HL7 FHIR Overview

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Corepoint HEALTH

Thanks Lloyd *et al*

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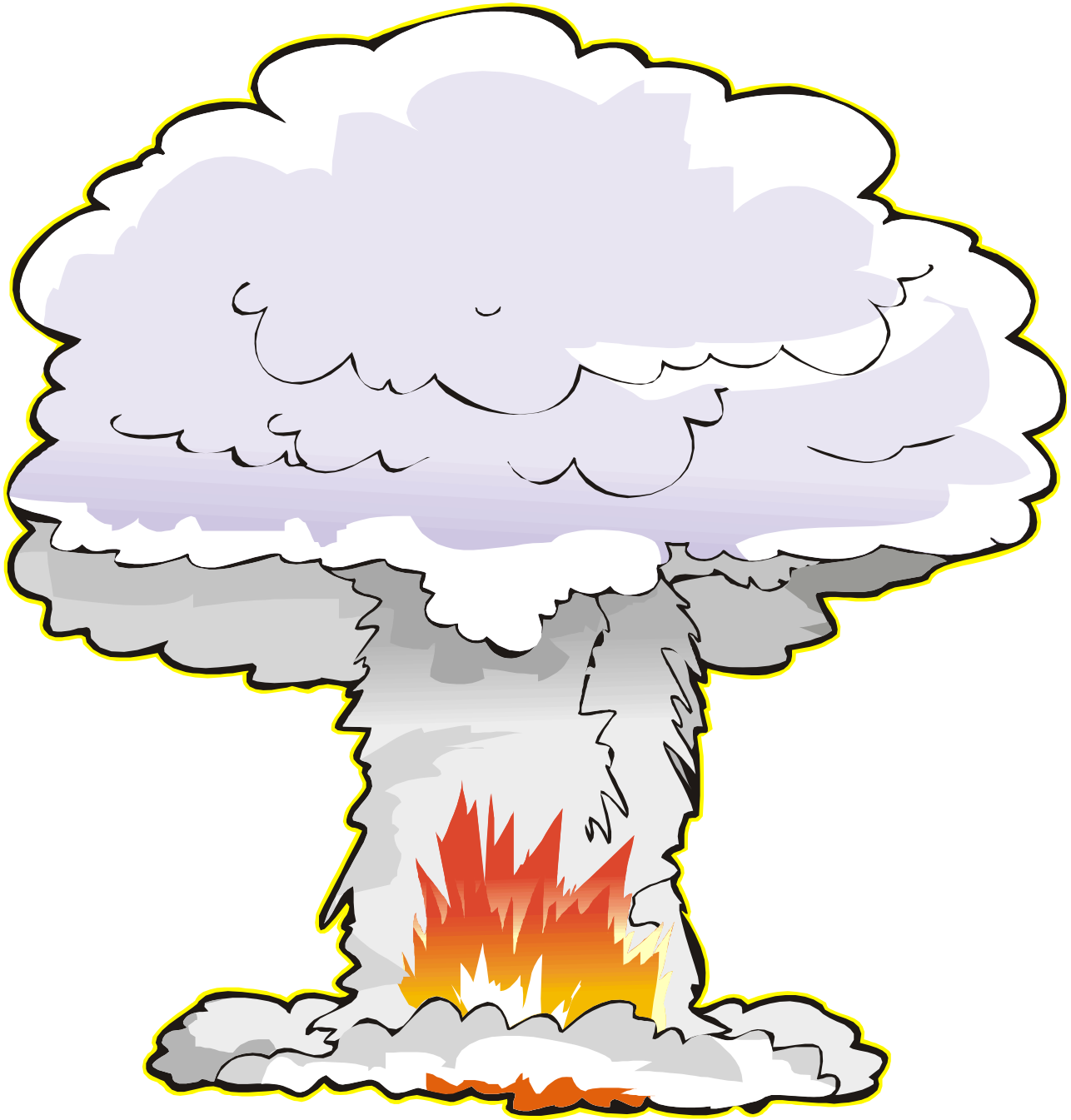
- **http://gforge.hl7.org/gf/project/fhir**

As

- **/trunk/presentations/2016-04 Webinars**

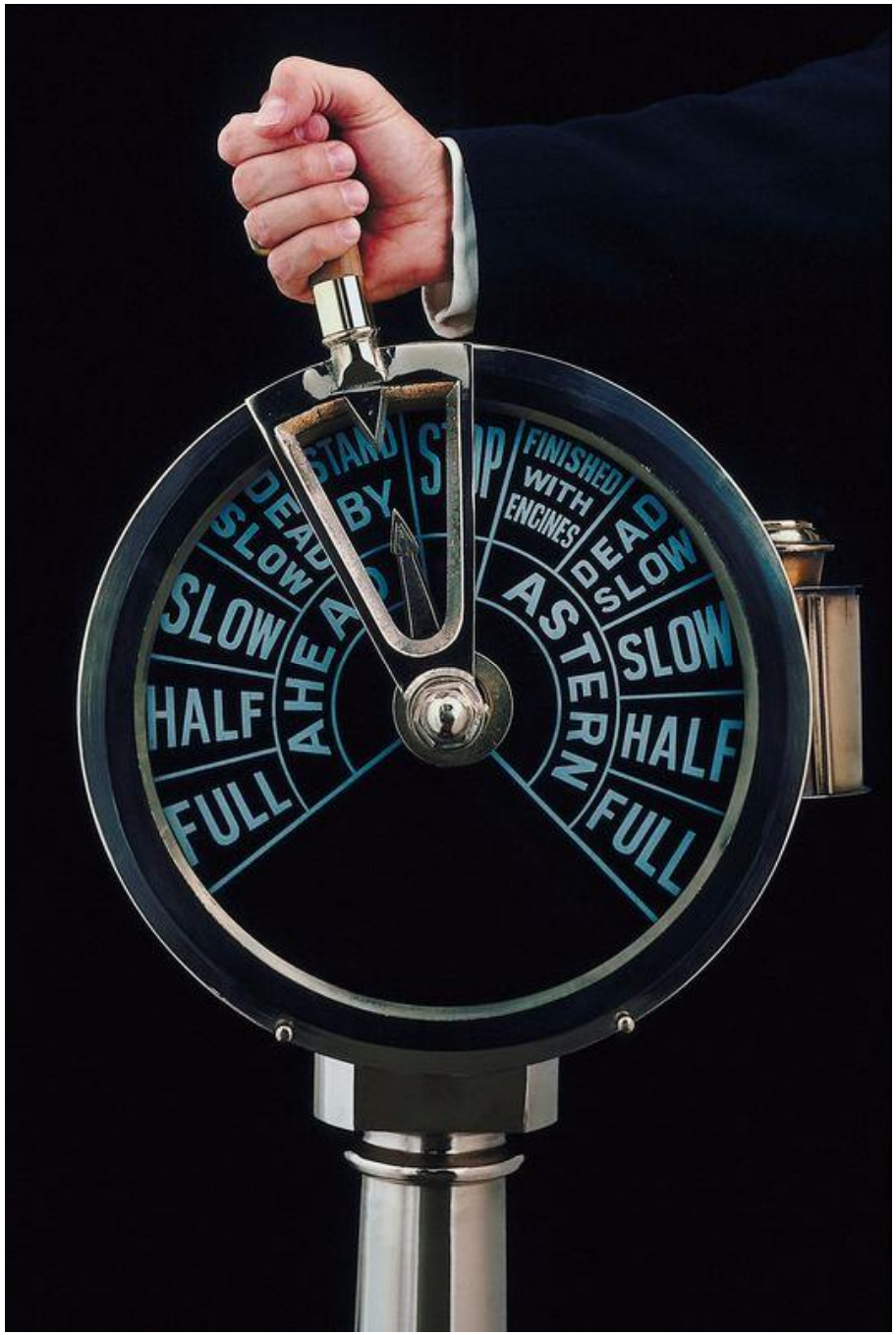
Goals

1. Survey
2. Market Context
3. Standards Context
    1. Technologies
    2. Relationships
    3. Details
4. Q&A




THE UNITED STATES OF AMERICA
WASHINGTON, D.C.


FOR
SAL


STAND BY
STOP
FINISHED WITH ENGINES
DEAD SLOW
SLOW
HALF
FULL
AHEAD
ASTERN
DEAD SLOW
SLOW
HALF
FULL

Interoperability

How many legs does this elephant have?

HL7 in one sentence

- “HL7 makes it easi**er** to integrate!”
- “HL7 is a framework for negotiation”
- “When you have seen one HL7 interface you’ve seen… one”

– Wes Rishel

- "Communication and interoperability are not a science. They are an art form perfected over time.“

– Keith Boone

(@motorcycle_guy) "On Models" (http://motorcycleguy.blogspot.com/2013/08/on-models.html)

Pick Two

- Fast, Good, Cheap
- Scope, Time, Budget
- Risk, Resources, Quality
- Privacy, Accuracy, Security
- Cheap, Light, Strong
- Fast, Small, Flexible
- **Cheap, Flexible, Interoperable**

Dave's Triple Constraint

- **Usable**
  - Specific department
  - Across many facilities (customers)
- **Flexible**
  - Supporting many workflows
  - Configurable
- **Interoperable**
  - Across departments, workflows, and care settings
  - For "Free"

Boiled down, HL7 is all about…

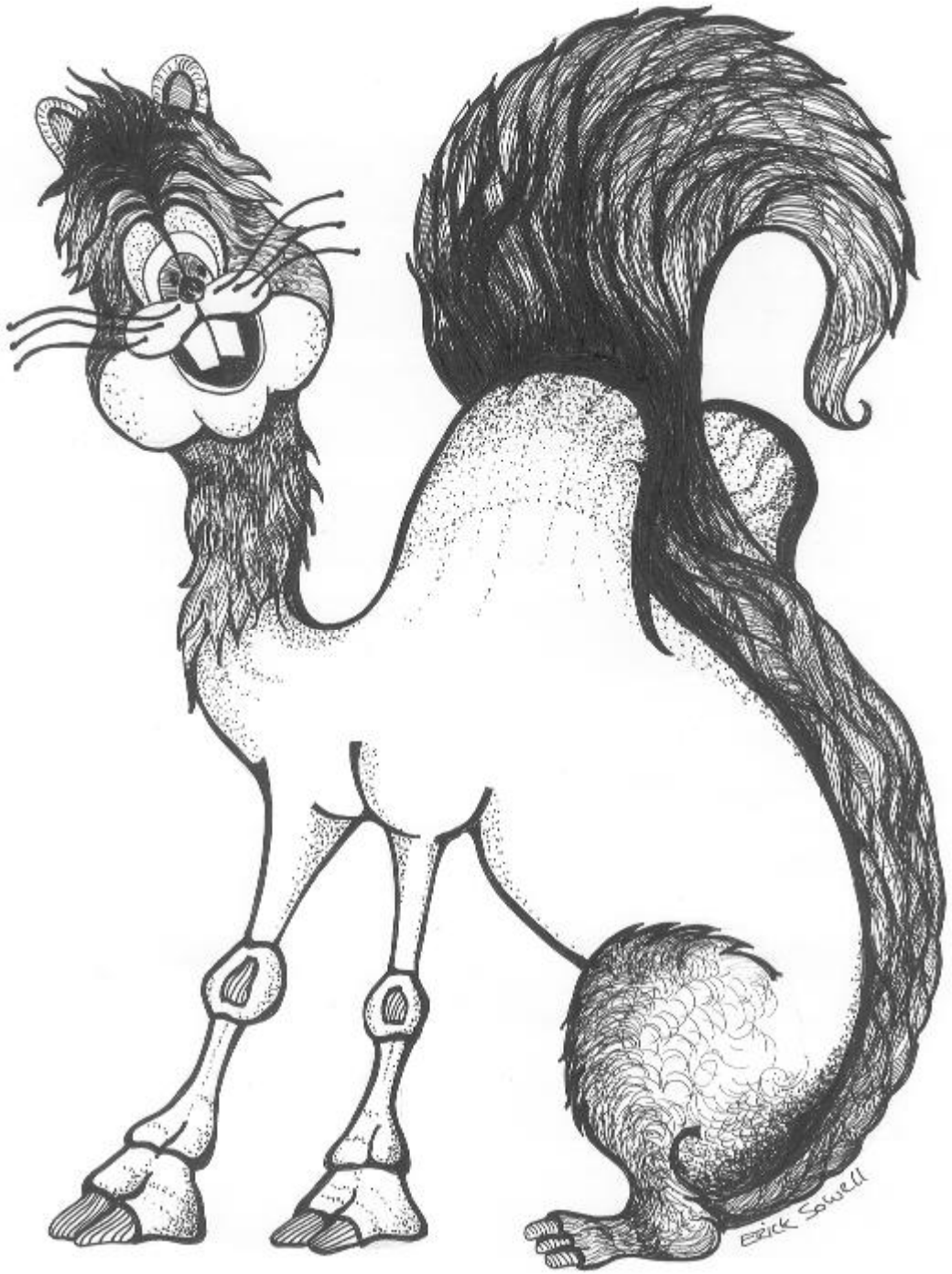
- Moving data between two applications
- Apps written by different vendors
- Vendors created the apps in a vacuum

Consequently:

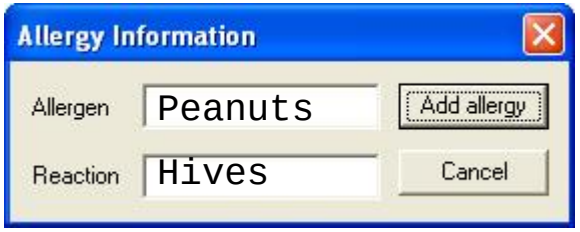
- Data models differ
- Application uses differ

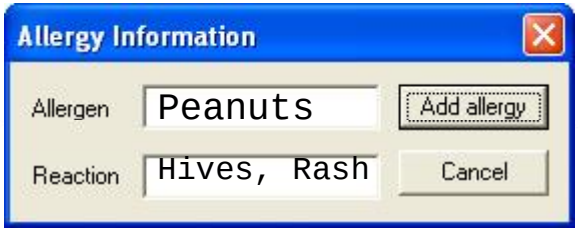
The not so rare...

