

HEALTH IT
STANDARDS TESTING INFRASTRUCTURE

A Framework for Testing Distributed Healthcare Applications

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NIST

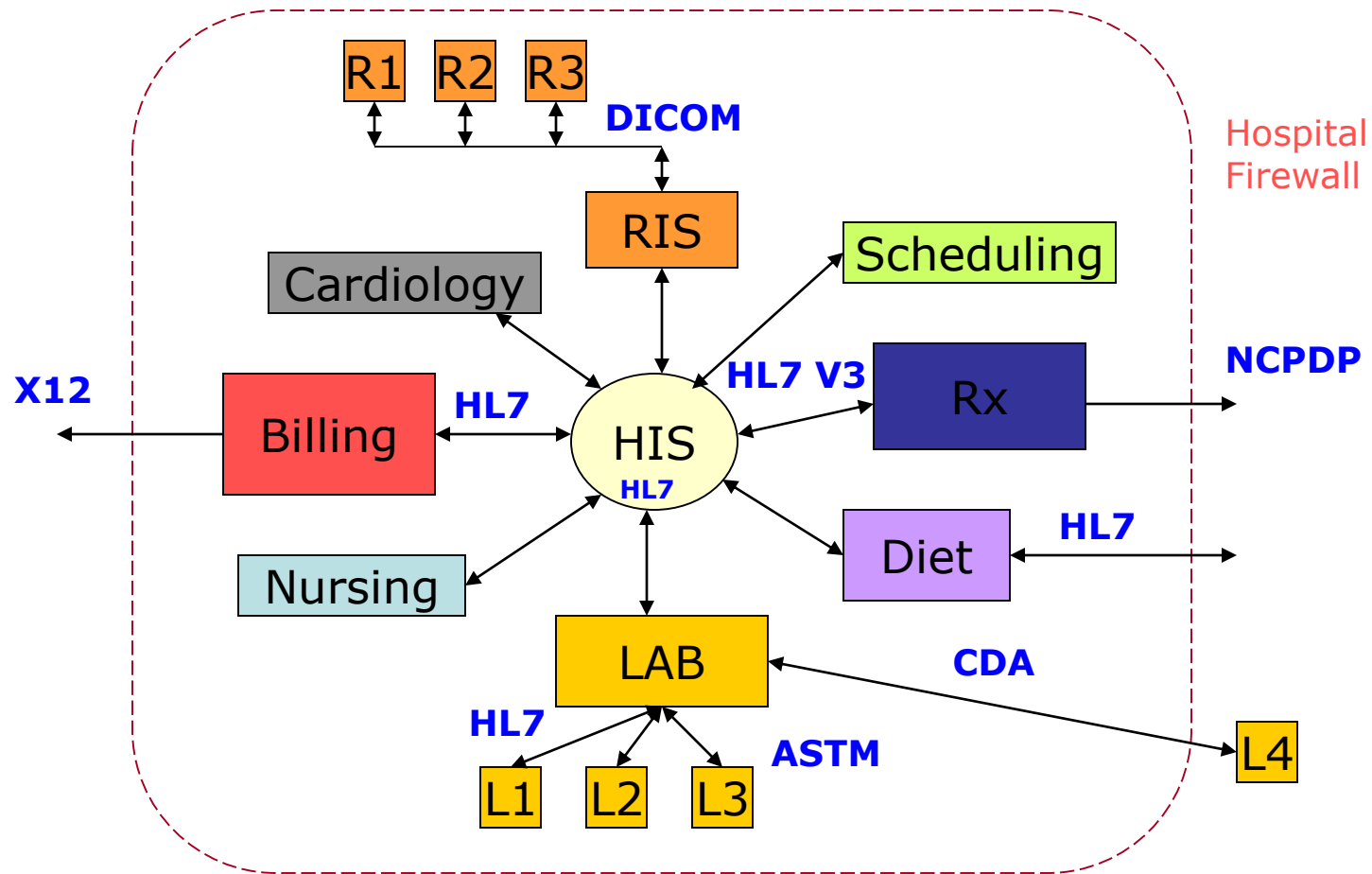
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Outline

- Overview
 - American Recovery and Reinvestment Act (ARRA)
- Healthcare System Landscape
- Healthcare Data Exchange Standards
- Testing Environments Taxonomy
 - Aspects of Conformance and Interoperability Testing
- Testing Framework Conceptual View
 - An SOA Approach
- Patient Management and Document Retrieval Use Case
- Testing Example Walk-through
- Summary

