

The Value of a Federated Architecture in Pathology

Part 1: Test Order Entry - *Balis*

Part 2: Test Result Reporting - *Routbort*

Part 3: Introduction of *LITS-Interop 2009* – *Balis and Routbort*

The Value of a Federated Architecture in Pathology: *Test Order Entry*

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Federation: An Overview

- What Federation is and is not
- A brief discussion of Sustainability; Why Federation is needed
- Comparison of current interface deployment strategies vs. those which are possible by use of newer information model approaches
- Examination of the role (if any) of Lean/Six Sigma approaches in the rational deployment of LIS/HIS interfaces and data dissemination.
- Test order entry as an exemplar of effective data model of Federation in Pathology

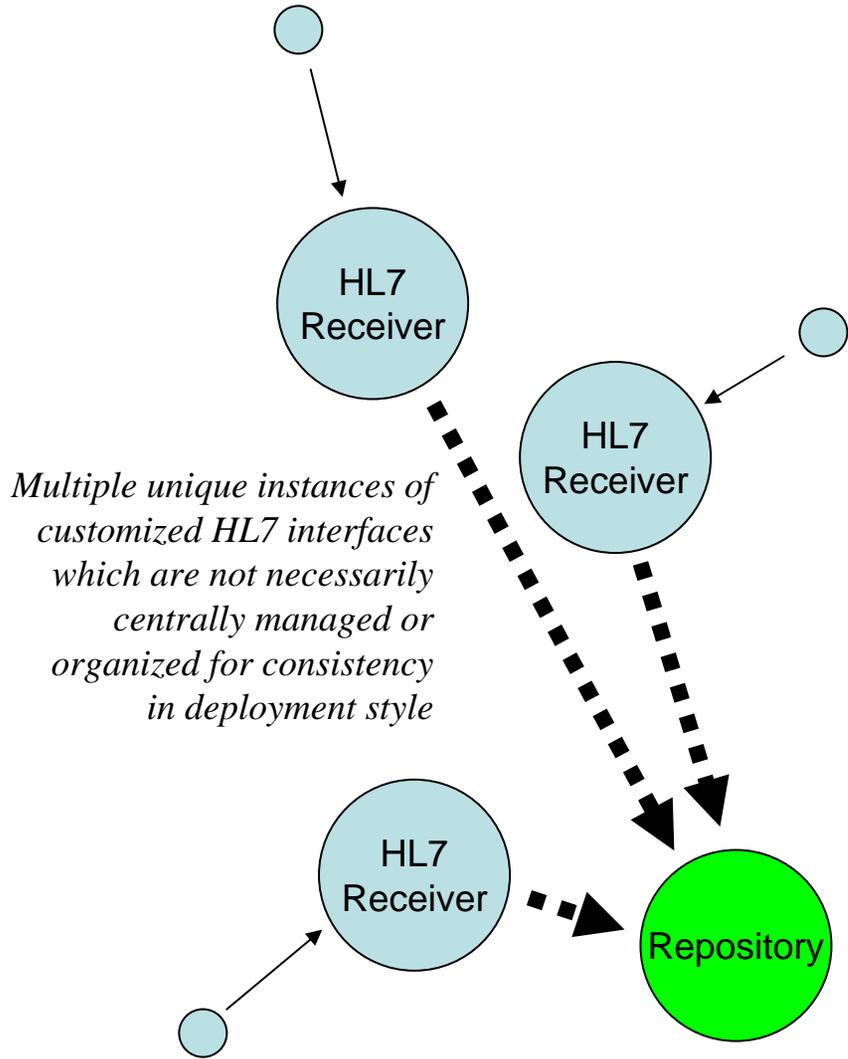


Federation

- Not...
 - Merely an aggregation of disparate repositories
- Is...
 - An opportunity to organize data in a relational manner across an organization, thus realizing the goal of a normalized data model
 - Single Source of Truth: any single referential data element exists one and exactly one place in the overall enterprise
 - An opportunity to organize not only atomic data but also, rules and namespaces.

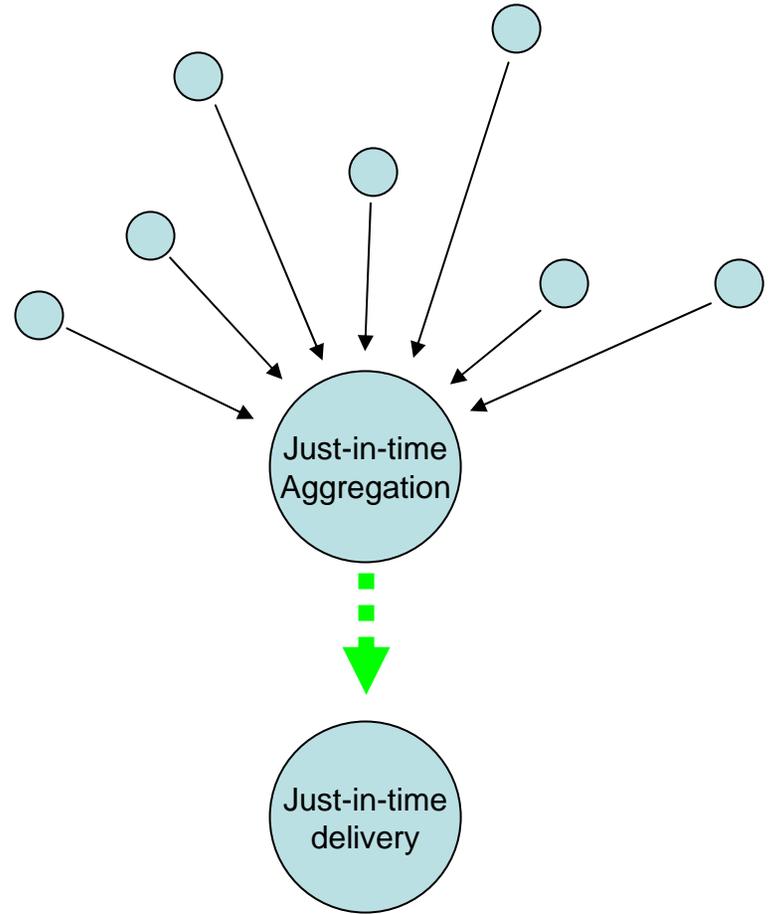
Why is federation needed?

