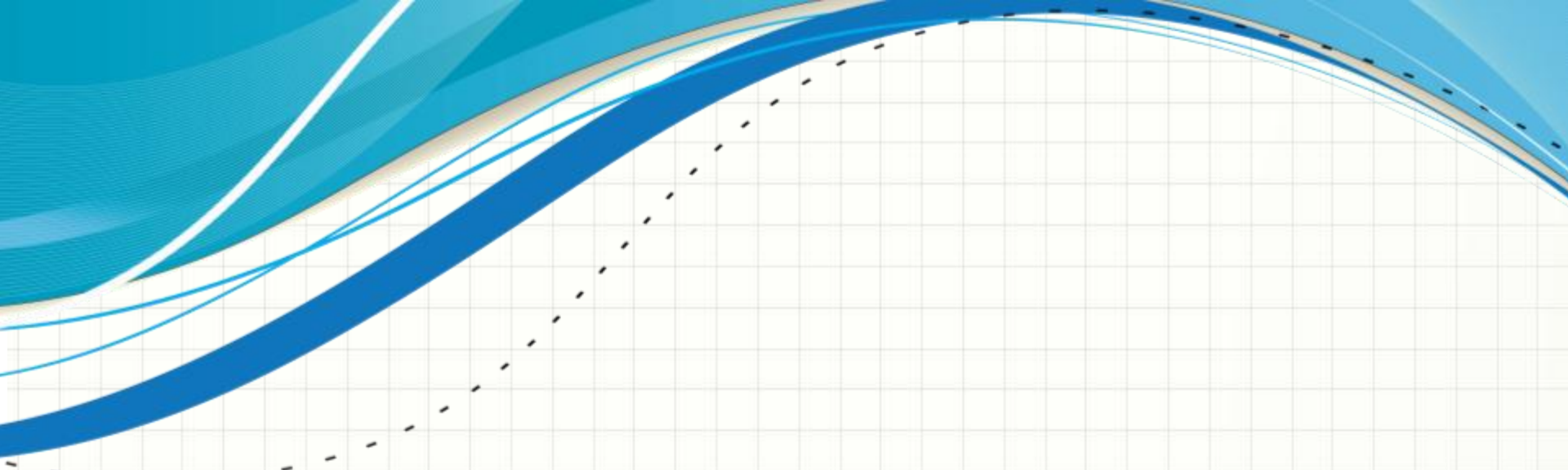# AMIE TECHNOLOGY REVIEW

Sri Koka

01/25/2010

HEALTH INFORMATION EXCHANGES (HIE)

A CLOSER LOOK

Health Information Exchange – What is it?

"The electronic **movement** of health-related information among organizations according to nationally recognized standards."

-Office of the National Coordinator, 2008

"Coordination of care requires **information sharing**. While many medical practices have systems that can share information internally, the connection between different regions and organizations allows me to track patient results from many labs or specialists," A Pediatrician

"It is only through this kind of **information exchange** that we can hope to coordinate care in an efficient manner." Same Pediatrician

The Patient is Waiting

Health Information Exchange

- What it isn't:

    – Computers or related equipment within hospitals, physician practices, pharmacies, labs, etc.

    – Software systems for patient care *except* where those systems intend to interface with the Network

Health Information Exchange

- What it is:

✓Standardization	✓Security	✓Indexing
✓Normalization	✓Privacy	✓Interface
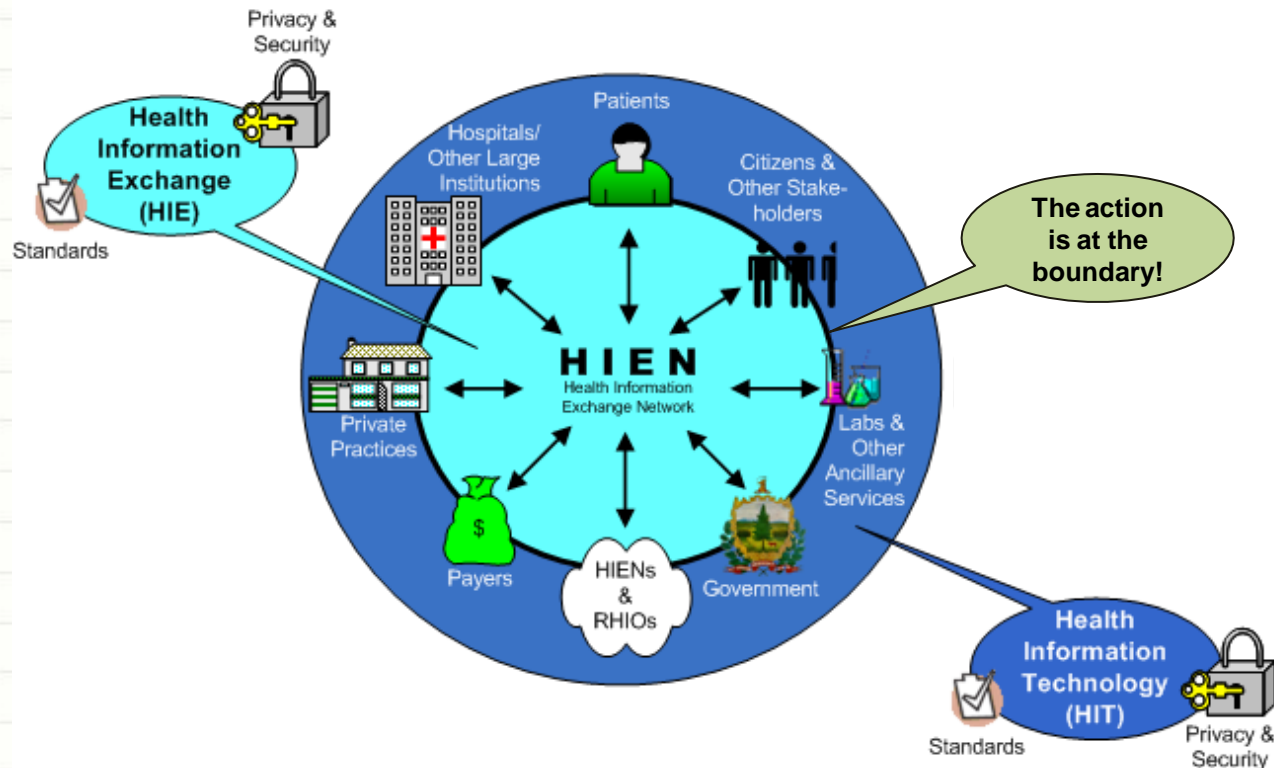
The Goal of HIE

The right information

to the right person (and place)

at the right time

The right Information…

- Master patient index identifies the patient
- Data Locator identifies *where* patient's health information resides
- Format standards describe the contents of the message
- Code standards provide the actual clinical detail

Assumptions:
- All parties adhere to standards (or HIEN provides standardization)
- All parties use the same clinical terms (or HIEN provides normalization)

…to the right Person (and Place)…

- Mutual trust (sender and receiver) allow transmission

- Messaging standards deliver the data ("envelope")

Assumptions:
- Patient consent and authorization granted
- Provider is assigned the minimum necessary access
- Agreements have been established between organizations
- Adequate patient identifiers available
- Data sources available via Internet connection
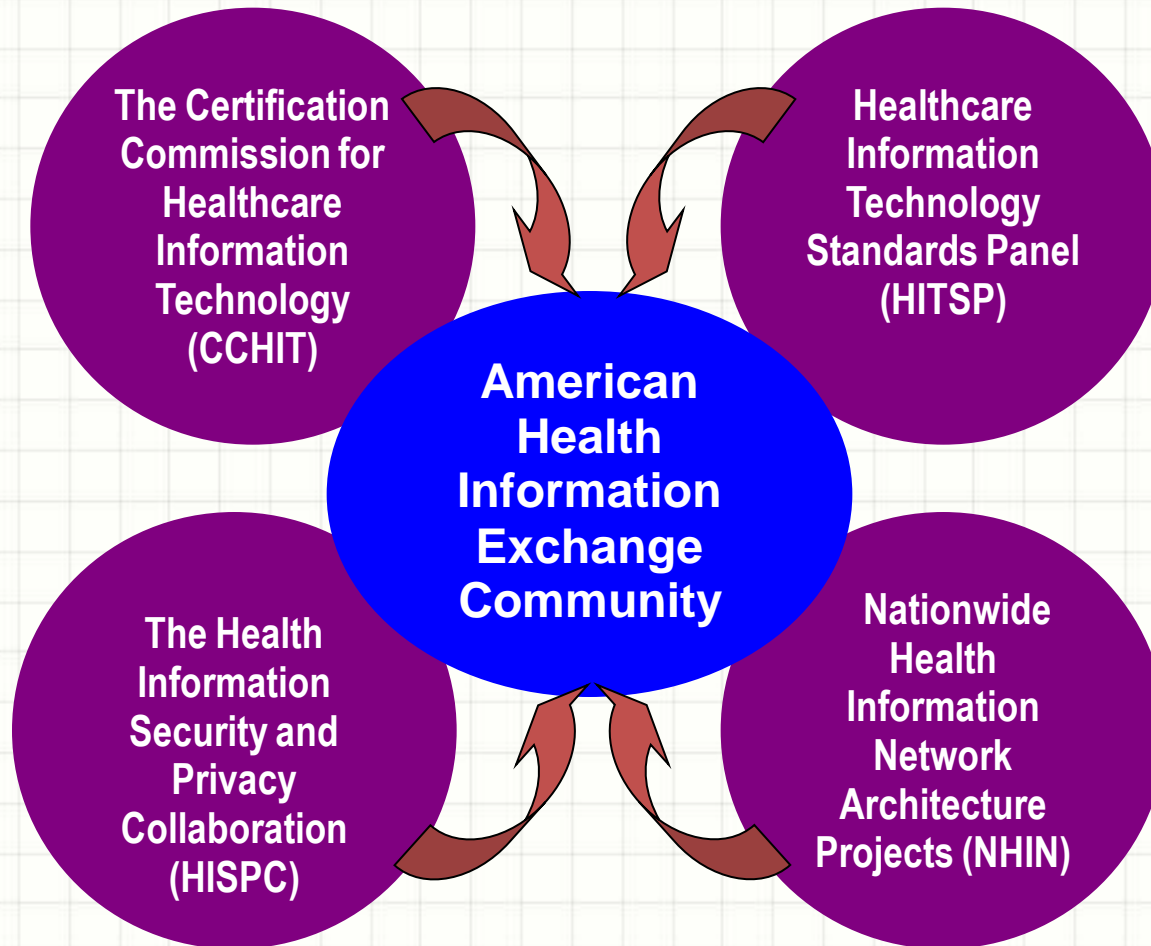
...at the right Time

- Clinicians can view the right information
    - In preparation for patient visit
    - During patient visit
    - After exams/tests
    - ED visit

Assumptions:
- Internet connection
- A fully automated system responding within seconds

Four Pillars for American Health Information Exchange Community

The Certification Commission for Healthcare Information Technology (CCHIT)

Healthcare Information Technology Standards Panel (HITSP)

American Health Information Exchange Community

The Health Information Security and Privacy Collaboration (HISPC)

Nationwide Health Information Network Architecture Projects (NHIN)

HITSP Overview

HITSP is a volunteer-driven, consensus-based organization that is funded through a contract from the Department of Health and Human Services

HITSP develops Interoperability Specifications (IS) – documents that harmonize and recommend the technical standards that are necessary to assure the interoperability of electronic health records

HiTSP Healthcare Information Technology Standards Panel

HITSP Interoperability Specifications (IS)

	IS 01	Electronic Health Record (EHR) Laboratory Results Reporting
	IS 02	Biosurveillance
	IS 03	Consumer Empowerment
	IS 04	Emergency Responder Electronic Health Record (ER - EHR)
	IS 05	Consumer Empowerment and Access to Clinical Information via Media
	IS 06	Quality
	IS 07	Medication Management

Recognized
Accepted

HiTSP Healthcare Information Technology Standards Panel

HITSP Interoperability Specifications (IS)

	IS 08	Personalized Healthcare
	IS 09	Consultations and Transfers of Care
	IS 10	Immunizations and Response Management
	IS 11	Public Health Case Reporting
	IS 12	Patient – Provider Secure Messaging
	IS 77	Remote Monitoring

Released / Panel Approved

Certification – The Certification Commission for Health Information Technology (CCHIT)

Mission:

Accelerate the adoption of robust, interoperable health IT by creating an efficient, credible certification process.

