FHIR® Webinar

FHIR Exchange: REST, Messaging and Documents

March 2, 2022

Agenda & Structure

- House rules, intro, agenda (5’)
- Recap FHIR basics (5’)
- FHIR REST (10’)
  - Exchanging Resources

    or groups of related resources
  - Other ways of exchanging FHIR
- FHIR messaging (5’)
- FHIR Subscriptions (5’)
- FHIR Documents (5’)
- MHDS (10’)
- How to choose (5’)
- Q&A, Discussion (5-10’)

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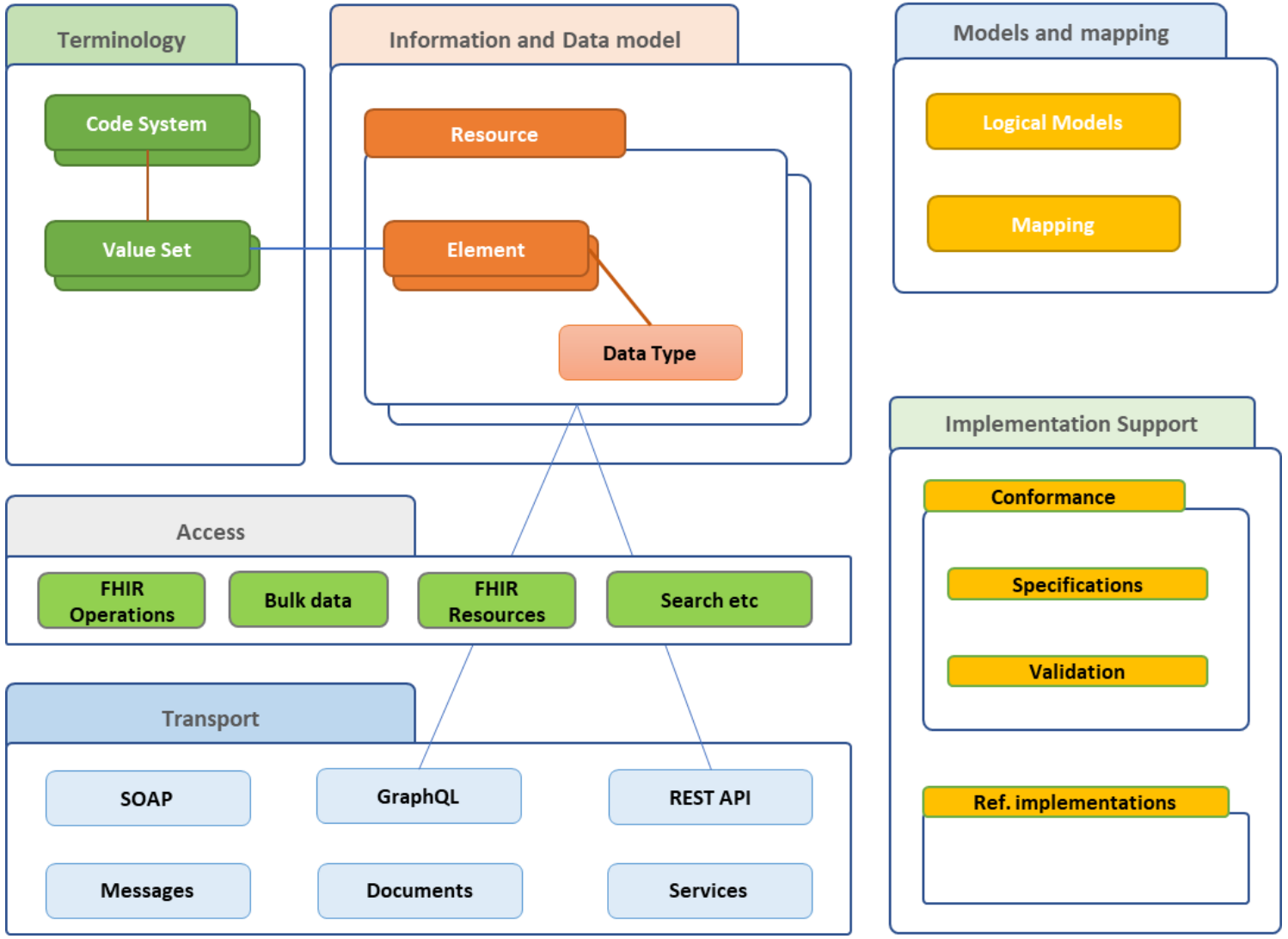
Goals

1. Identify the basic exchange approach for FHIR using REST
2. Explore the Document and Messaging paradigms
3. Look at the other (main) paradigms
4. Check the impact / criteria of deciding which paradigm to use
5. See a reference architecture specification for Documents

Part 1
Recap

FHIR Resource:

Usually the atomic unit of data exchange.