- A matter of sustainability
 - With a small plurality of information sources, support for individual interfaces is possible
 - With increasing complexity, support requirements experience geometric increase in complexity
 - Interfaces for 2 sites? 20 sites?



Multiple unique instances of customized HL7 interfaces which are not necessarily centrally managed or organized for consistency in deployment style

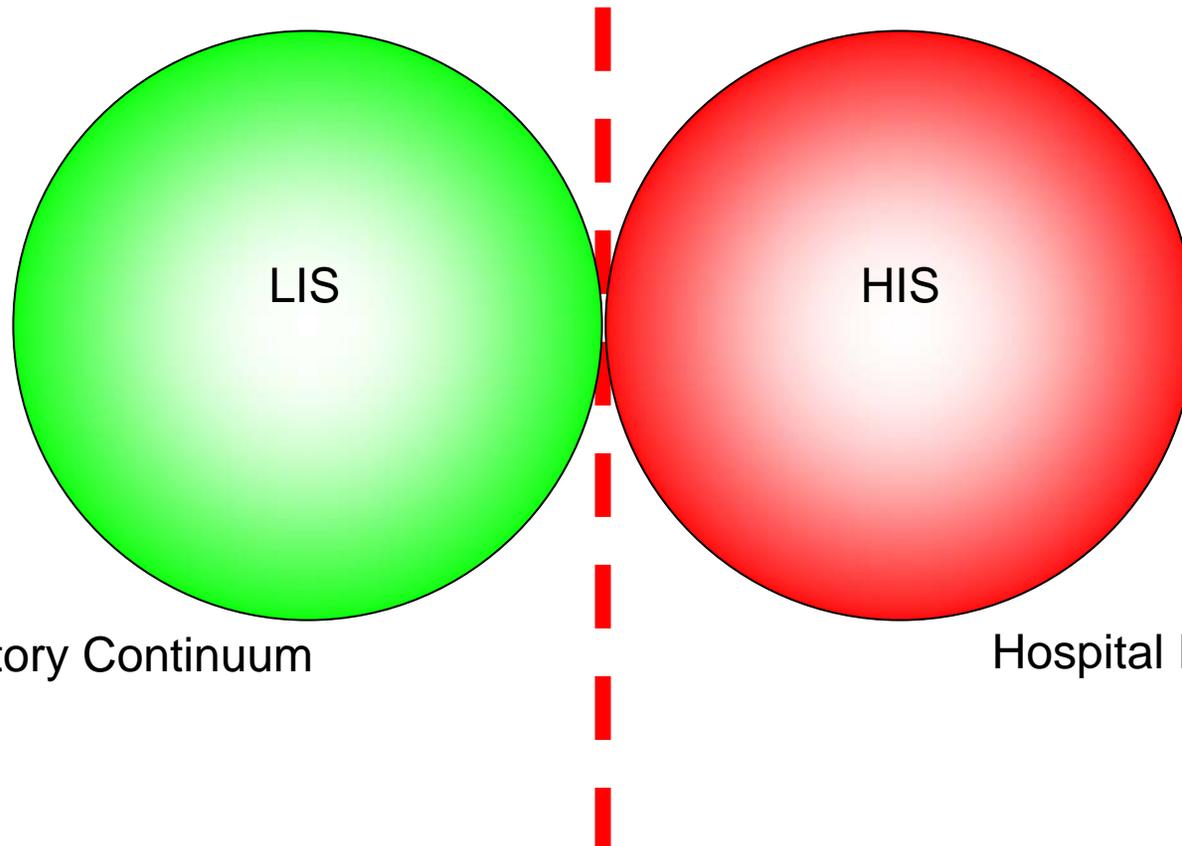
Present State



Future State

The Imbalance of Infrastructure to Required Support