Healthcare Integration

Problem: Exchanging Data Reliably

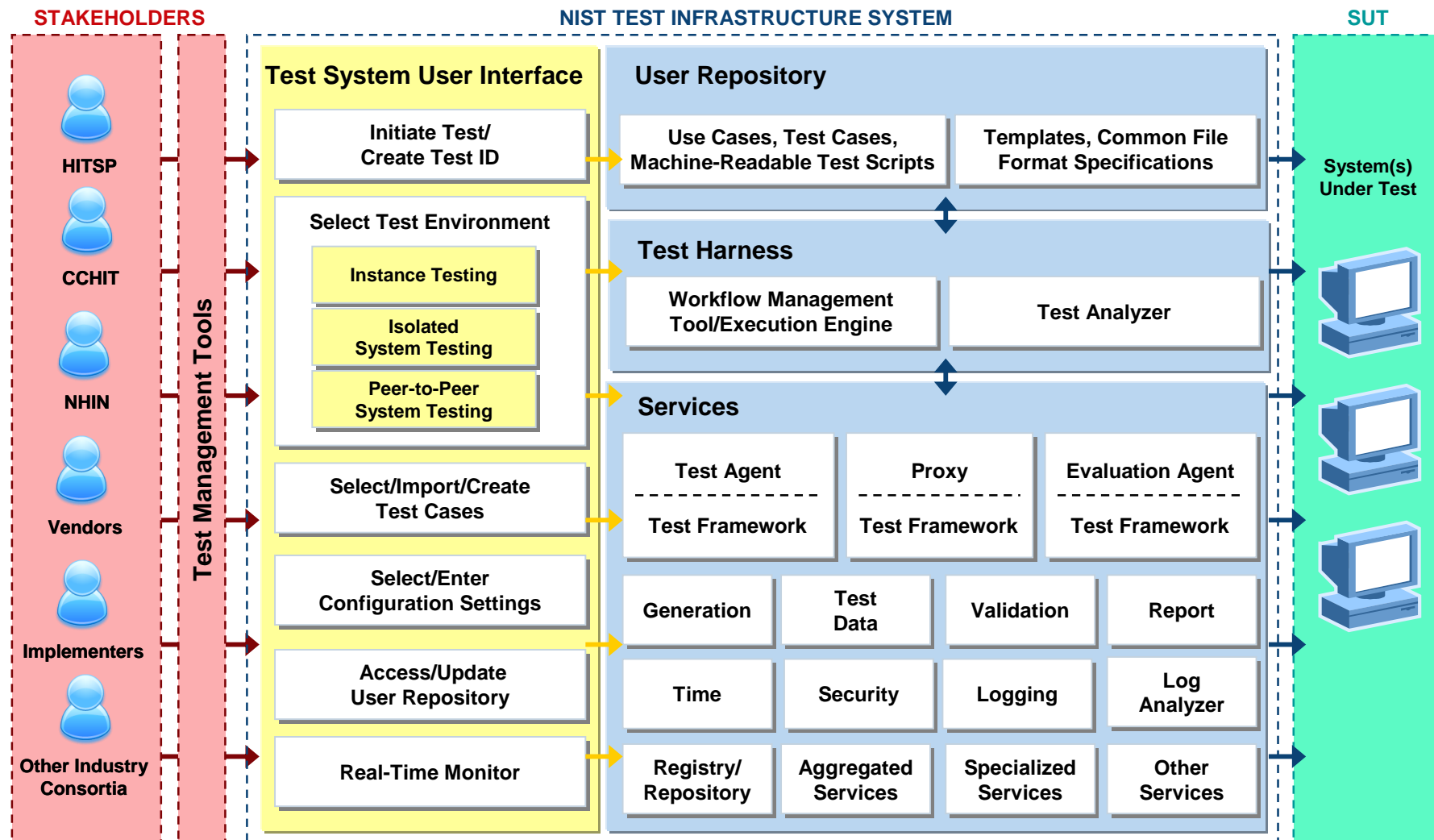


Adapted from HL7 Desktop Reference Guide—NeoTool 2002

Healthcare Data Exchange Standards

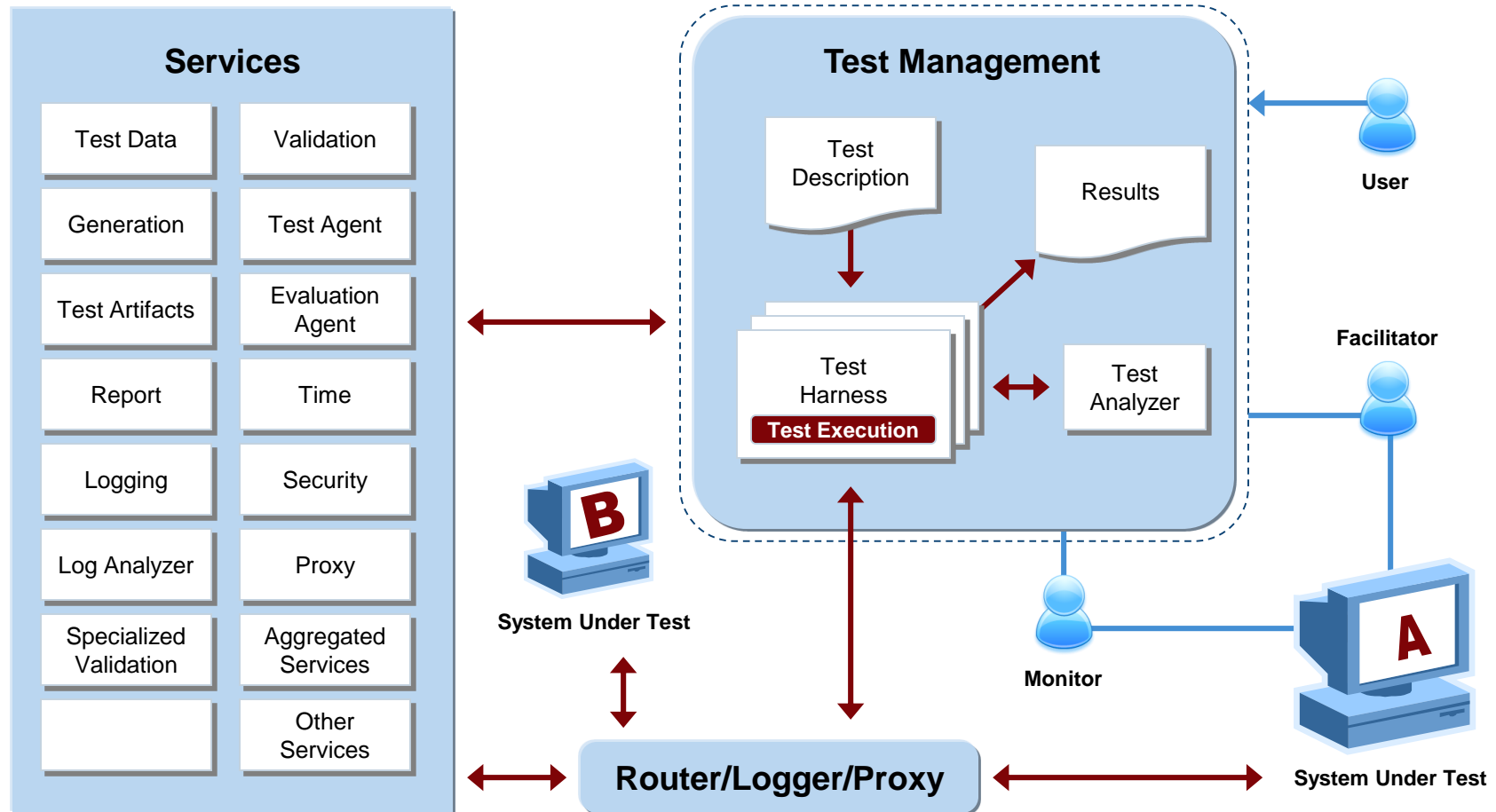
- Standards
 - HL7 V2 – messaging standard for exchange of administrative and clinical data
 - HL7 V3
 - messaging standard for exchange of administrative and clinical
 - Reference Information Model/XML Based/OO Approach
 - DICOM – messaging standard for exchange of medical images
 - CDA – document standard for exchange of administrative and clinical data
 - IEEE 1073 – standard for exchange of data between medical devices
- Organizations
 - HITSP - Develop HIT Standards and Specifications
 - NHIN - Conduct testing to ensure that products align with recognized HIT standards
 - CCHIT - Conduct testing associated with the organization's certification criteria
 - IHE
 - Develop HIT Standards and Specifications
 - Conducts standards testing in various contexts