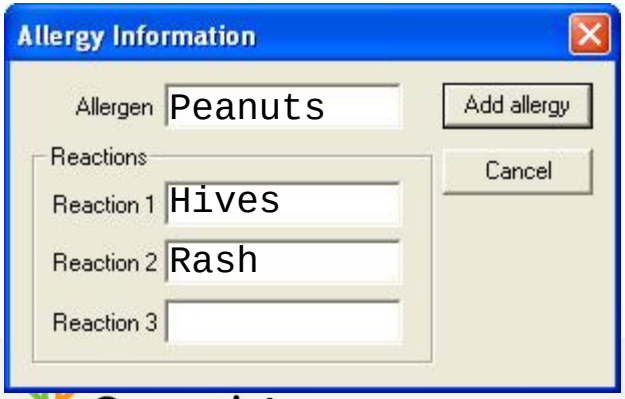
Squamel
Committeeous

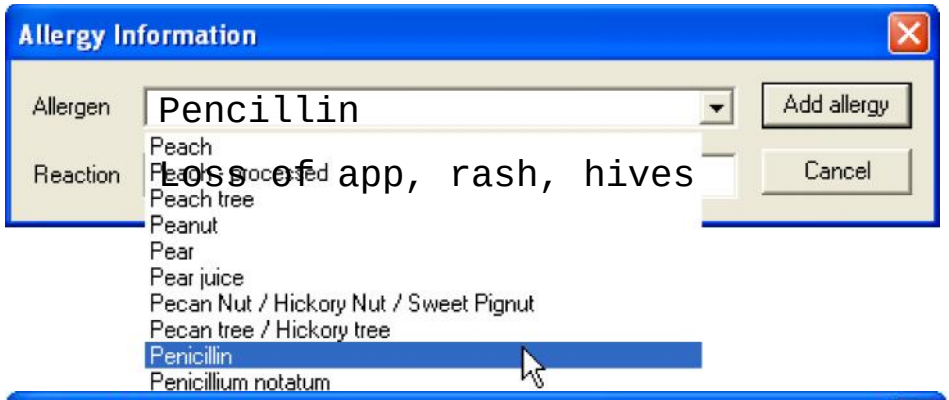


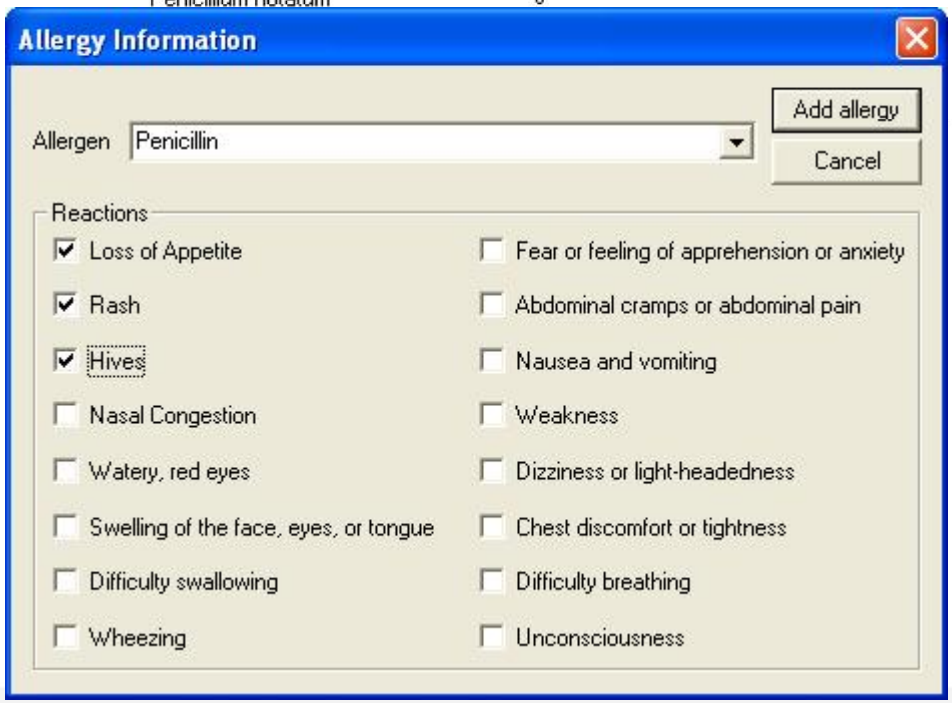
Different data models











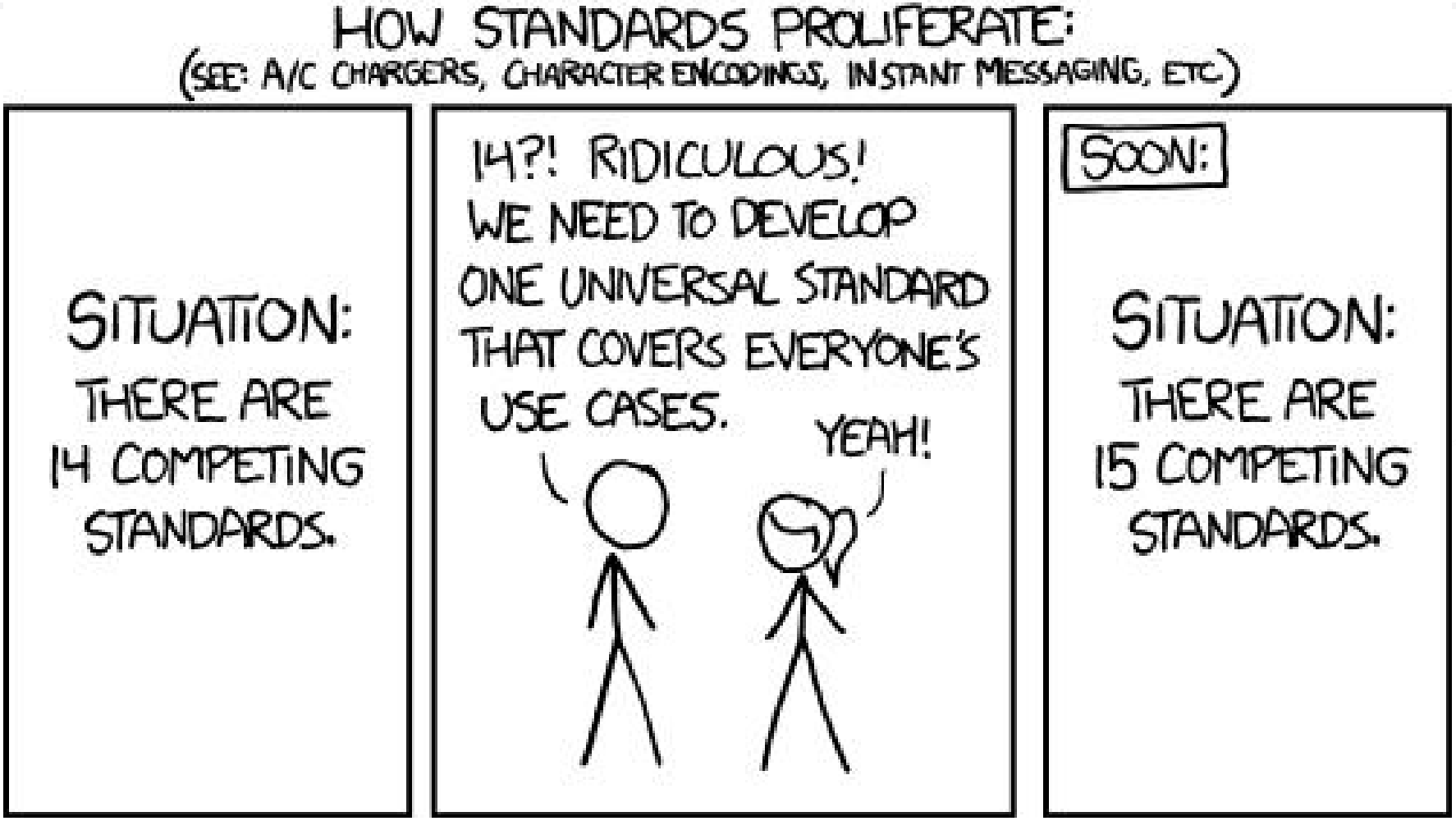
Corepoint HEALTH

SCALE SMARTER.

Intro to FHIR

- What is FHIR?
- Historical Relationships to Other Standards
- Context & Examples

Dave Shaver
President & CTO



http://xkcd.com/927

Fast (to design and implement)

Health

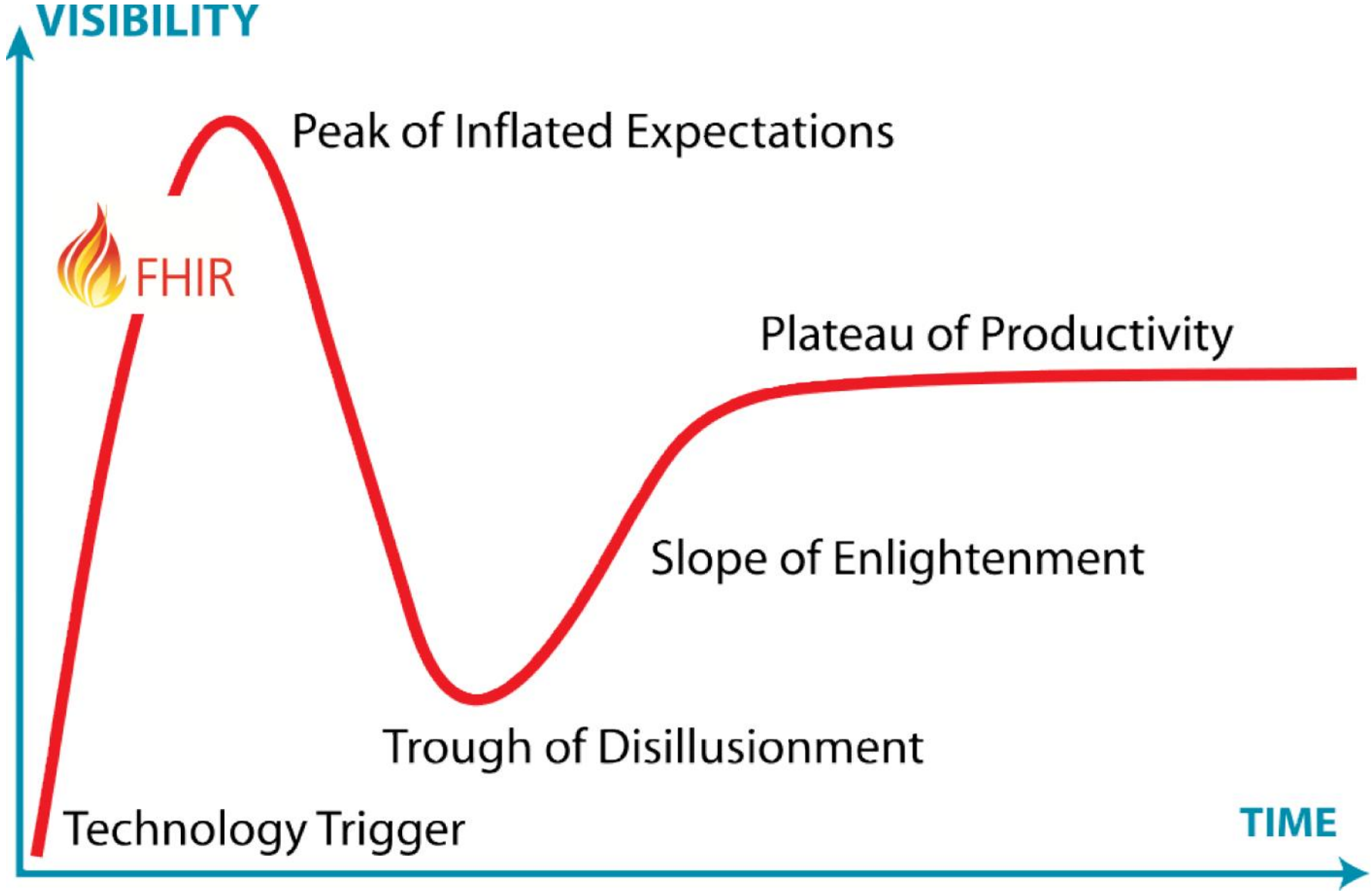
Interoperable

Resources

- Old: Transactions sent at a point-in-time
- New: API to Source of Truth

- Old: Data *only* pushed by Source of Truth
- New: Consumer pulls data *when needed*

- What would healthcare exchange look like if we started anew?
  - RESTful based API
  - Exemplar: Highrise (https://github.com/37signals/highrise-api)


VISIBILITY
Peak of Inflated Expectations
FHIR
Plateau of Productivity
Slope of Enlightenment
Trough of Disillusionment
Technology Trigger
TIME

Dave's 30 second take

1. V3 RIM(ish) + RESTful + (JSON|XML)
2. Semantic rigor + implementation-focus
3. Design for the 80% yet allow for the 100%