Ideal Oversight Model



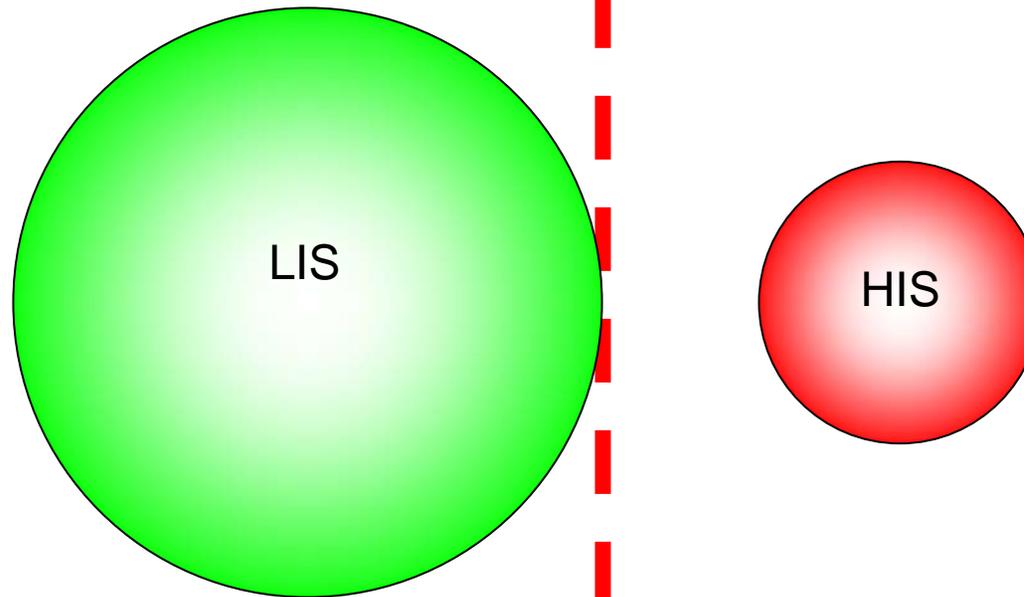
Clinical Laboratory Continuum

Hospital I.T. Continuum

Demarcation of Intended Scope of Influence/oversight

The Imbalance of Infrastructure to Required Support

Diminishing Central IT Expertise

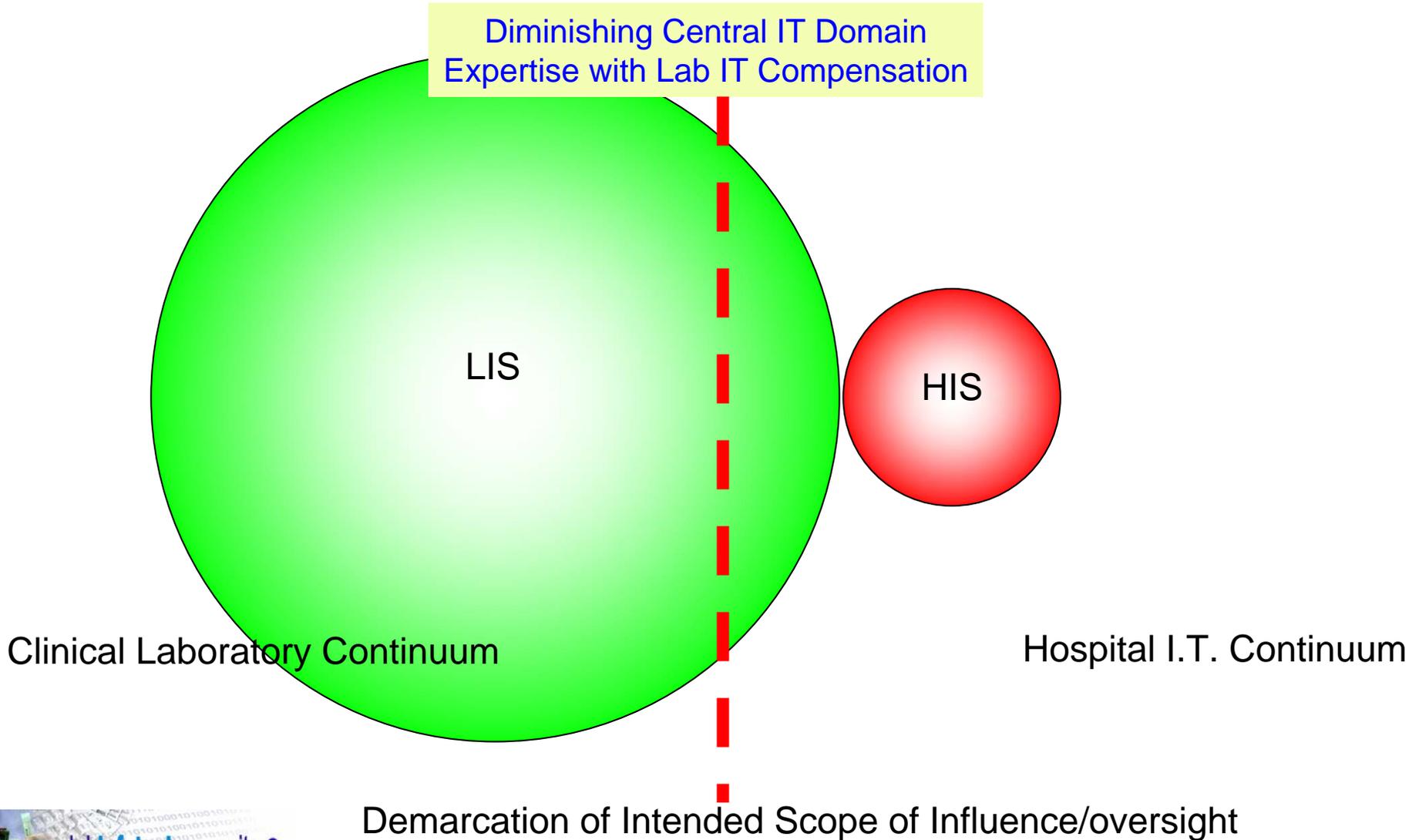


Clinical Laboratory Continuum

Hospital I.T. Continuum

Demarcation of Intended Scope of Influence/oversight

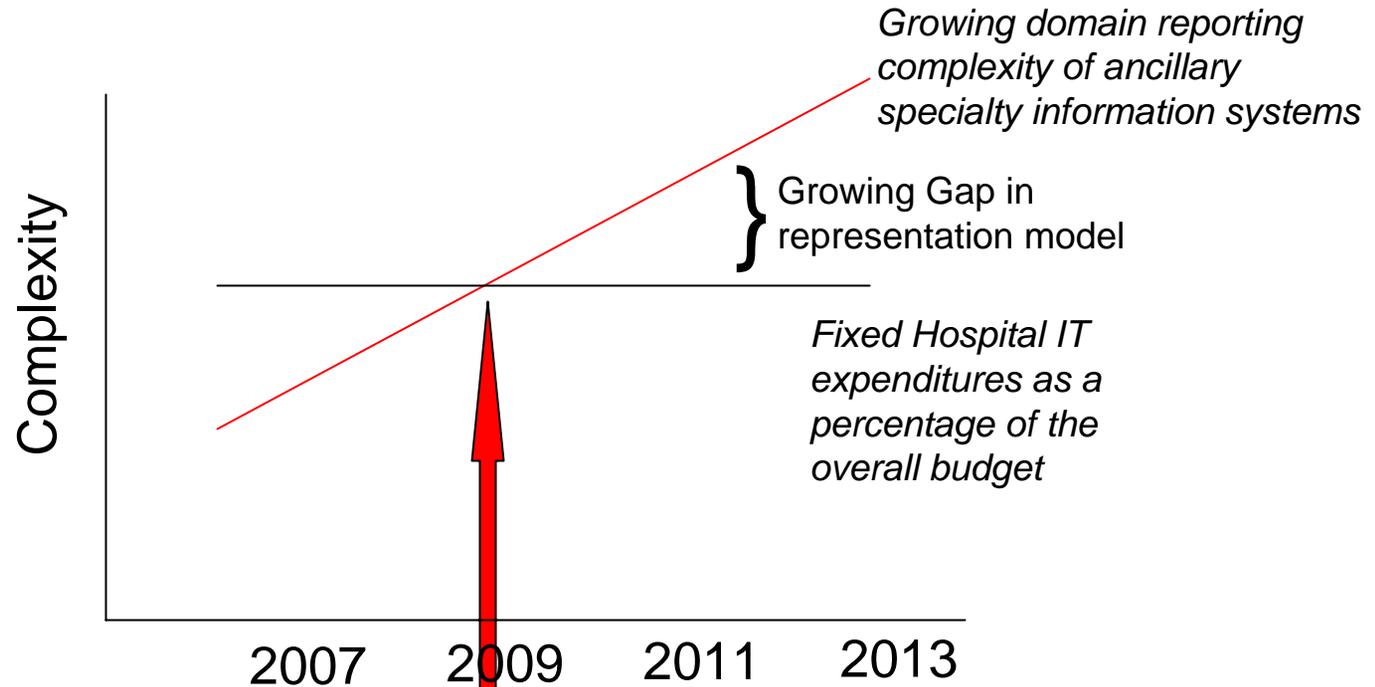
The Imbalance of Infrastructure to Required Support



