FHIR® Webinar

Profiling and Documentation

May 26, 2021

Agenda & Structure

- House rules, intro, agenda
- FHIR® Profiling: Why
- FHIR® Profiling: What
  - Functional
  - Technical
- FHIR® Profiling: How
- Interactive example + Q&A

- Profiling process
  - Analysis – workflow, exchange approach, content
  - Technical implementation
  - (Agile) Review
- Profiling artifacts:
  - Data and behaviour – StructureDefinition, OperationDefinition, SearchParameter
  - Vocabulary – ValueSet, CodeSystem, NamingSystem, ConceptMap
  - Examples – Instances and ExampleScenario
  - Support - CapabilityStatement

Remarks and disclaimers

- FHIR® is the registered trademark of Health Level Seven® (HL7®) International.
- The use of the FHIR® trademark does not constitute endorsement of this course/product/service by HL7 ®.
- This is not an official HL7 training. For such training opportunities, you are encouraged to
  - http://www.hl7.org/training
- This presentation is a collection of freely available materials.
  - All diagrams, except those that state otherwise, are original materials or taken from the FHIR website and support materials; all screenshots are from the FHIR website
- This presentation is shared under a Creative Commons Attribution 4.0 (CC BY 4.0) license - (ok to share and adapt if credits are given)

Goals

- Understand and apply the key concepts for HL7® FHIR® profiling
- In our limited time, we'll expose some examples and entertain questions – please participate!

Before we start…

The most important outcome of this is that we collaborate, experiment and participate:

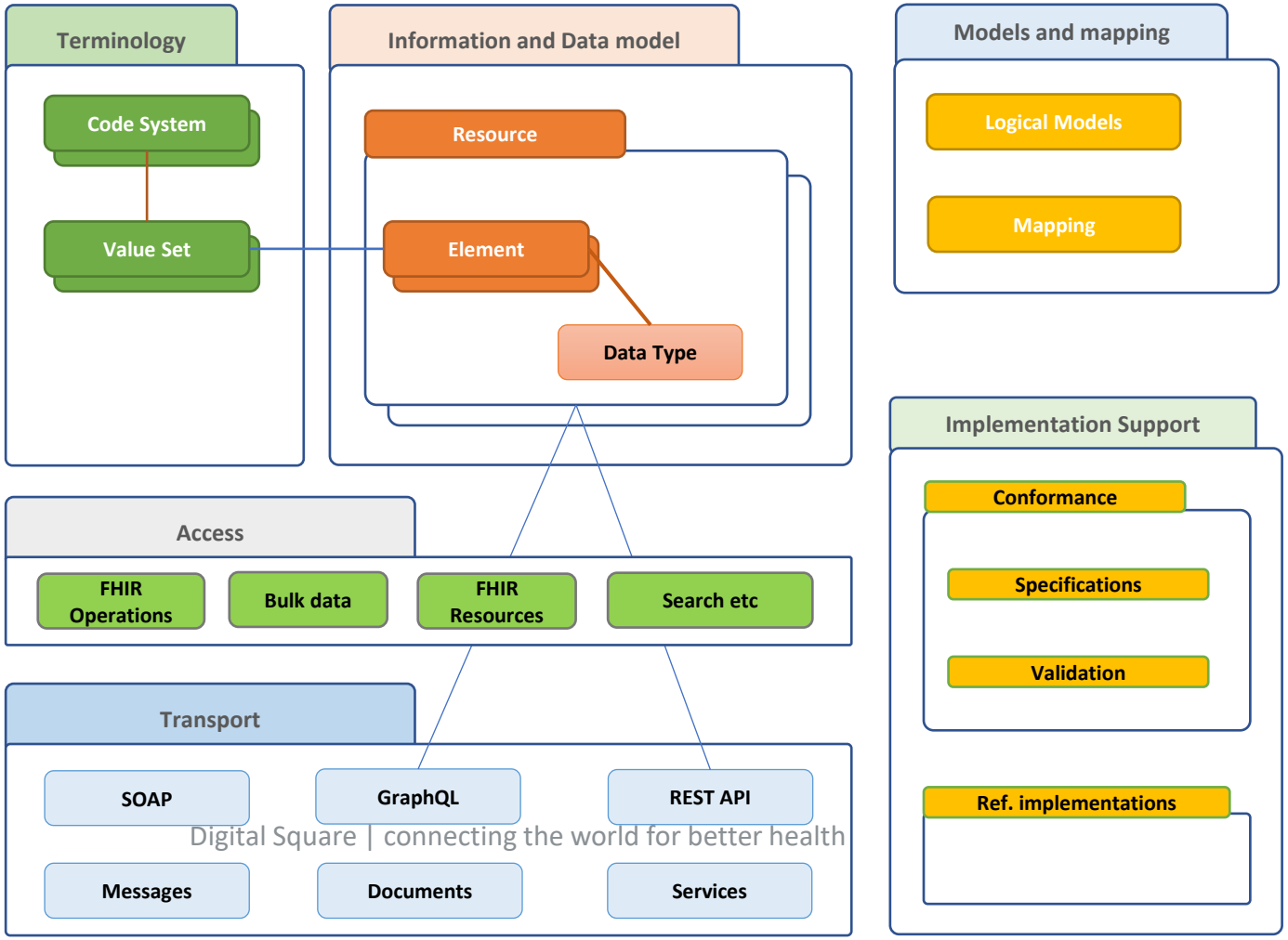
- https://chat.fhir.org
- http://community.fhir.org