FHIR REST, Messaging and Documents

FHIR REST basics

REST

- Most common approach / starting point
- Handle resources with the REST verbs:
  - GET (the “read” verb)
    - GET a single resource: GET Patient/43961584
    - GET a set of resources GET Patient (?...)
    - Response is a resource (a Patient, or a Bundle, or an OperationOutcome
  - POST (create)
  - PUT (update)
  - DELETE (delete)

https://build.fhir.org/http

REST

Parameters/payload will determine the content of the response

E.g. Search parameters, format, etc

(GET) **http://hapi.fhir.org/baseR4/Patient/1607944/_history/5?_pretty=true**

https://hapi.fhir.org/baseR4/Patient/1607944/$everything

One resource at a time

- All REST transactions are based on one resource at a time…
- …but often the communication includes several resources,
  - related to each other

Multiple resources

subject	Σ	1..1	Reference(Patient | Group)
encounter		0..1	Reference(Encounter)
supportingInformation		0..*	Reference(Any)
authoredOn	Σ	0..1	dateTime
requester	Σ	0..1	Reference(Practitioner | PractitionerRole | Organization | Patient | RelatedPerson | Device)
performer		0..1	Reference(Practitioner | PractitionerRole | Organization | Patient | Device | RelatedPerson | CareTeam | HealthcareService)

2.3.0.2 Literal References

The `reference` is the key element - resources are identified and addressed by their URL. It contains a URL that is either

- an absolute URL
- a relative URL, which is relative to the Service Base URL, or, if processing a resource from a bundle, which is relative to the base URL implied by the `Bundle.entry.fullUrl` (see Resolving References in Bundles)
- an internal fragment reference (see "Contained Resources" below)

A relative reference to the Patient "034AB16" in an element named `subject` on a FHIR RESTful server:

```
<subject>
  <reference value="Patient/034AB16" />
</subject>
```

An absolute reference to a Structure Definition in an element named `profile`:

```
{
  "profile" : {
    "reference" : "http://fhir.hl7.org/svc/StructureDefinition/c8973a22-2b5b-4e76-9c66-00639c99e61b"
  }
}
```

2.3.0.3 Logical References

In many contexts where FHIR is used, applications building a resource may know an identifier for the target of the reference, but there is no way for the application to convert this to a literal reference that directly references an actual resource. This situation may arise for several reasons:

- There is no server exposing any such resource. This is often the case with national identifiers (e.g. US SSN or NPI), and such identifiers are widely used
- The server that exposes the resource is not available to the source application, so it has no way to resolve an identifier to a reference
- The application is not in a RESTful environment - it is creating a message or a document

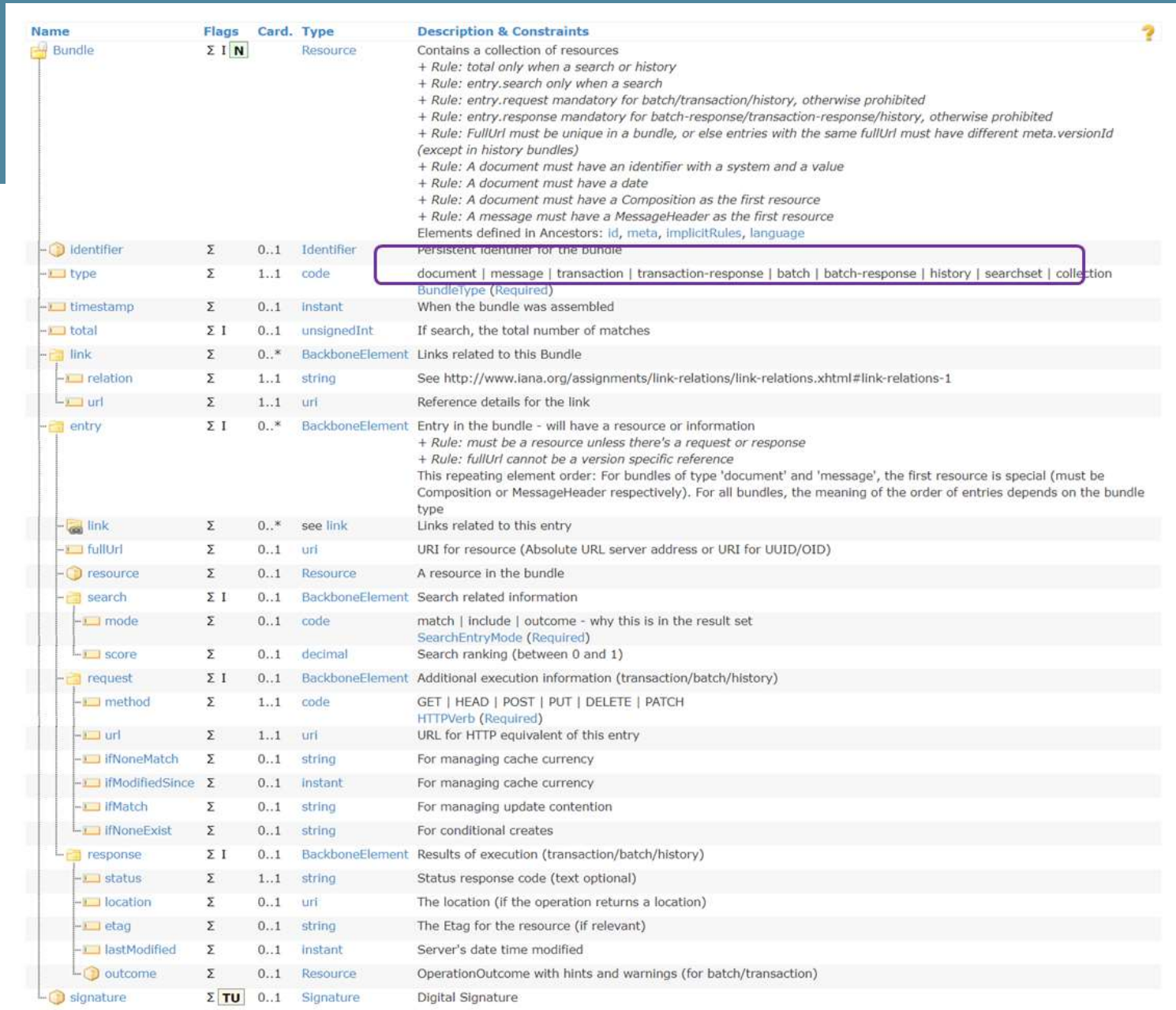
For further discussion of the use of identifiers on resources, see Consistent Resource Identification. In these cases, the source application may provide the identifier as a logical reference to the entity that the target resource would describe.