Some Estimates of Effort

- Typical LIS implementation
 - 10+ instrument interfaces
 - 2 HIS interfaces
 - An average of 2 external HL7 interfaces
- 40 programmer hours/interface/year as a conservative support metric
- 800+ hours effort/site-year
- 54 Million programmer hours of interface maintenance and customization effort annually.

The Pending Imbalance...



LIS Data Model complexity exceeds HIS receiver capabilities

Federation and the Value Stream

- Observation: Our current operational partitions end at departmental limits
- Reality: actual workflow, and demarcation of oversight, spans both departments and institutions
- Lean approaches are instrumental in highlighting that our current model of information interchange is critically flawed.
- Goal: Incorporate all aspects of order entry into a unified information exchange model
 - Realize that any system is only as robust as its weakest link

Emergence of Lean and Six-Sigma Approaches in LIS Deployment: how does it apply to Federation?

- 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



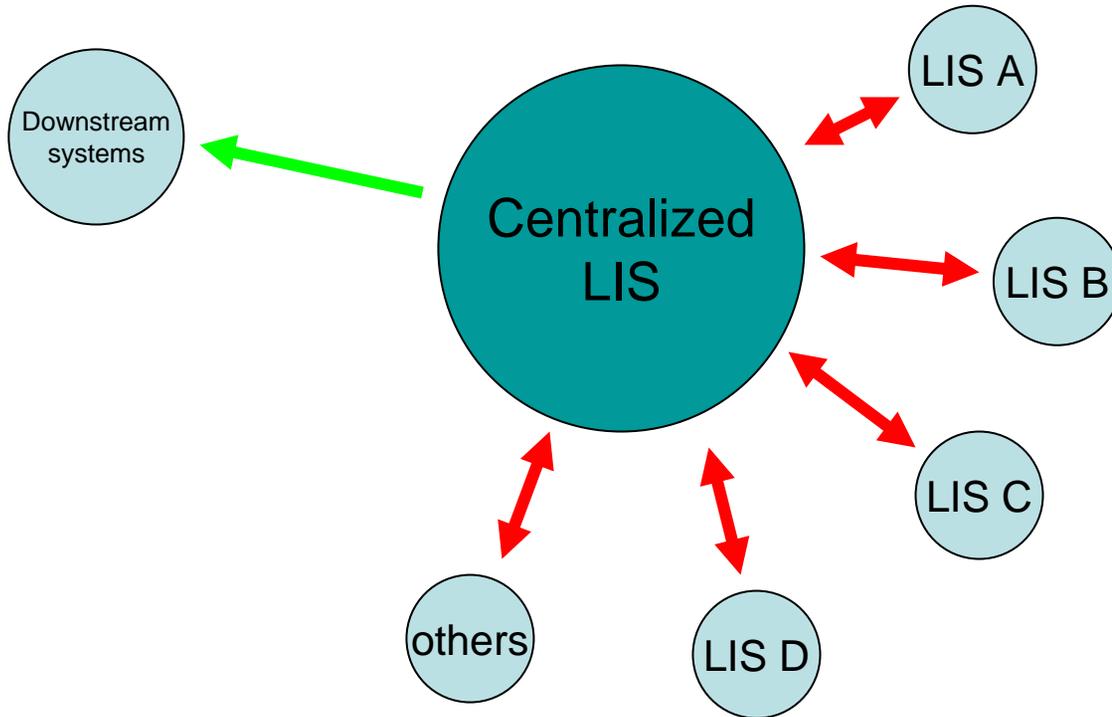
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The Promise of Federation

- 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?

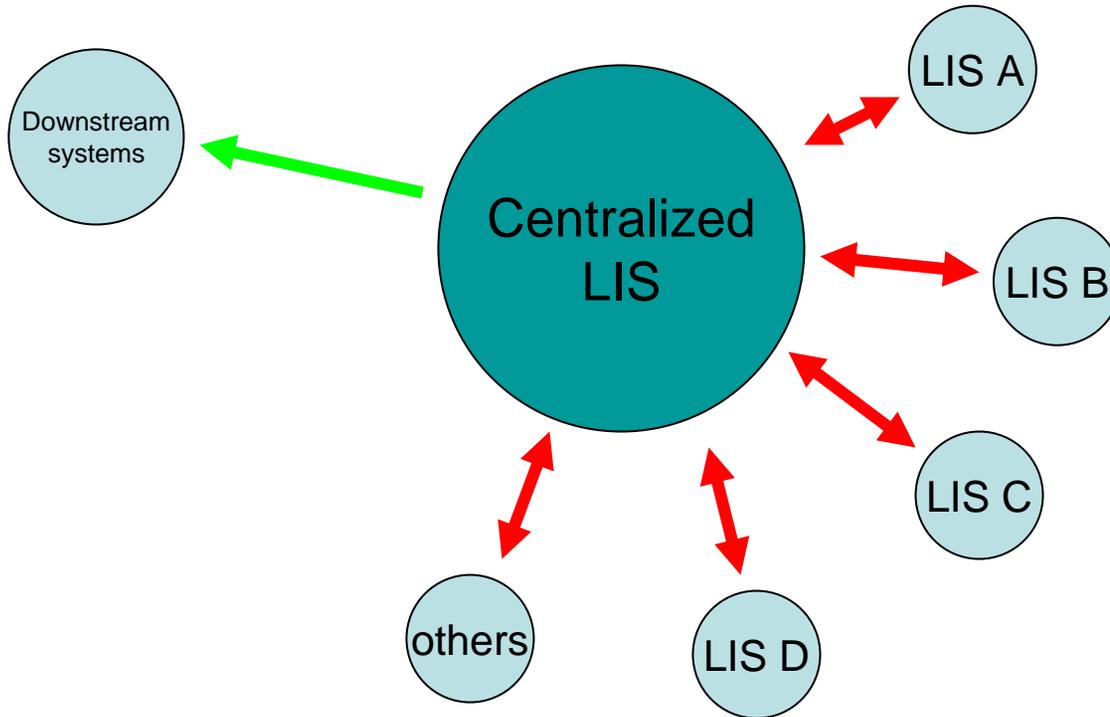
Conventional Data Model



■ Conventional HL7 interfaces (all different)

What is Federation?