Upcoming event | DevDays 2021

- ***Participants from Low and Lower Middle Income Countries***
  For those living in low and lower-middle-income countries, an opportunity to register at a discounted fee is available. The fee for those from Africa is $50 USD. The fee for other low and lower-middle-income countries is $100 USD (early bird before May 14, 2021) and $150 USD (regular after May 14, 2021).
- https://www.devdays.com/june-2021/registration/

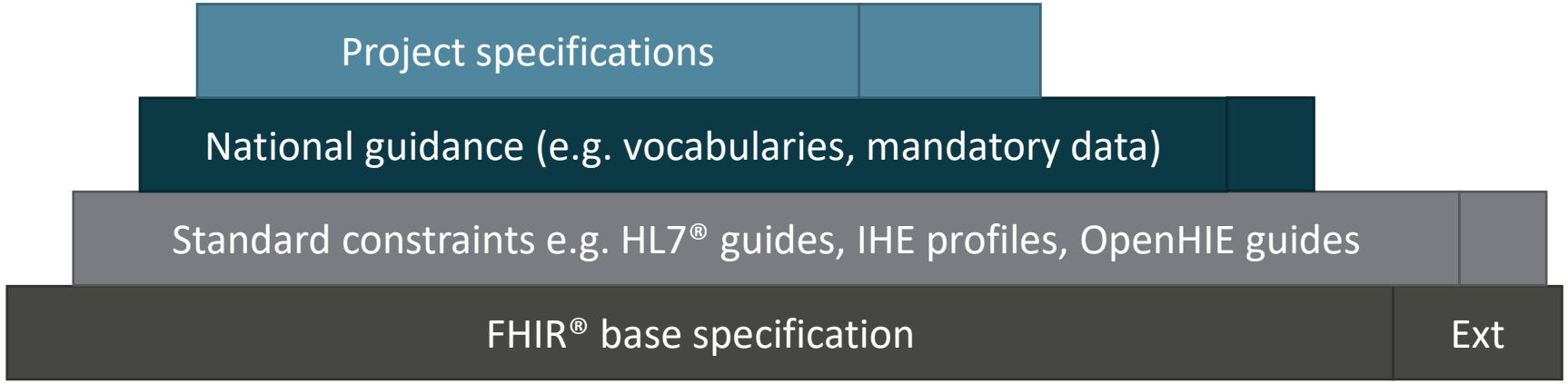
Why FHIR® Profiling

FHIR Implementation



Using FHIR® in an implementation

- There are different levels of specification.
- A specification is based on the FHIR® base, or, very commonly, on existing specifications (OpenHID, IHE, national guidance).
- A FHIR® specification can add constraints and extensions to the specification it depends on.



Why to do FHIR® profiling (and why not)

- FHIR® profiling adapts the underlying specifications to a given context.

- Purpose is important:
  - Be clear about your purpose: Your system? Or your expectations for many systems?
  - When a constraint is applied, it cannot be removed in upper layers.
    - Be flexible with what you accept, strict with what you send.
    - Avoid systems to become non-compliant because of “ideal” constraints.

- Use profiling to transport your functional (and technical) constraints to the technical specifications.

What is FHIR® Profiling

FHIR base resources

- FHIR® base resources (in a given version) represent the common agreed data sets for exchange
  - Usually referred as the 80%-20% rule: the 80% that are common across implementations

- *FHIR® Resources are designed to be profiled*
  - *Constrained*
  - *Extended*

FHIR® workflow

- The FHIR® workflow module defines the foundation for managing workflow with FHIR®.
  - For example, a prescription is a Request, a Dispense of that prescription is an Event.
  - When using these resources, there are foundational expectations about status, exchanged data, etc.
  - Examples: REST vs Subscriptions vs Messaging; Task to manage workflows, etc.

- *Workflow can be implemented using different types of FHIR® constructs*

FHIR® data exchange

- FHIR® provides mechanisms for exchanging data in several ways
  - REST
  - Messaging
  - Documents
  - Subscriptions
  - (others)

  - A good reference: the DaVinci Health Record Exchange ImplementationGuide

  - *The data exchange can be defined using different FHIR® constructs*

FHIR® terminologies

- Coded Elements are associated with a ValueSet
- ValueSets get codes from CodeSystems
- Identifiers are associated with NamingSystems