Test Framework Conceptual View



NIST HIT Testing Infrastructure Design

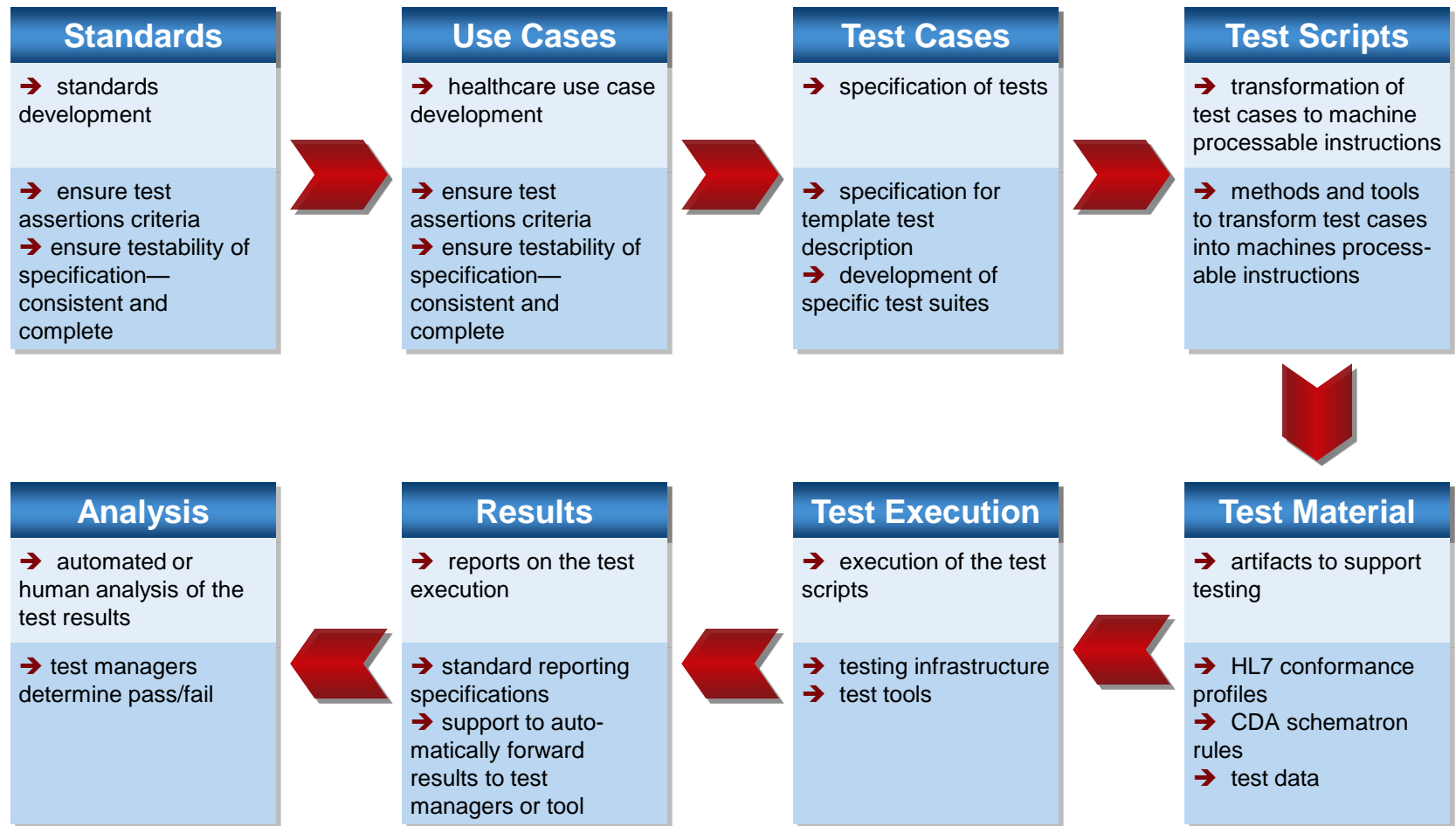
A Framework for Building Test Systems—an SOA Approach



