those which are possible by use of newer information model approaches
- Review of the promise of Federated Topologies
- Examination of the role (if any) of Lean/Six Sigma approaches in the rational deployment of LIS/HIS interfaces and data dissemination.
- Review of the underlying data model technologies which will enable possible federated architectures

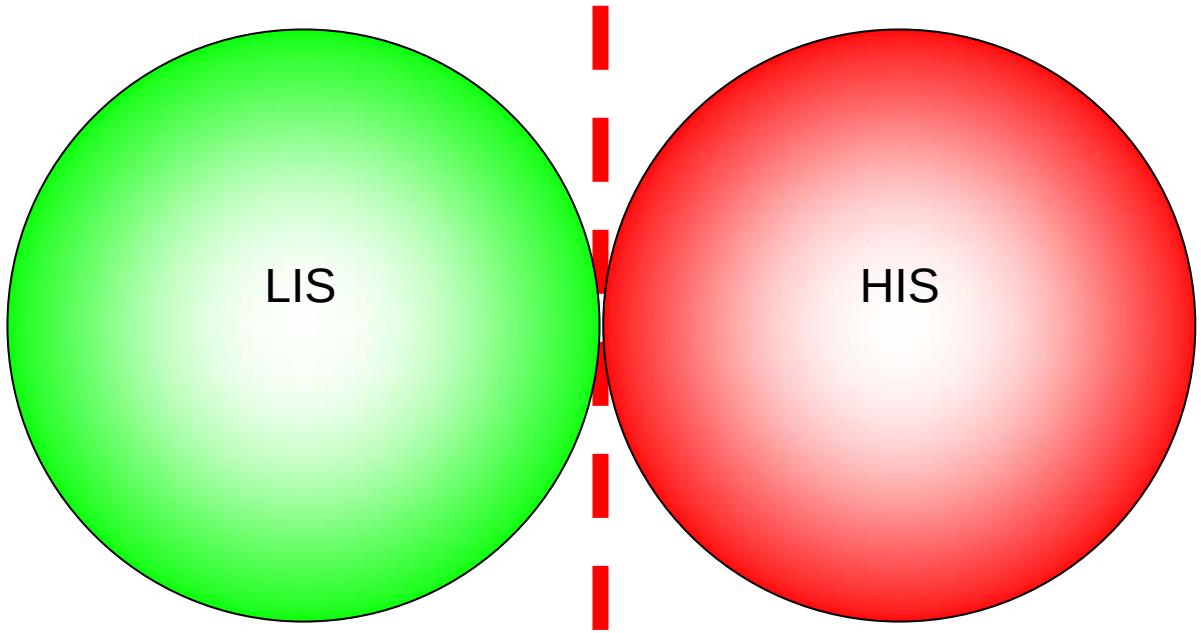
Trends with Central Hospital I.T. Strategic Planning

- Realization that central repositories designed for clinical decision support are increasingly difficult to support.
- Realization that ancillary departments (LIS, RIS, OR, ED, etc.) are optimally empowered to control both content *and display* of their data.
- Identification of monolithic repositories as being ideal for research support and not necessarily for clinical support.


HL7 Receiver
HL7 Receiver
HL7 Receiver
Repository
Multiple unique instances of customized HL7 interfaces which are not necessarily centrally managed or organized for consistency in deployment style
Present State
Just-in-time Aggregation
Just-in-time delivery
Future State