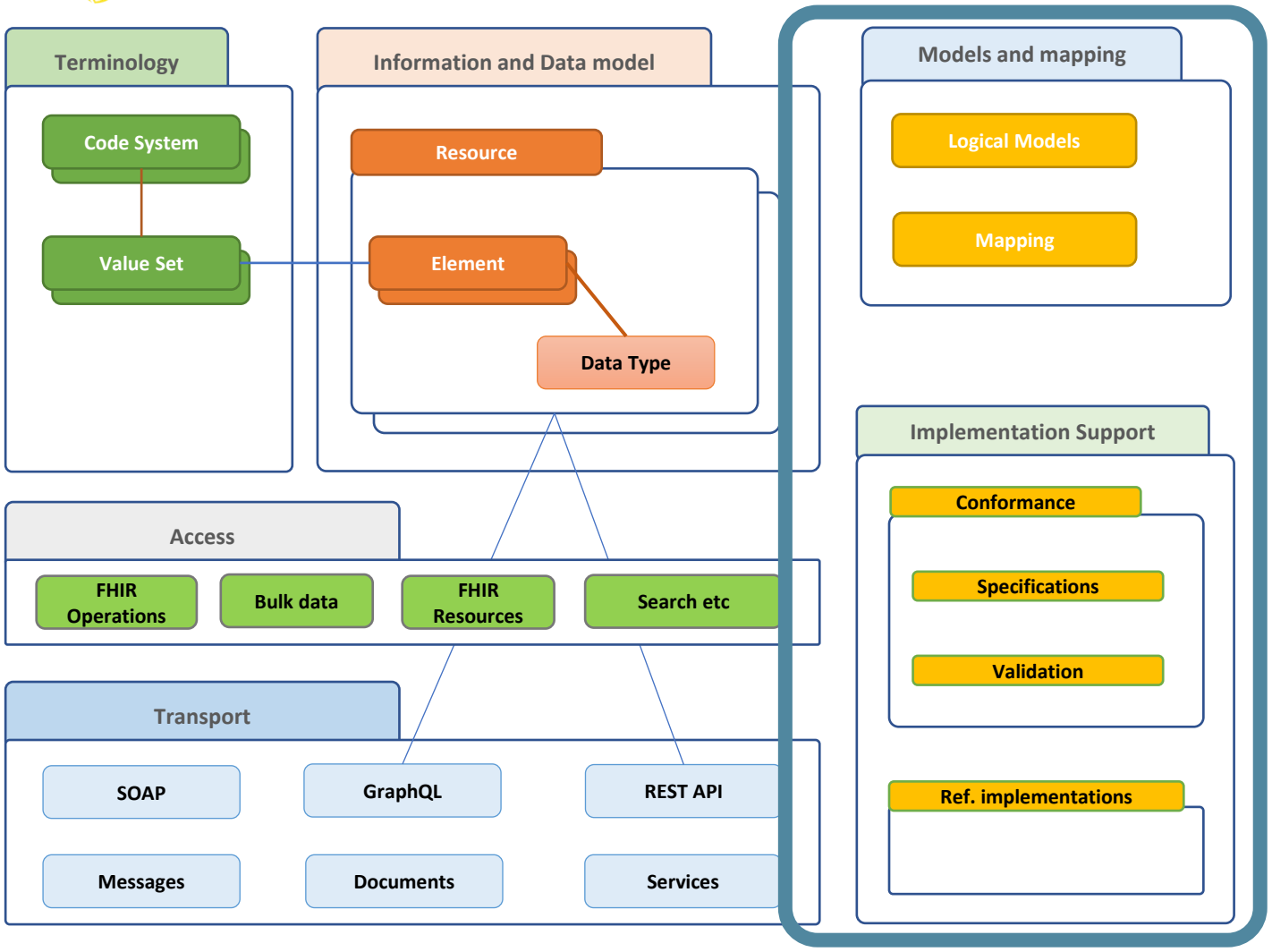
- *All of the above are FHIR® concepts that can be reused or defined when profiling*

FHIR® resource profiles

- *FHIR® resources can be profiled:*

- Extensions added or constrained
- Cardinalities constrained
- Vocabulary bindings constrained
- Slices can be created
- …