Goals:

- Reduce the risks of investing in health IT
- Facilitate interoperability of EHRs and Networks
- Enhance availability of adoption incentives and regulatory relief
- Protect the privacy of health information

CCHIT

Health Information Security and Privacy Collaboration (HISPC):
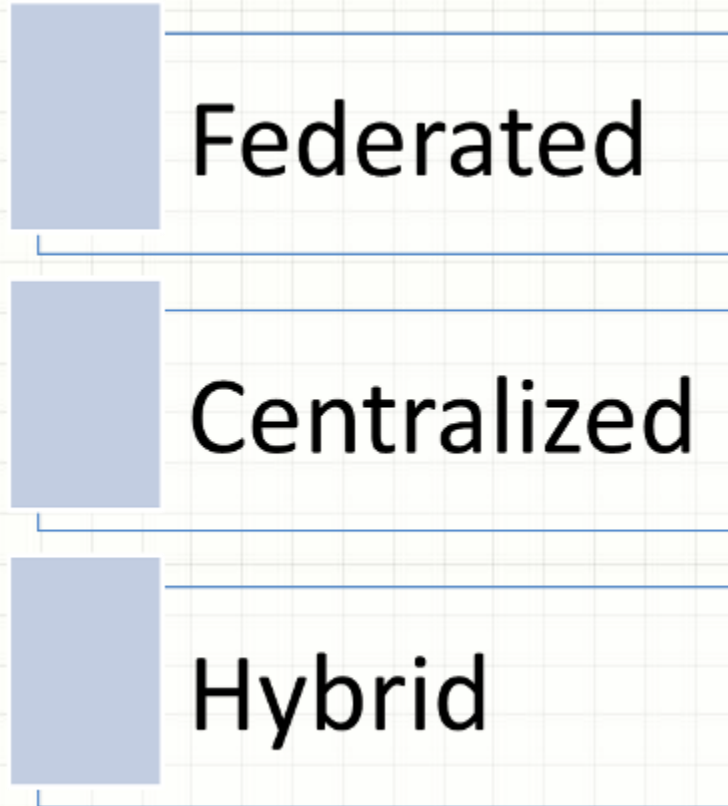
Objective: Federal coordination with local decisions.

Scope: Assess variation, develop solutions and implementation plans

Methods:

- Community-based research model
- Engage a broad range of stakeholders
- Follow common methodology
- Panel of experts
- National direction with local control

HIE – Types of Architectures

Federated

Centralized

Hybrid

Federated

- **Generally, the federated model leaves patient data on the source systems and does not duplicate in the HIE infrastructure.**

- **Requestor of data must:**
  - **Identify the patient (MPI)**
  - **Query the HIE for location of records (RLS)**
  - **Query the source systems for data on the patient**
  - **Assemble the returned information for display**

- **Patient data privacy protection is strongly retained as a source system responsibility but collecting communicating and validating users identity and role becomes a complex shared activity between source systems and HIE.**

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Centralized

- **MPI services are in the HIE, but RLS is not explicitly necessary**

- **All patient data accessible to the HIE is hosted on HIE databases. Source data is fed to the HIE on a transactional basis as created keeping the HIE database reasonably up to date.**

- **Privacy and role-based access become is the responsibility of the HIE.**

Hybrid

- **HIE provides MPI and RLS services as in the Federated Model.**

- **Patient data is staged within the HIE infrastructure and/or within the source system but on a dedicated (to the HIE) database.**

- **Patient data privacy protection is a simpler shared HIE/Source/User responsibility.**

Architectural Challenges

- **There are several characteristics that have clearly been problematic (to varying degrees) across all three models in both prototype and production environments:**

  - **Privacy and Security is strongest in the Federated Model and the most difficult to assure in the Centralized model because primary responsibility for maintaining the patient's privacy trust sits with the source system.**

Architectural Challenges

- **Performance: HIE systems have been demonstrated have adoption rates that are inversely proportional to response time. In all demonstrated uses of HIE prototypes and production systems that I have discussed with the principals involved performance is a significant issue and particularly problematic in the Federated Model.**

- **Vendor Source Systems: As currently designed and deployed source system vendor's systems are not designed to support HIEs. Furthermore, provider organizations have not implemented these systems with a performance capacity that anticipated the needs of HIEs.**

Architectural Challenges

- **Patient Identification: Unlike most other countries that are implementing interoperable EHRs, the US does not have (and will not likely have in the foreseeable future) patient identifiers. MPI services augment this deficiency with a cost and complexity that is less reliable than the same MPI service with a patient identifier. This leads to two undesirable outcomes:**

  - **False Negative matches—this leaves out possibly vital information (e.g., current medicines or allergies) from the patient's record while indicating that all available data has been retrieved.**

  - **False Positives—this creates an even more undesirable condition where two or more patient's data is effectively "intermixed" when presented to the HIE using physician.**

HIE Core Services

- – Master Person Indexing
- – Provider Identity Management Services
- – Registry Services
- – Repository Services
- – Authentication Services
- – Audit Services
- – Nomenclature Normalization Services
- – Consent / Authorization Management Services
- – Network Monitoring Services

EMPIs

- An Enterprise Master Patient Index (EMPI) is a database that contains a unique identifier for every patient in the HIEN.
 - Deterministic and rule based (AMIE Implementation)
    An EMPI will have either deterministic indexing where one can search based on an exact match of the combination of name, social security no, date of birth, and sex
  - Probabilistic (Initiates)
    This is considered to be the most sophisticated technique available and are based on complex mathematical formula

Deterministic Algorithm (AMIE Implementation)

- Provides traditional Database functionality
- High accuracy on small number of records and records with fixed quality
- Must be re-educated with each new source

- Deterministic Matching
  - Rules based matching
  - Limited weighting of characteristics
 - Performance intensive
  - Does not "learn"

Deterministic

Do Not link

Automatically Link
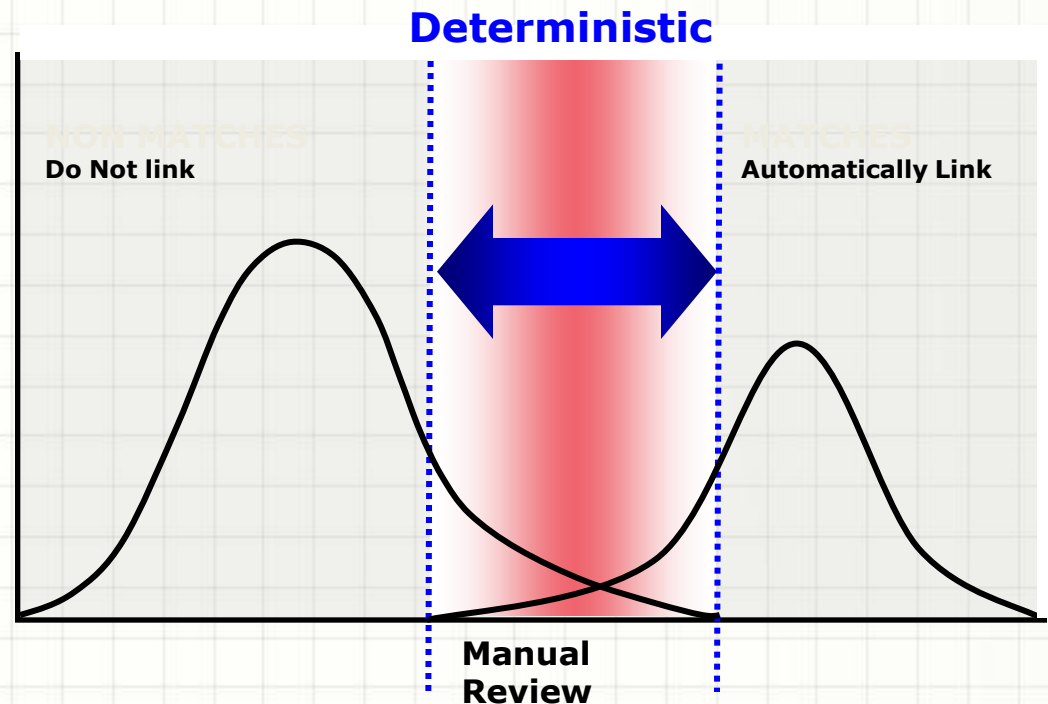
Manual Review

Probabilistic Methods (Initiate Method)

– Introduces false positives

– Minimizes false negatives

– Minimize manual review

•Probabilistic Matching

- Assigns weights to attributes
- Determines composite score
- Unrivaled Performance
- Learns from trends in data