The Imbalance of Infrastructure to Required Support

Ideal Oversight Model



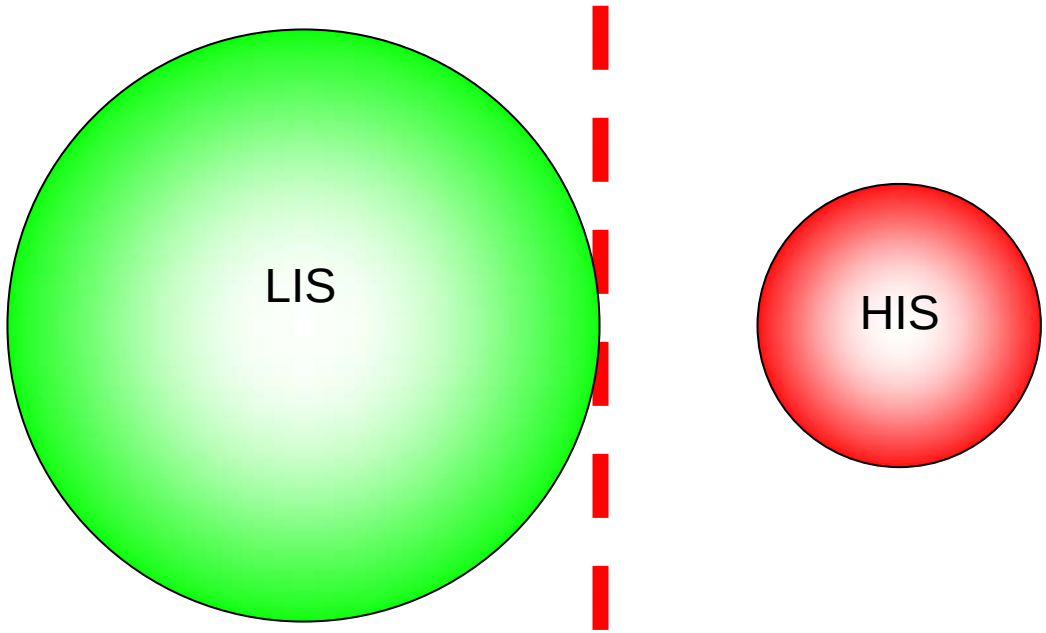
Clinical Laboratory Continuum

Hospital I.T. Continuum

Demarcation of Intended Scope of Influence/oversight

The Imbalance of Infrastructure to Required Support

Diminishing Central IT Expertise



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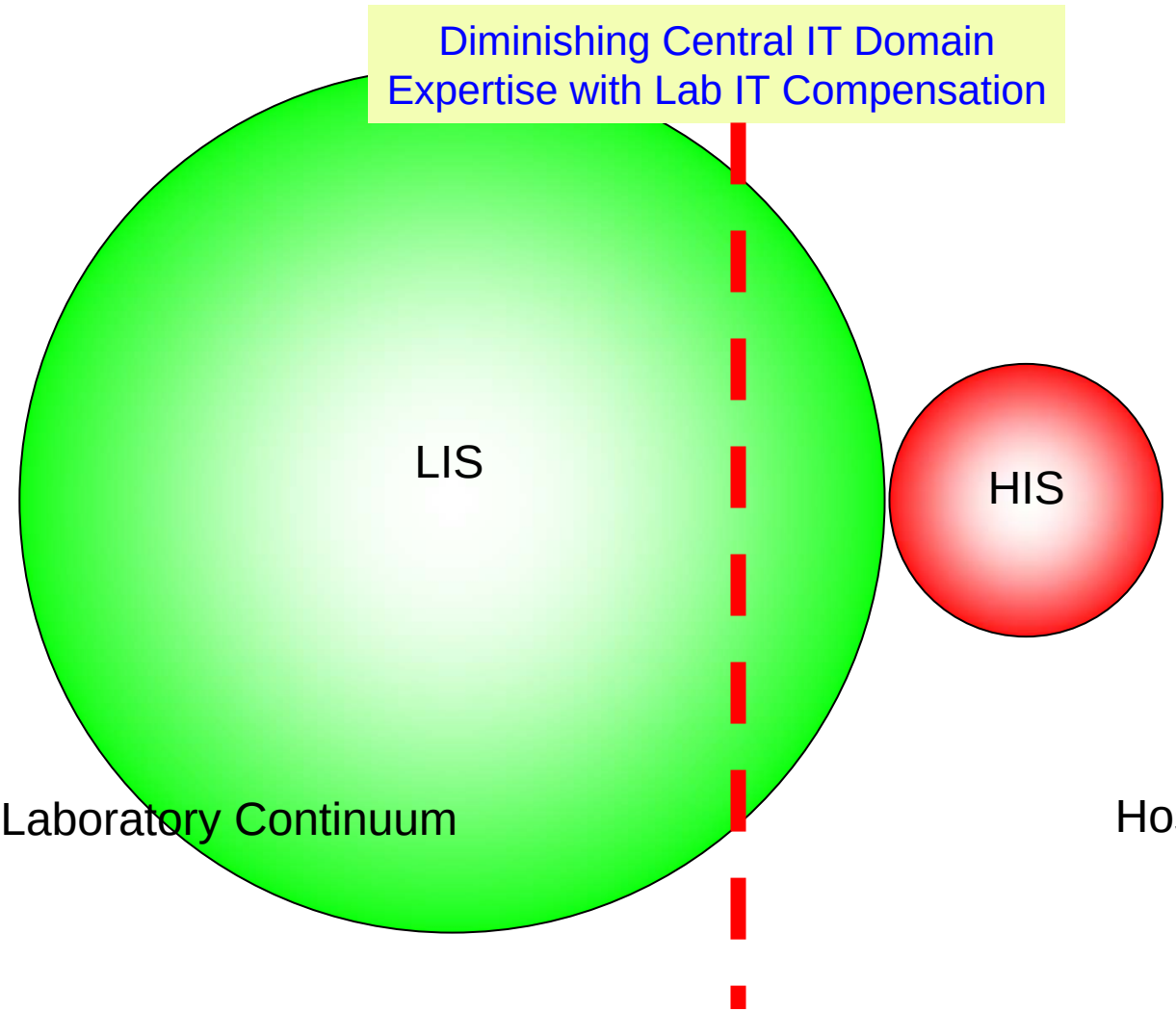


Present State

- Effort expended to interface instruments to the LIS and the LIS to the HIS represent an increasing percentage of overall operational effort of the generally fixed Lab IT resource.
- Hospital migration of HIS platforms can impose a sudden and daunting resource requirement on lab IT resources to design, implement and test the myriad of extant interfaces required by such a new system
- The current language of interface HL7 2.x represents a formalized exchange construct that requires precisely constructed specification of the sender/receiver pair to create a functional data channel; this is labor-intensive and requires specialized programming expertise.

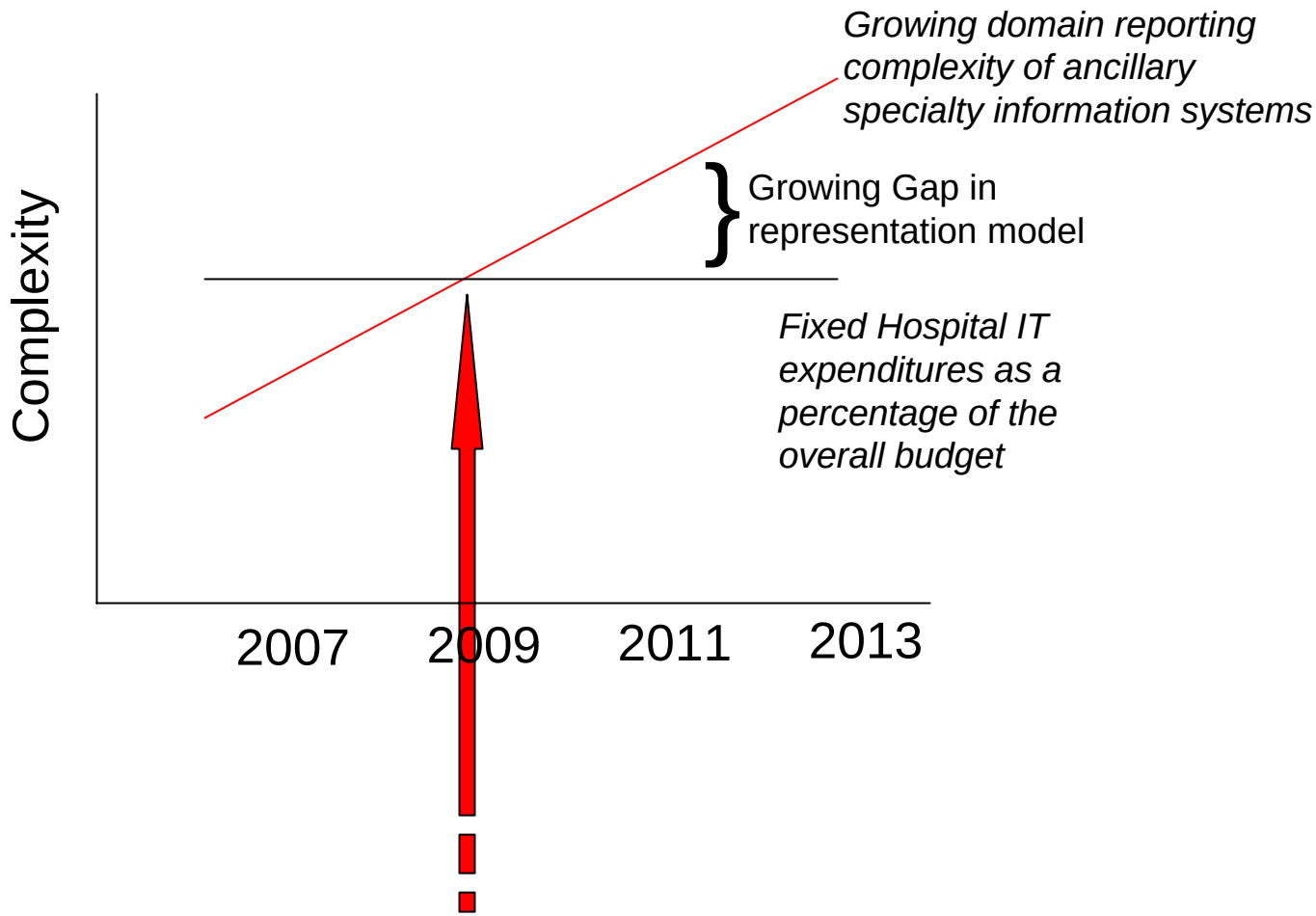
Future State

- Use of standards that reduce error, maintenance/rework, complexity, data duplication and multiple (and often complex) interdependencies.
- Use of empowering technologies:
  - ? HL7 3.x, ?HL7 2.x with use of XML
  - Stand-alone XML schema definitions standards
  - Framework systems of knowledge representation
  - Adoption of Lean/Six Six Sigma philosophies to the LIS/HIS production continuum

Some Estimates of Effort

- Typical LIS implementation
  - 10+ instrument interfaces
  - 2 HIS interfaces
- 40 programmer hours/interface/year as a conservative support metric
- 800+ hours effort/site-year
- ~Millions of programmer hours of interface maintenance and customization effort annually.