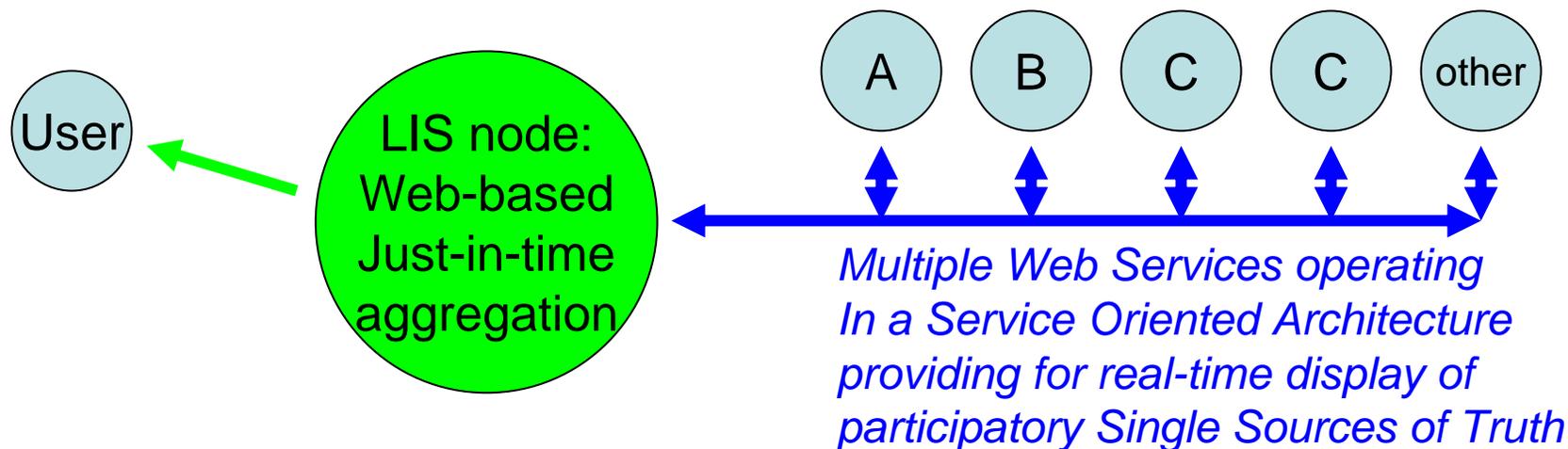
Slightly Revised Data Model



■ Conventional HL7 interfaces (all **SAME**)

What is Federation?

Potential Revised Data Model



- Consequences of shifting to a Web-based SSOT model:
- Simplified transfer and display of complex order data types
 - Simplified exchange of information via Web-based standards, supporting **intra-** and **inter-** institutional needs

■ Participatory SOA-Web servers

Web Portal Case Study

- Setting:
 - “Next generation” Lab Information System is three years away
 - In this interval, client and market pressures mandate that additional service models and IT capabilities be added
 - Web Based CPOE-Light
 - Web-Based Client support
 - Lab to lab
 - Lab to physician office
 - Lab to patient
 - Sophisticated standing orders and future orders scheduling capability
 - Real-time order to result reconciliation reporting for:
 - Lab client views
 - Physician office views
 - Single patient views
 - Need for flexible compartmentalization of patient data to prevent HIPAA non-compliance
- The reality: it is both impractical and prohibitively expensive to carry out deployment of such functionality as enhancements or customizations to legacy architectures; The solution is to federate existing “big iron” to more nimble modular building blocks (portal solutions, hubs etc)

Atlas Medical LabWorks® as a Possible Modular Solution

- Fully Web-based
- Agnostic to legacy architecture
- Designed for Lab to lab and lab to physician office support in a multi-client model
- Sophisticated order scheduling capabilities
- Flexible interface model
- Allows the lab presence to remain constant while the back-end infrastructure evolves, thus providing stability in workflow for the client
- Highly cost effective as compared to modifying a legacy LIS
- *SOA-enabled*



Patient Search

Patient TEST,AUGSEVEN DOB-Age 07/12/1981 - 26 Y ID 985247931
 Prim. Phys REEVES,PAMELA SSN Gender Female

Lookup By

Patient Recently Selected Patients

Name	ID	SSN	DOB	Gender	City
TEST,AMIC1	991558888		05/25/1977	Female	WYANDOTTE
TEST,ASEND1	998877011		09/21/1968	Female	TECUMSEH
TEST,AUGSEVEN	985247931		07/12/1981	Female	ALBANY
TEST,AUGTEN	998877006		05/14/1948	Male	ALBANY
TEST,AUGTWONINE	998877029		07/28/1957	Female	ROESSLEVILLE
TEST,CHEM1	951357951		07/21/1982	Female	ALBANY
TEST,JOE	569874	957-45-4444	12/14/1989	Male	PLANO
TEST,JOHN Q	996663214	666-65-5522	10/04/1978	Male	SOUTHGATE
TEST,JULYTHIRTYONE	963851473		07/31/1980	Male	ALBANY
TEST,LITTLEROD	998877041	999-99-9922	01/25/1949	Male	LEXINGTON
TEST,OCTOBERTHREE	998877332		07/24/1982	Female	ALBANY
TEST,OCTOBERTWO	998877301		10/15/1997	Male	ALBANY
TEST,PATIENT01			02/02/2005	Male	DALLAS
TEST,SUSAN	1212555		12/30/1954	Female	ANN ARBOR
TESTCPI,ATLUCY	4241944		04/24/1944	Female	ANN ARBOR
TESTCPI,AUGFOURTEEN	3081407		08/14/1967	Male	ANN ARBOR