Probabilistic

Do Not link

NON MATCHES

MATCHES

Automatically Link

Manual Review
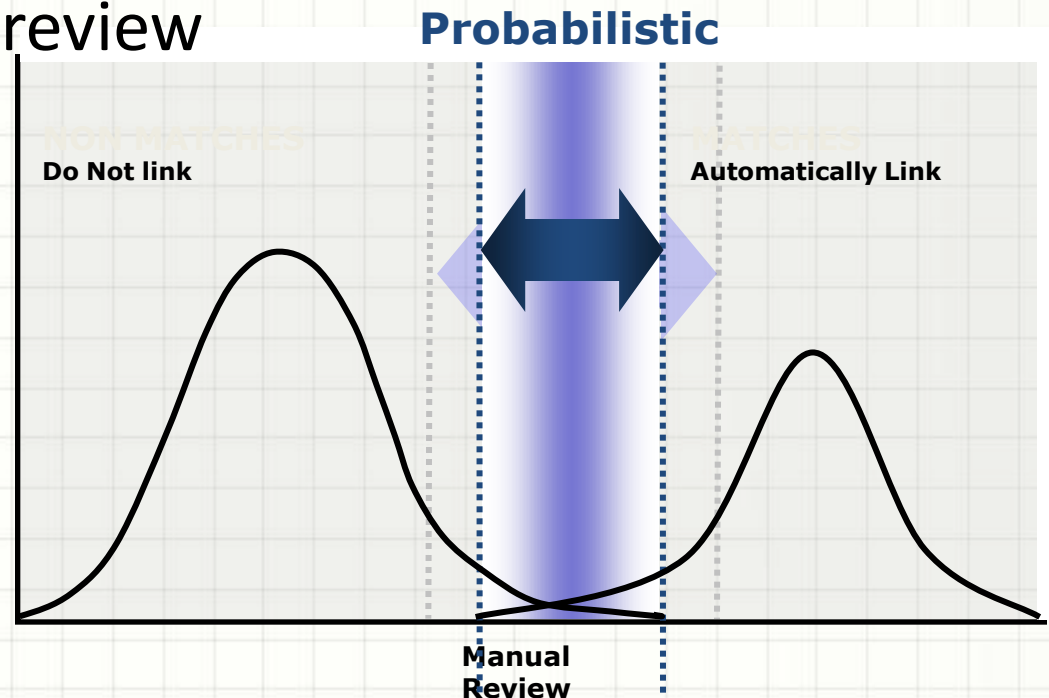
Standards

- Messaging Standards:
  - Communicate actual patient data
  - Combine a data element and a concept code in the same stream
  - Messages contain identifiers for patients, date and time, transaction type, service provider etc.
  - Examples: HL7, DICOM
- Coding Standards:
  - Represent *clinical knowledge* using codes
  - Contain *NO* patient data
    - Examples: LOINC, Snomed, ICD9, CPT, UMLS
  - These codes are *attached* to data elements to represent the semantics (meaning) of the message

Meaningful Use objectives requiring health exchange.

Meaningful Use objectives requiring health exchange

2011
- Lab results delivery
- Prescribing
- Claims and eligibility checking
- Quality & immunization reporting, if available

Increases volume of transactions that are most commonly happening today
- Lab to provider
- Provider to pharmacy

2013
- Registry reporting and reporting to public health
- Electronic ordering
- Health summaries for continuity of care
- Receive public health alerts
- Home monitoring
- Populate PHRs

Substantially steps up exchange
- Provider to lab
- Pharmacy to provider
- Office to hospital & vice versa
- Office to office
- Hospital/office to public health & vice versa
- Hospital to patient
- Office to patient & vice versa
- Hospital/office to reporting entities

2015
- Access comprehensive data from all available sources
- Experience of care reporting
- Medical device interoperability

Starts to envision routine availability of relatively rich exchange transactions
- "Anyone to anyone"
- Patient to reporting entities

Nationwide health information network (NHIN)

# NATIONWIDE HEALTH INFORMATION NETWORK (NHIN)

- **NHIN**: the nationwide "Network of Networks"... of Networks
  - Framework for health information network service providers
  - Interconnecting NHIEs
  - Business/Technical Issues: Standards, Sustainability, Security
- **NHIEs**: Local, state, regional HIEs interoperable with NHIN
- NHIN-Connect:

http://www.hhs.gov/healthit/healthnetwork/background/
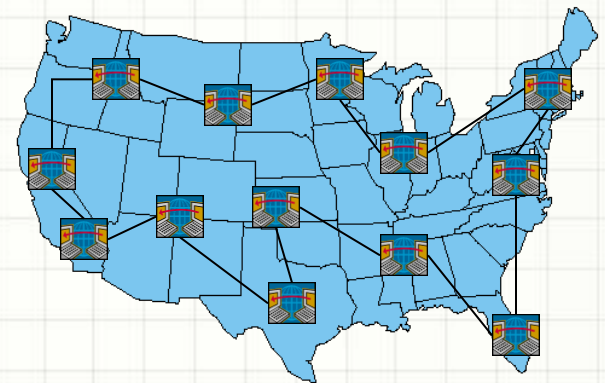
The Nationwide Health Information Network
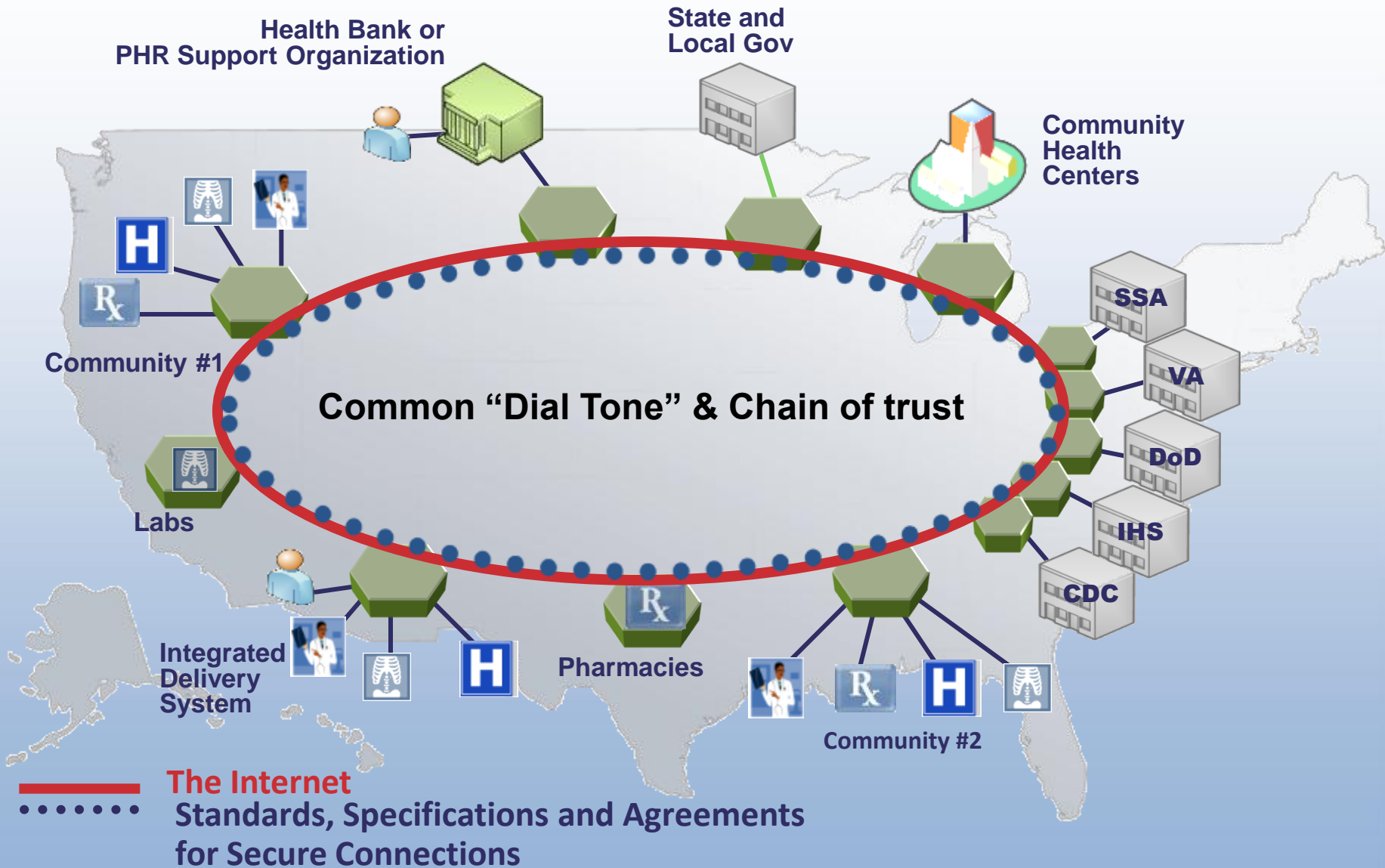
Federal and Private-Sector Partners Using CONNECT for NHIN

Agency (7)

Department of Defense **

Department of Veterans Affairs **

Social Security Administration **

Indian Health Service **

Centers for Disease Control and Prevention **

National Cancer Institute **

National Disaster Medical System **

> **Currently in Limited Production**

Private Sector (15)

CareSpark

Cleveland Clinic Foundation

Community Health Information Collaborative

Delaware Health Information Network

Healthbridge

Healthlinc (Bloomington Hospital)

MedVirginia **

INHS

Kaiser Permanente

Long Beach Network For Health

Lovelace Clinic Foundation

Minnesota Community Health Information Collaborative (CHIC)

New York eHealth Collaborative

NCHICA

NMHIC

Regenstrief Institute

West Virginia Health Information Network

Wright State University **

State Level (3)

New York State Department of Health **

Washington State Department of Health **

Indiana State Department of Health

*Via demonstration and/or production activities.
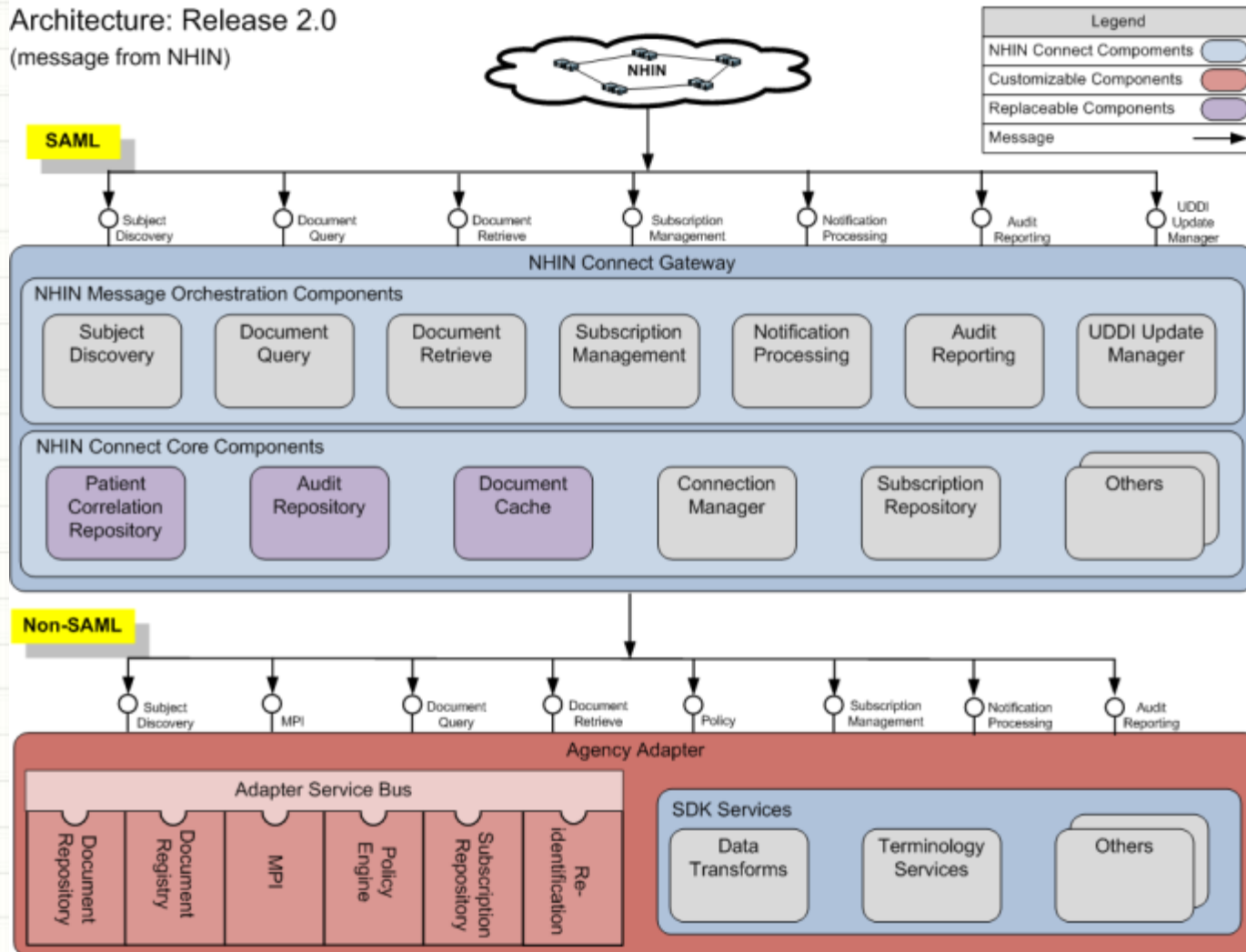** Using the **CONNECT Solution**