Dave's Additional 90 Seconds

1. Interfaces based on a statement of *capabilities*
2. Data stays in the application that is *source of truth*
3. "API-like" query to data – *pull not push*

Paradigms

- FHIR supports four interoperability paradigms
  - REST – Lightweight, leverages web stack
  - Documents – Long-term persistence
  - Messages – Request/response paradigm
  - Services – other SOA-based interfaces
- Regardless of approach, content stays the same
  - Can leverage same models, same profiles everywhere

Advantages

- Based on RESTful web services
  - IHE profiles are based on SOAP
  - Many modern applications (Twitter, Amazon, etc.) based on RESTful
- FHIR is encoded using XML or JSON
- FHIR data can be pushed or pulled
- Off-the-shelf Security
  - HTTPS, OAuth

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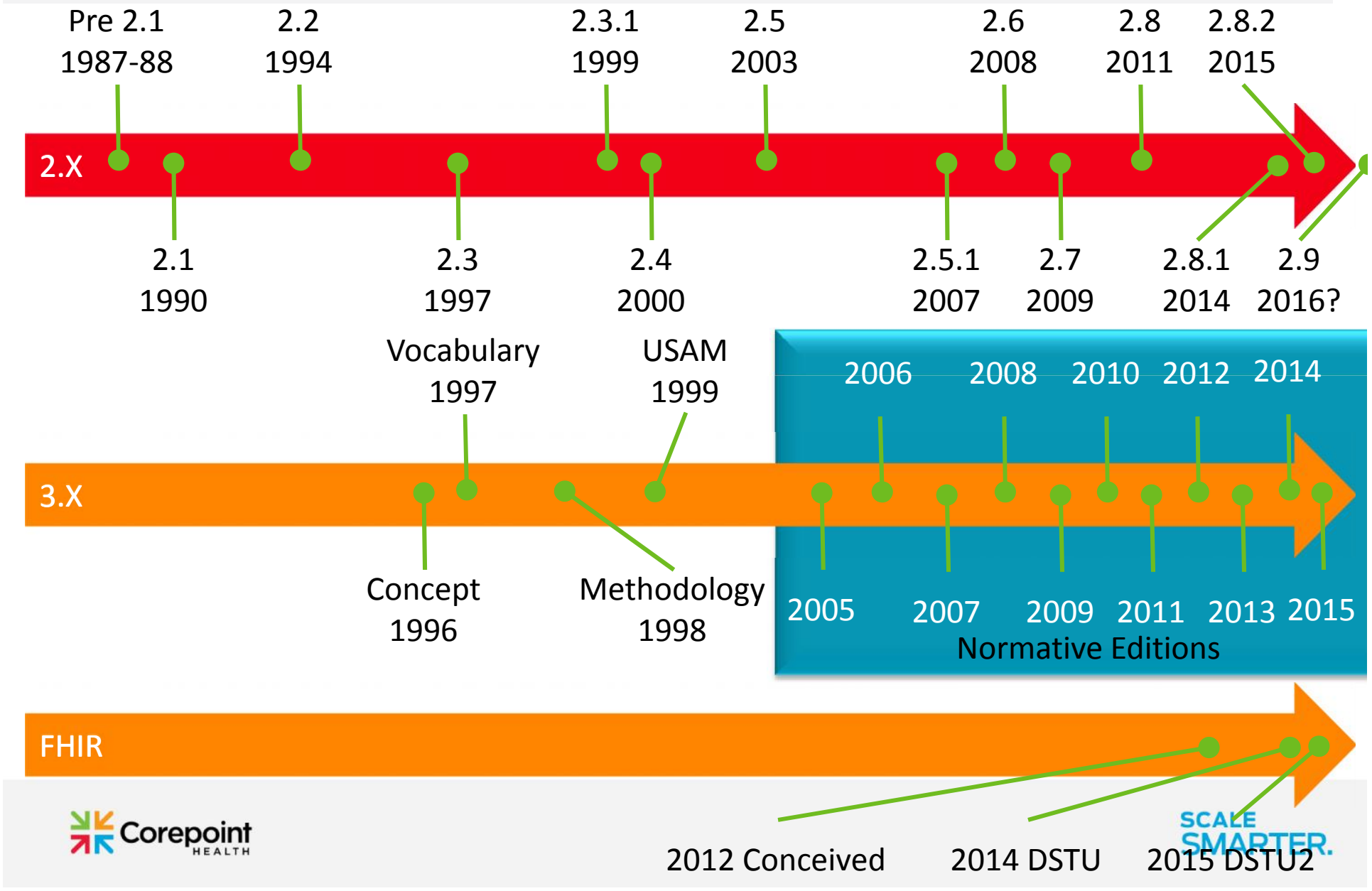
HL7 Timeline



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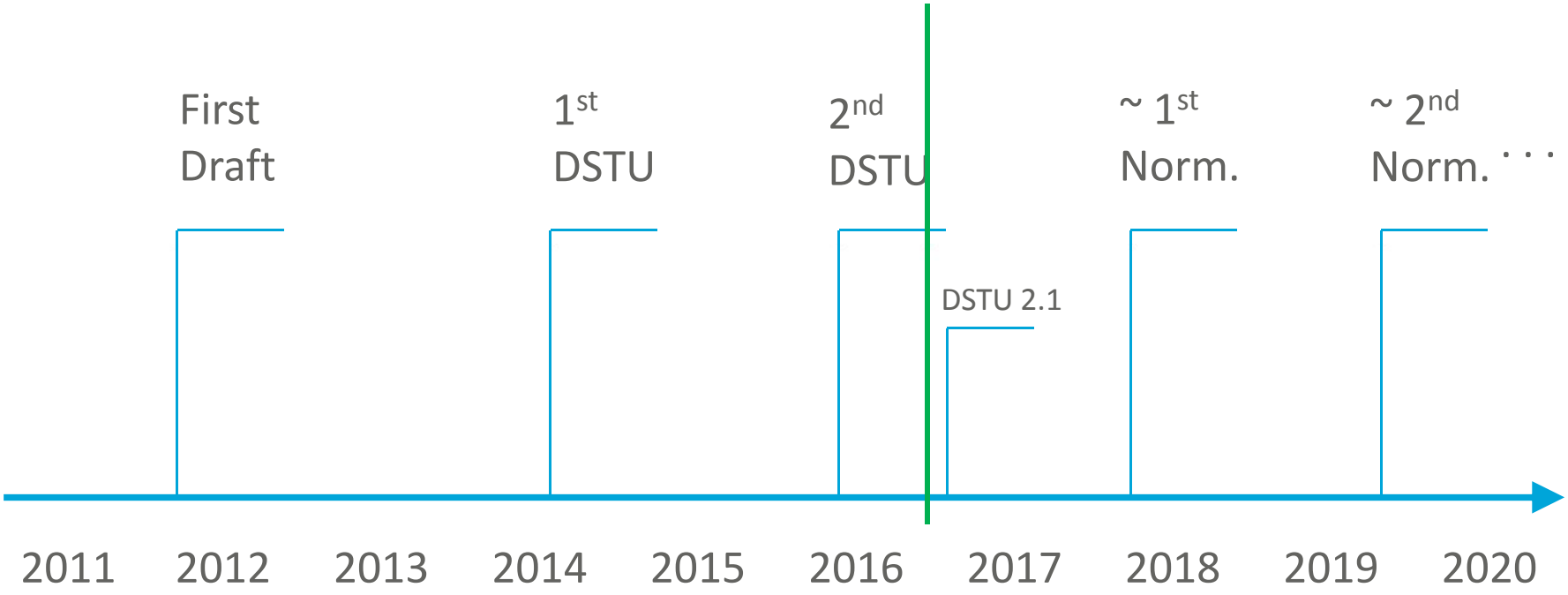
SCALE SMARTER.

FHIR Timeline (planned)



What does STU mean?

1.0 FHIR Documentation Index

This page provides and index to the FHIR Documentation. In addition to this documentation, there are implementation assistance (which has important information about how practical use or FHIR), and the list of resources.

Administration

Documentation Guidance / Background.

- Full Table of Contents
- License and Legal Terms
- Community & Credits
- Version History
- Outstanding Issues

Resources

Underlying Definitions for Resources.

Data Types

Common types used throughout FHIR.

"…all aspects of the FHIR specification are potentially subject to change

Overview

Background and Tutorial Information.

- 1 page Summary (Glossy)
- Overview & Roadmap
- **Read prior to use (DSTU Note)**
- Appendices:
  - Comparison with other HL7 Specifications
  - Appendix: How FHIR fits into an EHR
  - Appendix: Coming Challenges Driving Change

- Extensibility (Examples)
- Formal Definitions

- Using Codes in Resources
- System List
- Value Set List
- V2 Table List
- V3 Code System / Value set List
- Mappings between Value sets
- + see the Value Set Concept Map Resources

Maturity levels

- Intended to indicate level of stability
  - FMM1 – Resource is “done”, no build warnings
  - FMM2 – Tested at approved Connectathon
  - FMM3 – Passes QA, has passed ballot
  - FMM4* – Tested across scope, published, prototype implementation
  - FMM5* – 5 distinct production implementations, multiple countries
- Non-compatible changes at level 4 and 5 will face increased hurdles

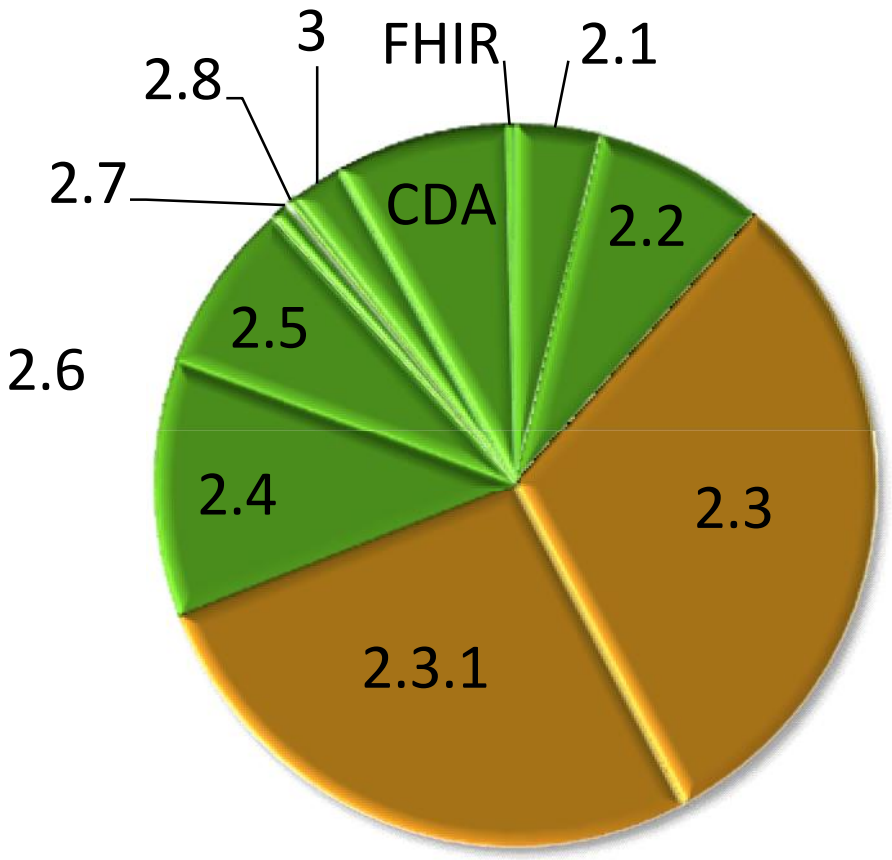
Normative FHIR

- Will include
  - Core specification
  - Structural resources
  - Subset of other resources
    - Some resources won't go normative right away
- Future releases
  - Add more resources
  - Add profiles on existing resources
  - May add elements to resources
    - Very rare