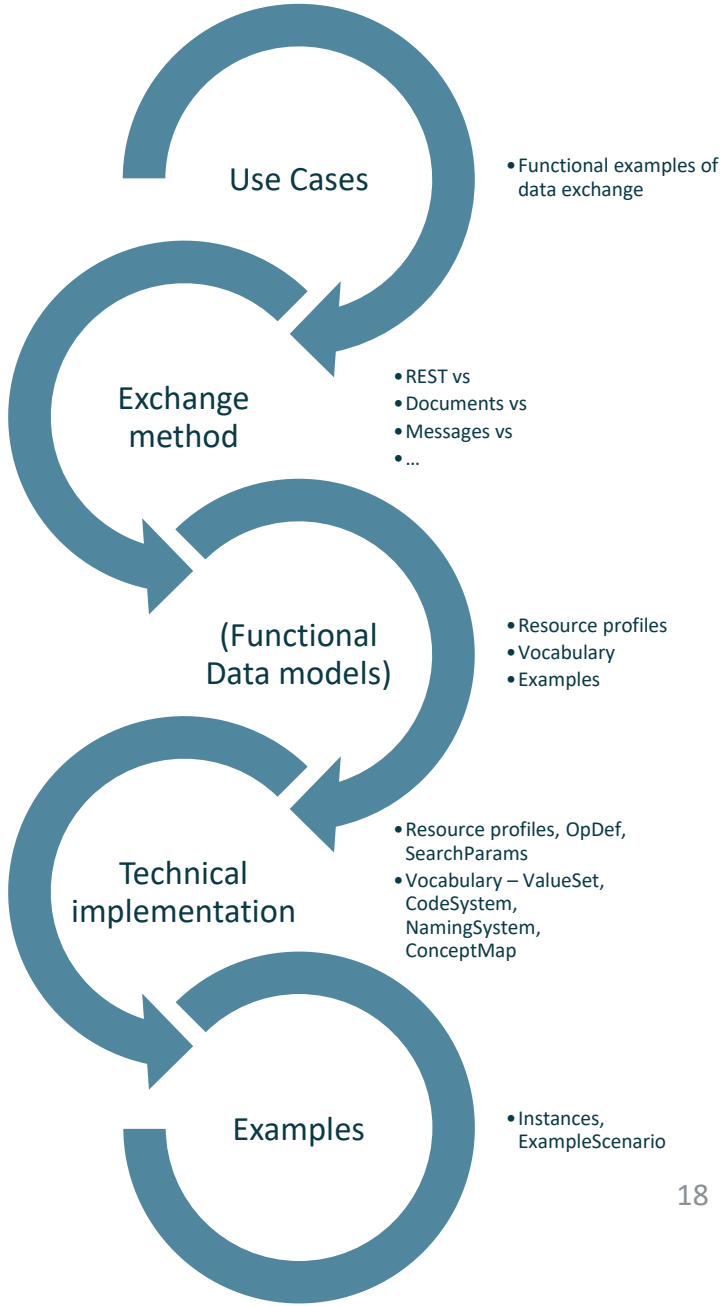
FHIR® Implementation



How to do FHIR® Profiling and specification

Iterative process

- Use Cases
- Exchange method
- (Functional Data models)
- Technical implementation
  - Choose a base
  - Resource profiles
  - Vocabulary
  - Examples



Use Cases

1. Identify your data exchange process
    1. (trick: it helps to imagine a dialog)
2. List the actors, what they say to each other, what they expect
    1. Document
    2. Validate with your stakeholders
3. Capture meaningful examples

Exchange method

- Define / decide:
  - Push / Pull model? Who initiates?
  - Consistency of data?
  - …

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

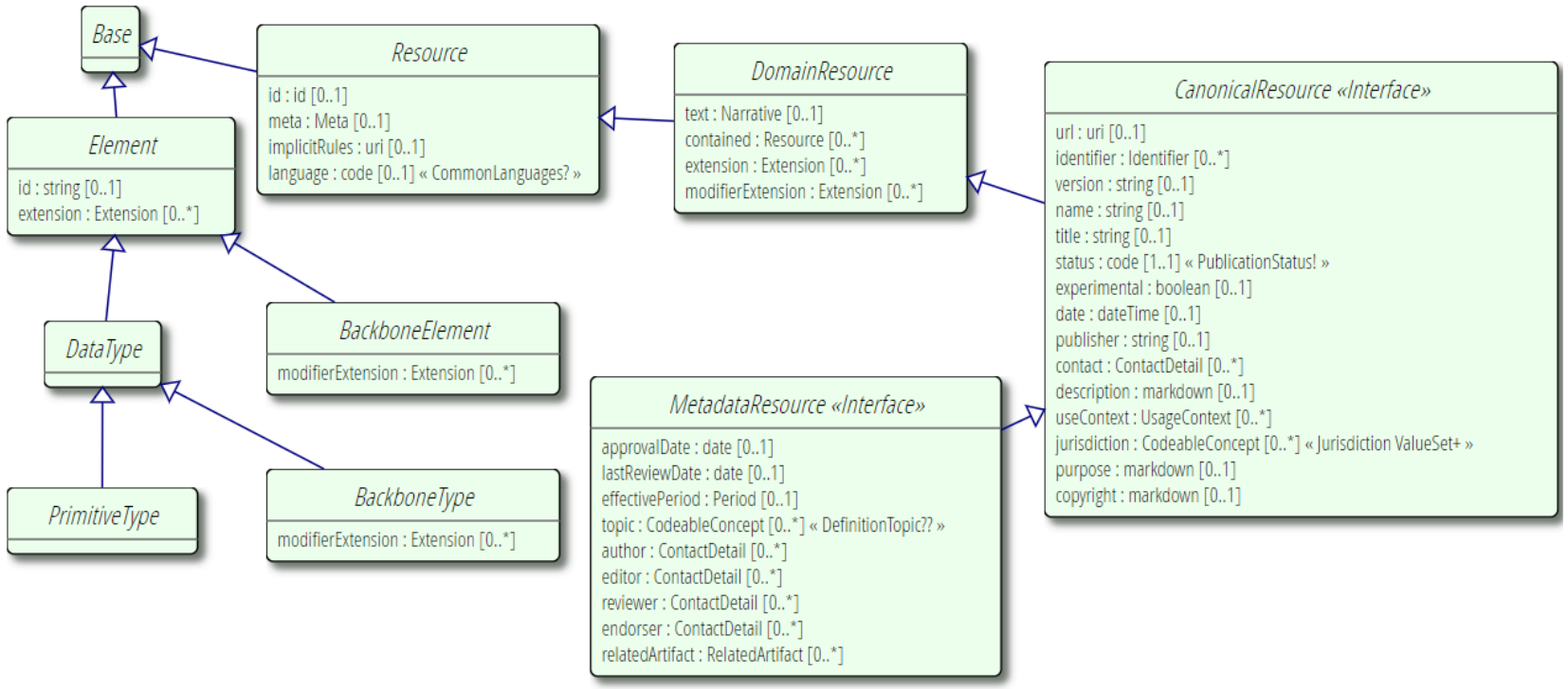
Functional Data Models

- Keeping your data in a “functional” module can be very helpful:
  - Facilitates discussion with non-technical people
  - Allows mapping to existing / other implementations
  - Enables structured capture of functional requirements (cardinalities, bindings..)
  - Facilitates migration to different FHIR versions or updates in base guidance
- If you have a reference, use it. If not, start with the FHIR® resource model.

Technical Implementation

FHIR® Foundation

Profiling data structures



http://build.fhir.org/types.html

Profiling data structures

- http://build.fhir.org/profiling.html

- Profiling in FHIR® is a technical-based mechanism. Some narrative applies but most is computable

- A “profile” is the name given to a constrained resource in FHIR®. Example: MedicationPrescription (profile of MedicationRequest).