The Pending Imbalance…



Taking a “Postmodern” View of Date Warehousing…

- While stand-alone repositories are effective for clinical research extraction applications, they represent an exponentially growing area of complexity for operational support of conventional clinical reporting needs.
- Specifically, the re-work associated with recapitulating domain data management practices in a single central instantiation represents a challenge for even large central IT department.

Emergence of Lean and Six-Sigma Approaches in LIS Deployment

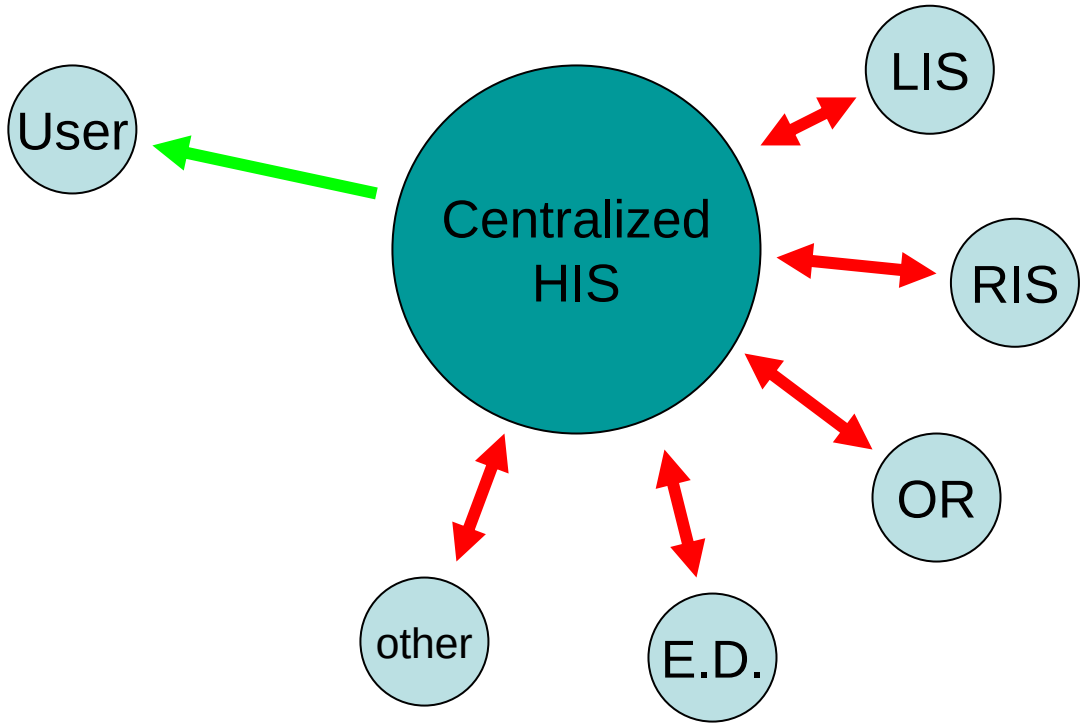
- There are seven categories of waste (Muda): when applied to the LIS/HIS production environment continuum, these categories form the following interesting parallels to the conventional production setting:
  - Overproduction: carrying out more computational effort than is required to effectively deliver information to the consumer
  - Conveyance: imposing more interface transfer steps than what should be required
  - Waiting: delays in reporting associated with cascaded and single-threaded interfaces.
  - Motion: Added complexity of multiple interfaces caused data to be moved incremental iterations, increasing the chance for data corruption over each successive step.
  - Rework: being forced to re-specify and retest downstream interfaces when local processes are modified (e.g. a new addendum method within-Lab requires validation of the new addendum functionality at the HIS level)
  - Over-processing: extra effort associated with denormalized data models and the effort to ensure that all copies are kept in sync with the single source of truth (SSOT), if it even exists. This imparts risk that one or more copies of the data will become unsynchronized with the SSOT.
  - Inventory: added institutional data storage infrastructure associated with denormalized data models and storing of the exact same data elements in multiple locations

The Promise of Federation

- Recognize that central IT departments have increasing demands and often diminishing composite resources to meet such demands
- Recognize that ancillary departments are usually the *most qualified* domain experts in terms of appropriate stewardship of data.
- Recognize that it takes less effort and imparts less risk to store every data element once and no more than just once (affirming the use of SSOT principles)
- Reduce time-consuming rework associated with cascaded interface changes, in the setting of evolution in both workflow and data model practices.

What is Federation?

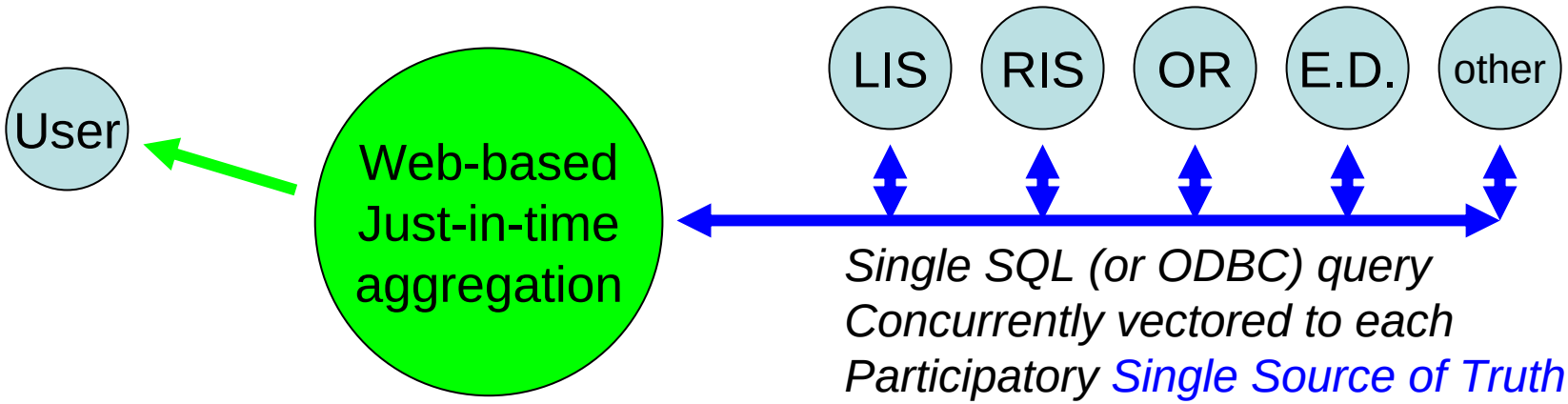
Conventional Data Model



Conventional HL7 interface

What is Federation?