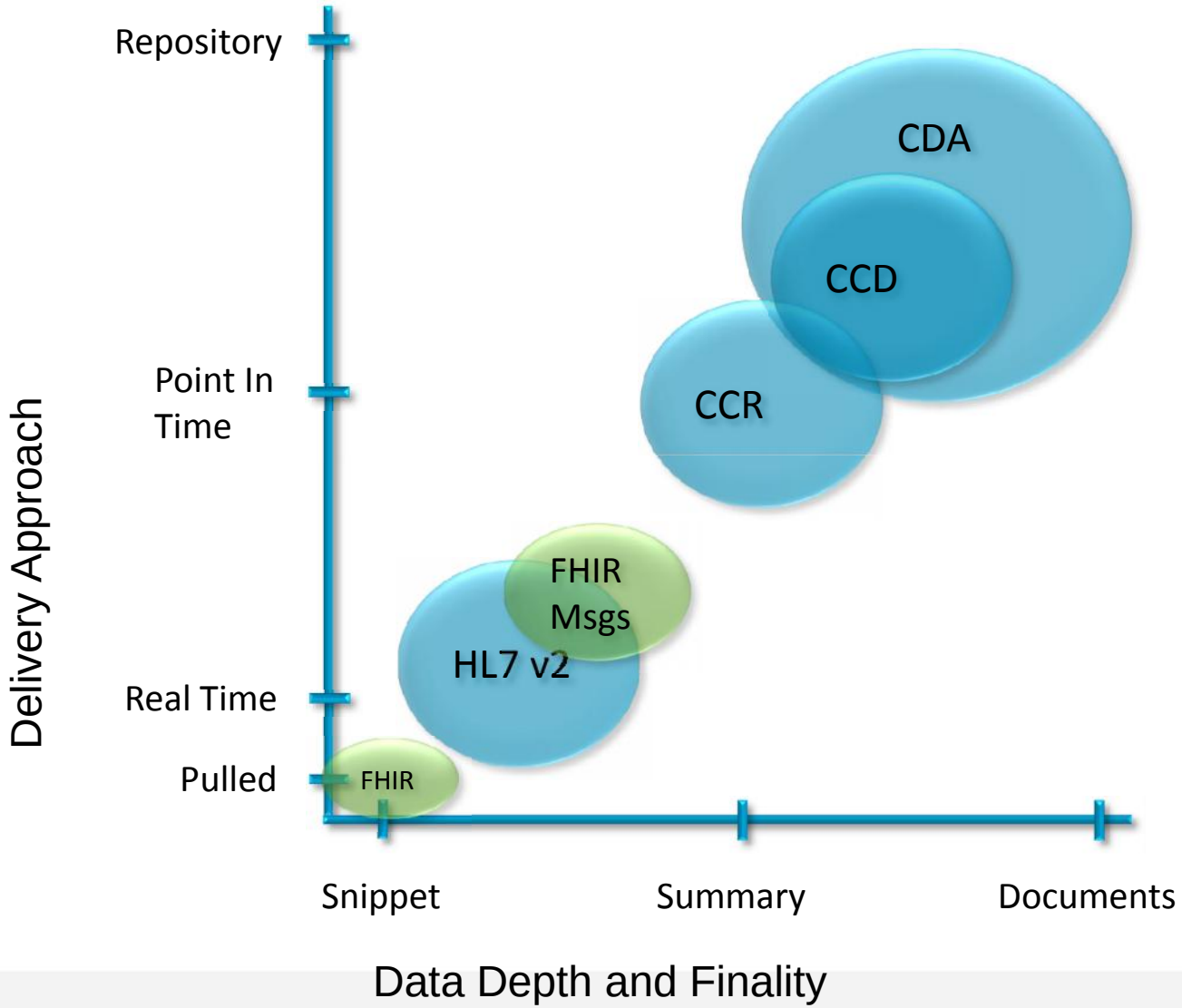
Migration

- No expectation that people will migrate existing interfaces – any time soon if ever
- Initial adopters will be green-field, new technology
- FHIR may see use behind the scenes in v2 systems before it sees use over the wire
- Forthcoming policy initiatives may necessitate revisiting existing interfaces

“In the wild” HL7 Interfaces



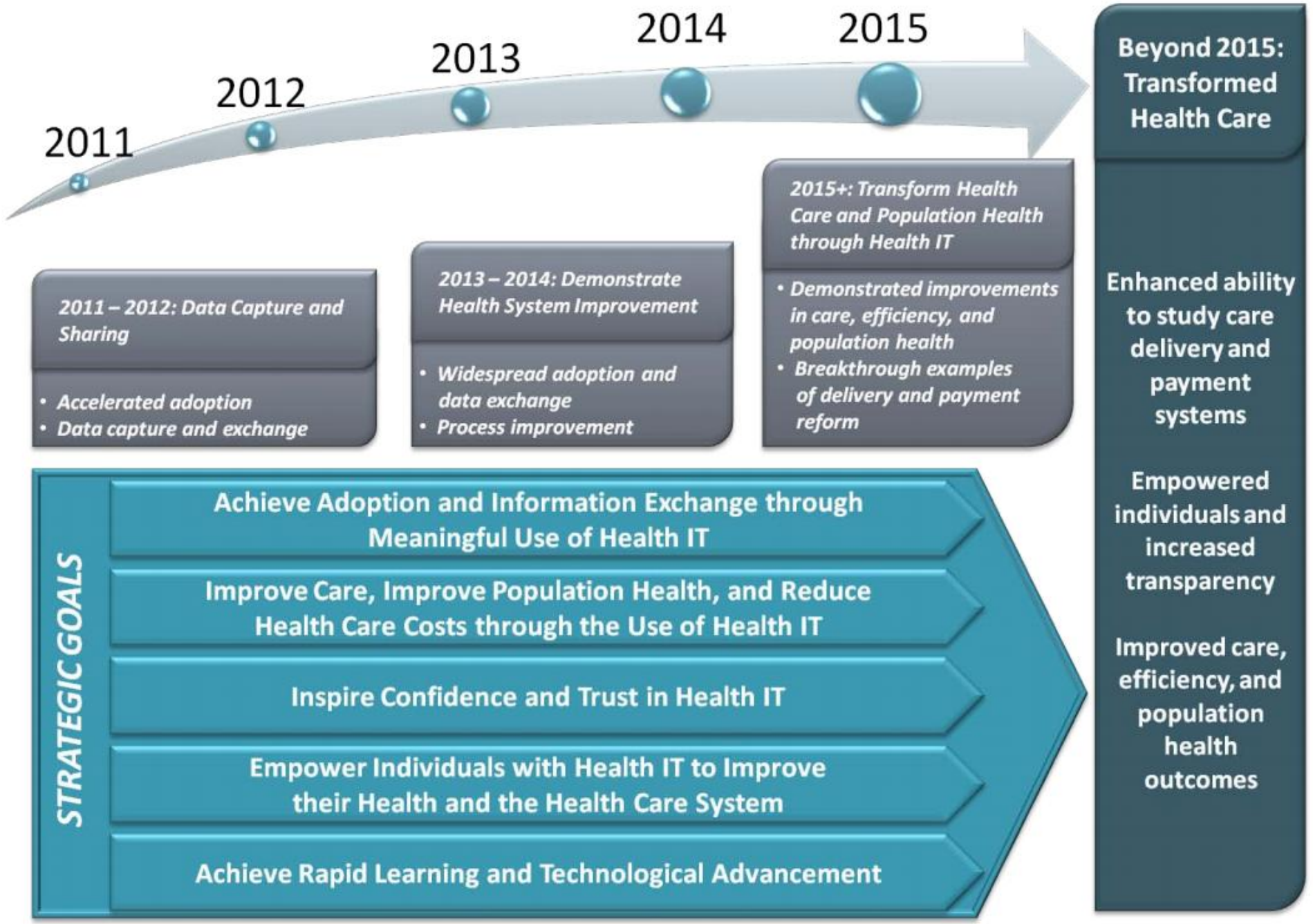
Message Data and Message Delivery



Changing Health IT Landscape

1. Regulations
2. Customers

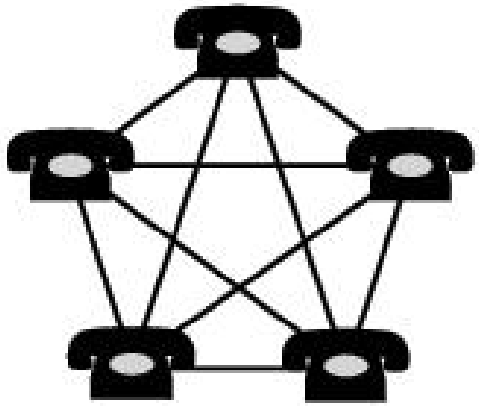
Graphic A: Federal Health IT Strategy Map



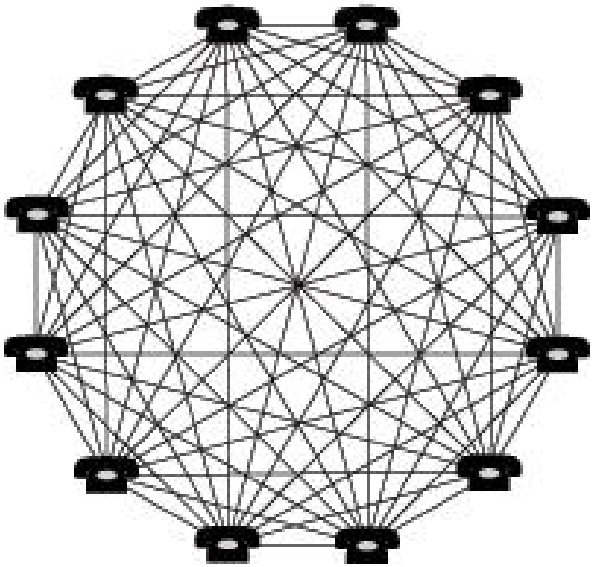
Metcalfe's Law

Network Value = $(\text{number of users})^2$

Value = $2^2 = 4$



Value = $5^2 = 25$



Value = $12^2 = 144$

http://en.wikipedia.org/wiki/Metcalfe's_law

Dave's Corollary to Metcalfe's Law

- The value of a healthcare standard to a new user is driven by number of prior adopters.
- Few prior adopters = little value