What is CONNECT?

CONNECT is the Federal Health IT Consortium's strategy for connecting to the
Nationwide Health Information Network (NHIN)

COLLABORATING *Federal Agencies Include…*

NHIN Connect Architecture

NHIN Core Components

NHIN INTERFACE SPECIFICATION

- Patient Discovery
- Query for Documents
- Retrieve Documents
- Health Information Event Messaging

- Query Audit Log
- Authorization Framework
- Consumer Preferences Profile
- Messaging Platform
- NHIE Service Registry

- Authorized Case Follow-Up

- Six to Eight Additional Services

ENTERPRISE SERVICE COMPONENTS

- Document Registry/Repository
- Messaging Engine
- Master Patient Index
- Policy Engine

- Consumer Preferences Profile Repository
- Subscription Manager
- Data Persistence Services

- Transformation Services

- Terminology Services

Tools from FHA to become NHIE

FHA's CONNECT Initiative provides three related tools to enable organizations to connect to the NHIN:

The Gateway, which implements the core services defined by the NHIN

Enterprise Service Components, which provide robust tools for indexing patient identities, maintaining patient health documents, implementing business rules for authorizing the release of medical information and more

Universal Client, a client framework for developers to implement enterprise service components

Data Use and Reciprocal Support Agreement (DURSA)

The DURSA provides the legal framework governing participation in nationwide information exchange by requiring the signatories to abide by a common set of terms and conditions that establish the Participants' obligations and the trust fabric to support the privacy, confidentiality and security of the health data that is exchanged.

Key DURSA Terms and Responsibilities of Requesting and responding Participants

- Multi-Party Agreement

- Participants in Production

- Privacy and Security Obligations

- Requests for Data Based on Permitted Purposes

- Duty to Respond

- Future Use of Data Received Through the NHIN

Duties of Requesting and Responding Participants. Each Participant has certain duties when acting as a requesting or responding Participant.

Breach Notification

Mandatory Non-Binding Dispute Resolution

Allocation of Liability Risk Applicable Law

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ARIZONA MEDICAL INFORMATION EXCHANGE (AMIE)

AMIE

(Arizona Medical Information Exchange)

- Launched September 2008
- Treatment Only
- All Patients
- Current Volume
  - 7.1 Million Records
  - 2.9 Million Patients (~ 44% of State)
  - 605 Patients Accessed (October)
  - 428 Records Checked (October)
- Expansions underway
  - Clinician Users
  - Data Partners
  - Behavioral Health Pilot
  - Children's Rehabilitative Services

Key Decisions

Use Open Source technology for the project

- Embrace Web Services internally as well as externally to provide maximum flexibility and extensibility, using an enterprise service bus

Utilize Microsoft .Net as the underlying platform

- Hybrid architecture with capabilities to support both federated and centralized applications, centralized and de-centralized data

- Build in-house developed deterministic MPI .

Adopt existing solutions where possible for critical enterprise service components, such as patient consent policy engine.

Architectural Objectives

- Open Source: Committed to a platform that was open and readily modifiable

- Extensibility: The Gateway needed to support both current and future evolutions of the national standards such as MITA & NHIN.

- Portability: The Gateway must be deployable using a widely available operating system and database platforms across the data partners in Arizona.

- Reliability: AMIE needed to design a solution that could perform high-volume, mission-critical information processing

- Substitutability: The application needs to provide robust, enterprise-class components while enabling data partners to replace them with their own implementations if necessary

- Standard Compliance : Conform to the most current technical industry standards such as HL7, IHE, CDA, CCD, and HITSP and semantic interoperability standards such as LOINC, SNOMED, etc.

AMIE & MITA

- Since AMIE is a CMS Transformation Grant application AMIE has to be incompliance with MITA

- We saw common threads between MITA and NHIN:

- Few of MITA's objectives,

  - Adopt data and industry standards

  - Promote secure data exchange

  - Promote reusable components through modularity

  - Promote efficient and effective data sharing to meet stakeholders' needs

  - Provide a beneficiary-centric focus

  - Support interoperability and integration using open architecture standards

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AMIE – **Data, Messaging, Transport Standards**

- HL7
  - HL7 Version 2.x, 3.0, CDA & CCD
- Web services
  - Follow WS-I Basic Profile interop standards
    - SOAP 1.1 / WSDL 1.2 / UDDI 2.0
- Security
  - Distributed user authentication and SSL based server authentication and transport level encryption
  - Message-based security using XACML, SAML, XML Signatures, XML Encryptions of message parts etc.

AMIE Architecture is designed is based on Connecting for Health Common Framework.

What is Connecting for Health?

- A public-private collaborative of 100+ organizations representing all the points of view in healthcare.

- A neutral forum.

- Founded & supported by the Markle Foundation

- Additional support from the Robert Wood Johnson Foundation
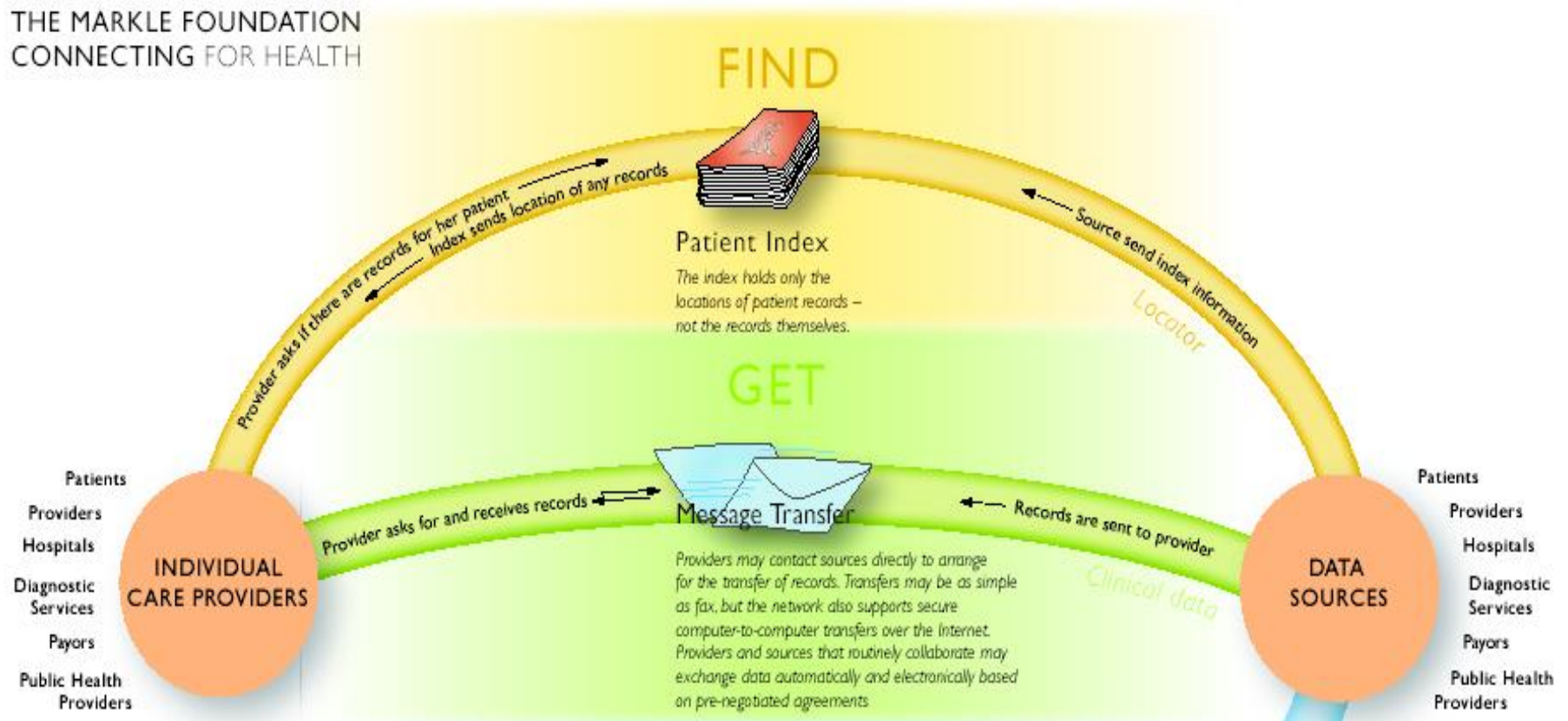
What is Common Framework?

- The Common Framework is the minimum necessary set of rules or protocols for *everyone* who shares health information to follow.