New Patient Demographics Insurance Delete Patient Show Deleted Patients

Search In LES Refresh Grid

New Lab Order

Patient TEST,AUGSEVEN DOB-Age 07/12/1981 - 26 Y ID 985247931
 Prim. Phys REEVES,PAMELA SSN Gender Female
 Ord. Phys REEVES,PAMELA Order # A002498

Order Info Tests ICD-9s Questions

Apply ICD-9s to Selected Tests

Ordered Test	ICD-9s
Renal Panel (MLabs/Clinical Laboratories)	V50.3
Salicylate Level (MLabs/Clinical Laboratories)	V50.3

Delete ICD-9s

ICD-9 filter by: Code Name Mnemonic

- Short List** Site Physician Specialty
- 742.53 Hydromyelia 354.0 Carpal tunnel syndr 124 Trichinosis 005.89 Other bacterial fo
 - 417.1 Aneurysm of pulmo... V50.3 Ear piercing 531.01 Acute gastric ulce 341.1 Schilder's disease
 - 520.1 Supernumerary teeth 250.33 Type I diabetes me 472.2 Chronic nasopharyng 120.3 Cutaneous schistoso
 - 391.0 Acute rheumatic per





MLabs/Clinical Laboratories
 1500 E. Medical Center Dr. SPC 5054
 Ann Arbor, MI 48109-5054
 734-936-2598 (Local)
 800-862-7284 (Toll Free)

Client		Patient					
Client/Loc Code: 9200ATLP Site Name: Atlas Patient Bill - TEST Location: UMHS - Medical Science 1 Address: 1301 Catherine Ann Arbor, MI 48109 Phone: (734)763-2333		Sex/DOB/Age: Female 07/12/1981 26 Years Name: TEST,AUGSEVEN UM CPI: 033835577  SS#: _____ Client MRN: 985247931 Address: 654 WEST ALBANY, NY 12207 Phone: (142)987-3574					
Send Additional Copy To:		Primary Insurance		Order			
Physician: Contact Info:		Insurance Name: Aetna HMO Policy/Contract #: R976356 Group #: A78743 Policy Holder's Name: TEST,AUGSEVEN - Self Policy Holder's DOB: 07/12/1981		Billing Type: Insurance Collected: 10/09/2007 11:28 Atlas Order #: A002498 			
Phlebotomist/Collection		Secondary Insurance		Ordering Physician: REEVES,PAMELA Ordering Physician #: 4684 Attending Physician: REEVES,PAMELA Attending Physician #: 4684 Order Entered By: alanjohn			
Date of Collection: 10/09/2007 Time of Collection: 11:28 Phlebotomist signature / Code: ajm		Insurance Name: Policy/Contract #: Group #: Policy Holder's Name: Policy Holder's DOB:					
Clinical Info							
Information typed in here appears on the requisition and the report.							
Notes							
Notes typed in here display on the requisition only.				URINE VOL 24HR	FASTING	RANDOM	HMS PP
Code	Test Name	Temperature	ICD-9 Codes				
2 ml Serum SST/Gold (Corvac)		Refrigerated					
RENAL	Renal Panel		V50.3				
SAL	Salicylate Level		V50.3				



Order Search

Patient TEST,AUGSEVEN DOB-Age 07/12/1981 - 26 Y ID 985247931
 Pri.m. Phys REEVES,PAMELA SSN Gender Female

[Orders](#)

ABN Printed/Signed [P/S](#)

Collected	Order	Status	Name	ID	Acct	Phys	Type
10/09/07 11:28	A002498	Received By Lab	TEST,AUGSEVEN	985247931	9200	REEVES,PAMELA	Insurance
10/04/07 15:29	A002460	Received By Lab	TEST,OCTOBERTHREE	998877332	9200	REEVES,PAMELA	Insurance
10/03/07 15:00	A002459	Received By Lab	TEST,OCTOBERTHREE	998877332	9200	Aagesen,Matthew	Insurance
10/03/07 13:50	A002456	Not Sent To Lab	JOHNSON,ANNIE	998877044	9200	Akin,Cem	Insurance
09/20/07 11:16	A002447	Not Sent To Lab	JOHNSON,ANNIE	998877044	9200	Akin,Cem	Insurance
09/20/07 09:06	A002446	Not Sent To Lab	JOHNSON,ANNIE	998877044	9200	Akin,Cem	Insurance
09/20/07 08:52	A002445	Not Sent To Lab	JOHNSON,ANNIE	998877044	9200	Akin,Cem	Insurance
09/20/07 08:26	A002444	Not Sent To Lab	JOHNSON,ANNIE	998877044	9200	Akin,Cem	Insurance
09/20/07 08:23	A002443	Not Sent To Lab	JOHNSON,ANNIE	998877044	9200	Akin,Cem	Insurance
09/18/07 15:17	A002438	Not Sent To Lab	JOHNSON,ANNIE	998877044	9200	GRADWOHL,STEVE	Insurance
09/17/07 17:20	A002436	Received By Lab	CAT,FLAT	998877032	9200	GRADWOHL,STEVE	Insurance
09/14/07 15:25	A002432	Not Sent To Lab	JOHNSON,ANNIE	998877044	9200	CABANA,MICHAEL	Insurance
09/14/07 15:15	A002431	Not Sent To Lab	JOHNSON,ANNIE	998877044	9200	MANDELL,STEVEN	Insurance
09/14/07 15:03	A002430	Not Sent To Lab	JOHNSON,ANNIE	998877044	9200	CABANA,MICHAEL	Insurance
09/14/07 15:02	A002429	Not Sent To Lab	JOHNSON,ANNIE	998877044	9200	CAMPBELL,DARRE	Insurance
09/14/07 15:01	A002423	Sent To Lab	JOHNSON,ANNIE	998877044	9200	HERTZ,ROGER	Insurance
09/14/07 11:01	A002422	Received By Lab	TEST,LITTLEROD	998877041	9200	CAMPBELL,DARRE	Insurance

Requisition
 Order
 Edit Order
 Delete Order
 Missing Information
 Send Order
 Add-On Test
 Cancel Tests
 Update Demographics
 Re-Order Tests