Potential Revised Data Model

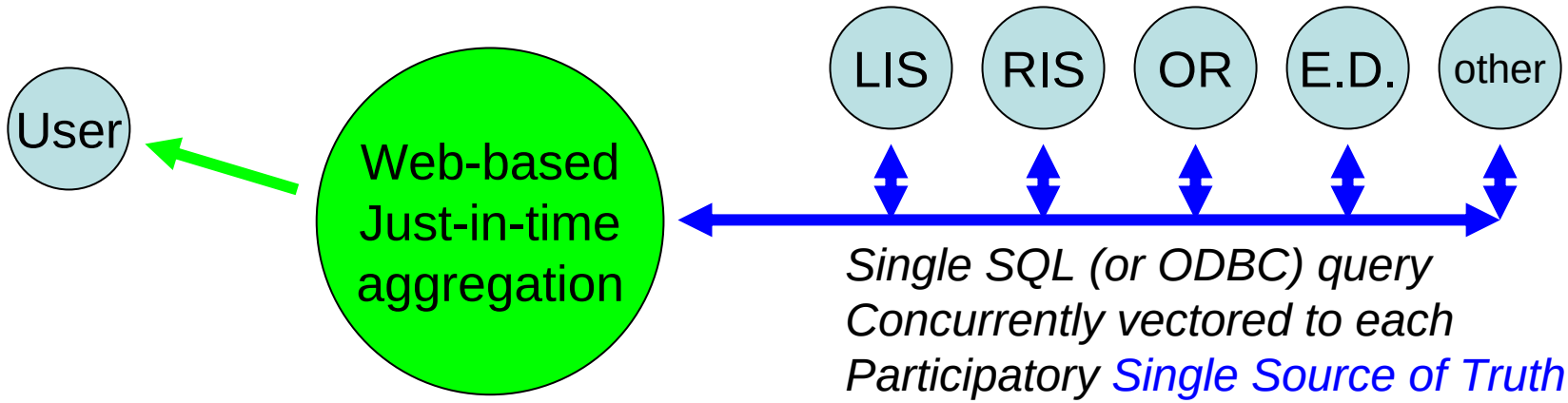


SSOT shifted to the appropriate domain-specific stewards of data from the HIS domain

- Participatory SQL servers

What is Federation?

Potential Revised Data Model



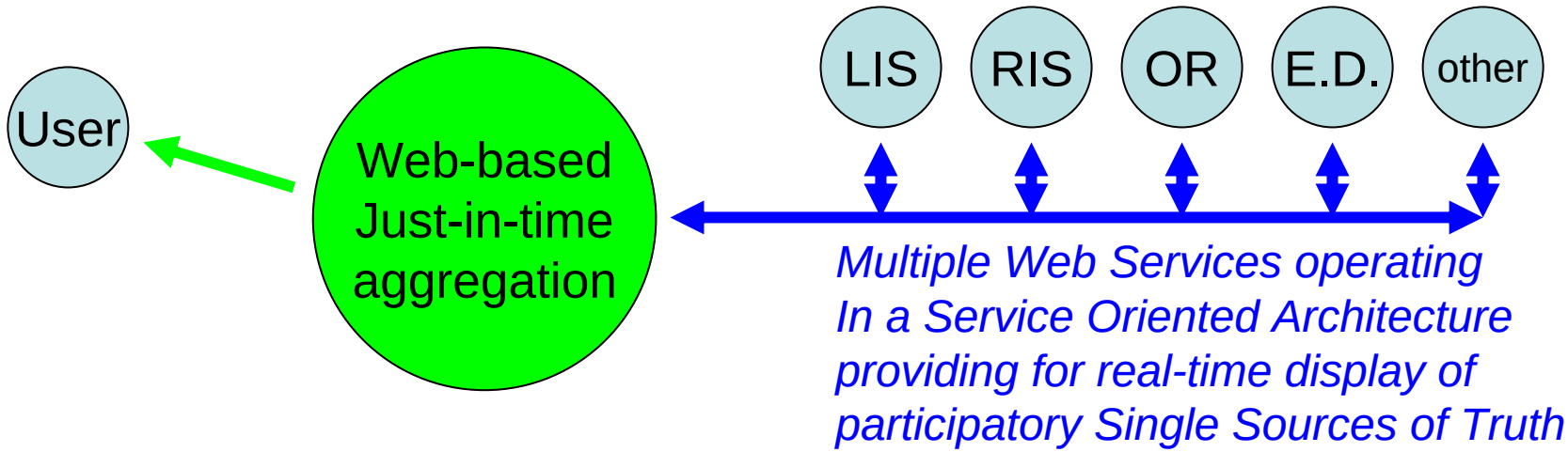
Consequences of shifting to a SQL-based SSOT model:

- Data only represented once in overall enterprise model
- Reduction in number of interfaces requiring support
- Potential to transfer classes information other than text
- Reduction in support responsibilities of central hospital IT.

■ Participatory SQL servers

What is Federation?

Potential Revised Data Model



Consequences of shifting to a Web-based SSOT model:

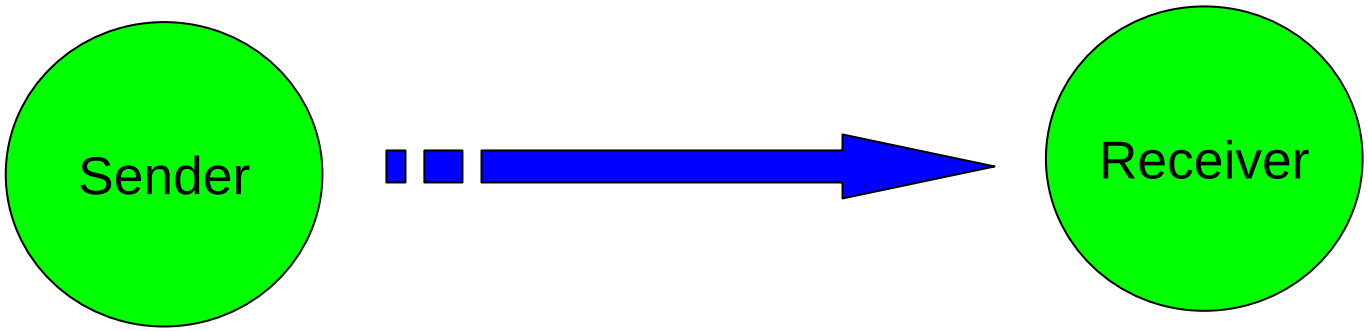
- Simplified transfer and display of complex data types
- Simplified exchange of information via Web-based standards, supporting intra- and inter- institutional needs

■ Participatory SOA-Web servers

What is beyond HL7?