Test Environments Taxonomy

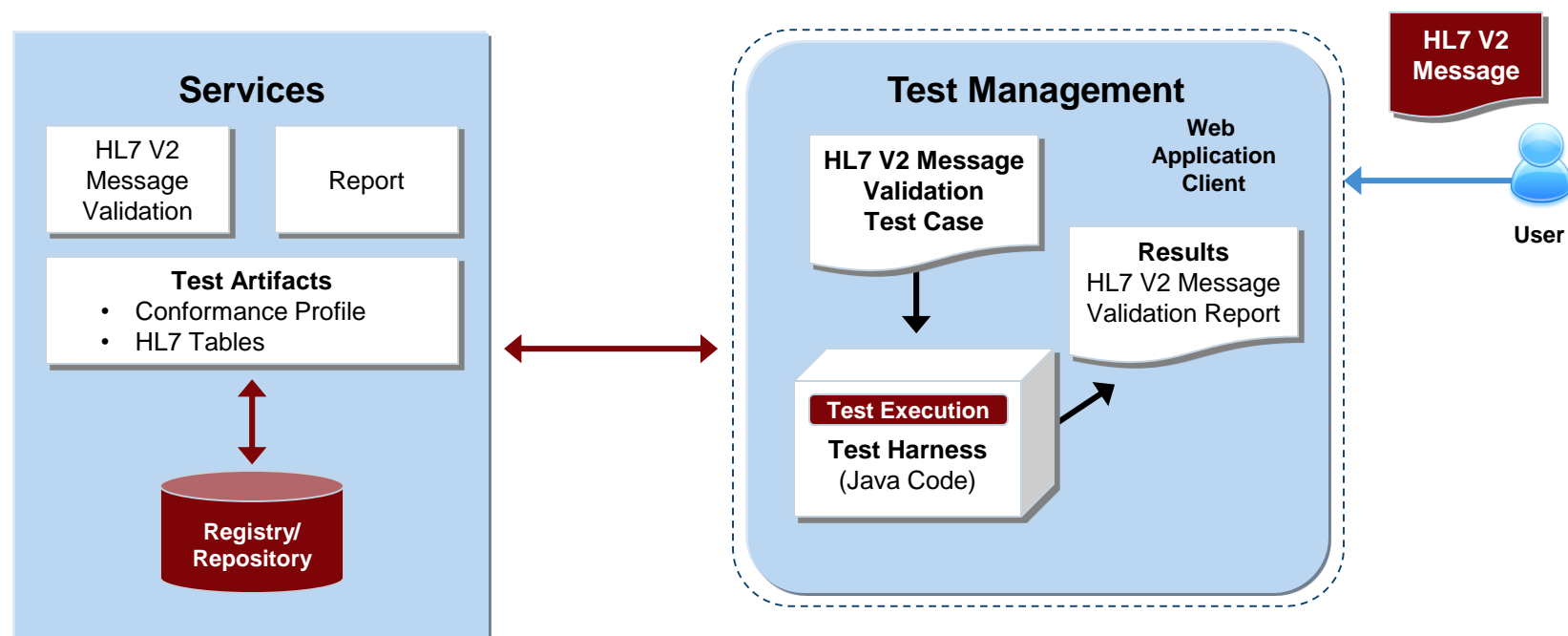
- Data Instance Test Environment
 - Evaluation of data content against a set of conformance rules
 - Data Content Validation Testing
 - No Context; not associated with an application
 - Data Content Conformance Testing
 - Test object is identified as having been produced by a specific application
- Isolated System Test Environment
 - Includes Instance Testing Activities
 - Protocol Usage Conformance Testing
 - Testing for Conformance to the Requirements of the Data Exchange Standard
 - Test range of conformance requirements
 - Multiple test cases conducted
 - System Behavior Conformance Testing from Application Functional Requirements
 - e.g., Pre-connectathon Testing
- Peer-to-peer System Test Environment
 - Includes Isolated System Testing Activities
 - Syntactic Interoperability Testing
 - Semantic Interoperability Testing
 - e.g., Connectathon Testing