A logical reference to the Patient with an SSN of 000111111:

```
<patient>
  <identifier>
    <system value="http://hl7.org/fhir/sid/us-ssn" />
    <value value="000111111" />
  </identifier>
</patient>
```

FHIR Bundle

- Used to contain and group resources
- Different bundle types
- Others resources for grouping only:
  - List
  - Composition
  - (Group)



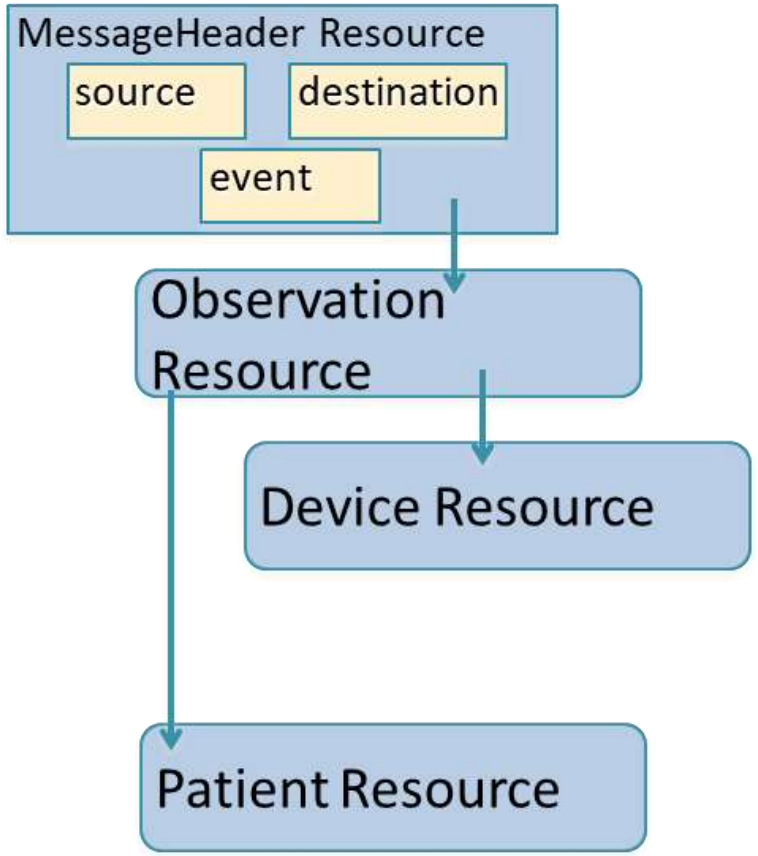
Name	Flags	Card.	Type	Description & Constraints
Bundle	Σ I N		Resource	Contains a collection of resources + *Rule: total only when a search or history* + *Rule: entry.search only when a search* + *Rule: entry.request mandatory for batch/transaction/history, otherwise prohibited* + *Rule: entry.response mandatory for batch-response/transaction-response/history, otherwise prohibited* + *Rule: FullUrl must be unique in a bundle, or else entries with the same fullUrl must have different meta.versionId (except in history bundles)* + *Rule: A document must have an identifier with a system and a value* + *Rule: A document must have a date* + *Rule: A document must have a Composition as the first resource* + *Rule: A message must have a MessageHeader as the first resource* Elements defined in Ancestors: id, meta, implicitRules, language
identifier	Σ	0..1	Identifier	Persistent identifier for the bundle
type	Σ	1..1	code	document | message | transaction | transaction-response | batch | batch-response | history | searchset | collection BundleType (Required)
timestamp	Σ	0..1	instant	When the bundle was assembled
total	Σ I	0..1	unsignedInt	If search, the total number of matches
link	Σ	0..*	BackboneElement	Links related to this Bundle
relation	Σ	1..1	string	See http://www.iana.org/assignments/link-relations/link-relations.xhtml#link-relations-1
url	Σ	1..1	uri	Reference details for the link
entry	Σ I	0..*	BackboneElement	Entry in the bundle - will have a resource or information + *Rule: must be a resource unless there's a request or response* + *Rule: fullUrl cannot be a version specific reference* This repeating element order: For bundles of type 'document' and 'message', the first resource is special (must be Composition or MessageHeader respectively). For all bundles, the meaning of the order of entries depends on the bundle type
link	Σ	0..*	see link	Links related to this entry