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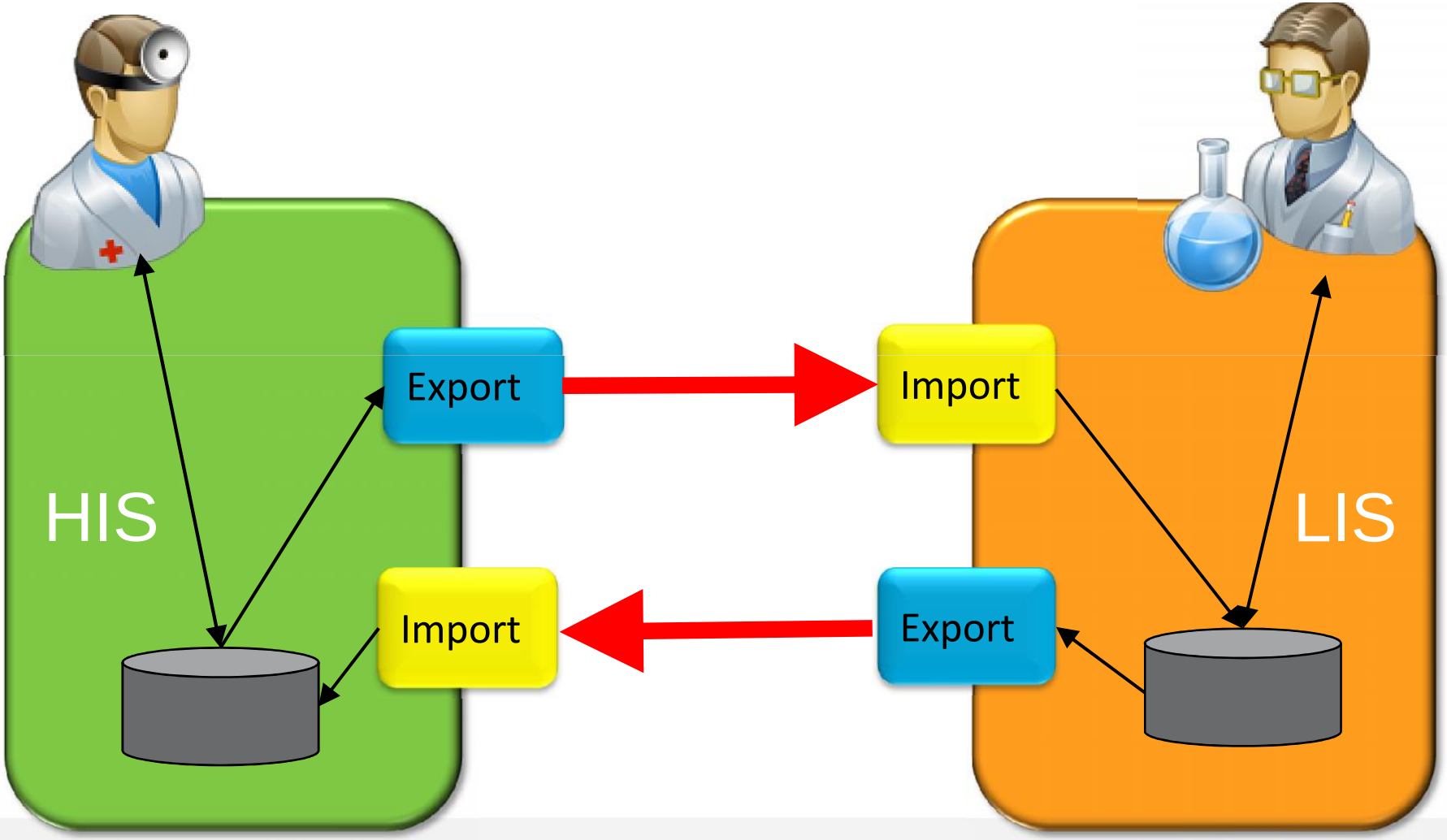
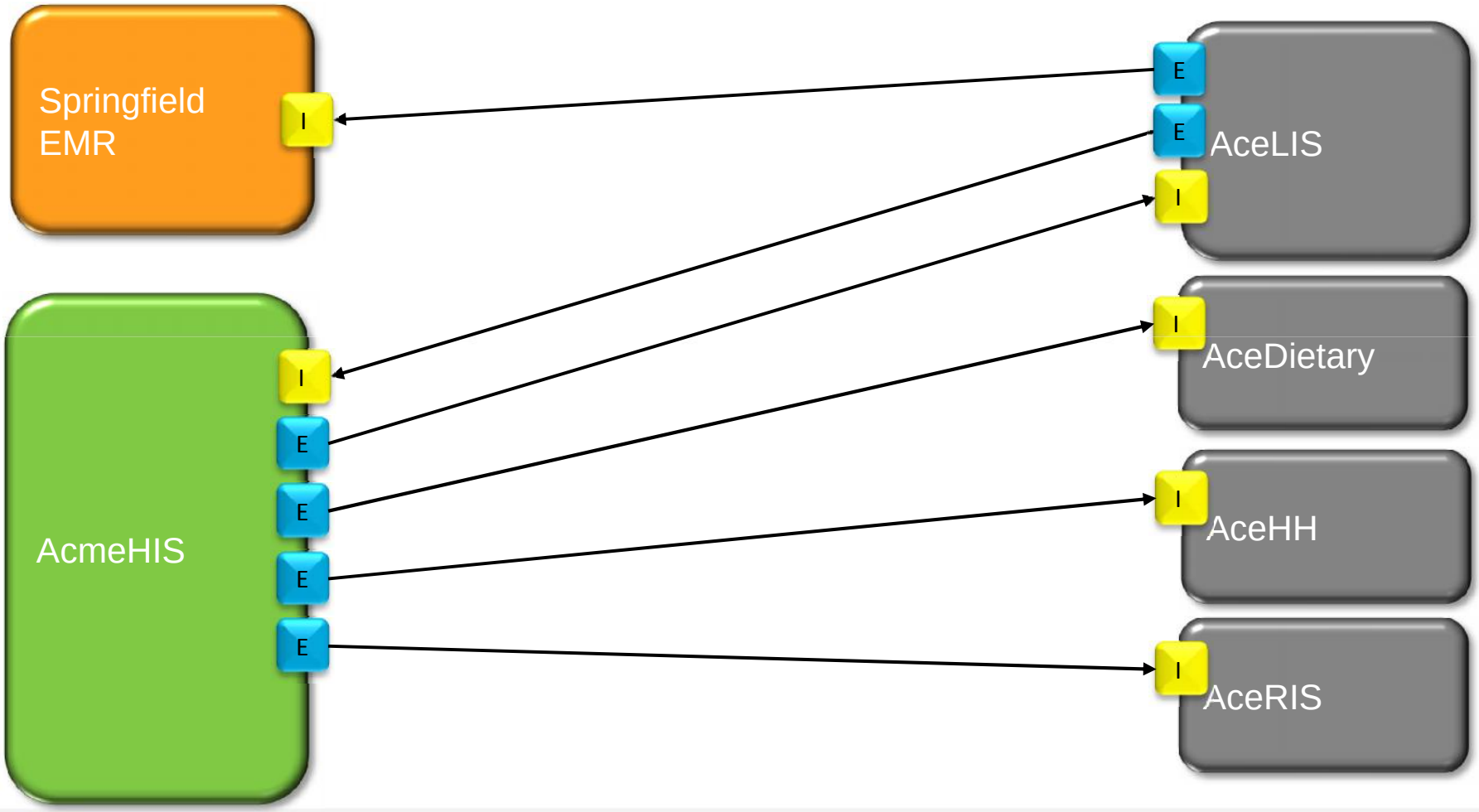
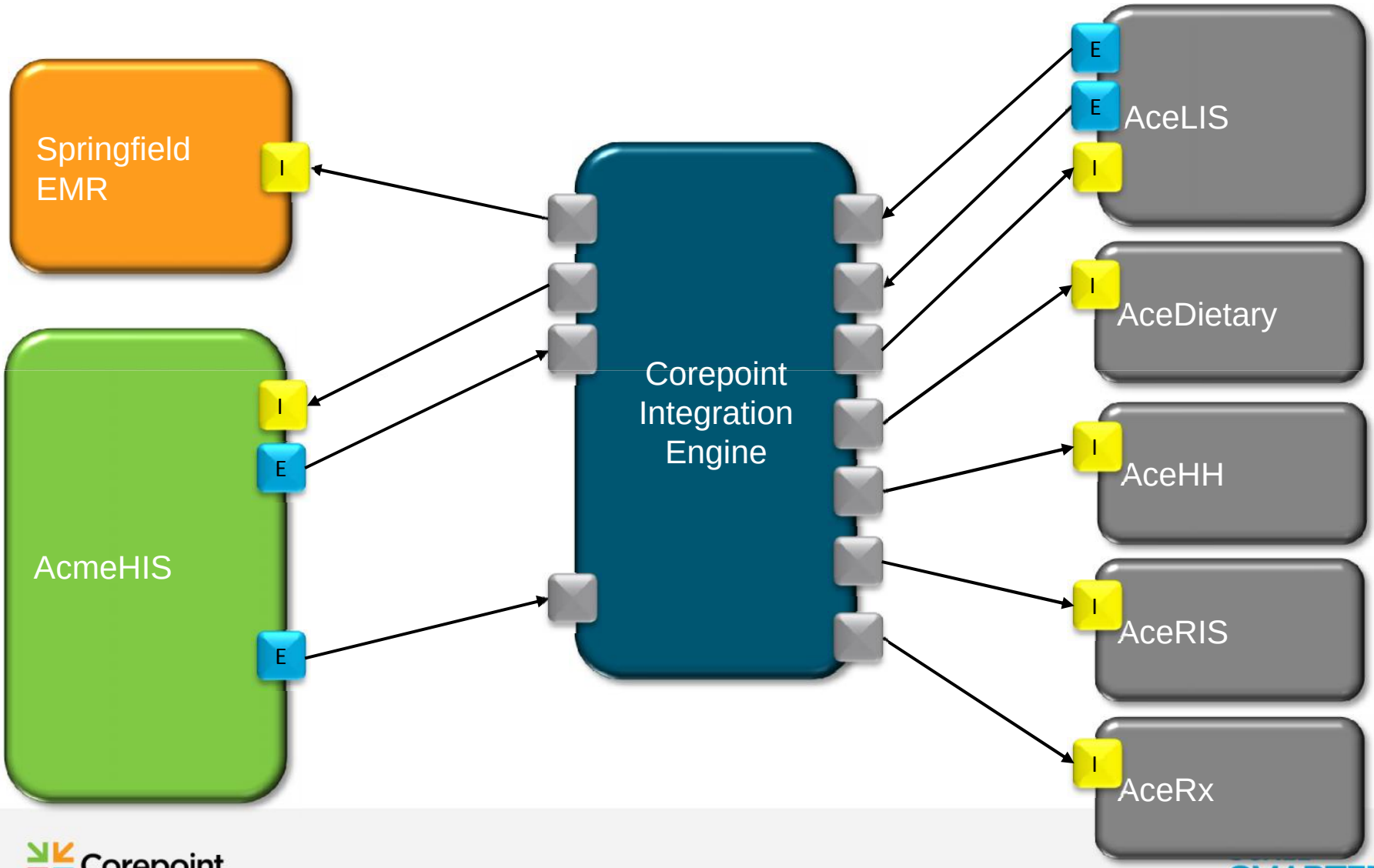
HL7 2.X Connectivity