- Zero-Knowledge message exchange
- HL7 (XML)
- True Federation
  - Transact-SQL
  - ODBC
- ISO-11179
- RDF

HL7-based message exchange



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PV1|1|||||789^Referring^John^D^M.D.|^^^^|^^^^|||||||^^^^
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OBX|6|NM|395511002^Polyp stalk length (observable entity)^SCT^R-0045B^^SCT2|1|3.0000|cm^centimeters^ISO+|||||F|||200606211453||TM
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OBX|8|CWE|371469007^Histologic grade (observable entity)^SCT^R-00258^^SCT2|1|60815008^Grade not determined (finding)^SCT^G-F505^^SCT2|||||F|||200606211453||TM
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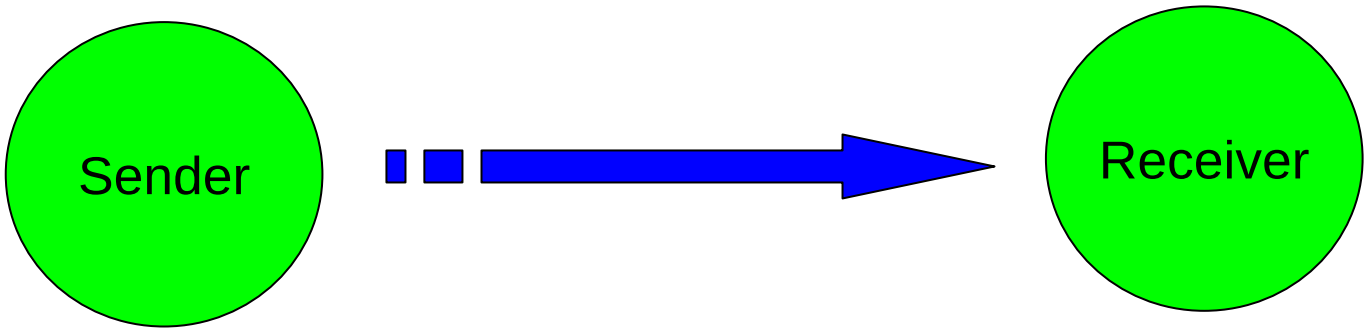
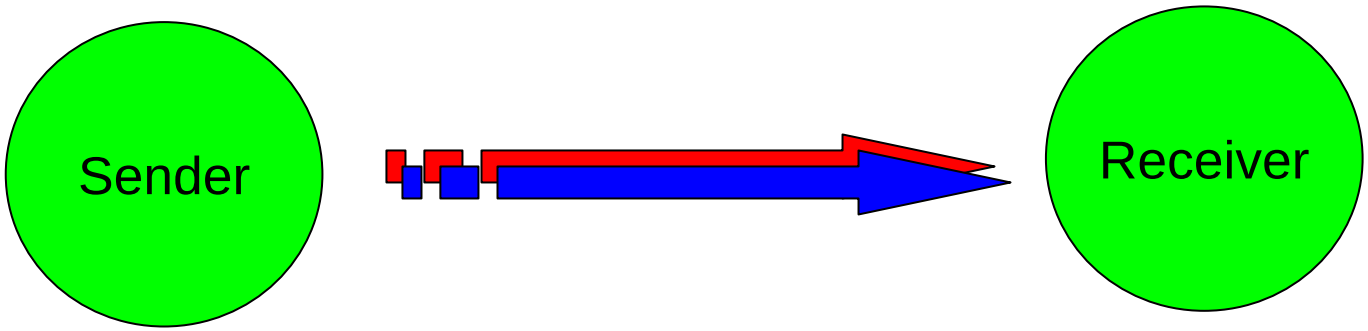
OBX|10|CWE|395715009^Status of lymphatic (small vessel) invasion by tumor (observable entity)^SCT^R-00404^^SCT2|1|44649003^L0 stage (finding)^SCT^G-F220^^SCT2|||||F|||200606211453||TM

HL7-based message exchange



- Dependence upon:
  - Precise pre-coordination of expected data fields, formatting and specific sequence of data elements between sender and receiver
  - That each interface must be precisely specified and implemented on both ends
  - That when an internal change in workflow will results in substantive data model changes, there is the requirement to amend the interface on both ends

Zero Knowledge-based message exchange



- Differences:
  - Data elements are transferred along with a message specification layer
  - No *a priori* knowledge of either message content or format required at the receiver
  - In essence, the message is both self-contained and self-defined.
  - Due to use of data element standardization, (ISO-11179), each term is fully defined and recognizable by the receiver, without pre-coordinated effort

Tools to Empower the Creation of Zero-Knowledge Interfaces

- Informatics metadata construct Toolset
  - ISO-11179
  - XML (.XSD)
  - RDF
  - DAML
  - OWL
  - Dublin Core
  - W3C Compliance