fullUrl	Σ	0..1	uri	URI for resource (Absolute URL server address or URI for UUID/OID)
resource	Σ	0..1	Resource	A resource in the bundle
search	Σ I	0..1	BackboneElement	Search related information
mode	Σ	0..1	code	match | include | outcome - why this is in the result set SearchEntryMode (Required)
score	Σ	0..1	decimal	Search ranking (between 0 and 1)
request	Σ I	0..1	BackboneElement	Additional execution information (transaction/batch/history)
method	Σ	1..1	code	GET | HEAD | POST | PUT | DELETE | PATCH HTTPVerb (Required)
url	Σ	1..1	uri	URL for HTTP equivalent of this entry
ifNoneMatch	Σ	0..1	string	For managing cache currency
ifModifiedSince	Σ	0..1	instant	For managing cache currency
ifMatch	Σ	0..1	string	For managing update contention
ifNoneExist	Σ	0..1	string	For conditional creates
response	Σ I	0..1	BackboneElement	Results of execution (transaction/batch/history)
status	Σ	1..1	string	Status response code (text optional)
location	Σ	0..1	uri	The location (if the operation returns a location)
etag	Σ	0..1	string	The Etag for the resource (if relevant)
lastModified	Σ	0..1	instant	Server's date time modified
outcome	Σ	0..1	Resource	OperationOutcome with hints and warnings (for batch/transaction)
signature	Σ TU	0..1	Signature	Digital Signature

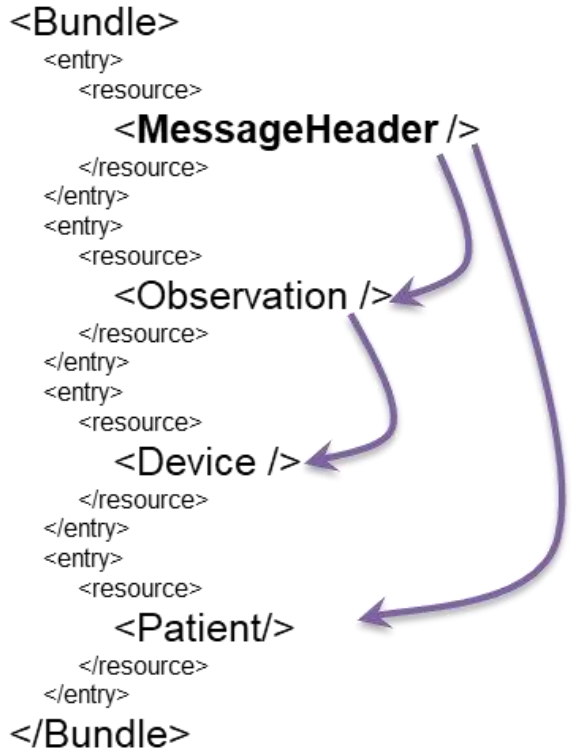
Exchange paradigms - built on same resources as REST

- REST https://build.fhir.org/http
- Messaging https://build.fhir.org/messaging
- Subscription https://build.fhir.org/subscriptions
- Documents https://build.fhir.org/documents
- Graphql https://build.fhir.org/graphql

FHIR Messages

Messages - are Bundles





https://www.hl7.org/fhir/messaging.html

When to use Messaging

- Request/response workflow
- Need to drive behaviors more complex than CRUD on a single resource
  - E.g. merge, complex queries
- Need for asynchronous/indirect exchange
- Need to communicate information about many resources but want to minimize exchanges

No “identity” for many resources

FHIR Subscriptions

FHIR R4 Subscriptions

- Subscriptions are based on the Subscription resource.
  - Search criteria
  - Channels
    - REST Hook
    - WebSockets
    - Email/SMS
    - FHIR Message
- Workflow
  - Client creates Subscription resource based on search criteria.
  - Server sends updates based on the search criteria to the channel.