Search Results
 Pending Tests

[Tests](#) [Issues](#)

Tests for Selected Order #A002498

Test Code	Test Name	Status	ICD-9 Codes	Passed LCD/NCD	Lab
RENAL	Renal Panel	Received By Lab	V50.3	Passed	MLabs/Clinical Laborat
SAL	Salicylate Level	Received By Lab	V50.3	Passed	MLabs/Clinical Laborat

Open Test Catalog
 View Test Details

Lab Reports

Patient TEST,AUGSEVEN DOB-Age 07/12/1981 - 26 Y ID 985247931
 Prim. Phys REEVES,PAMELA SSN Gender Female

Lab Reports

UT Unsolicited Tests

Patient	ID	Order #	Collected	Reported	New	Lab	Status
TEST,AUGSEVEN	985247931	A002498	10/09/07 11:28	10/09/07 11:55	X	1	A Final

[Report](#) [Historical](#) [Mark Report As Read](#) [Order](#)

[Print All Reports](#)

[Result List >>](#)

Tests Issues

Tests for Selected Order #A002498

Test Code	Test Name	Status	ICD-9 Codes	Passed LCD/MCD	Lab
RENAL	Renal Panel	Final	V50.3	Passed	MLabs/Clinical Laborat
SAL	Salicylate Level	Final	V50.3	Passed	MLabs/Clinical Laborat

[Open Test Catalog](#) [View Test Details](#)



MLabs/Clinical Laboratories
 1500 E. Medical Center Dr. SPC 5054
 Ann Arbor, MI 48109-5054
 734-936-2598 (Local)
 800-862-7284 (Toll Free)

LABORATORY REPORT

PATIENT NAME TEST,AUGSEVEN 654 WEST			UM CPI 033835577
ALBANY, NY 12207			CLIENT MRN 985247931
SEX Female	DOB 07/12/1981	AGE 26 Years	PHONE (142)987-3574

REPORT STATUS FINAL		PAGE 1 OF 1		ORDERING PHYSICIAN: REEVES,PAMELA	
UM ACCESSION # 07-282-00017	ORDER # A002498	REPORTED 10/09/2007 11:55		ORDERING LOCATION: UMHS - Medical Science 1 1301 Catherine Ann Arbor, MI 48109	
COLLECTED 10/09/2007 11:28	IN LAB 10/09/2007 11:46	RESULTED 10/09/2007 11:54		CLIENT ID: 9200ATLP	

CLINICAL INFORMATION

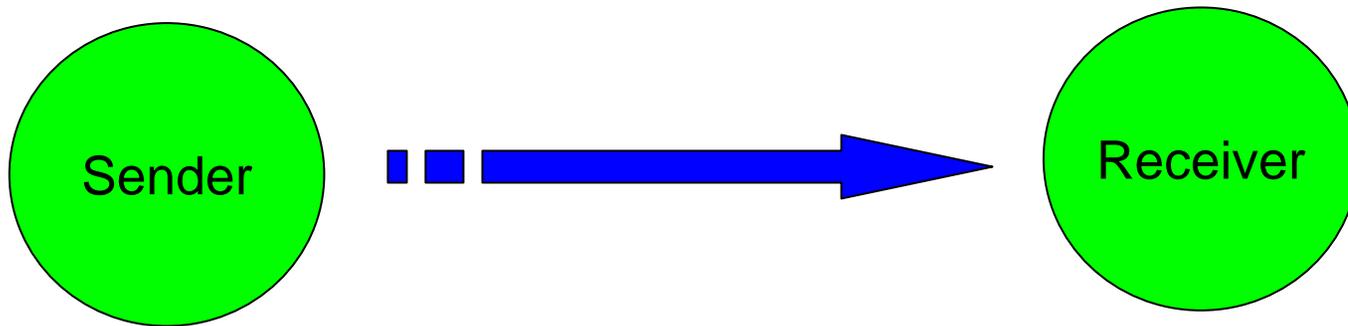
Information typed in here appears on the requisition and the report.

TEST	RESULT	ABNORMAL	REFERENCE RANGE
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Renal Panel

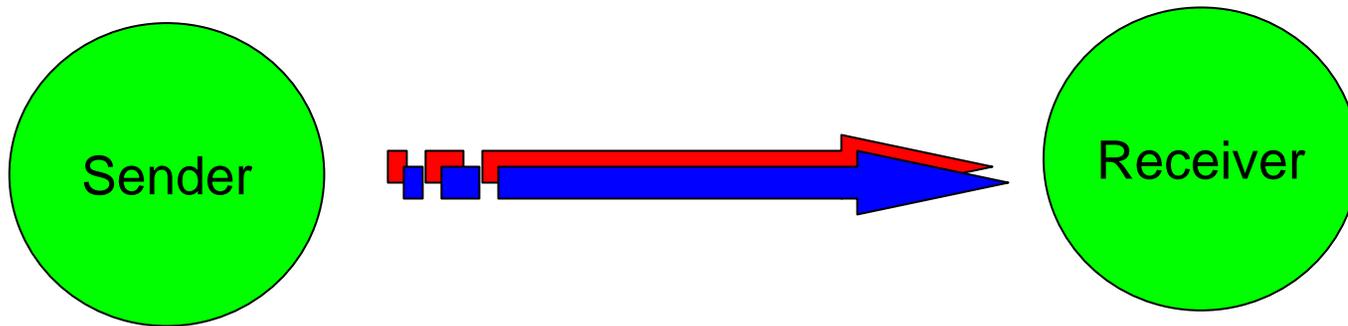
TEST	RESULT	ABNORMAL	REFERENCE RANGE
Comment		See Below	H
Test specific comment displays with that result on the report.			
SODIUM LEVEL	145		136-146 MEQ/L
POTASSIUM LEVEL	3.5		3.5-5.0 MEQ/L
CHLORIDE	105		99-111 MEQ/L
CO2	30		24-34 MEQ/L
UREA NITROGEN	15		8-20 MG/DL
CREATININE		1.2	H 0.6-1.0 MG/DL
GLUCOSE LEVEL		205	H 73-110 MG/DL
CALCIUM LEVEL	8.9		8.6-10.2 MG/DL
PHOSPHORUS LEVEL		5.2	H 2.5-4.9 MG/DL
ALBUMIN LEVEL	4.2		3.5-4.9 G/DL
EST GLOMERULAR FILTRATION RATE			
AFRICAN AMERICAN EGFR	70		> 59 ML/MIN
NON-AFRICAN AMERICAN EGFR		58	L > 59 ML/MIN