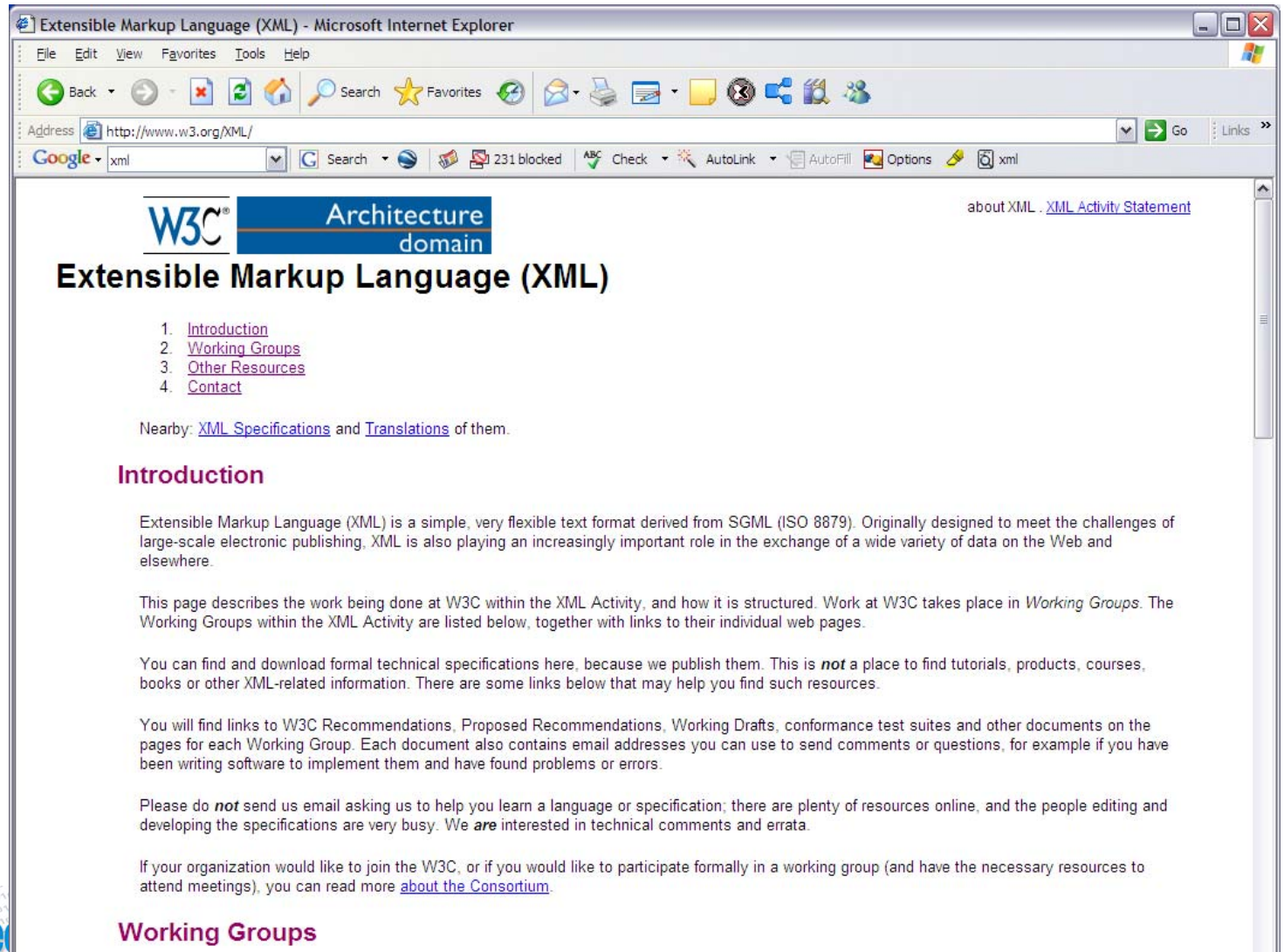
ISO/IEC 11179

- Recognized world-wide
- Allows representation of data elements via markup language (XML) where markup definitions are consistently specified and

ISO-11179 Subparts

Parts	Description
11179-1	**Part 1: Framework**, introduces and discusses fundamental ideas of data elements, value domains, data element concepts, conceptual domains, and classification schemes essential to the understanding of this set of standards and provides the context for associating the individual parts of ISO/IEC 11179.
11179-2	**Part 2: Classification**, provides a conceptual model for managing classification schemes. There are many structures used to organize classification schemes and there are many subject matter areas that classification schemes describe. So, this Part also provides a two-faceted classification for classification schemes themselves.
11179-3	**Part 3: Registry Metamodel and Basic Attributes**, specifies a conceptual model for a metadata registry. It is limited to a set of basic attributes for data elements, data element concepts, value domains, conceptual domains, classification schemes, and other related classes, called administered items. The basic attributes specified for data elements in ISO/IEC 11179-3:1994 are provided in this revision.
11179-4	**Part 4: Formulation of Data Definitions**, provides guidance on how to develop unambiguous data definitions. A number of specific rules and guidelines are presented in ISO/IEC 11179-4 that specify exactly how a data definition should be formed. A precise, well-formed definition is one of the most critical requirements for shared understanding of an administered item; well-formed definitions are imperative for the exchange of information. Only if every user has a common and exact understanding of the data item can it be exchanged trouble-free.
11179-5	**Part 5: Naming and Identification Principles**, provides guidance for the identification of administered items. Identification is a broad term for designating, or identifying, a particular data item. Identification can be accomplished in various ways, depending upon the use of the identifier. Identification includes the assignment of numerical identifiers that have no inherent meanings to humans; icons (graphic symbols to which meaning has been assigned); and names with embedded meaning, usually for human understanding, that are associated with the data item's definition and value domain.
11179-6	**Part 6: Registration**, provides instruction on how a registration applicant may register a data item with a central Registration Authority and the allocation of unique identifiers for each data item. Maintenance of administered items already registered is also specified in this document.

XML



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  </dnaChange>
- <!--  Defines the change to the amino acid sequence.
                    Types are: Frame Shift, Missense, Nonsense, Silent, Substitution, Deletion