FHIR R5 Subscriptions

- Subscriptions are currently being revised for R5.
  - Resources: Subscription, SubscriptionTopic, SubscriptionStatus
  - https://build.fhir.org/subscriptions.html
- Workflow
  - Server maintains list of SubscriptionTopic resources.
  - Client can create a new Subscription resource based on a SubscriptionTopic.
  - Server sends updates using a subscription-notification Bundle including a SubscriptionStatus resource.
  - $events operation to retrieve missing notifications.

Subscription/Message Example

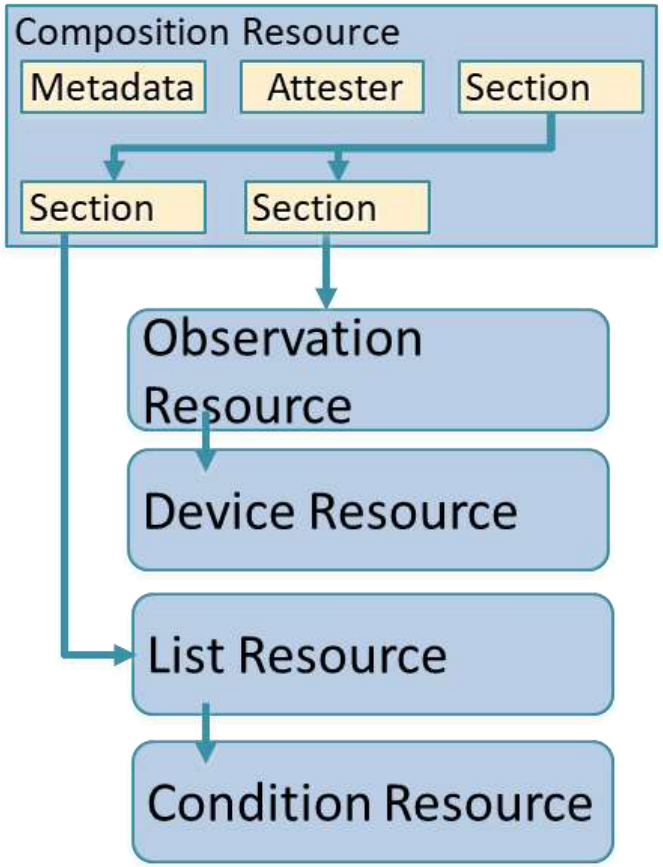
IHE's Patient Master Identity Registry (PMIR) profile uses Subscriptions with a Message channel.

https://www.ihe.net/uploadedFiles/Documents/ITI/IHE_ITI_Suppl_PMIR.pdf

- ITI-93: Mobile Patient Identity Feed is a FHIR message.
- ITI-94: Subscribe to Patient Updates uses FHIR Subscriptions.

FHIR Documents

Documents – are bundles




```
<Bundle>
  <entry>
    <resource>
      <Composition />
    </resource>
  </entry>
  <entry>
    <resource>
      <Observation />
    </resource>
  </entry>
  <entry>
    <resource>
      <Device />
    </resource>
  </entry>
  <entry>
    <resource>
      <List/>
    </resource>
  </entry>
  <entry>
    <resource>
      <Condition/>
    <resource>
  </entry>
</Bundle>
```