Testing Process



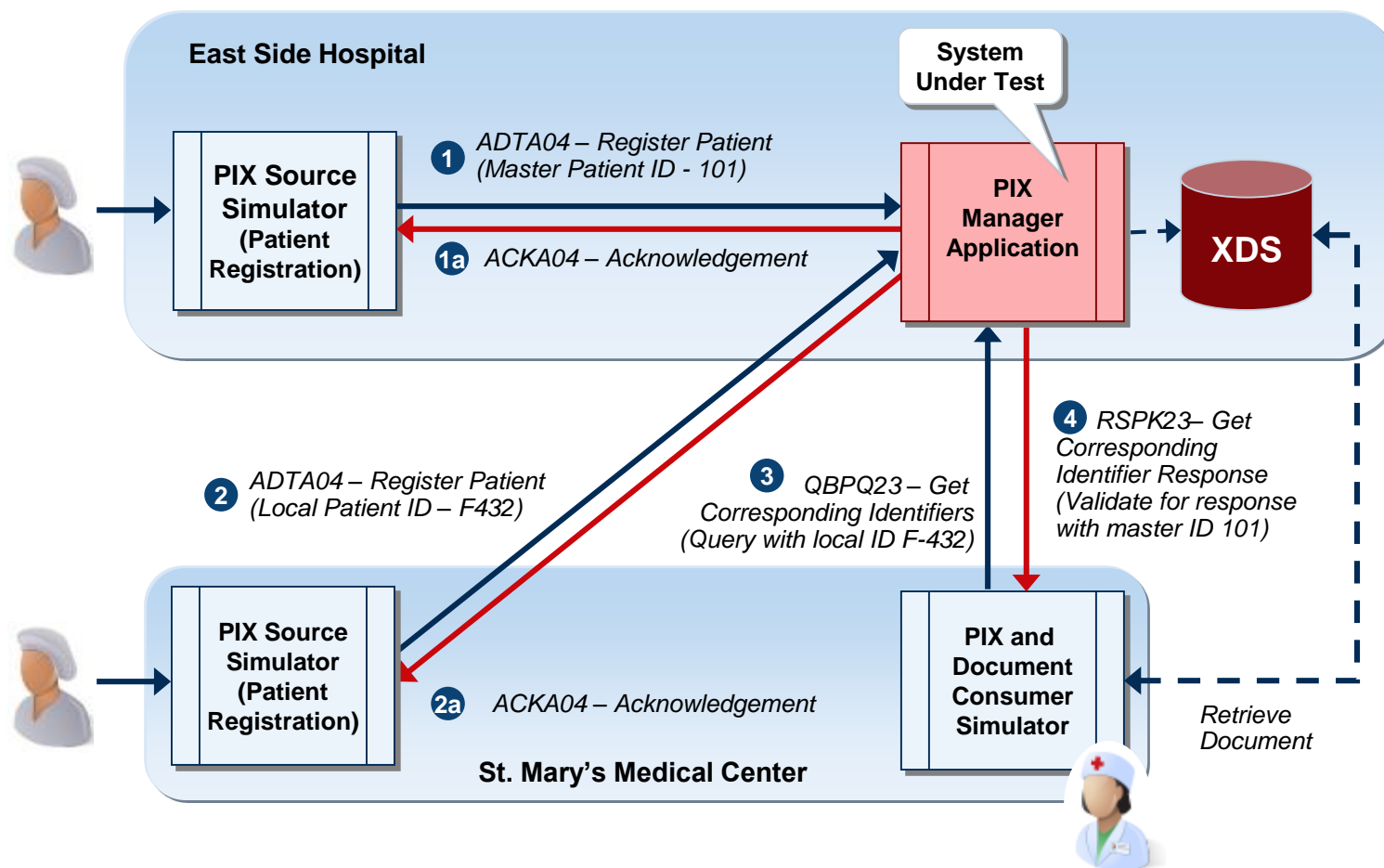
Instance Testing

Conformance Testing of an HL7 V2 Message



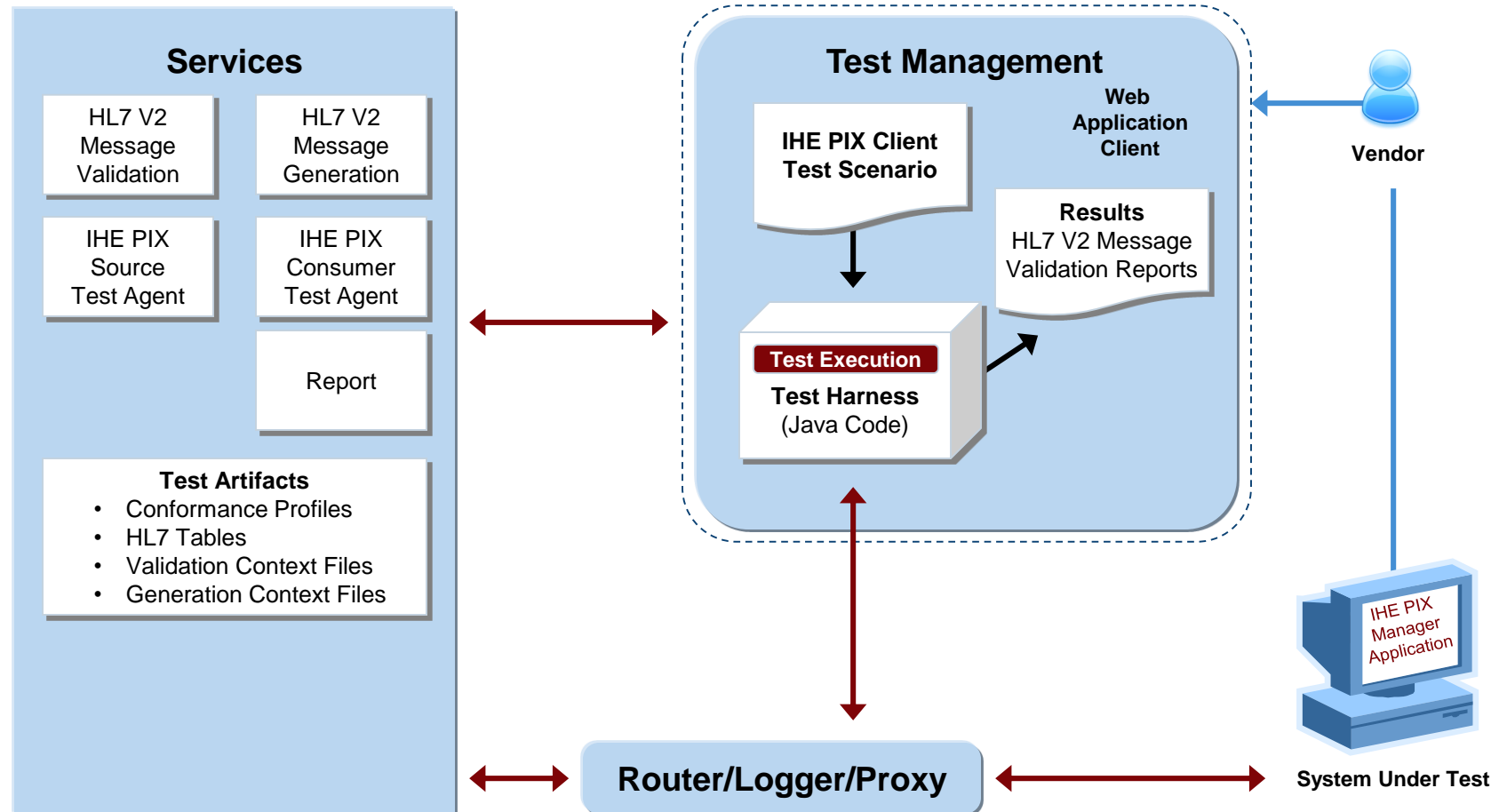
Isolated System Testing

Pre-Connectathon PIX Client Test Case



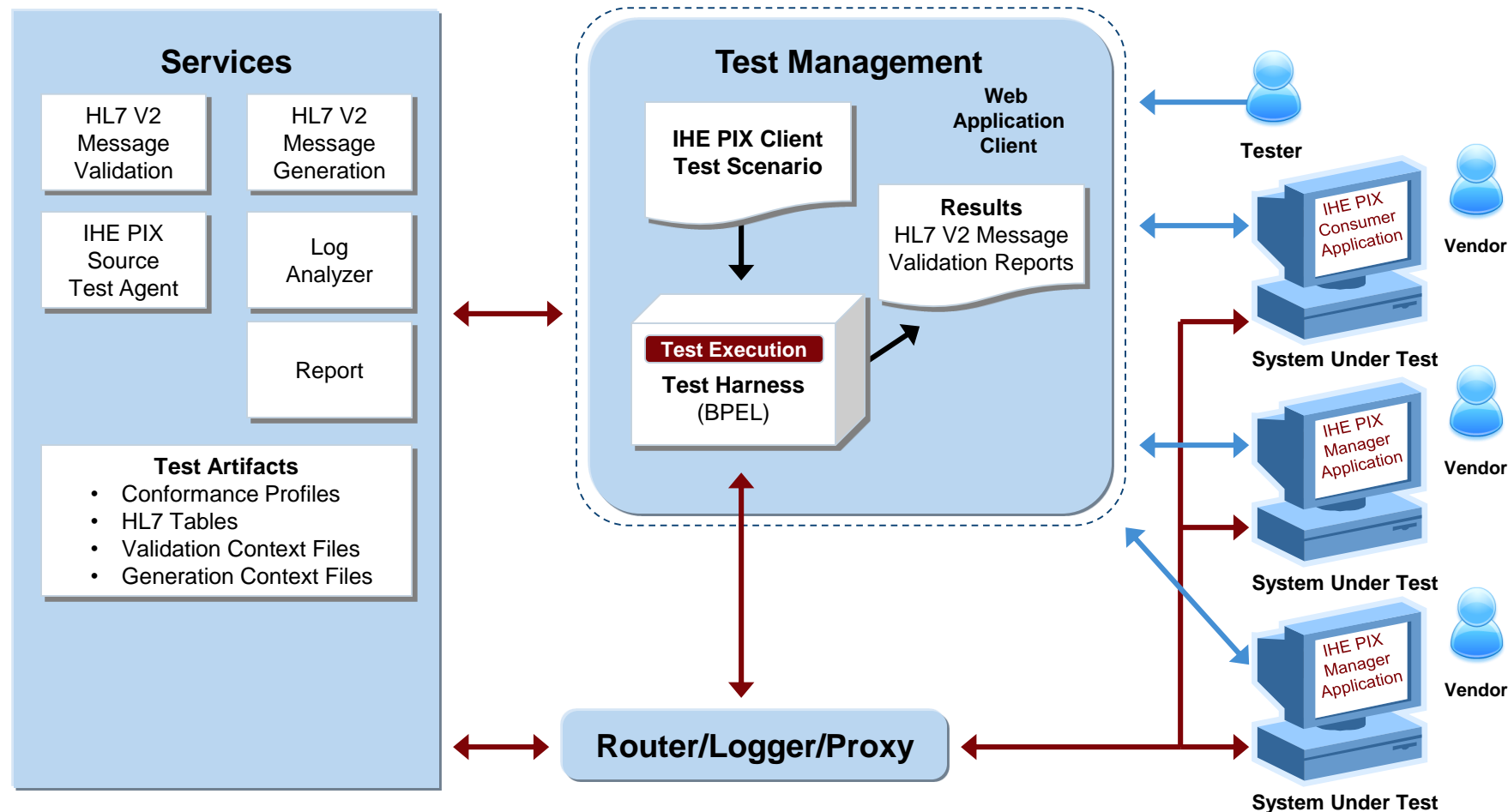
Isolated System Testing

IHE PIX Testing using a Web Application Client



Peer-to-Peer System Testing

IHE PIX Testing using BPM/Proxy Model



Summary

- Beyond a collection of tools
- Integrated testing system—Holistic View
 - Address the testing needs of entire process
 - From standards development to analysis
 - Users can make use of the framework to suit their needs
 - Composition of services is at their discretion
 - Formal methodology will live on beyond a collection of disparate tools
- System Requirements
 - Perform conformance and interoperability testing of healthcare information systems
 - Support multiple healthcare messaging and data standards
 - Support broad scope testing environments
 - Support different delivery mechanisms of tools