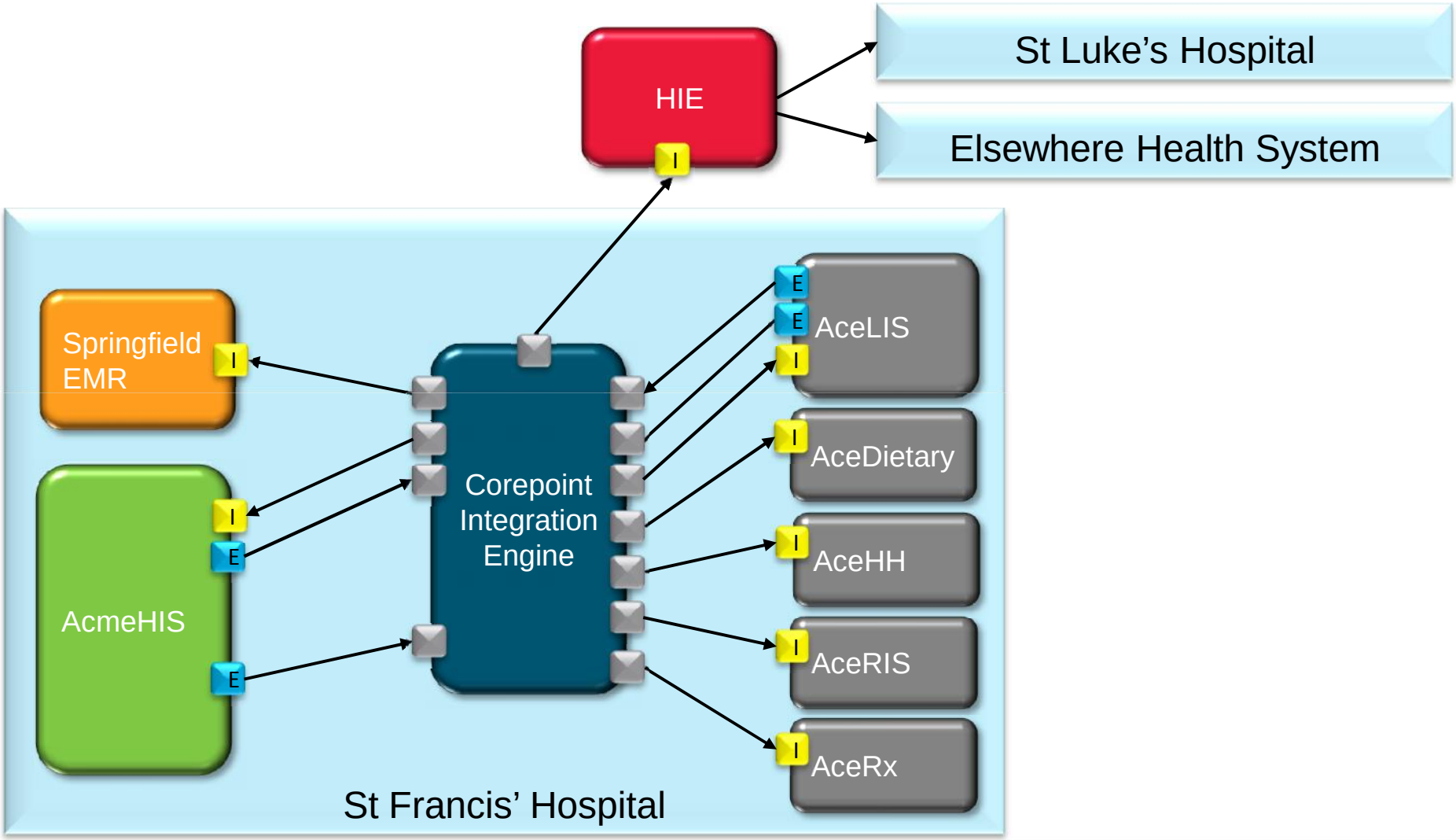
Hospital – Point-to-Point



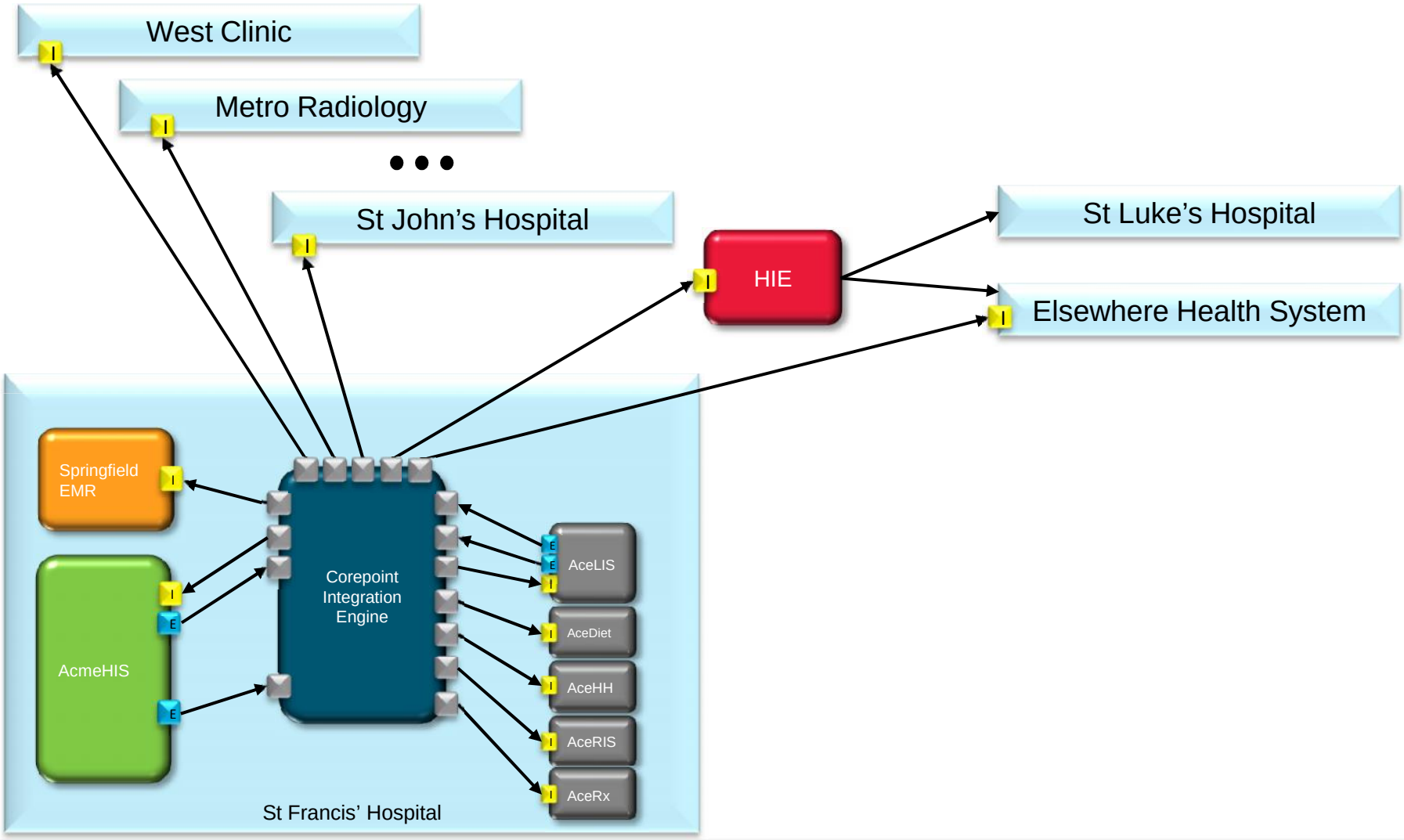
Hospital – Engine



Community: Dream

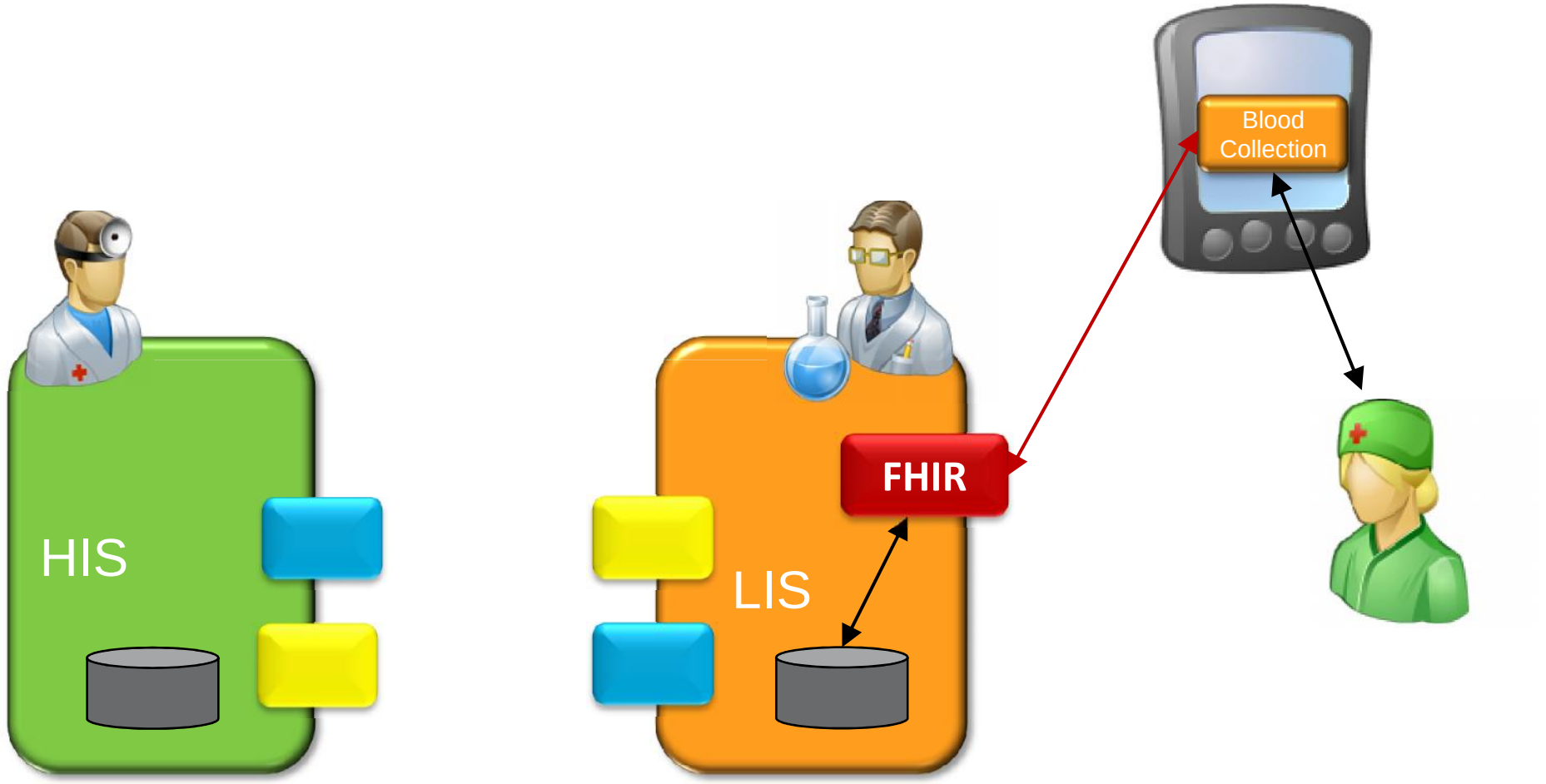


Community: Reality



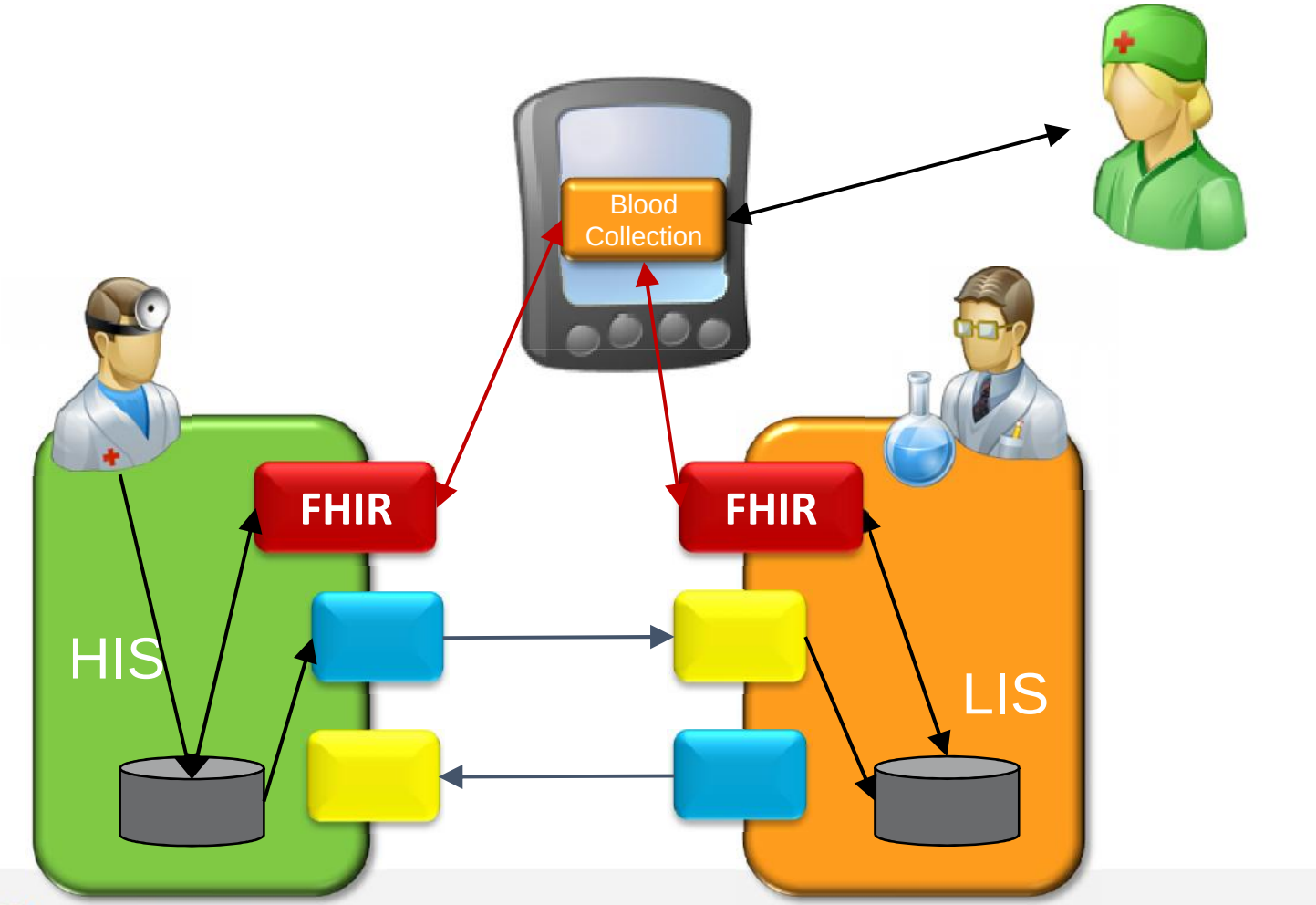
Mobile App – FHIR Connectivity backbone

Leveraging a standard in a proprietary manner



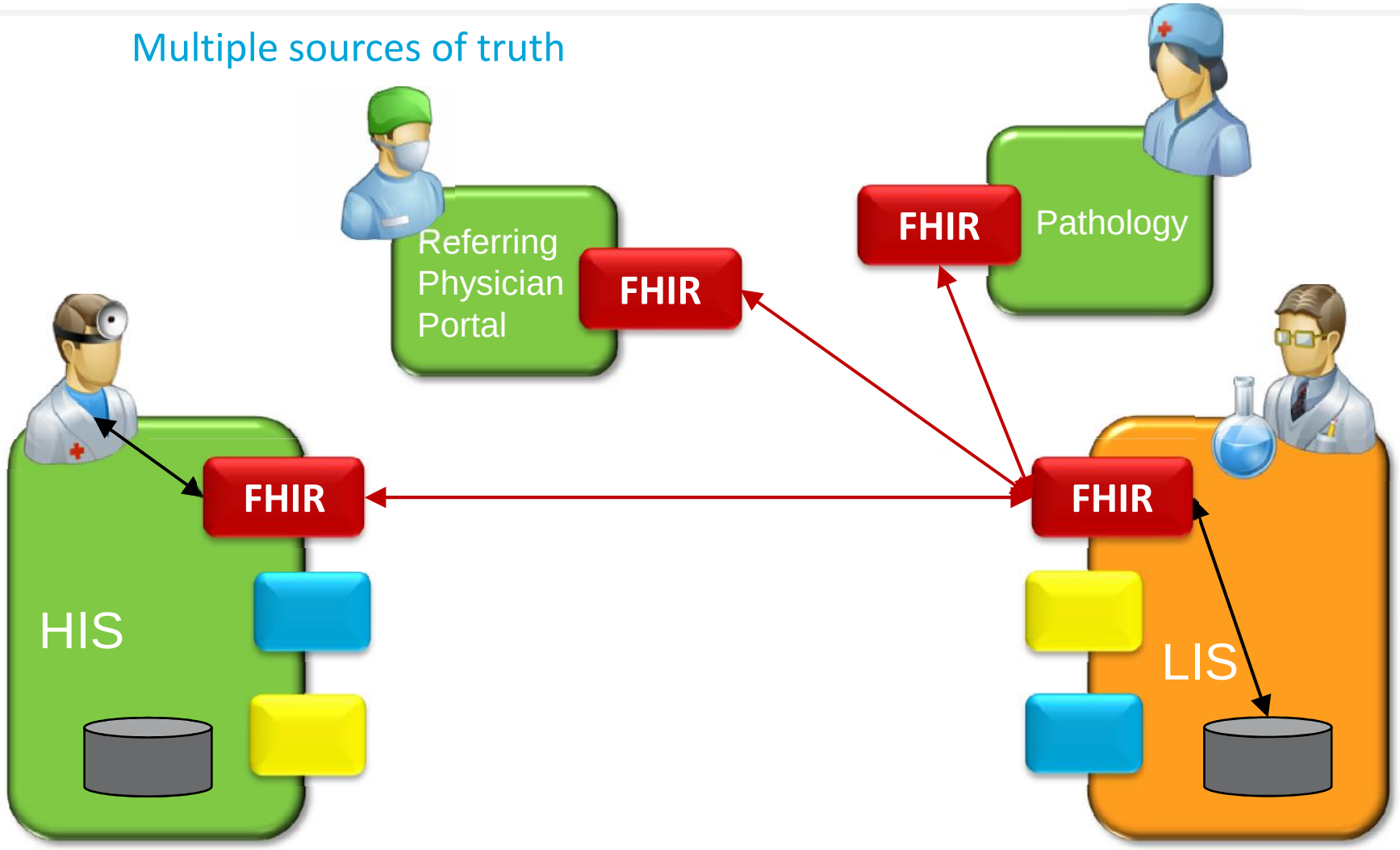
Real World: HL7 2.X + FHIR Integration

Multiple sources of truth

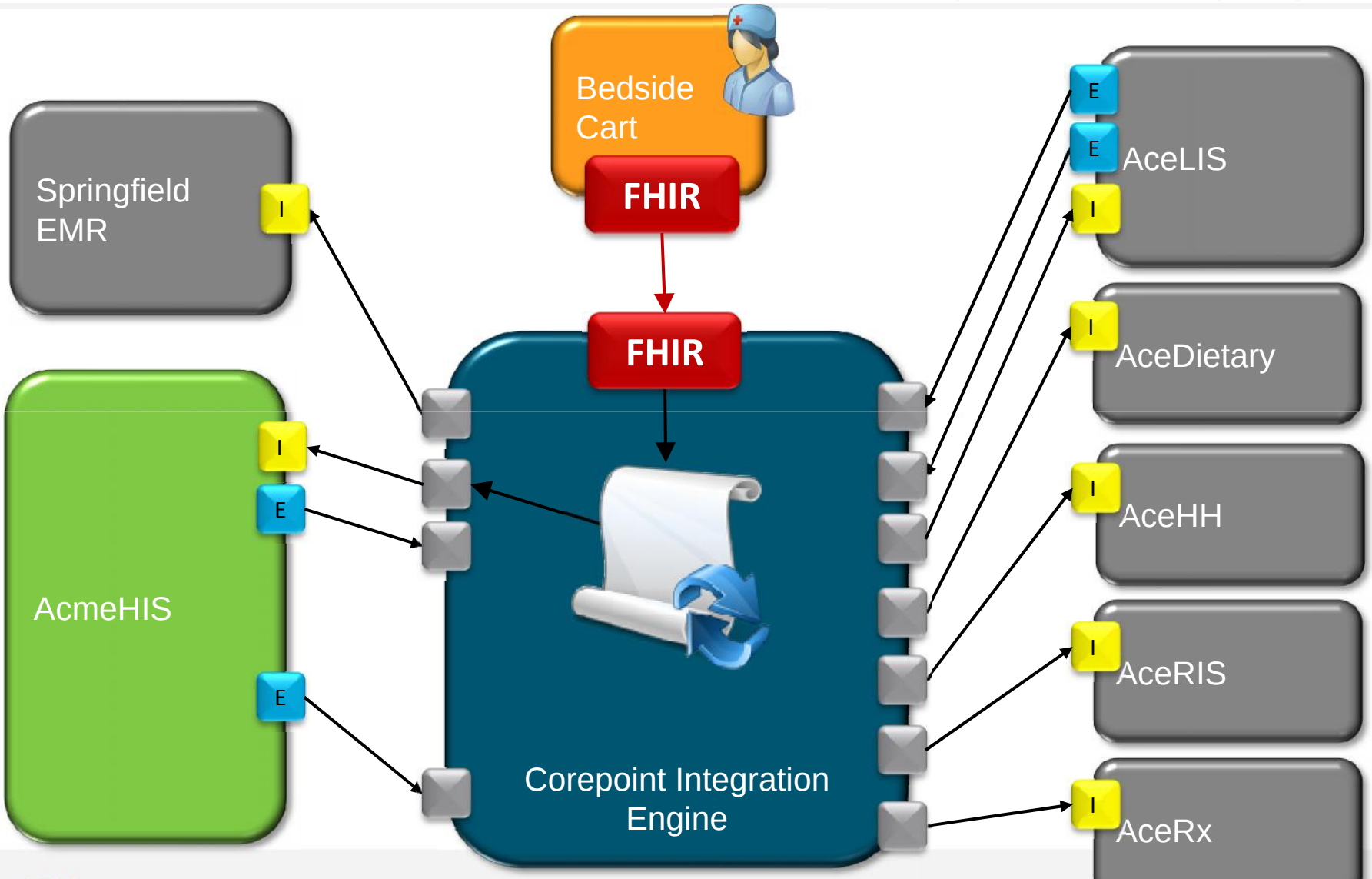


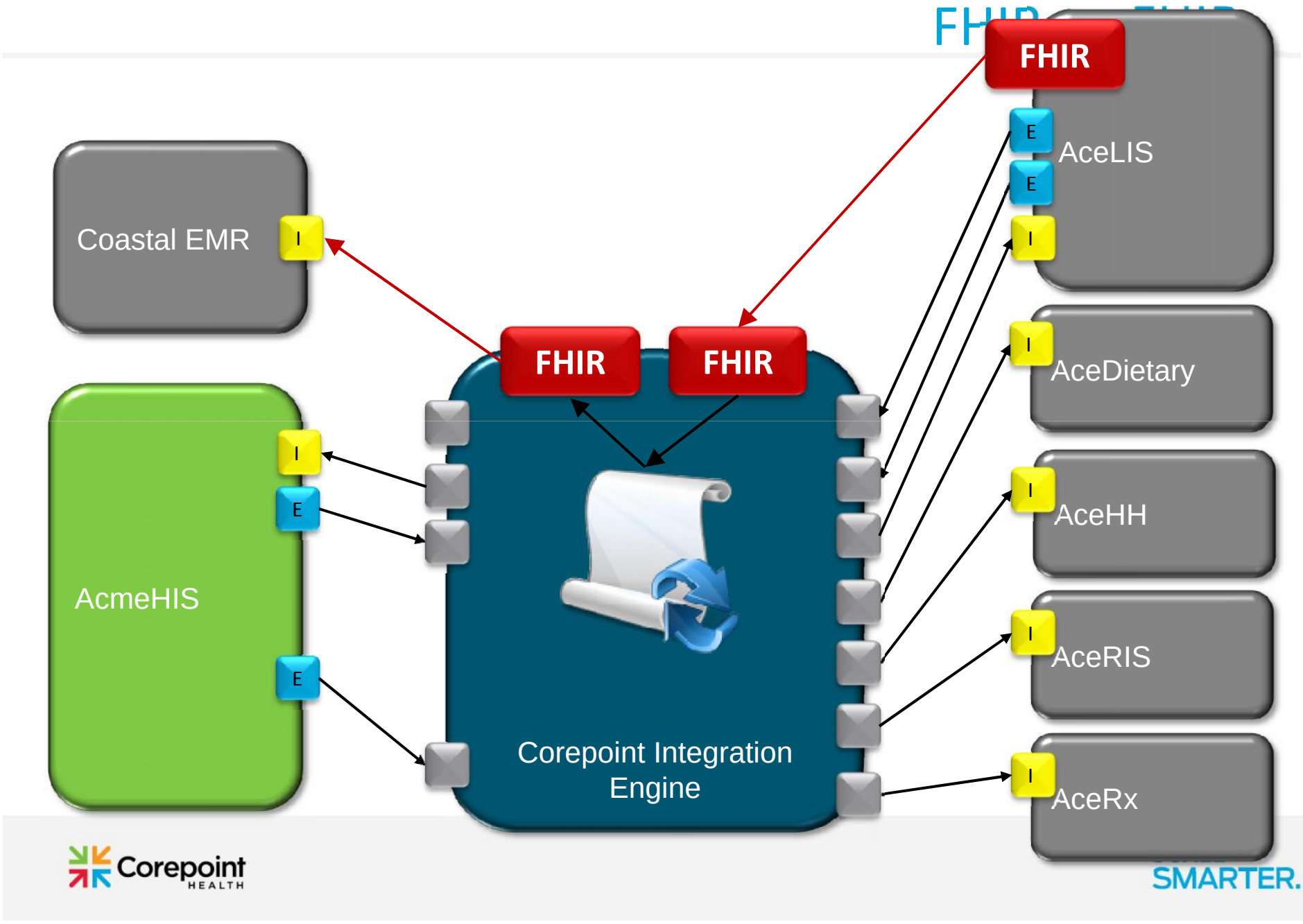
Mobile App – FHIR Integration

Multiple sources of truth



FHIR-to-HL7 V2 ORU

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AceRx
Corepoint Integration Engine
Corepoint HEALTH
SMARTER.

Context: Standard

FHIR Manifesto

- Focus on **Implementers**
- Target support for **common scenarios**
- Leverage cross-industry **web technologies**
- Require **human readability** as base level of interoperability
- Make content **freely available**
- Support multiple **paradigms** & architectures
- Demonstrate best practice **governance**

Support for Common Scenarios

Content in specification Based on 80% rule	Include only data elements that 80% of normal implementations will likely use Remaining 20% of content can be included in extensions
Resources Data elements used in the common scenarios	Goal: Simple to use and understand

Example: HL7 2.X AD Data type as of 2.3.1

2.8.1 AD - address

Components: <street address (ST)> ^ < other designation (ST)> ^ <city (ST)> ^ <state or province (ST)> ^ <zip or postal code (ST)> ^ <country (ID)> ^ <address type (ID)> ^ <other geographic designation (ST)>

Example:

```
|10 ASH LN^#3^LIMA^OH^48132|
```

2.A.87 XAD - extended address

HL7 Component Table - XAD – Extended Address

SEQ	LEN	C.LEN	DT	OPT	TBL#	COMPONENT NAME	COMMENTS	SEC.REF.
1			SAD	O		Street Address		2.A.68
2		120#	ST	O		Other Designation		2.A.76
3		50#	ST	O		City		2.A.76
4		50#	ST	O		State or Province		2.A.76
5		12=	ST	O		Zip or Postal Code		2.A.76
6	3..3		ID	O	0399	Country		2.A.35
7	1..3		ID	C	0190	Address Type		2.A.35
8		50#	ST	O		Other Geographic Designation		2.A.76
9			CWE	O	0289	County/Parish Code		2.A.36
10			CWE	O	0288	Census Tract		2.A.36
11	1..1		ID	O	0465	Address Representation Code		2.A.35
12				W		Address Validity Range	Withdrawn as of v2.7.	
13		8=	DTM	O		Effective Date		2.A.22
14		8=	DTM	O		Expiration Date		2.A.22
15			CWE	O	0616	Expiration Reason		2.A.13
16	1..1		ID	O	0136	Temporary Indicator		2.A.35
17	1..1		ID	O	0136	Bad Address Indicator		2.A.35
18	1..1		ID	O	0617	Address Usage		2.A.35
19		199#	ST	O		Addressee		2.A.76
20		199#	ST	O		Comment		2.A.76
21		2=	NM	O		Preference Order		2.A.47
22			CWE	O	0618	Protection Code		2.A.13
23			EI	O		Address Identifier		2.A.25

Definition: This data type specifies the address of a person, place or organization plus associated information.

Note: Replaces the AD data type as of v2.3.

Example: HL7 2.X XAD Data type as of 2.8.2

SCALE SMARTER.

Example – ISO AD type

- isNotOrdered, updateMode, flavorId, nullFlavor, controlAct root & extension, validTime low and high, useable period (GTS – no room on the slide), use
  - home, primary home, vacation home, workplace, direct, public, bad, physical, postal, temporary, alphabetic, ideographic, syllabic, search, soundex, phonetic
- 0..* parts, each with:
  - value, code, code system, code system name, code system version, language, type:
    - address line, additional locator, unit identifier, unit designator, delivery address line, delivery installation type, delivery installation area, delivery installation qualifier, delivery mode, delivery mode identifier, street address line, building number, building number numeric, building number suffix, street name, street name base, street type, direction, intersection, care of, census tract, country, county or parish, municipality, delimiter, post box, precinct, state or province, postal code, delivery point identifier