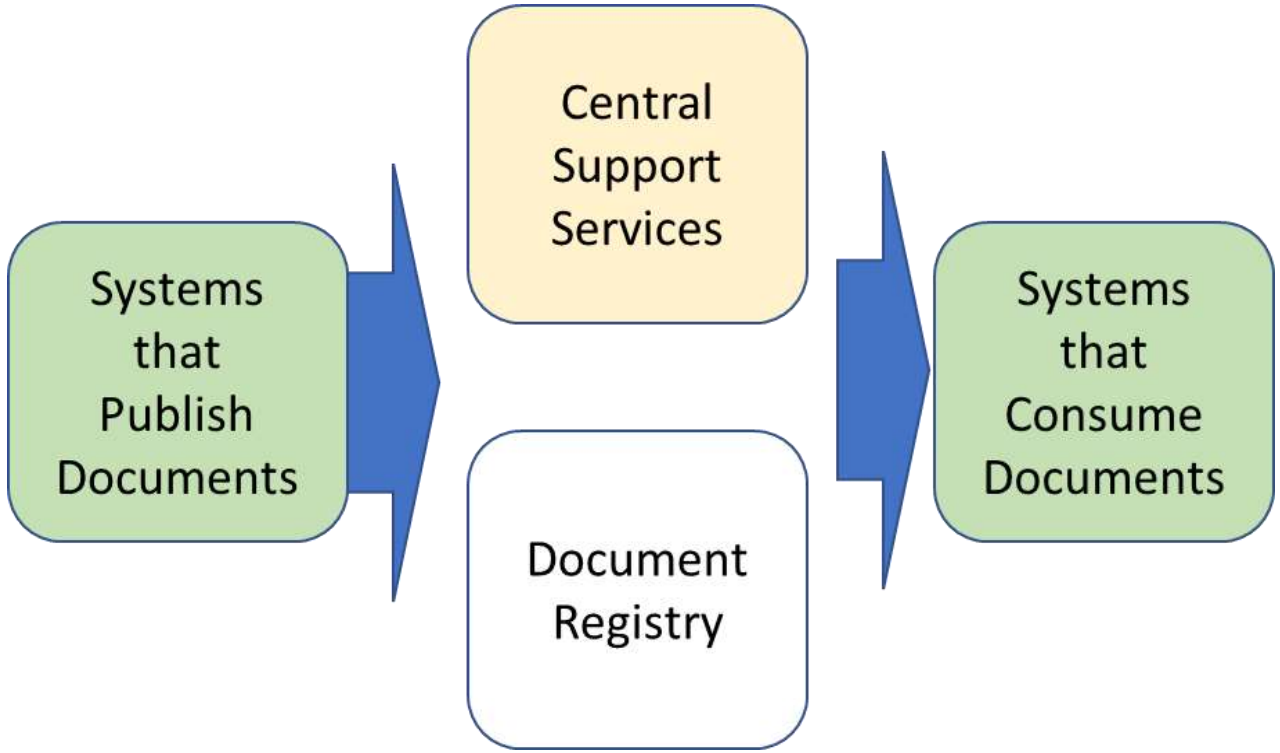
When to use Documents

- Focus is on persistence
  - Data is ‘static’, managed by 1 person
- No workflow involved
  - other than post/retrieve document
- Need tight rules over authenticated content
- Want to communicate multiple resources with control over how data is presented
- Data spans multiple resources