- Most profiles are for existing resources. A new, custom resource is seldom needed – if you think you need one, please let us know.
  - Custom resources are based on the fhir Basic resource

http://build.fhir.org/types.html

StructureDefinition

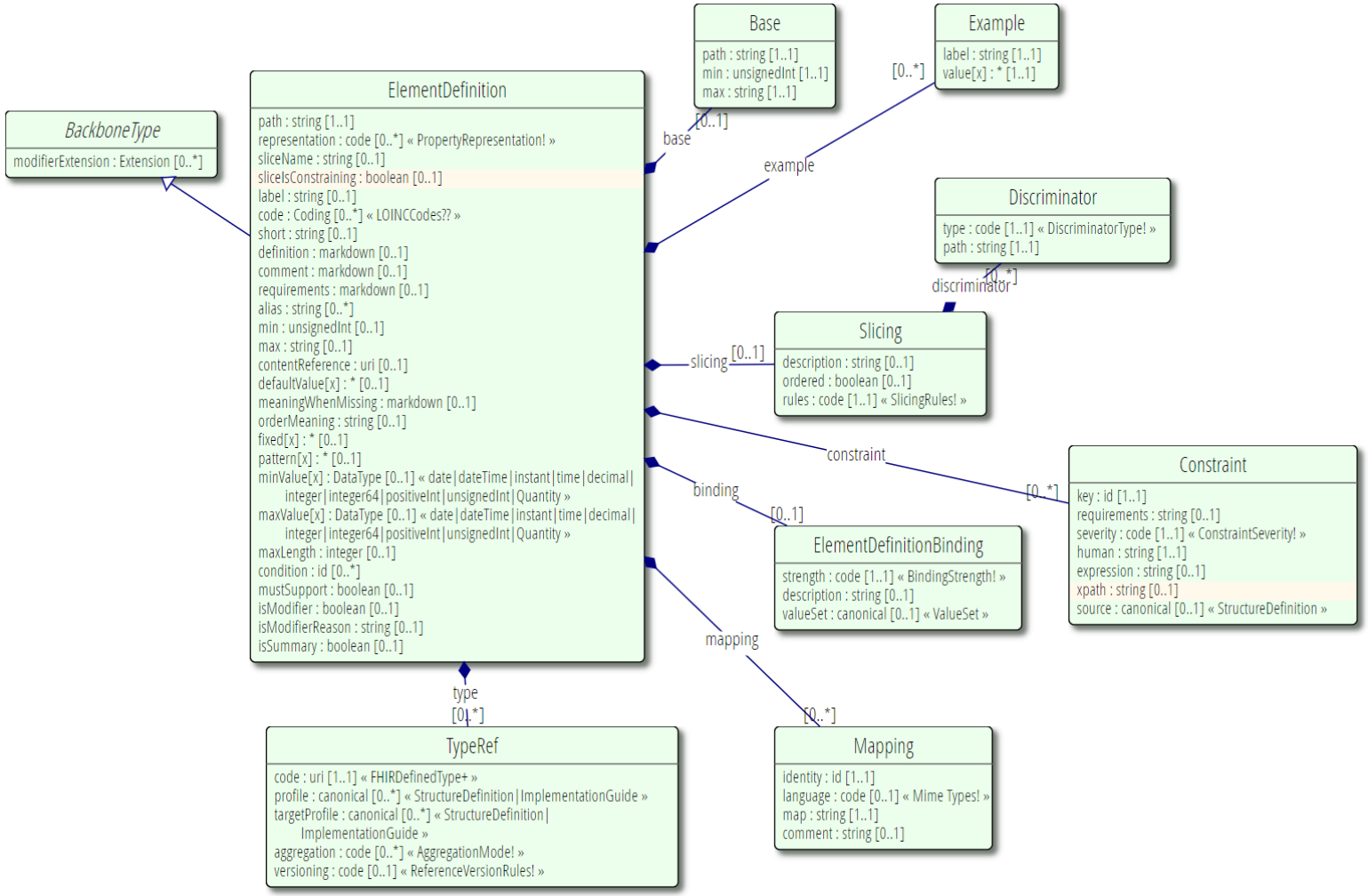
- Defines a data structure – a set of elements
  - Snapshot – full structure
  - Differential – difference to base