Example – FHIR Address

- ~~isNotOrdered, updateMode, flavorId, nullFlavor, controlAct root & extension, validTime low and high, useable~~ **period** (low, high) ~~(GTS – no room on the slide),~~ **use**
  - **home**~~, primary home, vacation home,~~ **work**~~place, direct, public, bad,~~ ~~physical~~visit**, postal, temp**~~orary, alphabetic, ideographic, syllabic, search, soundex, phonetic,~~ old
- ~~0..* parts, each with:~~text
  - ~~value, code, code system, code system name, code system version, language, type:~~
    - ~~address~~ **line**~~, additional locator, unit identifier, unit designator, delivery address line, delivery installation type, delivery installation area, delivery installation qualifier, delivery mode, delivery mode identifier, street address line, building number, building number numeric, building number suffix, street name, street name base, street type, direction, intersection, care of, census tract,~~ **country**~~, county or parish, municipality~~**city**~~, delimiter, post box, precinct,~~ **state** ~~or province,~~ **postalCode**~~, delivery point identifier~~

Example: HL7 FHIR DSTU 2 Address Datatype

1.19.0.13 Address

See also Examples, Detailed Descriptions and Mappings.

A postal address. There are a variety of postal address formats defined around the world. Postal addresses are often also used to record a location that can be visited to find a patient or person.

Structure | UML | XML | JSON | All

Structure

Name	Flags	Card.	Type	Description & Constraints
Address	Σ		Element	A postal address
use	?! Σ	0..1	code	home | work | temp | old - purpose of this address AddressUse (Required)
type	Σ	0..1	code	postal | physical | both AddressType (Required)
text	Σ	0..1	string	Text representation of the address
line	Σ	0..*	string	Street name, number, direction & P.O. Box etc.
city	Σ	0..1	string	Name of city, town etc.
district	Σ	0..1	string	District name (aka county)
state	Σ	0..1	string	Sub-unit of country (abbreviations ok)
postalCode	Σ	0..1	string	Postal code for area
country	Σ	0..1	string	Country (can be ISO 3166 3 letter code)
period	Σ	0..1	Period	Time period when address was/is in use

Documentation for this format

FHIR & Cost of Integration

- Cost Factors:
  - Easier to Develop
  - Easier to Troubleshoot
  - Easier to Leverage in production
  - More people to do the work
- Competing approaches must match the cost or disappear – already being felt

Long term: 100-150 Resources

Examples

- Administrative
  - Patient, Practitioner, Organization, Location, Coverage, Invoice
- Clinical Concepts
  - Allergy, Condition, Family History, Care Plan
- Infrastructure
  - Document, Message, Profile, Conformance

Non-examples

- Gender
  - Too small
- Electronic Health Record
  - Too big
- Blood Pressure
  - Too specific
- Intervention
  - Too broad

STU 2 Resource List

Clinical

General:

- AllergyIntolerance 0
- ClinicalImpression 0
- Condition (aka Problem) 0
- ReferralRequest 0
- Procedure 0
- Contraindication 1
- RiskAssessment 0

Data Collection & Care Plan:

- Questionnaire 0
- QuestionnaireAnswers 0
- FamilyMemberHistory (+ Genetics) 0
- CarePlan 0
- Goal 0

Medication, Immunization & Nutrition:

- Medication 0
- MedicationPrescription 0
- MedicationAdministration (+ Immunization) 0
- MedicationDispense 0
- MedicationStatement 0
- NutritionOrder 0
- Immunization 1
- ImmunizationRecommendation 1

Diagnostics:

- Observation (+ Genetics & Devices) 4
- DiagnosticReport 3
- DiagnosticOrder 1
- ImagingStudy 0
- ImagingObjectSelection 0
- Specimen 1
- BodySite 0

Administrative

Attribution:

- Patient 5
- RelatedPerson 0
- Person 1
- Practitioner 3
- Organization 4
- HealthcareService 0

Entities:

- Contract (+ Consent) 0
- Device 0
- DeviceComponent 0
- DeviceMetric 0
- Location 1
- Substance 0
- Group 0

Workflow Management:

- Encounter 0
- EpisodeOfCare 0
- Flag (aka Alert) 0
- Communication 0
- CommunicationRequest 0
- Supply 1
- SupplyRequest 0
- SupplyDelivery 0
- DeviceUseStatement 0
- ProcessRequest 0
- ProcessResponse 0

Scheduling / Ordering:

- Appointment 0
- AppointmentResponse 0
- Schedule 0
- Slot 0
- Order 0
- OrderResponse 0
- DeviceUseRequest 0
- ProcedureRequest 0
- VisionPrescription 0

STU 2 Resource List

Infrastructure

Support:

- Media 1
- Basic 1
- Provenance 0
- AuditEvent 0

Documents & Structure:

- List 0
- Composition (+ Clinical Document) 2
- DocumentReference (+ XDS) 0
- DocumentManifest 0

Exchange:

- MessageHeader 2
- OperationOutcome 5
- Subscription 1
- Bundle 3
- Binary 3
- Parameters 0

Conformance:

- ImplementationGuide 0
- Conformance 0
- StructureDefinition 3
- ValueSet 4
- ConceptMap 2
- DataElement 3
- OperationDefinition 0
- SearchParameter 0
- NamingSystem 0
- TestScript 0

Financial

Support:

- Coverage 0
- EligibilityRequest 0
- EligibilityResponse 0
- EnrollmentRequest 0
- EnrollmentResponse 0

Billing:

- Claim 0
- ClaimResponse 0

Payment:

- PaymentNotice 0
- PaymentReconciliation 0

Other:

- ExplanationOfBenefit 0

```
<Patient xmlns="http://hl7.org/fhir">
  <id value="glossy"/>
  <meta>
    <lastUpdated value="2014-11-13T11:41:00+11:00"/>
  </meta>
  <text>
    <status value="generated"/>
    <div xmlns="http://www.w3.org/1999/xhtml">
      <p>Henry Levin the 7th</p>
      <p>MRN: 123456. Male, 24-Sept 1932</p>
    </div>
  </text>
  <extension url="http://example.org/StructureDefinition/trials">
    <valueCode value="renal"/>
  </extension>
  <identifier>
    <use value="usual"/>
    <type>
      <coding>
        <system value="http://hl7.org/fhir/v2/0203"/>
        <code value="MR"/>
      </coding>
    </type>
    <system value="http://www.goodhealth.org/identifiers/mrn"/>
    <value value="123456"/>
  </identifier>
  <name>
    <family value="Levin"/>
    <given value="Henry"/>
    <suffix value="The 7th"/>
  </name>
  <gender value="male"/>
  <birthDate value="1932-09-24"/>
  <careProvider>
    <reference value="Organization/2"/>
    <display value="Good Health Clinic"/>
  </careProvider>
  <active value="true"/>
</Patient>
```

Identity & Metadata

Human Readable Summary

Extension with reference to its definition

Standard Data Content:

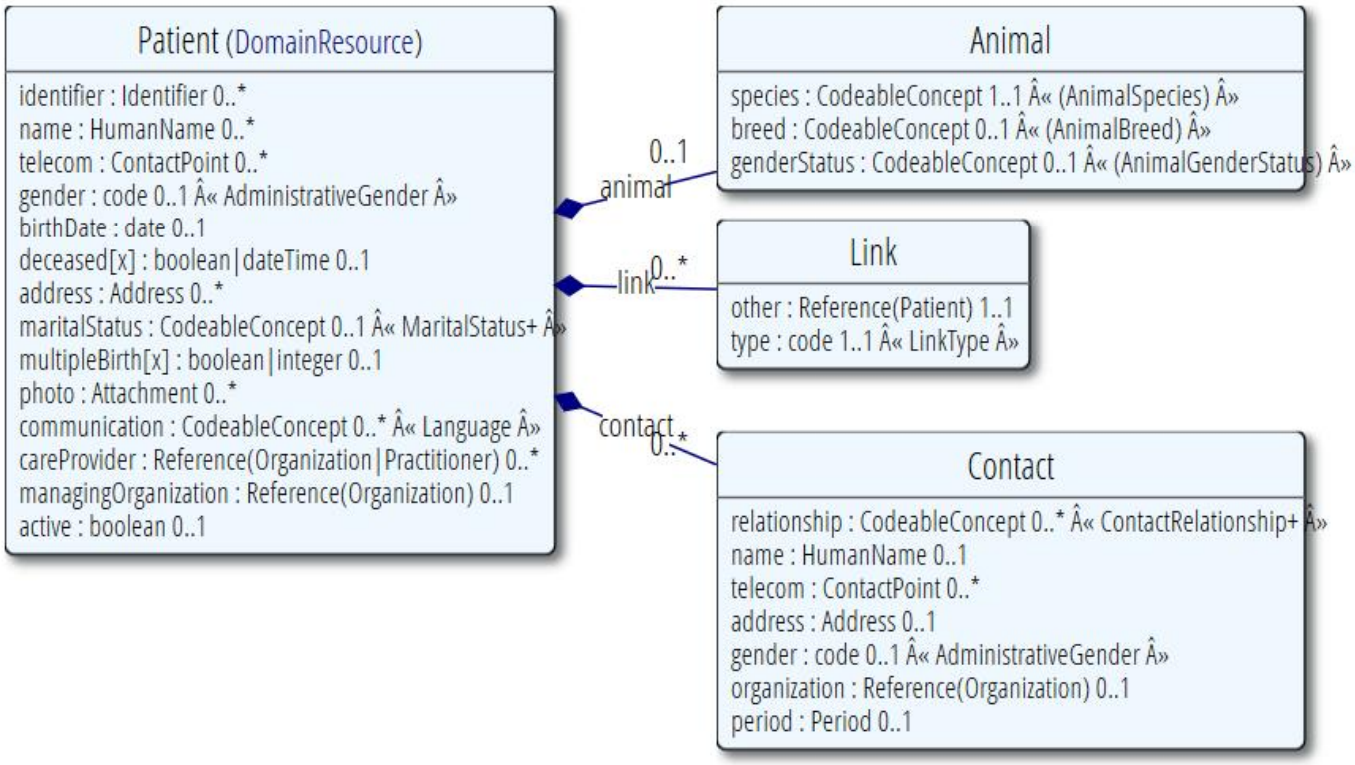
- MRN
- Name
- Gender
- Date of Birth
- Provider

Resource Definitions

Name	Flags	Card.	Type	Description & Constraints
Patient			DomainResource	Information about a person or animal receiving health care services
identifier	ÎF	0..*	Identifier	An identifier for the person as this patient
name	ÎŁ	0..*	HumanName	A name associated with the patient
telecom	ÎF	0..*	ContactPoint	A contact detail for the individual
gender	ÎŁ	0..1	code	male | female | other | unknown AdministrativeGender (Required)
birthDate	ÎŁ	0..1	date	The date and time of birth for the individual
deceased[x]	M ÎŁ			Indicates if the individual is deceased or not
deceasedBoolean		0..1	boolean	
deceasedDateTime		0..1	dateTime	
address	ÎŁ	0..*	Address	Addresses for the individual
maritalStatus	ÎŁ	0..1	CodeableConcept	Marital (civil) status of a person MaritalStatus (Incomplete)
multipleBirth[x]	ÎF			Whether patient is part of a multiple birth
multipleBirthBoolean		0..1	boolean	
multipleBirthInteger		0..1	integer	
photo		0..*	Attachment	Image of the person
contact	I	0..*	Element	A contact party (e.g. guardian, partner, friend) for the patient *SHALL at least contain a contact's details or a reference to an organization*
relationship		0..*	CodeableConcept	The kind of relationship ContactRelationship (Incomplete)
name		0..1	HumanName	A name associated with the person
telecom		0..*	ContactPoint	A contact detail for the person
address		0..1	Address	Address for the contact person
gender		0..1	code	male | female | other | unknown AdministrativeGender (Required)
organization	I	0..1	Organization	Organization that is associated with the contact
period		0..1	Period	The period during which this person or organization is valid to be contacted relating to this patient
ant to enter text.	M ÎŁ	0..1	Element	If this patient is an animal (non-human)
species	ÎŁ	1..1	CodeableConcept	E.g. Dog, Cow AnimalSpecies (Example)
breed	ÎŁ	0..1	CodeableConcept	E.g. Poodle, Angus AnimalBreed (Example)
genderStatus	ÎŁ	0..1	CodeableConcept	E.g. Neutered, Intact AnimalGenderStatus (Example)
communication		0..*	CodeableConcept	Languages which may be used to communicate with the patient about

Resource Definitions

UML Diagram



```
<Patient xmlns="http://hl7.org/fhir">
 <!-- from Resource: id, meta, implicitRules, and language -->
 <!-- from DomainResource: text, contained, extension, and modifierExtension -->
 <identifier><!-- 0..* Identifier An identifier for the person as this patient --></identifier>
 <name><!-- 0..* HumanName A name associated with the patient --></name>
 <telecom><!-- 0..* ContactPoint A contact detail for the individual --></telecom>
 <gender value="[code]"/><!-- 0..1 male | female | other | unknown -->
 <birthDate value="[date]"/><!-- 0..1 The date and time of birth for the individual -->
 <deceased[x]><!-- 0..1 boolean|dateTime Indicates if the individual is deceased or not --></deceased[x]>
 <address><!-- 0..* Address Addresses for the individual --></address>
 <maritalStatus><!-- 0..1 CodeableConcept Marital (civil) status of a person --></maritalStatus>
 <multipleBirth[x]><!-- 0..1 boolean|integer
    Whether patient is part of a multiple birth --></multipleBirth[x]>
 <photo><!-- 0..* Attachment Image of the person --></photo>
 <contact>  <!-- 0..* A contact party (e.g. guardian, partner, friend) for the patient -->
  <relationship><!-- 0..* CodeableConcept The kind of relationship --></relationship>
  <name><!-- 0..1 HumanName A name associated with the person --></name>
  <telecom><!-- 0..* ContactPoint A contact detail for the person --></telecom>
  <address><!-- 0..1 Address Address for the contact person --></address>
  <gender value="[code]"/><!-- 0..1 male | female | other | unknown -->
  <organization><!-- 0..1 Reference(Organization)
     Organization that is associated with the contact --></organization>
  <period><!-- 0..1 Period
     The period during which this person or organization is valid to be contacted relating to this patie
nt --></period>
 </contact>
 <animal>  <!-- 0..1 If this patient is an animal (non-human) -->
  <species><!-- 1..1 CodeableConcept E.g. Dog, Cow --></species>
  <breed><!-- 0..1 CodeableConcept E.g. Poodle, Angus --></breed>
  <genderStatus><!-- 0..1 CodeableConcept E.g. Neutered, Intact --></genderStatus>
 </animal>
 <communication><!-- 0..* CodeableConcept Languages which may be used to communicate with the patient abo
ut his or her health --></communication>
 <careProvider><!-- 0..* Reference(Organization|Practitioner)
    Patient's nominated care provider --></careProvider>
```

```
{
  "resourceType" : "Patient",
  // from Resource: id, meta, implicitRules, and language
  // from DomainResource: text, contained, extension, and modifierExtension
  "identifier" : [{ Identifier }], // An identifier for the person as this patient
  "name" : [{ HumanName }], // A name associated with the patient
  "telecom" : [{ ContactPoint }], // A contact detail for the individual
  "gender" : "<code>", // male | female | other | unknown
  "birthDate" : "<date>", // The date and time of birth for the individual
  // deceased[x]: Indicates if the individual is deceased or not. One of these 2:
  "deceasedBoolean" : <boolean>,
  "deceasedDateTime" : "<dateTime>",
  "address" : [{ Address }], // Addresses for the individual
  "maritalStatus" : { CodeableConcept }, // Marital (civil) status of a person
  // multipleBirth[x]: Whether patient is part of a multiple birth. One of these 2:
  "multipleBirthBoolean" : <boolean>,
  "multipleBirthInteger" : <integer>,
  "photo" : [{ Attachment }], // Image of the person
  "contact" : [{ // A contact party (e.g. guardian, partner, friend) for the patient
    "relationship" : [{ CodeableConcept }], // The kind of relationship
    "name" : { HumanName }, // A name associated with the person
    "telecom" : [{ ContactPoint }], // A contact detail for the person
    "address" : { Address }, // Address for the contact person
    "gender" : "<code>", // male | female | other | unknown
    "organization" : { Reference(Organization) }, // C?
      Organization that is associated with the contact
    "period" : { Period } //
      The period during which this person or organization is valid to be contacted relating to this patie
nt
  }],
  "animal" : { // If this patient is an animal (non-human)
    "species" : { CodeableConcept }, // R! E.g. Dog, Cow
    "breed" : { CodeableConcept }, // E.g. Poodle, Angus
    "genderStatus" : { CodeableConcept } // E.g. Neutered, Intact
  },
  "communication" : [{ CodeableConcept }], // Languages which may be used to communicate with the patient
 about his or her health
  "careProvider" : [{ Reference(Organization|Practitioner) }], //
     Patient's nominated care provider
  "managingOrganization" : { Reference(Organization) }, //
     Organization that is the custodian of the patient record
  "link" : [{ // Link to another patient resource that concerns the same actual person
    "other" : { Reference(Patient) }, // R! The other patient resource that the link refers to
```

Bonus Topics

Other Critical Topics

- SMART on FHIR
- MU3
- Argonaut Project
- JSON vs XML
- Resource Extensions

Q&A: HL7 FHIR Overview

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