- Helps organizations overcome the barriers without "reinventing the wheel"

- Enables nationwide interoperability...avoiding isolated islands of information

- Builds *trust*
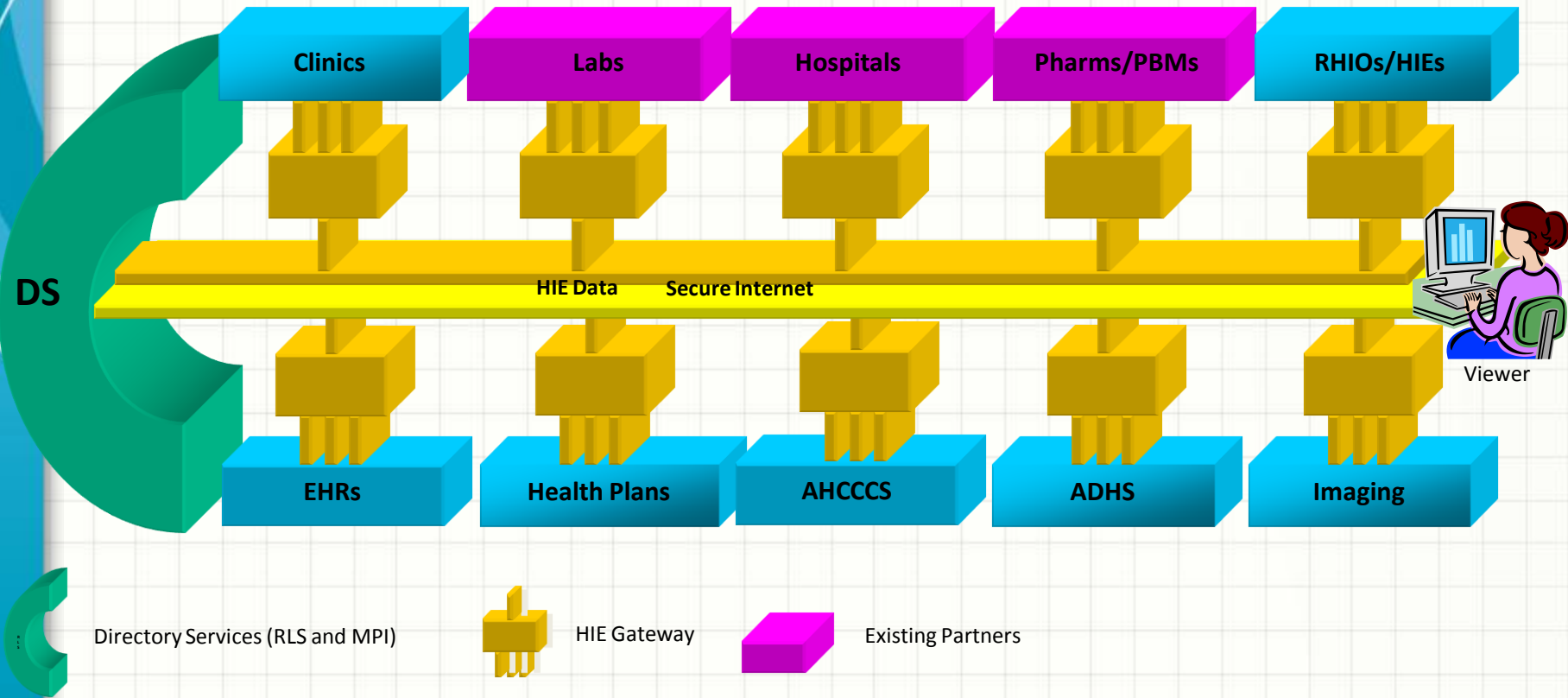
The Connecting for Health Model

- Sharing = linking existing sources of information
- Health information can *stay where it is*—with the doctors and others who created it
- Specific information is shared *only* when and where it is needed.
- Sharing *does not* require an all new "network" or infrastructure
- Sharing *does not* require a central database or a national ID
- Sharing *does* require a Common Framework

Architecture is Federated and Decentralized: Once records are located, health information flows peer-to-peer

Federated Approach

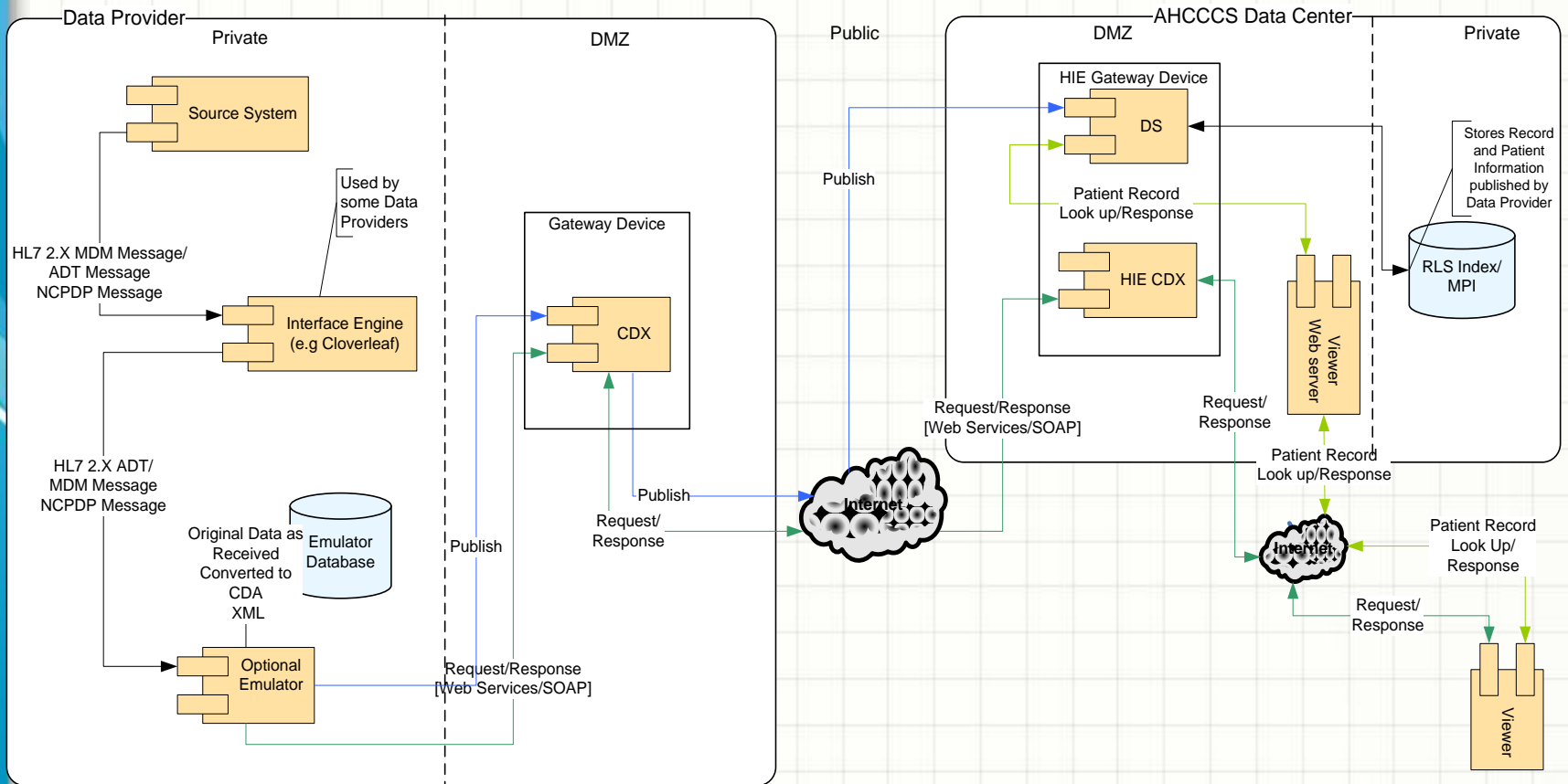**DS**

Clinics | Labs | Hospitals | Pharms/PBMs | RHIOs/HIEs

HIE Data   Secure Internet

Viewer

EHRs | Health Plans | AHCCCS | ADHS | Imaging

Directory Services (RLS and MPI)   HIE Gateway   Existing Partners

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Partners Control Their Data

# Service-Oriented Gateway Architecture

- Common infrastructural (plumbing) services
  - Systems management
    - Logging, auditing, service management
  - Security
    - Authentication, policy, consent management
- Integration services
  - Messaging, transformation, orchestration, adaptor
- Presentation/Business services
- Data management and storage
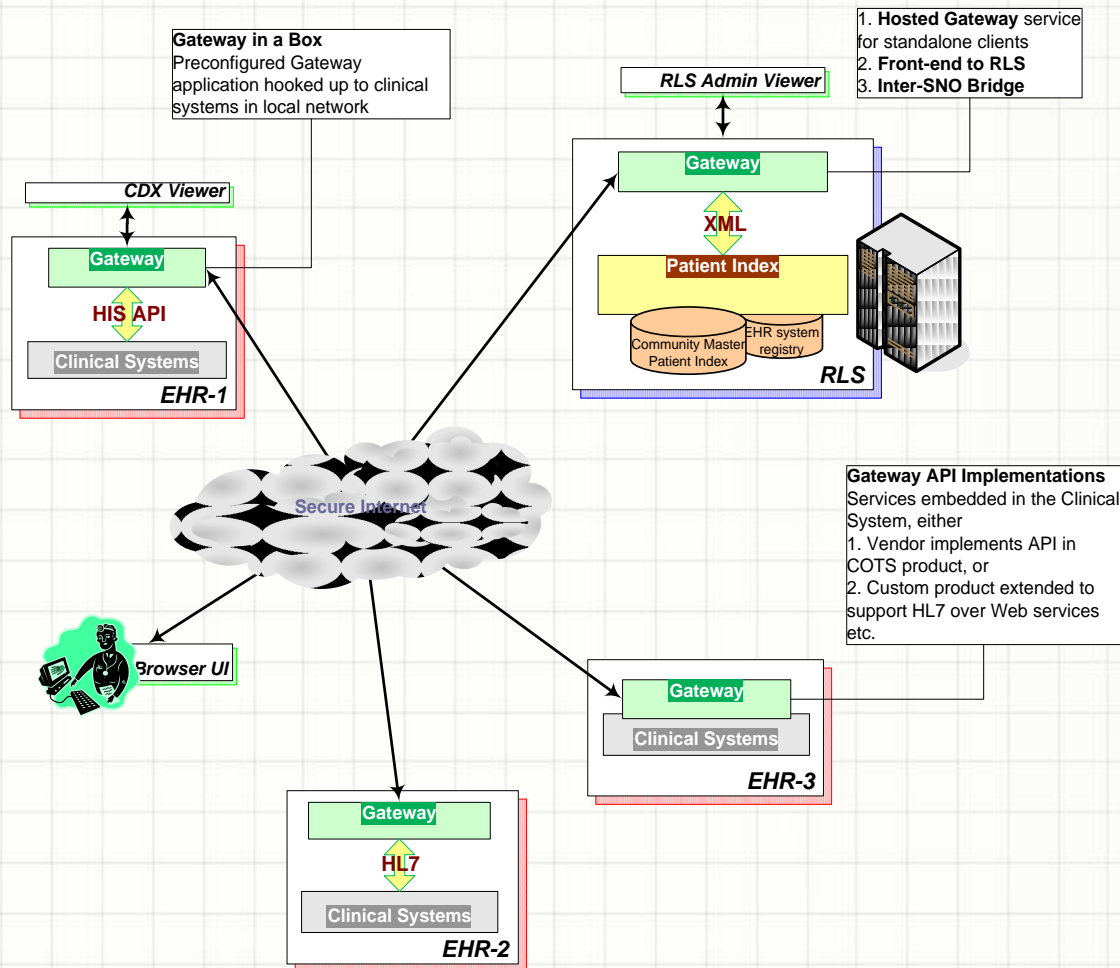 - Clinical Systems Proxy
  - Caching