                  REQUIRED sub-elements:
                    name

  -->
- <aminoAcidChange type="Frame Shift">
  <name />
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- <!--  Genomic location of variant
  -->
- <genomicLocation>
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  <chromosomeRegion>13q12</chromosomeRegion>
  <gene>GJB2</gene>
  <geneRegion>Exon 1</geneRegion>
  </genomicLocation>
- <!--  Class of this variant: Pathogenic, Presumed Pathogenic, Novel Presumed Pathogenic, Novel Unknown,
                              Novel Presumed Benign, Presumed Benign, Benign, Resistant, Responsive,
                              Polymorphism, Unclassified, Unknown
  -->
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- <!--  Allele state of the variant: Homozygous, Heterozygous, Hemizygous, Homoplasmic, Heteroplasmic
  -->
  <allelicStateCode code="Homozygous" />
- <!--  Clinical significance of the variant: Incidental, Non-incidental
```

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                        Polymorphism, Unclassified, Unknown
  -->
  <interpretationCode code="Pathogenic" />
- <!--  Allele state of the variant: Homozygous, Heterozygous, Hemizygous, Homoplasmic, Heteroplasmic
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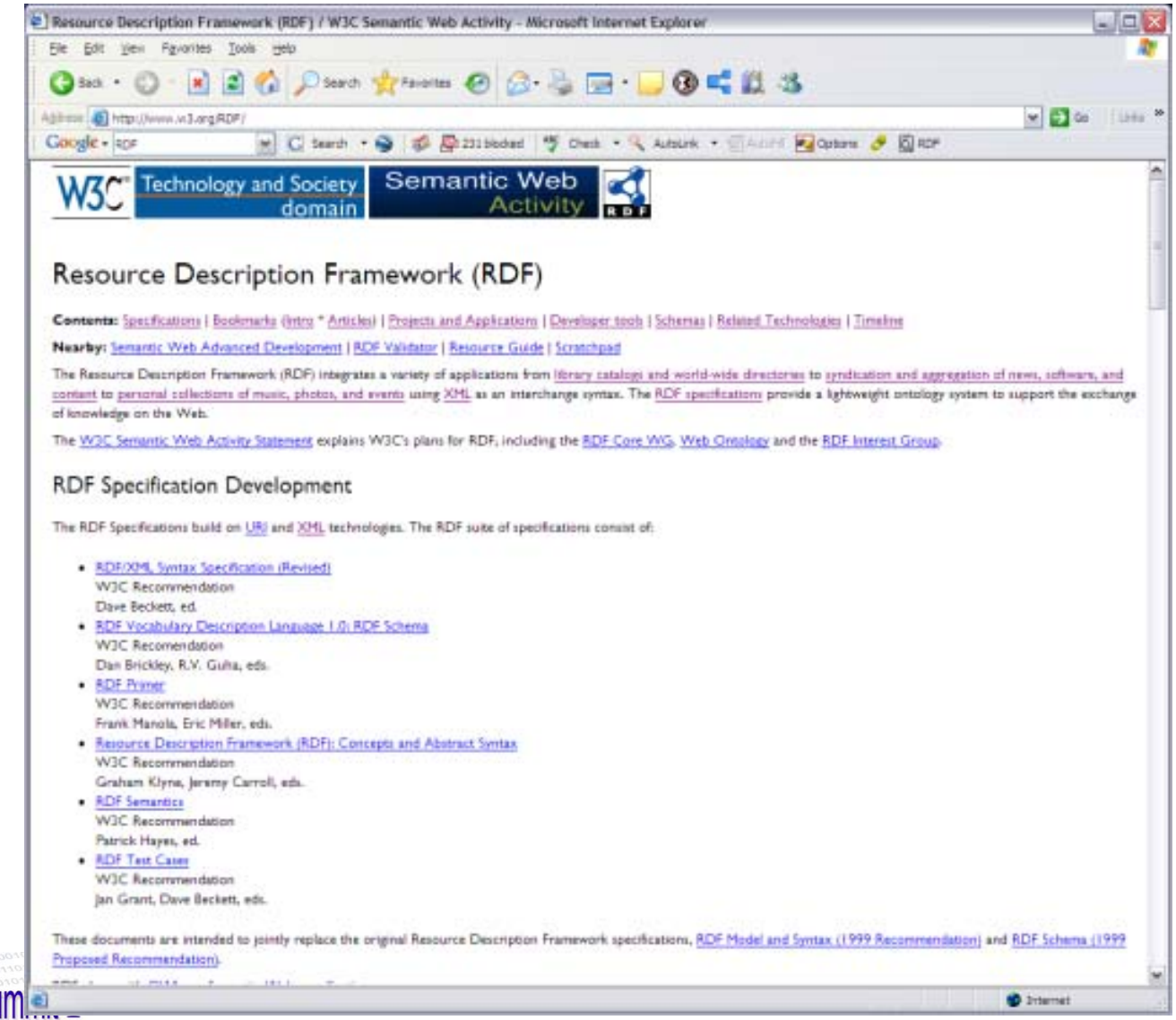
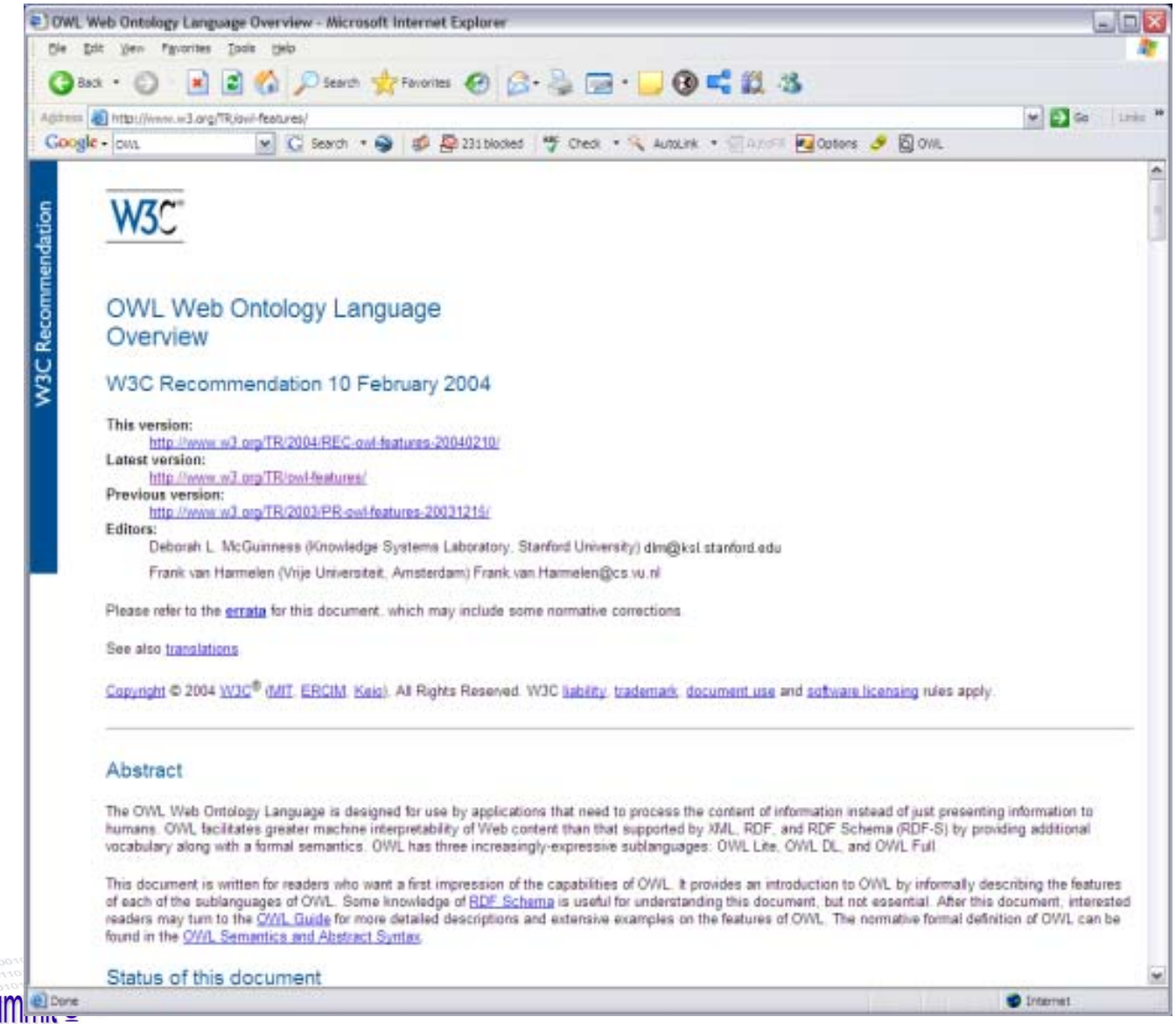
RDF


Resource Description Framework (RDF) / W3C Semantic Web Activity - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
http://www.w3.org/RDF/
Google RDF
Search 231 blocked Check AutoLink Options RDF
W3C Technology and Society domain Semantic Web Activity
Resource Description Framework (RDF)
Contents: Specifications | Bookmarks (Intro * Articles) | Projects and Applications | Developer tools | Schemas | Related Technologies | Timeline
Nearby: Semantic Web Advanced Development | RDF Validator | Resource Guide | Scratchpad
The Resource Description Framework (RDF) integrates a variety of applications from library catalogs and world-wide directories to syndication and aggregation of news, software, and content to personal collections of music, photos, and events using XML as an interchange syntax. The RDF specifications provide a lightweight ontology system to support the exchange of knowledge on the Web.
The W3C Semantic Web Activity Statement explains W3C's plans for RDF, including the RDF Core WG, Web Ontology and the RDF Interest Group.
RDF Specification Development
The RDF Specifications build on URI and XML technologies. The RDF suite of specifications consist of:
RDF/XML Syntax Specification (Revised)
W3C Recommendation
Dave Beckett, ed.
RDF Vocabulary Description Language 1.0: RDF Schema
W3C Recomendation
Dan Brickley, R.V. Guha, eds.
RDF Primer
W3C Recommendation
Frank Manola, Eric Miller, eds.
Resource Description Framework (RDF): Concepts and Abstract Syntax
W3C Recommendation
Graham Klyne, Jeremy Carroll, eds.
RDF Semantics
W3C Recommendation