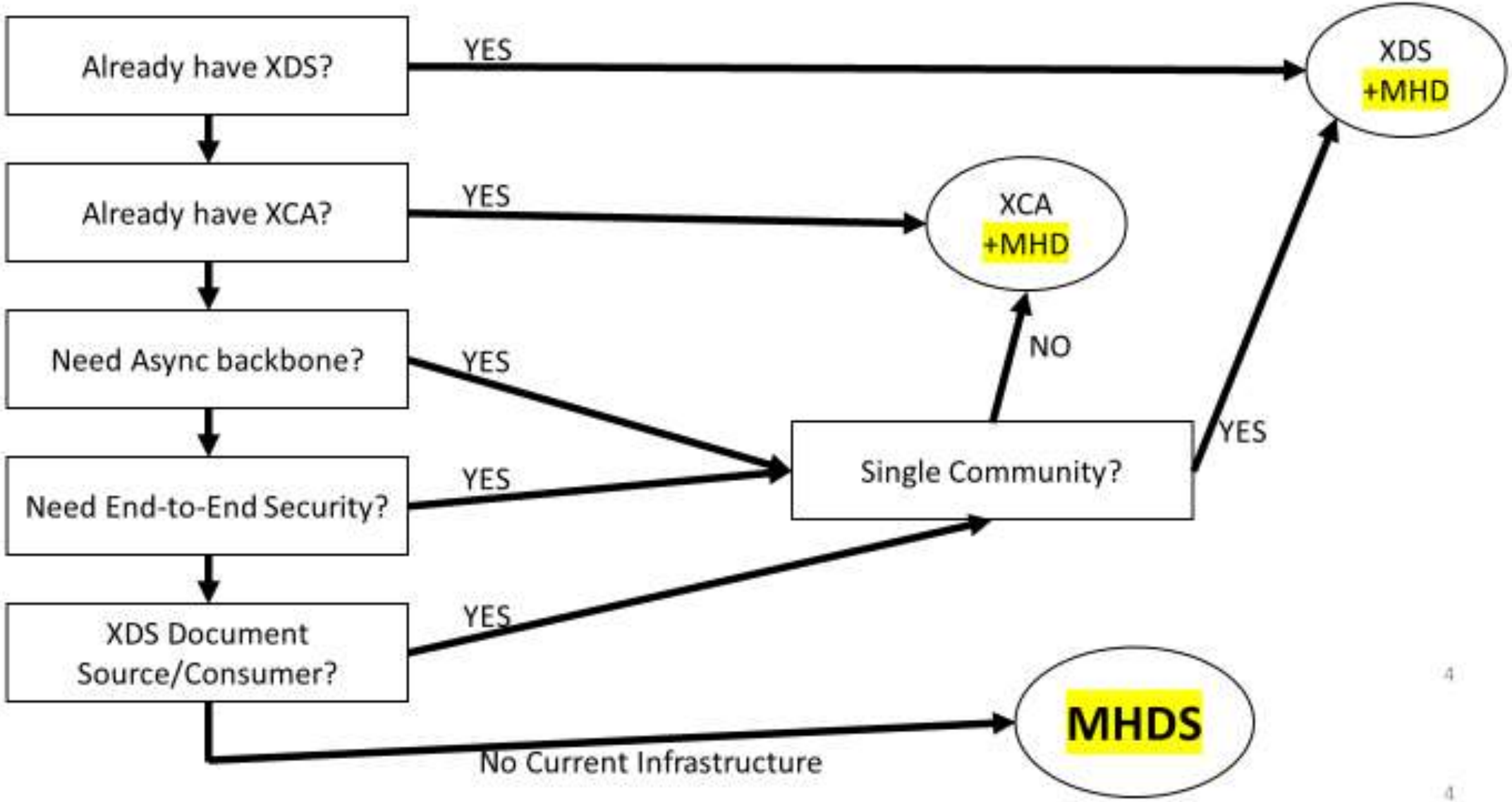
Document architecture - IHE MHDS

MHDS – Document Sharing Infrastructure

- 100% FHIR infrastructure
- Document Registry
- MHD transactions
- Persistence and lifecycle management
- Patient Identity Management
- Authorization - OAuth
- Consent Management
- Trust Framework – Certificate Authority
- Vocabulary Management
- Audit Record Repository
- Provider Directory



Which Infrastructure to use?