49
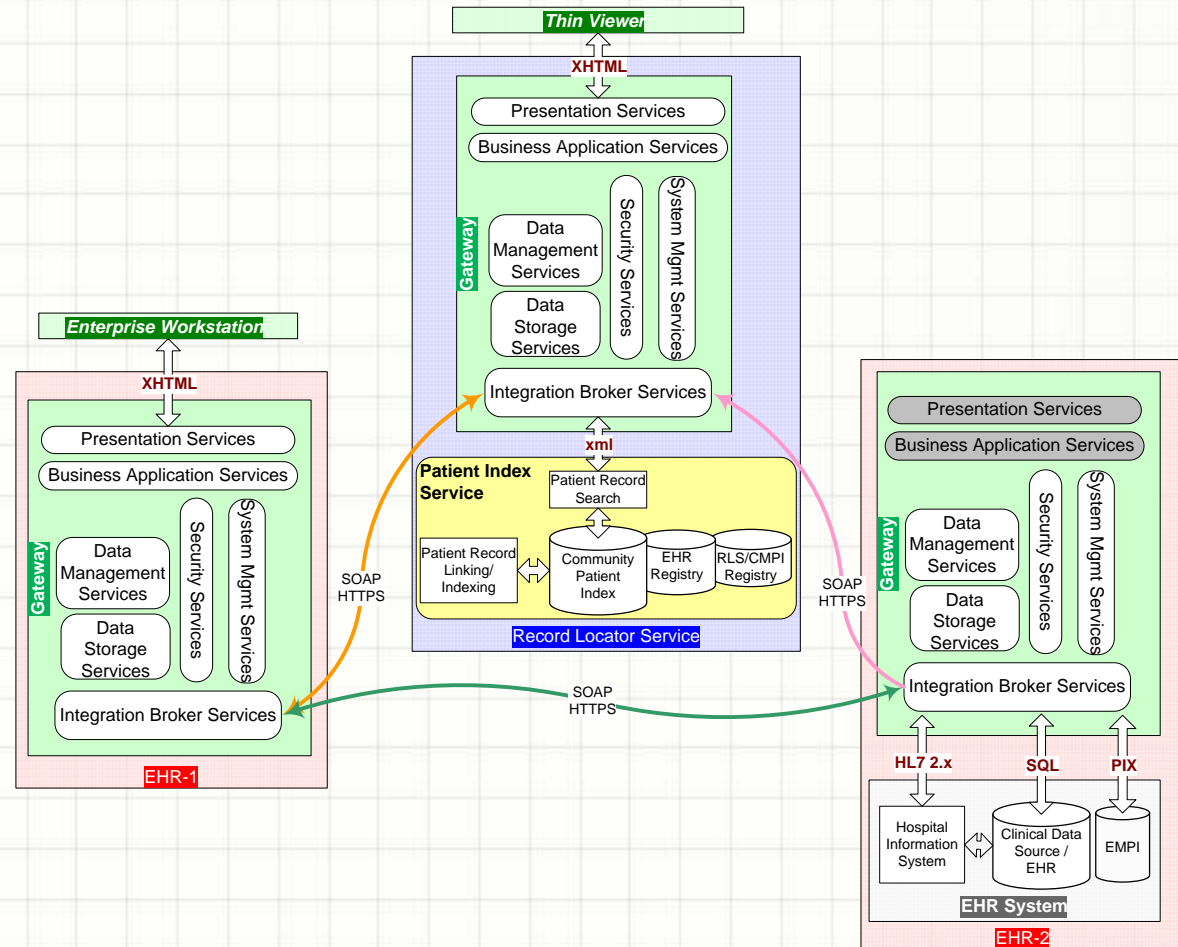
Gateways Provide Edge Services

- Gateways abstract differences between EHR application interfaces through standards based interfaces
  - HL7 and other clinical data exchange standards
  - SOAP / WSDL and other Web services standards
- Hosted Gateway Service
  - Enables direct (browser based) client access to remote clinical systems
  - Inter-SNO Bridge services
  - Other centralized services
    - EHR Registry
    - Standard Metadata, e.g. Schema, WSDL, Policy

Gateway in a Box
Preconfigured Gateway application hooked up to clinical systems in local network

CDX Viewer

Gateway

HIS API

Clinical Systems

EHR-1

1. **Hosted Gateway** service for standalone clients
2. **Front-end to RLS**
3. **Inter-SNO Bridge**

RLS Admin Viewer

Gateway

XML

Patient Index

Community Master Patient Index

EHR system registry

RLS

Gateway API Implementations
Services embedded in the Clinical System, either
1. Vendor implements API in COTS product, or
2. Custom product extended to support HL7 over Web services etc.

Secure Internet

Browser UI

Gateway

Clinical Systems

EHR-3

Gateway

HL7

Clinical Systems

EHR-2

50

AMIE HIE Components

Core Gateway – ESB & Web Services Oriented Architecture.

Directory Services
- Record Locator Services
- MPI
- Patient Consent Management

CDX (Clinical Data Exchange)

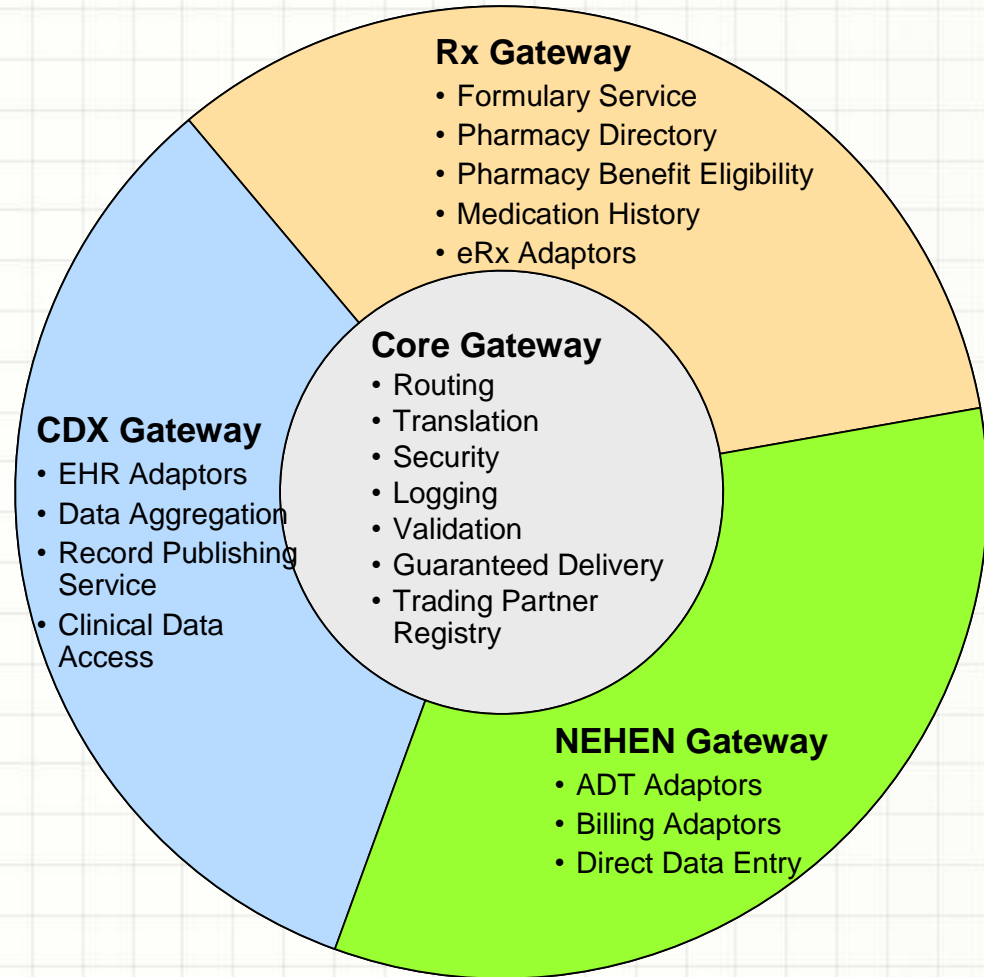PDX (Pharmacy Data Exchange)