 - Flexible—can be use in many ways
 - Modular—component based, reusable pieces
 - Scalable—capable of handling increasing loads
 - Extensible—extend functionality via component integration

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Testing Infrastructure Key Components

- Test Harness
 - Portal into test system
 - Orchestration of services to execute tests
 - Test execution engine
 - Many test harnesses will be built (NIST and others)
- Services
 - Provides a testing function
 - Accessible via Web Services or ESB (for thin clients)
- Network Functions
 - Routing
 - Logging
 - Proxy
- “Glue” Components
 - Interfaces
 - Common file formats
- Test Specification Methodology
 - Common Template
 - Automated transformation to test scripting language
 - Tools to build test suites
- Design Templates
 - e.g., HL7 V2 Test Agents
 - e.g., Test Harness UI Templates
- Test Management
 - Ancillary system
 - Controls the setup, selection, and analysis of results

Services

- Provides a healthcare testing function
 - e.g., validation of a CDA document
- Reusable building-block components
 - can be used in many test systems and compositions
- Can be realized as a web service
 - expose to public readily
- Autonomous
 - not subject to control from outside
- Hides implementation details
- Ownership is distributed

Example Service: Validation

- Conformance Testing
 - HL7 V2.x Messages
 - HL7 V3 Messages
 - CDA Documents
 - DICOM Messages
- Content testing
 - Specific data values based on the scenario
- Vocabulary
- Specialized Testing
 - Additional validation that is difficult to generalize in a validation service (catch-all validation)
 - e.g., Checking the relationship of elements in HL7 V2 Lab Messages

Test Agent Services

- Implementation of the functionality of an actor to support testing
- Replaces a vendor's application in a test scenario
- Can range from simple implementations to reference implementations
- Examples
 - IHE PIX Source, Manager, Consumer
- Hundreds of test agents expected