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

Near - 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

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
 - Supports **Best-of-Breed** deployment
 - Approaching the vision of plug and play interoperability in both intramural and extramural settings for electronic orders (*a first step towards working RHIOs*)

Part 2...

lits-INTEROP

- An opportunity for *lab infotech summit* to serve as the host and convener of a project to
 - Demonstrate true, standards-based interoperability for selected exemplars in both anatomic and clinical pathology
 - Based on the very successful model used by Radiology to demonstrate the utility of PACS interoperability, nearly twenty years ago

Clinical Pathology Exemplar

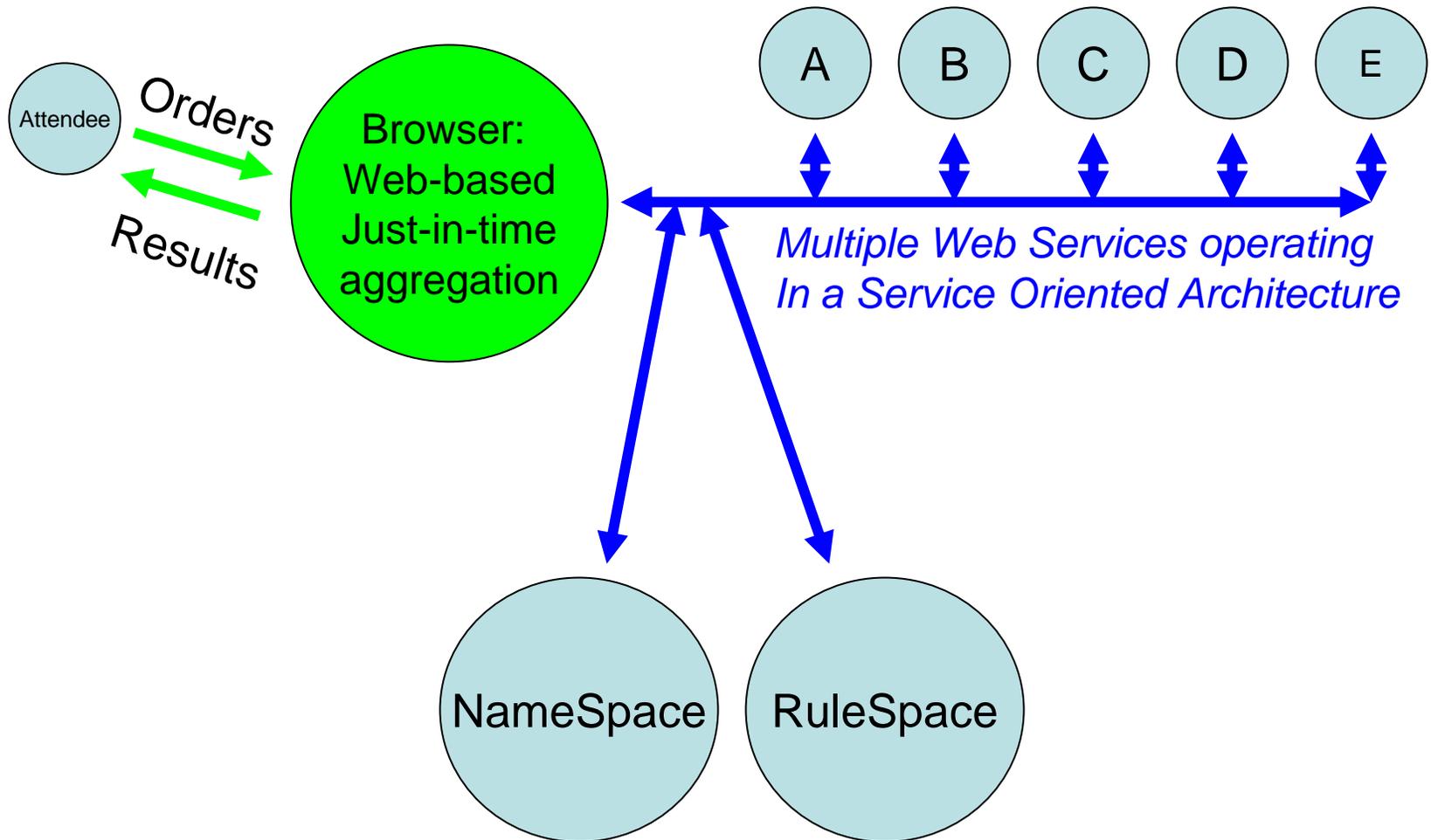
- Attendees, when registered, become “bar-coded specimens”
- They may order “tests” by presenting their badge to any participating vendor
- The tests, when complete will be available via a standard web-based SOA for on-demand dissemination
- Attendees may present their ID to other participants, who will then retrieve the results, via the SOA protocol.
- The exercise will demonstrate the utility of a number of essential service layers
 - Order entry SOA
 - Results SOA
 - Central NameSpace SOA
 - Central RuleSpace SOA
 - Possibly others
- Deliverables include:
 - Development of an XML Schema to encapsulate both materials and diagnostic data
 - White paper describing use and best practices
 - XSLT template to provide human readable format
 - Examples of different transfer strategies
 - CD-ROM
 - Electronic-to-paper-to-electronic (reconstitution strategy)
 - Federation
- Demos including
 - Outgoing materials
 - Automatic ordering and annotation on incoming cases

Anatomic Pathology Exemplar

- Exchange of pathology materials (slides, blocks) and reports between facilities for case review/second opinions
- Deliverables include:
 - Development of an XML Schema to encapsulate both materials and diagnostic data
 - White paper describing use and best practices
 - XSLT template to provide human readable format
 - Examples of different transfer strategies
 - CD-ROM
 - Electronic-to-paper-to-electronic (reconstitution strategy)
 - Federation
- Demos including
 - Outgoing materials
 - Automatic ordering and annotation on incoming cases

lits-INTEROP

CP Exemplar



Confirmed Participants:

- McKesson
- Apollo
- Impac
- PKS
- Others