StructureDefinition	N		CanonicalResource	Structural Definition
url	Σ	1..1	uri	Canonical identifier for this structure definition, represented as a URI (globally unique)
identifier	Σ	0..*	Identifier	Additional identifier for the structure definition
version	Σ	0..1	string	Business version of the structure definition
name	Σ I	1..1	string	Name for this structure definition (computer friendly)
title	Σ	0..1	string	Name for this structure definition (human friendly)
status	?! Σ	1..1	code	draft | active | retired | unknown PublicationStatus (Required)
experimental	Σ	0..1	boolean	For testing purposes, not real usage
date	Σ	0..1	dateTime	Date last changed
publisher	Σ	0..1	string	Name of the publisher (organization or individual)
contact	Σ	0..*	ContactDetail	Contact details for the publisher
description		0..1	markdown	Natural language description of the structure definition
useContext	Σ TU	0..*	UsageContext	The context that the content is intended to support
jurisdiction	Σ	0..*	CodeableConcept	Intended jurisdiction for structure definition (if applicable) Jurisdiction (Extensible)
purpose		0..1	markdown	Why this structure definition is defined
copyright		0..1	markdown	Use and/or publishing restrictions
keyword	Σ	0..*	Coding	Assist with indexing and finding Structure Definition Use Codes / Keywords (Extensible)
fhirVersion	Σ	0..1	code	FHIR Version this StructureDefinition targets FHIRVersion (Required)
mapping	I	0..*	BackboneElement	External specification that the content is mapped to *+ Rule: Must have at least a name or a uri (or both)*
identity		1..1	id	Internal id when this mapping is used
uri	I	0..1	uri	Identifies what this mapping refers to
name	I	0..1	string	Names what this mapping refers to
comment		0..1	string	Versions, Issues, Scope limitations etc.
kind	Σ	1..1	code	primitive-type | complex-type | resource | logical StructureDefinitionKind (Required)
abstract	Σ	1..1	boolean	Whether the structure is abstract
context	Σ I	0..*	BackboneElement	If an extension, where it can be used in instances
type	Σ	1..1	code	fhirpath | element | extension ExtensionContextType (Required)
expression	Σ	1..1	string	Where the extension can be used in instances
contextInvariant	Σ I	0..*	string	FHIRPath invariants - when the extension can be used
type	Σ I	1..1	uri	Type defined or constrained by this structure FHIRDefinedType (Extensible)
baseDefinition	Σ I	0..1	canonical(StructureDefinition)	Definition that this type is constrained/specialized from
derivation	Σ	0..1	code	specialization | constraint - How relates to base definition TypeDerivationRule (Required)
snapshot	I	0..1	BackboneElement	Snapshot view of the structure *+ Rule: Each element definition in a snapshot must have a formal definition and cardinalities* *+ Rule: All snapshot elements must start with the StructureDefinition's specified type for non-logical models, or with the same type name for logical models* *+ Rule: All snapshot elements must have a base definition*
element	I	1..*	ElementDefinition	Definition of elements in the resource (if no StructureDefinition) *+ Rule: provide either a binding reference or a description (or both)*
differential	I	0..1	BackboneElement	Differential view of the structure *+ Rule: No slicing on the root element* *+ Rule: In any differential, all the elements must start with the StructureDefinition's specified type for non-logical models, or with the same type name for logical models*
element		1..*	ElementDefinition	Definition of elements in the resource (if no StructureDefinition)

http://build.fhir.org/structuredefinition

ElementDefinition

- Definition of a single data element and its metadata and constraints



http://build.fhir.org/elementdefinition

Element

- Definitions
- Cardinality
- Bindings - terminologies
- Constraints – expressions that can be used to validate content
- MustSupport, isModifier

Profiling data structures

- Resources:
  - Take one resource as base, add (Differential) constraints to its elements
- Extensions:
  - Take the Extension resource as base, add (Differential) constraints to its elements, and define context

Extensions

http://build.fhir.org/extensibility.html

- Most everything can be extended
- There are several extensions available in HL7: http://build.fhir.org/extensibility-registry.html

Terminologies

- Define ValueSets, CodeSystems, NamingSystems
- Apply them to bindings of data elements

OperationDefinition

- FHIR® provides mechanisms to define / register server operations
- For example $document (return a document), $expand (return an expanded valueset)
- We can define our own operations

(keep in mind that FHIR® is an interoperability standard, not a single system's specification)

http://build.fhir.org/operationdefinition

Name	Flags	Card.	Type	Description & Constraints
OperationDefinition	N		CanonicalResource	Definition of an operation or a named query *+ Warning: Name should be usable as an identifier for the module by machine processing applications such as code generation* Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension, url, identifier, version, name, title, status, experimental, date, publisher, contact, description, useContext, jurisdiction, purpose, copyright
url	Σ	0..1	uri	Canonical identifier for this operation definition, represented as a URI (globally unique)
version	Σ	0..1	string	Business version of the operation definition
name	Σ I	1..1	string	Name for this operation definition (computer friendly)
title	Σ	0..1	string	Name for this operation definition (human friendly)
status	?! Σ	1..1	code	draft | active | retired | unknown PublicationStatus (Required)
kind	Σ	1..1	code	operation | query OperationKind (Required)
experimental	Σ	0..1	boolean	For testing purposes, not real usage
date	Σ	0..1	dateTime	Date last changed
publisher	Σ	0..1	string	Name of the publisher (organization or individual)
contact	Σ	0..*	ContactDetail	Contact details for the publisher
description		0..1	markdown	Natural language description of the operation definition
useContext	Σ TU	0..*	UsageContext	The context that the content is intended to support
jurisdiction	Σ	0..*	CodeableConcept	Intended jurisdiction for operation definition (if applicable) Jurisdiction (Extensible)
purpose		0..1	markdown	Why this operation definition is defined
affectsState	Σ	0..1	boolean	Whether content is changed by the operation
code	Σ	1..1	code	Name used to invoke the operation
comment		0..1	markdown	Additional information about use
base	Σ	0..1	canonical(OperationDefinition)	Marks this as a profile of the base
resource	Σ	0..*	code	Types this operation applies to ResourceType (Required)
system	Σ	1..1	boolean	Invoke at the system level?
type	Σ	1..1	boolean	Invoke at the type level?
instance	Σ	1..1	boolean	Invoke on an instance?
inputProfile		0..1	canonical(StructureDefinition)	Validation information for in parameters
outputProfile		0..1	canonical(StructureDefinition)	Validation information for out parameters
parameter	I	0..*	BackboneElement	Parameters for the operation/query *+ Rule: Either a type must be provided, or parts* *+ Rule: A search type can only be specified for parameters of type string* *+ Rule: A targetProfile can only be specified for parameters of type Reference or Canonical*
name		1..1	code	Name in Parameters.parameter.name or in URL
use		1..1	code	in | out OperationParameterUse (Required)
min		1..1	integer	Minimum Cardinality
max		1..1	string	Maximum Cardinality (a number or *)
documentation		0..1	string	Description of meaning/use
type	I	0..1	code	What type this parameter has FHIRAllTypes (Required)
targetProfile		0..*	canonical(StructureDefinition)	If type is Reference | canonical, allowed targets
searchType	I	0..1	code	number | date | string | token | reference | composite | quantity | uri | special SearchParamType (Required)
binding		0..1	BackboneElement	ValueSet details if this is coded
strength		1..1	code	required | extensible | preferred | example BindingStrength (Required)
valueSet		1..1	canonical(ValueSet)	Source of value set
referencedFrom	TU	0..*	BackboneElement	References to this parameter
source		1..1	string	Referencing parameter
sourceId		0..1	string	Element id of reference
part	I	0..*	see parameter	Parts of a nested Parameter
overload		0..*	BackboneElement	Define overloaded variants for when generating code
parameterName		0..*	string	Name of parameter to include in overload
comment		0..1	string	Comments to go on overload