Adapters

NHIN Directory Services

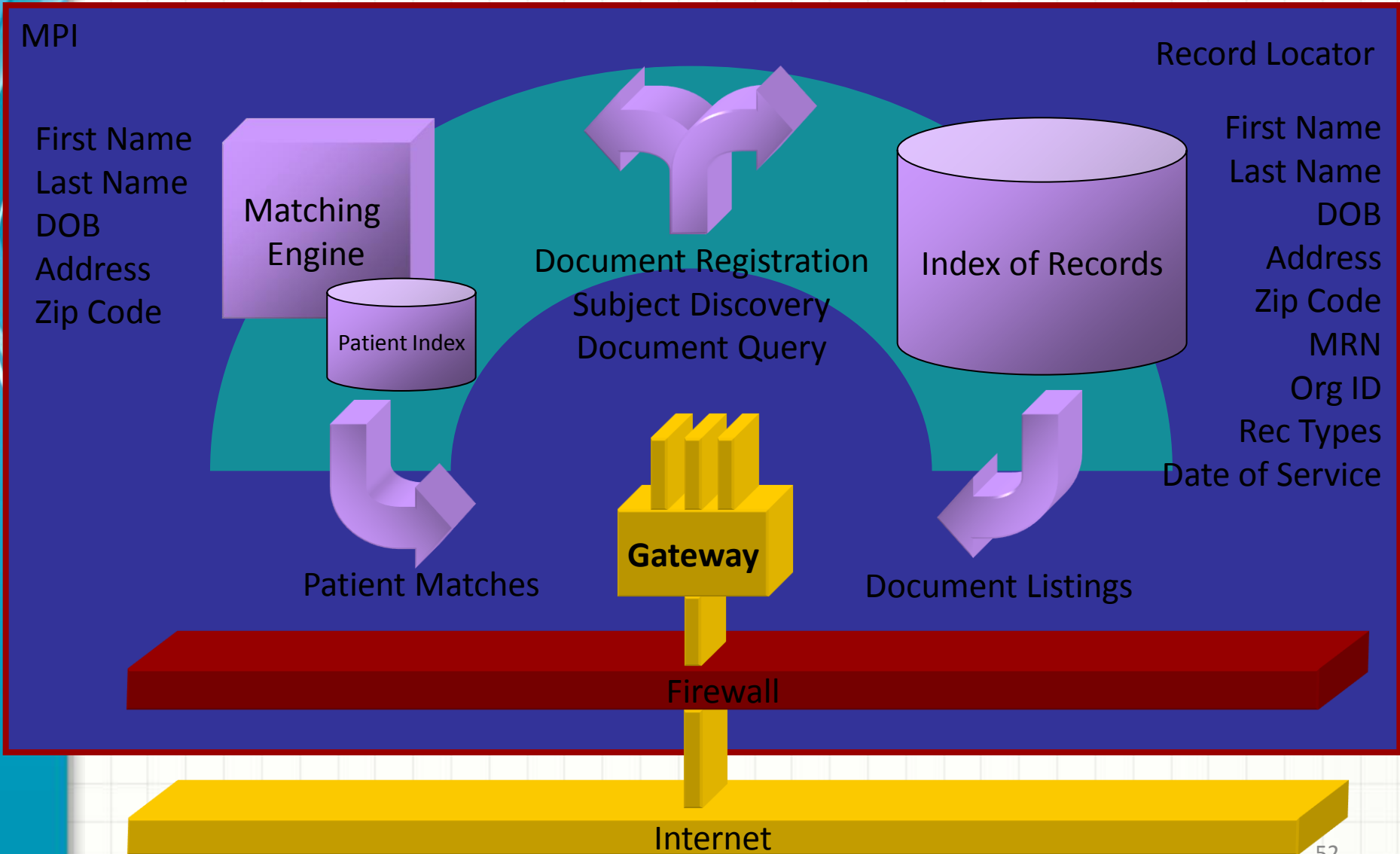NEHEN Gateway Services

AMIE Viewer

AMIE Admin and Reporting Tools

Consumer and Provider Portals

Emulator

Rx Gateway
- Formulary Service
- Pharmacy Directory
- Pharmacy Benefit Eligibility
- Medication History
- eRx Adaptors

Core Gateway
- Routing
- Translation
- Security
- Logging
- Validation
- Guaranteed Delivery
- Trading Partner Registry

CDX Gateway
- EHR Adaptors
- Data Aggregation
- Record Publishing Service
- Clinical Data Access

NEHEN Gateway
- ADT Adaptors
- Billing Adaptors
- Direct Data Entry

Directory Services

Clinical System and Gateway Communications

Clinical System Physical Location
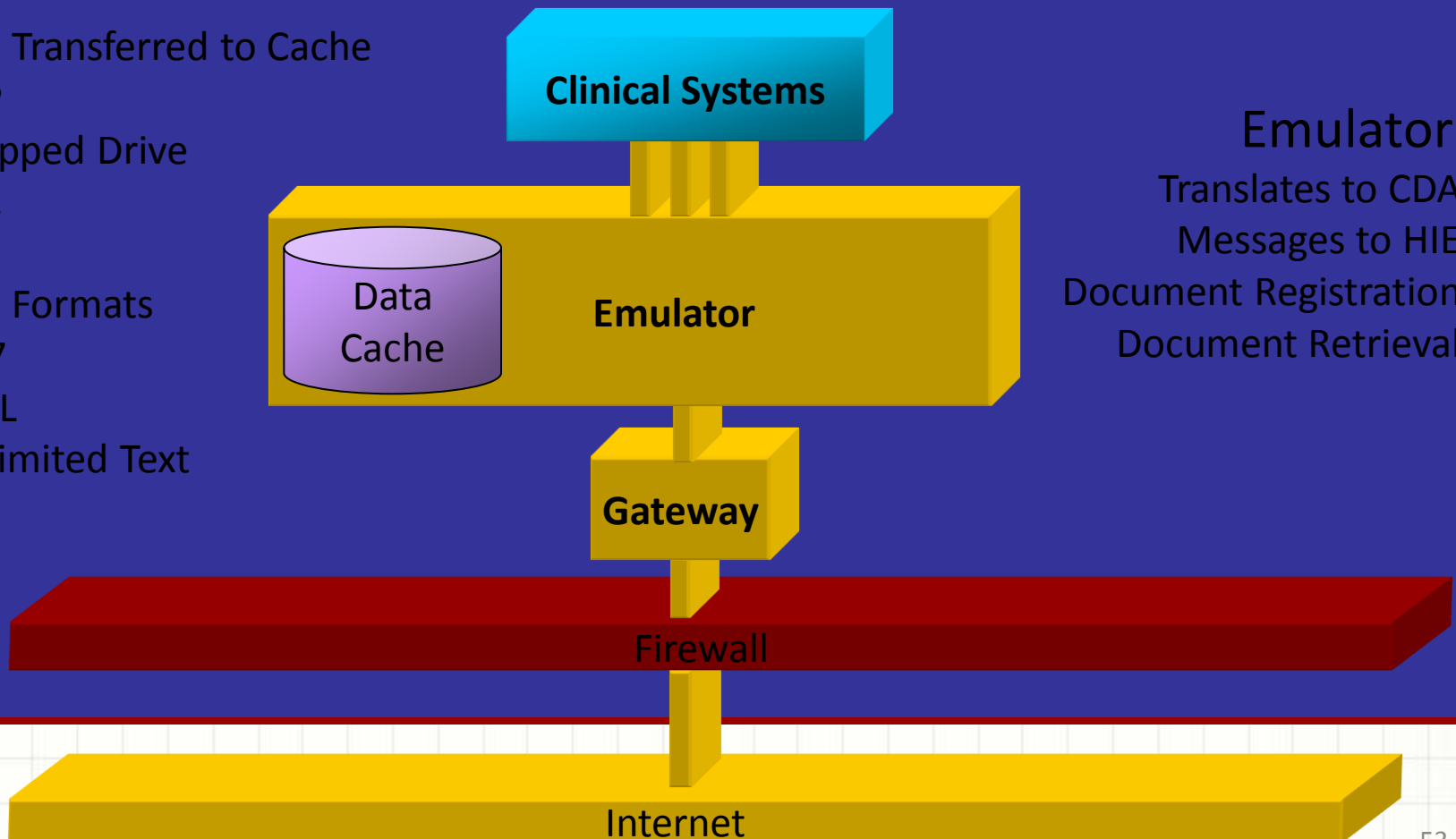
Data Transferred to Cache
FTP
Mapped Drive
Etc.

Data Formats
HL7
XML
Delimited Text

Clinical Systems

Emulator

Data Cache

Gateway

Firewall

Internet

Emulator Approach

Emulator
Translates to CDA
Messages to HIE
Document Registration
Document Retrieval

Browser Based Viewer

- Initial Strategy - Viewer
  - EHR Adoption is Limited
  - Need to Realize Value Early
  - Keep it Simple, Easy to Use
  - Still be Secure and Maintain Privacy
- Longer Term - EHRs
  - Services Oriented Architecture
  - Follow NHIN Concepts
    - Subject Discovery
    - Document Query
    - Document Retrieve
    - Document Registration

Tightly Managed Access

User Provisioning and Oversight

- Arizona License (MD, DO, PA or NP)
  - Standard HIPAA Privacy provisions
  - State privacy provisions

- AHCCCS provider contracts
  - Provider Registration
  - Health plan provider contract

- Participation Agreement & Policies
  - AMIE Training Modules, include <u>penalties for misuse</u>
  - AMIE *Viewer Account Management Form*
  - AMIE *Attestation* Screen
  - Each use and print Warnings and Disclaimers

AMIE Software Development Methodology is Agile.

- Agile Methodology –
  - Agile software development process framework
  - Extended Agile approach to all phases of the development life cycles
  - Used the advantages of the FDD workflows
  - Used the advantages of the Scrum methods
  - Daily Scrum meetings with the story and use case based implementation

AMIE Patient Consent is based on Oasis XACML Standards

AMIE Consent Model Is

- Opt-out
- All or Nothing

Consent Components

- Policy Enforcement Point (PEP)
- Policy Decision Point (PDP)

Patient Consent– HITSP TP30 Construct is used.

No authorization,
no access

Authorization at
each organization

Real-time authorization

Patient education

Rigorous information security practices

Managed at Point of Care
Centrally Maintained

- Patients informed
- Patient chooses to withhold consent
  - Informs practice staff
  - Staff registers directive in AMIE
- Consent Status Maintained by AMIE System
- AMIE monitors Break-the-Glass

Monitoring

- Utilization Reports
  - Activity by User, Organization
  - Record Types
  - Users by Individual, Organization
  - Login Analysis
- Audit Reports
  - Manual Review
  - Viewer Administration and Use
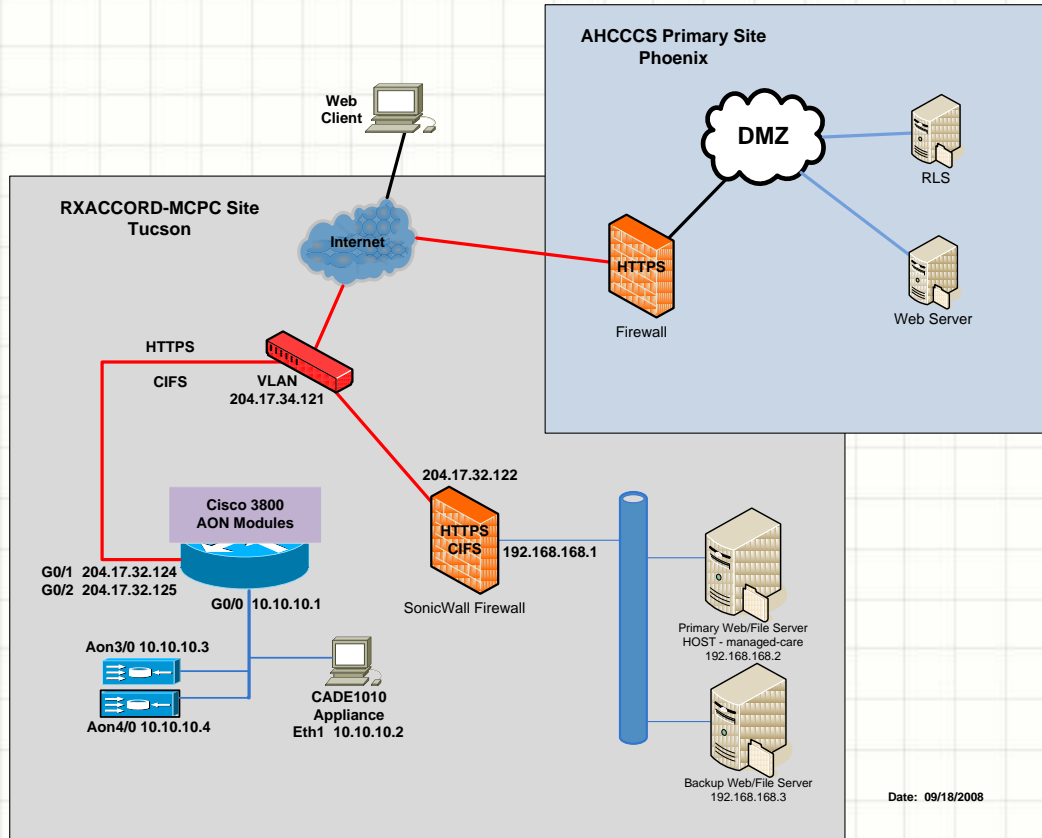- Ad hoc requests
- Penalties