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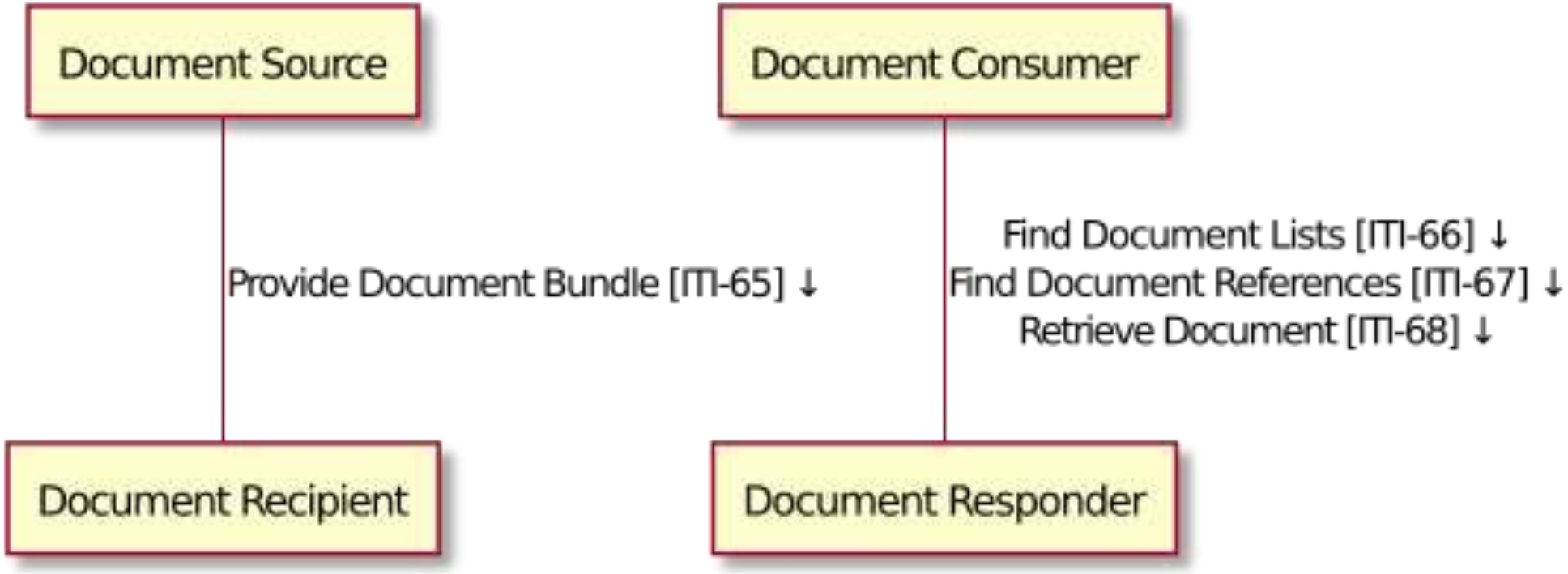
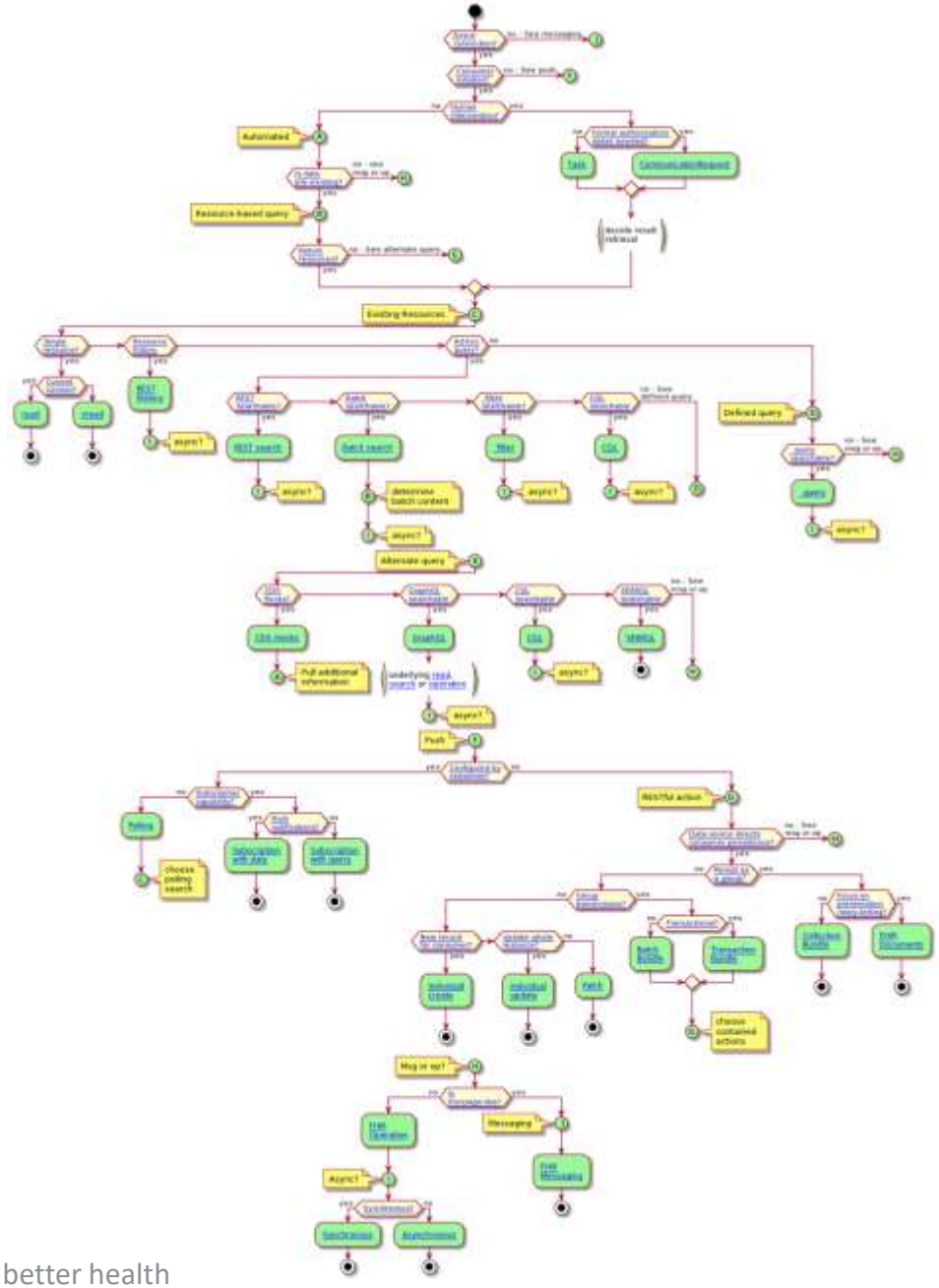
MHD Actors and Transactions



~~Which~~ How to choose

1. Point-to-point? Broadcast?
2. Integrity?
3. Idempotency?
4. Sync/Async?

https://build.fhir.org/ig/HL7/davinci-ehrx/exchanging.html



Impact

The choice of paradigm affects the entire architecture.

- Types of systems involved (repositories, registries)
- Data flows and integrity
- Access Control (who can access which resource / document)
- Type of applications expected
- …

Q&A, ideas

digital square

Get in touch, be active

- Check with others (at chat.fhir.org or community.fhir.org)
- Create (or ask someone to create) a change request
- Join a FHIR® event like DevDays (devdays.com), discuss
- Join a FHIR® connectathon, test and provide feedback

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Demo and hands-on

- https://lhcforms.nlm.nih.gov
- http://ui.hl7.beda.software
- http://smartqedit4.azurewebsites.net