SearchParameter

- FHIR® search works based on available search parameters.

  http://build.fhir.org/search

- Sometimes we need other search parameters
  - For an extension, a specific slice, or an attribute that was not searchable

- Many FHIR® servers support custom search parameters

SearchParameter	TU		CanonicalResource	Search parameter for a resource *+ Warning: Name should be usable as an identifier for the module by machine processing applications such as code generation* *+ Rule: If an xpath is present, there SHALL be an xpathUsage* *+ Rule: Search parameters can only have chain names when the search parameter type is 'reference'* Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension, url, identifier, version, name, title, status, experimental, date, publisher, contact, description, useContext, jurisdiction, purpose, copyright
url	Σ	1..1	uri	Canonical identifier for this search parameter, represented as a URI (globally unique)
version	Σ	0..1	string	Business version of the search parameter
name	Σ I	1..1	string	Name for this search parameter (computer friendly)
derivedFrom		0..1	canonical(SearchParameter)	Original definition for the search parameter
status	?! Σ	1..1	code	draft | active | retired | unknown PublicationStatus (Required)
experimental	Σ	0..1	boolean	For testing purposes, not real usage
date	Σ	0..1	dateTime	Date last changed
publisher	Σ	0..1	string	Name of the publisher (organization or individual)
contact	Σ	0..*	ContactDetail	Contact details for the publisher
description	Σ	1..1	markdown	Natural language description of the search parameter
useContext	Σ	0..*	UsageContext	The context that the content is intended to support
jurisdiction	Σ	0..*	CodeableConcept	Intended jurisdiction for search parameter (if applicable) Jurisdiction (Extensible)
purpose		0..1	markdown	Why this search parameter is defined
code	Σ	1..1	code	Code used in URL
base	Σ	1..*	code	The resource type(s) this search parameter applies to ResourceType (Required)
type	Σ	1..1	code	number | date | string | token | reference | composite | quantity | uri | special SearchParamType (Required)
expression	I	0..1	string	FHIRPath expression that extracts the values
xpath	I	0..1	string	XPath that extracts the values
xpathUsage	I	0..1	code	normal | phonetic | nearby | distance | other XPathUsageType (Required)
target		0..*	code	Types of resource (if a resource reference) ResourceType (Required)
multipleOr		0..1	boolean	Allow multiple values per parameter (or)
multipleAnd		0..1	boolean	Allow multiple parameters (and)
comparator		0..*	code	eq | ne | gt | lt | ge | le | sa | eb | ap SearchComparator (Required)
modifier		0..*	code	missing | exact | contains | not | text | in | not-in | below | above | type | identifier | ofType SearchModifierCode (Required)
chain		0..*	string	Chained names supported
component		0..*	BackboneElement	For Composite resources to define the parts
definition		1..1	canonical(SearchParameter)	Defines how the part works
expression		1..1	string	Subexpression relative to main expression

http://build.fhir.org/searchparameter

Higher-level constrains

- Aggregated content definition
  - Documents
  - Messages
- Workflow constraints

Special case - questionnaire

- Questionnaire can be used in some circumstances to collect information in a structured, simplified way.
- Does not replace the FHIR® resources and is not intended to handle standard interoperability, but is a means for structured data capture

- http://hl7.org/fhir/uv/sdc/2019May/

Examples

- Try to have examples for each (key) change or feature
- Ideally those examples would align with any narrative you have

Workflow / Exchange approach

- Capture as narrative, provide examples

CapabilityStatement

- A CapabilityStatement defines how a system is expected to behave
- Use it to assert and consult a system's expectations