Patrick Hayes, ed.
RDF Test Cases
W3C Recommendation
Jan Grant, Dave Beckett, eds.
These documents are intended to jointly replace the original Resource Description Framework specifications, RDF Model and Syntax (1999 Recommendation) and RDF Schema (1999 Proposed Recommendation).
Internet

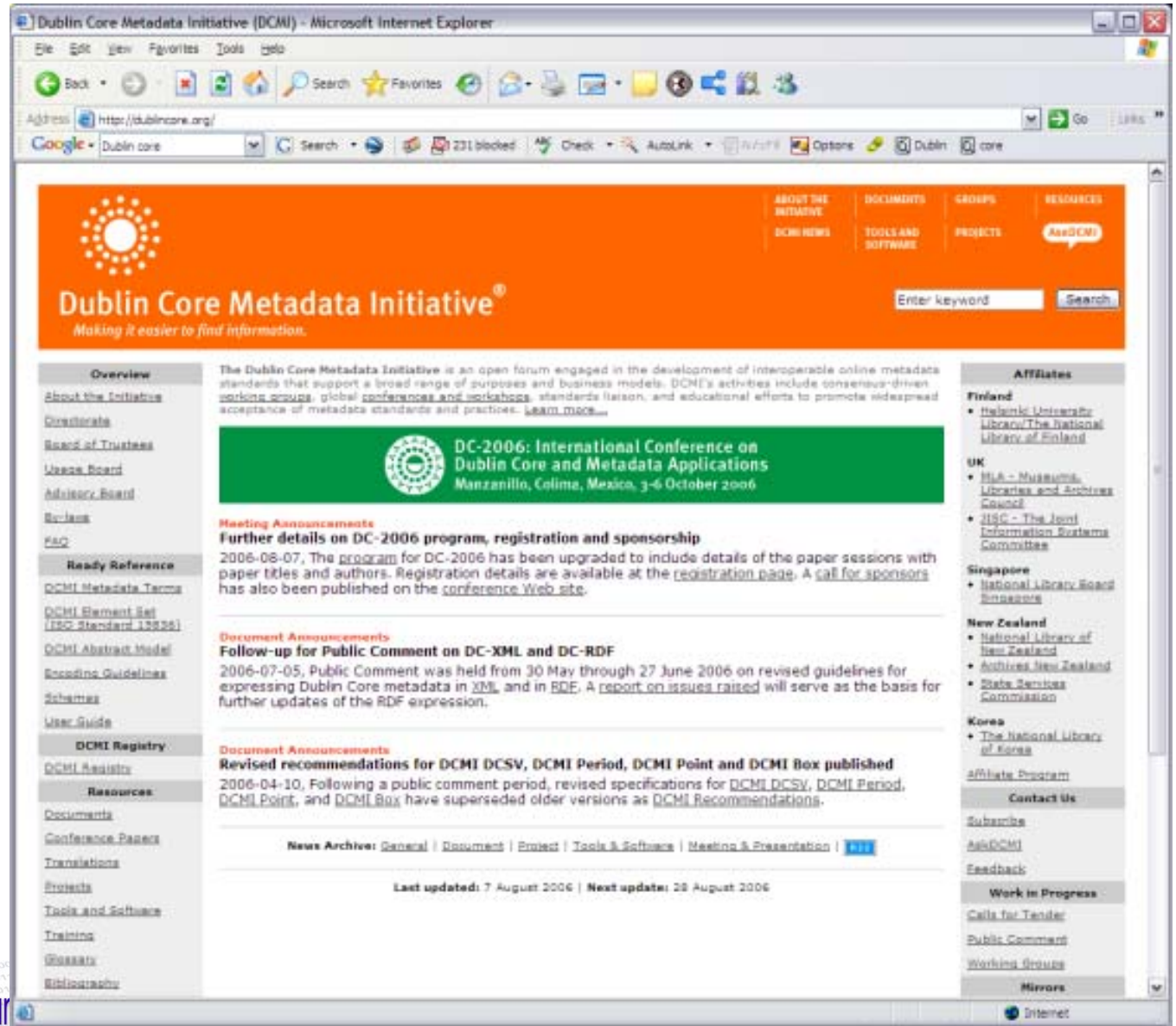
DAML


DAML.org - Microsoft Internet Explorer
The DARPA Agent Markup Language Homepage
The DARPA Agent Markup Language (DAML) Program officially began in August 2000. The goal of the DAML effort is to develop a language and tools to facilitate the concept of the Semantic Web. Michael Pagels is the DARPA Program Manager for DAML. The DAML program will end in early 2006.
Why Use DAML?
A set of Roadmaps have been tailored for different user communities to help them access and use the contents of this site more efficiently. The Roadmaps should be particularly useful for new visitors to the DAML web site.
Site Links
About DAML
New User Roadmap
daml-help mailing list
Announcements
HotDAML Newsletters
DAML in the News
Upcoming Events
Downloads
DAML Briefings
DAML Publications
Related Links
Site Map
Search the Site
Past DAML Meetings
DAML Researchers
DAML Language (DAML+OIL)
DAML Services (DAML-S)
DAML Query (DQL)
DAML Rules
DAML Time Ontology
DAML Ontology Library
Recent Announcements
2006-01-13: Michael Pagels has been named to succeed Bob Popp as DAML Program Manager.
2005-11-07: W3C has announced the creation of the Rule Interchange Format (RIF) Working Group.
2005-09-09: The Semantic Web Services Framework has been acknowledged as a Member Submission by W3C.
2005-05-27: Bob Popp has been named to succeed Mark Greaves as DAML Program Manager.
2005-04-19: Briefings presented at the Semantic Web Applications for National Security (SWANS) conference are now available.
2005-04-11: SWRL FOL has been acknowledged as a Member Submission by W3C.
all announcements

OWL



Dublin Core



Putting it all together:

- Federation enables:
  - Consolidation of optimal use of standards for pre-coordinated message exchange.
  - Reduced domain-expertise at the central IT level
  - Simplified application support → less hours spent every year on interface support
  - Elimination of the need for any customization whatsoever at the receiver site, made possible by ISO-11179, XML and RDF
  - Supports Best-of-Breed deployment
  - Approaching the vision of plug and play interoperability in both intramural and extramural settings *(a first step towards working RHIOs)*

An Example Standard that Embraces Federation

- Laboratory Digital Imaging Project (www.ldip.org)
  - A message Exchange Specification, based on XML and RDF (W3C compliant architecture).
  - True zero-knowledge functionality.
  - Use of ISO-11179.
  - Participation from major stakeholders in industry, academia and community practice.
  - Based upon XML and RDF Open source tool sets
  - Designed to be upwards compatible with DICOM