AMIE Technical Standards

- Development Standards
  - C#, Web Services, .Net, Java
- API Standards
  - .Net, Web Services, WCF, .Net
- Communication Standards
  - TCP/IP, HTTP, HTTPS, SOAP
- Messaging Standards
  - HL7 V2, HL7 V3
- Security Standards
  - TLS, SSL

AMIE Production Infrastructure
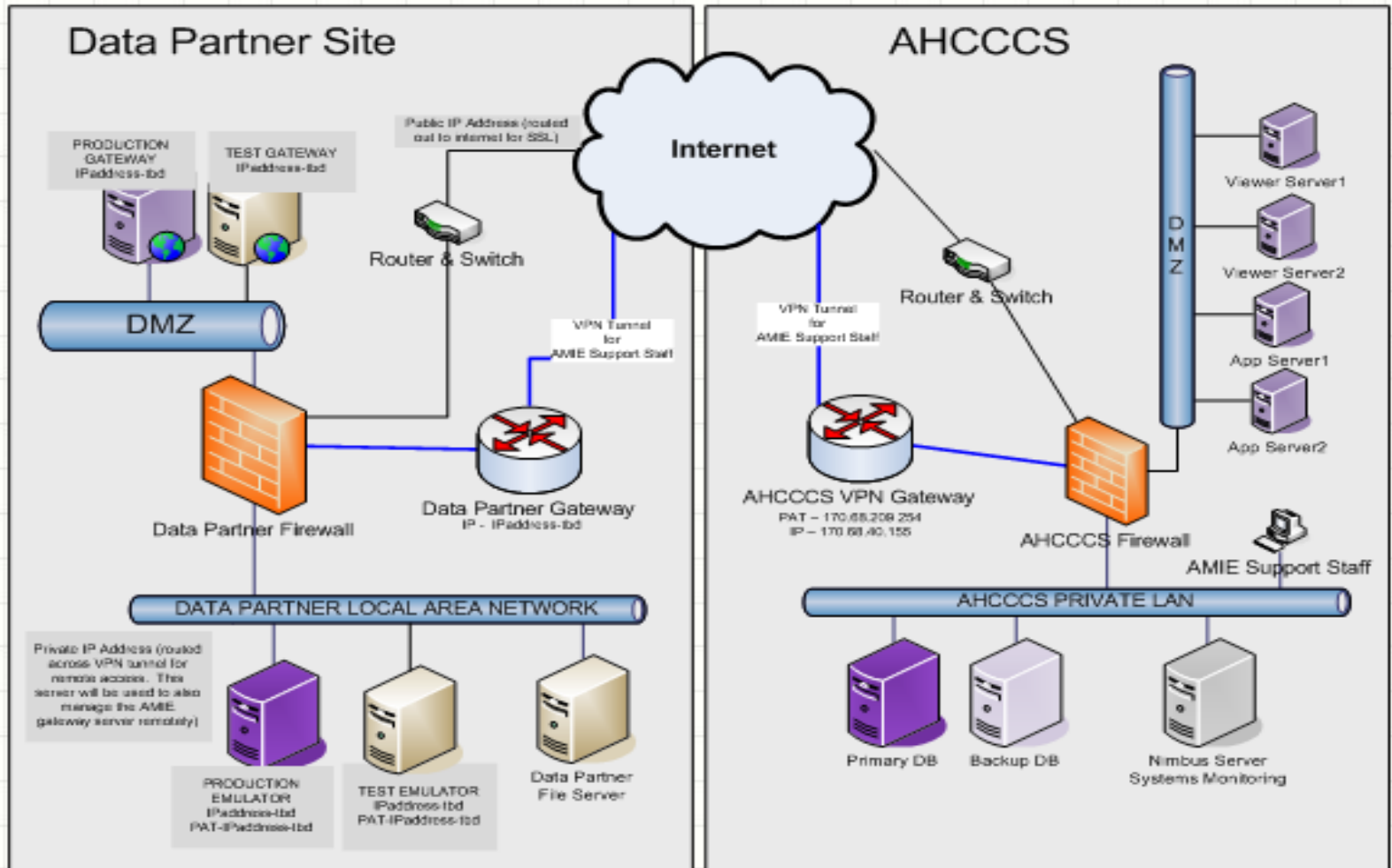
AMIE Cisco Implementation

AMIE POC Projects

- Cisco – External solution interoperability. Java based Cisco AON device to exchange Medication history with AMIE.

- Initiate Systems – Tested AMIE replacing the AMIE MPI with Initiate EMPI as a proof of concept project

- Intel SOA Expressway – Evaluated and tested Intel solution. This can be used as another option for data partners to plug into AMIE

AMIE Roadmap: HITSP Constructs and IHE Standards

HITSP

- **Quality Reporting**
  - C 38: Patient Level Quality Data Document Using IHE Medical Summary (XDS-MS)
- **Research Reporting**
  - C 25: Anonymize
- **General Transaction Delivery**
  - C 26: Nonrepudiation of Origin
  - T 16: Consistent Time
  - T 17: Secured Communication Channel
  - T 31: Document Reliable Interchange
  - T 29 : Notification of Document Availability
  - C 44 : Secure Web Connection
  - C 62 : Unstructured Document
  - C 80: Clinical Document and Message Terminology

- ☐ **Maintain Privacy and Security**
- ☐ TP13: Sharing of documents
- — TP20: Access Control Transaction Package
- — T 15: Collect and Communicate Security Audit Trail Transaction
- — TP30: Manage Consent Directives Transaction Package

HITSP & IHE Common

|	
HITSP TP22 IHE-PIX Patient lookup by ID	HITSP C32 IHE XDS-MS Medical summary
HITSP TP23 IHE-PDQ Patient lookup by demographics	HITSP C37 **IHE XD*-Lab** Lab data exchange
XDS HITSP TP23 IHE XDS Document storage/ retrieval	HITSP T17 IHE ATNA Secure node
	HITSP T15 IHE ATNA Audit logging
HITSP T14 HL7 V2.4 Exchange lab results	HITSP T16 IHE CT Consistent time
HITSP TP30 IHE BPPC Consent	

AMIE AS A
STATE LEVEL HIE & NHIE

State Level Health Information Exchange Vision
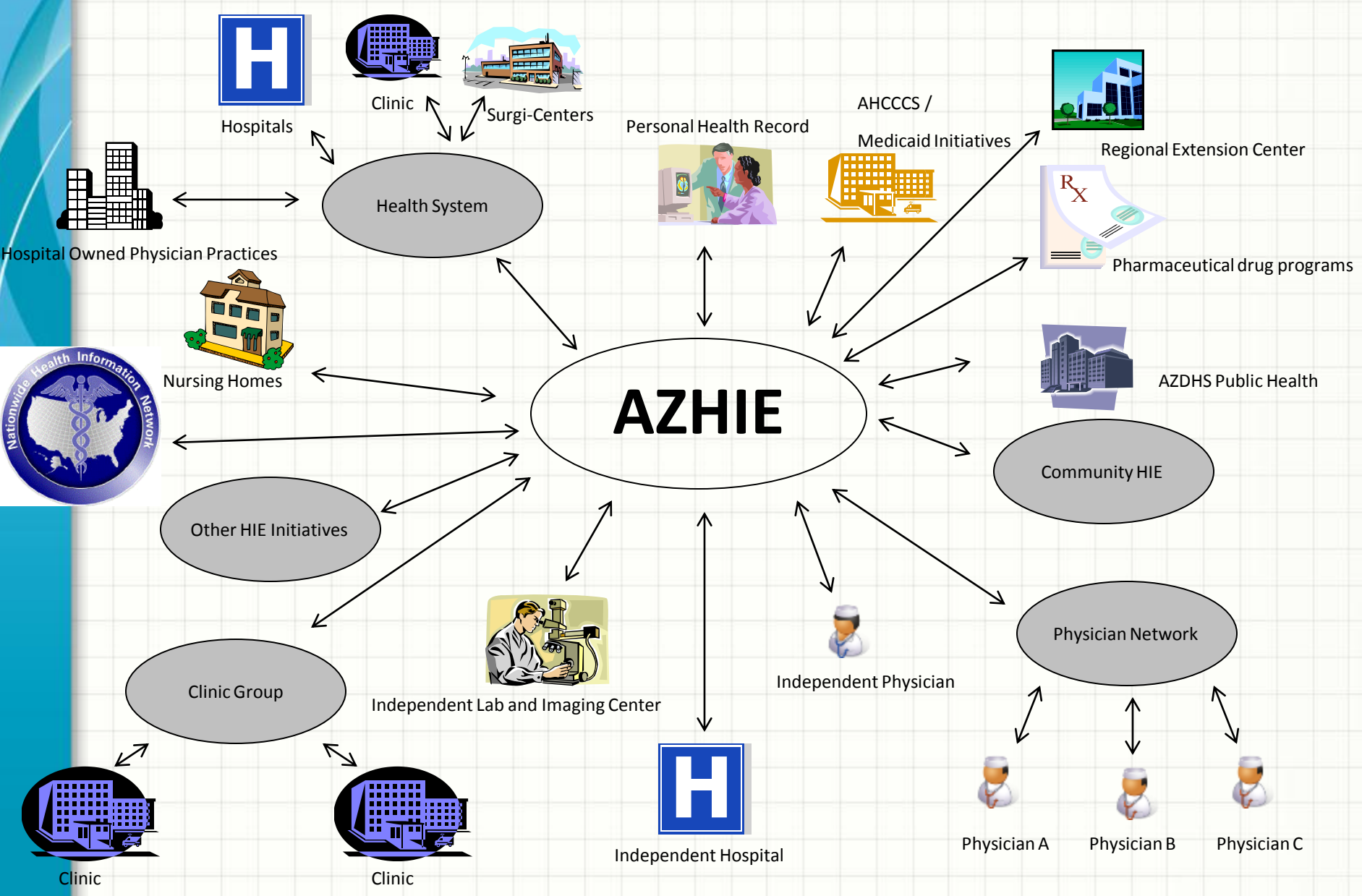
AMIE State Level HIE

- What work still needs to be done?
    - Implement Terminology Services
    - Implement IHE Profiles
    - Test with EHR and EMR Vendor Systems
    - Integrate with e-Prescribing applications.
    - Test with SureScripts and RxHubs
    - Replace AMIE MPI with robust vendor based EMPIs like Initiate

AMIE as an NHIE

- – NHIN Gateway deployed in the AMIE Labs
- – Integration tests with the NHIN Adapter to be completed
- – DURSA agreement signed.
- – Pick a testing partner with another federal agency or another willingly NHIE.