Health Intersections Conformance Statement

FHIR v4.0.1 released 2021-05-24. Server version 1.9.374 built 2021-05-24

Resource Type	Profile	Read	V-Read	Search	Update	Updates	Create	Delete	History
Account	account	✔	✔	✔	✔	✔	✔	✔	✔
ActivityDefinition	activitydefinition	✔	✔	✔	✔	✔	✔	✔	✔
AdverseEvent	adverseevent	✔	✔	✔	✔	✔	✔	✔	✔
AllergyIntolerance	allergyintolerance	✔	✔	✔	✔	✔	✔	✔	✔
Appointment	appointment	✔	✔	✔	✔	✔	✔	✔	✔
AppointmentResponse	appointmentresponse	✔	✔	✔	✔	✔	✔	✔	✔
AuditEvent	auditevent	✔	✔	✔		✔	✔		✔
Basic	basic	✔	✔	✔	✔	✔	✔	✔	✔
Binary	--	✔	✔		✔	✔	✔	✔	✔
BiologicallyDerivedProduct	biologicallyderivedproduct	✔	✔	✔	✔	✔	✔	✔	✔
BodyStructure	bodystructure	✔	✔	✔	✔	✔	✔	✔	✔
Bundle	bundle	✔	✔	✔	✔	✔	✔	✔	✔
CapabilityStatement	capabilitystatement	✔	✔	✔	✔	✔	✔	✔	✔
CarePlan	careplan	✔	✔	✔	✔	✔	✔	✔	✔
CareTeam	careteam	✔	✔	✔	✔	✔	✔	✔	✔
CatalogEntry	catalogentry	✔	✔	✔	✔	✔	✔	✔	✔
ChargeItem	chargeitem	✔	✔	✔	✔	✔	✔	✔	✔
ChargeItemDefinition	chargeitemdefinition	✔	✔	✔	✔	✔	✔	✔	✔
Claim	claim	✔	✔	✔	✔	✔	✔	✔	✔
ClaimResponse	claimresponse	✔	✔	✔	✔	✔	✔	✔	✔
ClinicalImpression	clinicalimpression	✔	✔	✔	✔	✔	✔	✔	✔
CodeSystem	codesystem	✔	✔	✔	✔	✔	✔	✔	✔
Communication	communication	✔	✔	✔	✔	✔	✔	✔	✔
CommunicationRequest	communicationrequest	✔	✔	✔	✔	✔	✔	✔	✔
CompartmentDefinition	compartmentdefinition	✔	✔	✔	✔	✔	✔	✔	✔
Composition	composition	✔	✔	✔	✔	✔	✔	✔	✔
ConceptMap	conceptmap	✔	✔	✔	✔	✔	✔	✔	✔
Condition	condition	✔	✔	✔	✔	✔	✔	✔	✔
Consent	consent	✔	✔	✔	✔	✔	✔	✔	✔
Contract	contract	✔	✔	✔	✔	✔	✔	✔	✔
Coverage	coverage	✔	✔	✔	✔	✔	✔	✔	✔
CoverageEligibilityRequest	coverageeligibilityrequest	✔	✔	✔	✔	✔	✔	✔	✔
CoverageEligibilityResponse	coverageeligibilityresponse	✔	✔	✔	✔	✔	✔	✔	✔
DetectedIssue	detectedissue	✔	✔	✔	✔	✔	✔	✔	✔
Device	device	✔	✔	✔	✔	✔	✔	✔	✔
DeviceDefinition	devicedefinition	✔	✔	✔	✔	✔	✔	✔	✔
DeviceMetric	devicemetric	✔	✔	✔	✔	✔	✔	✔	✔
DeviceRequest	devicerequest	✔	✔	✔	✔	✔	✔	✔	✔
DeviceUseStatement	deviceusestatement	✔	✔	✔	✔	✔	✔	✔	✔
DiagnosticReport	diagnosticreport	✔	✔	✔	✔	✔	✔	✔	✔
DocumentManifest	documentmanifest	✔	✔	✔	✔	✔	✔	✔	✔
DocumentReference	documentreference	✔	✔	✔	✔	✔	✔	✔	✔
EffectEvidenceSynthesis	effectevidencesynthesis	✔	✔	✔	✔	✔	✔	✔	✔
Encounter	encounter	✔	✔	✔	✔	✔	✔	✔	✔
Endpoint	endpoint	✔	✔	✔	✔	✔	✔	✔	✔
EnrollmentRequest	enrollmentrequest	✔	✔	✔	✔	✔	✔	✔	✔
EnrollmentResponse	enrollmentresponse	✔	✔	✔	✔	✔	✔	✔	✔
EpisodeOfCare	episodeofcare	✔	✔	✔	✔	✔	✔	✔	✔

Reference implementations

- http://fhir.org/guides/registry/
- https://simplifier.net/

Tooling

Tools for profiling

- …notepad…
- Forge https://fire.ly/products/forge/
- sushi (an implementation of FHIR® Shorthand) https://fshschool.org/
    - Include sushi online and gofsh
- FHIR® toolkit http://www.healthintersections.com.au/FhirServer/
- …

Technical Implementation

Example

- Prescription for COVID vaccine (NOT certificate)
  - Profile: prescription
  - Terminology: Vaccine codes
  - Extensions: Patient gender
  - …

Discussion

FHIR® Tools

FHIR® servers

- Readily available:
  - http://test.fhir.org/r4
  - http://hapi.fhir.org/

Reference implementations (servers and clients on several technology platforms)

https://confluence.hl7.org/display/FHIR/Open+Source+Implementations

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

Upcoming sessions

- ~~28 April | **FHIR® 101 Refresher**~~
- ~~26 May | **FHIR® profiling & documentation**~~
- 30 June | **FHIR® and Terminology**
- 28 July | **FHIR® Implementation Guide / Advanced Usage**

Digital Square is supported by:

Digital Square is a PATH-led initiative funded and designed by the United States Agency for International Development, the Bill & Melinda Gates Foundation, and a consortium of other donors.

This presentation was made possible by the generous support of the American people through the United States Agency for International Development. The contents are the responsibility of PATH and do not necessarily reflect the views of USAID or the United States Government.