



An **E**ducational **H**R **E**nvironment Based on open**H**R & REST

<http://www.imt.liu.se/mi/ehr/tools/>

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EEE

An Educational EHR Environment Extendable EHR Ecosystem? Exploding EHR Environment

(EHR = Electronic Health Record)

openEHR semantics & EEE

⦿ openEHR semantics of data is well defined

- ...but somewhat intertwined with semantics of operations on data due to object orientation

⦿ openEHR semantics of operations on data

- requirements on operations (e.g. versioning & contributions) are implicit in the object oriented data model
- no service interface published as public specification yet

⦿ EEE aims to

- use REST for operations and to allow for several different syntax encodings of the openEHR data semantics ('representations' in REST terms)
- Separate operations (OO functions) from the representations

Encourage implementation diversity while preserving semantic interoperability

- ⦿ open specifications (e.g. openEHR) enables implementation technology diversity **between** interoperable systems (great!)
- ⦿ EEE aims to simplify diversity and flexibility **within** a system deployment
- ⦿ Not new or unique, also present in:
 - Upcoming openEHR service specifications for SOAP
 - Opereffa (Java)
 - OSHP (Python, Java, Ruby, Lua, C++ ?)
 - GastrOS
 - Eiffel + .NET at commercial vendor?
 - Open EHR-Gen
 - ...

Why EEE?

MMM?

- ⦿ We (IMT/LiU) needed an EHR system based on Archetypes etc (openEHR and/or ISO 13606) for education and research
 - Modifiable & Open Source (e.g. OSHPD & Opereffa are also alternatives)
 - Modular & easy to get started with
 - > It was hard for new people to get started with openEHR projects in short time (e.g. master thesis projects or studies for a single paper). "Pluggable" components with limited scope could help.
 - > Integrate with other complete and partial implementations (any http-capable platform/programming language etc)
 - Massively scalable? (Yet unproven...) It would be nice if EEE's architecture nicely scaled out to massively distributed deployments, including for nation-wide epidemiological purposes.
 - > Slowness is a usability problem present in many EHRs
 - > EEE aims to make use of REST's load reducing constructs.

Encounter

Vital signs

Blood pressure

any event

den 25 maj 2008

data

systolic mm[Hg]

diastolic mm[Hg]

Pulse

Any event

den 25 maj 2008

Findings

Rate

Rate /min

Respirations

Any event

den 25 maj 2008

data

Rate /min

Blood gas assessment

Any event

Site of measurement

[vital_signs.oet]

- Template Properties
- Encounter
 - context
 - content
- Vital signs
 - items
 - Blood pressure
 - data
 - any event
 - systolic
 - diastolic
 - mean arterial pressure
 - pulse pressure
 - Comment
 - state
 - Position
 - Exer
 - Tilt
 - baseline read
 - 5 minute read
 - 10 minute read
 - Postural char
 - Paradox
- protocol
 - Cuff size
 - Instrument
 - Location of measurement
 - Korotkoff sounds
- Pulse
 - data

Archetypes (chaining points)

ehr://1234567/87284370-2D4B-4e3d-A3F3-F303D2F4F34B@latest_trunk_version/
content[openEHR-EHR-SECTION.v1]/items[openEHR-EHR-OBSERVATION.heart_rate-pulse.v1]
/data/events[at0006]/data/items[at0004]/value/magnitude

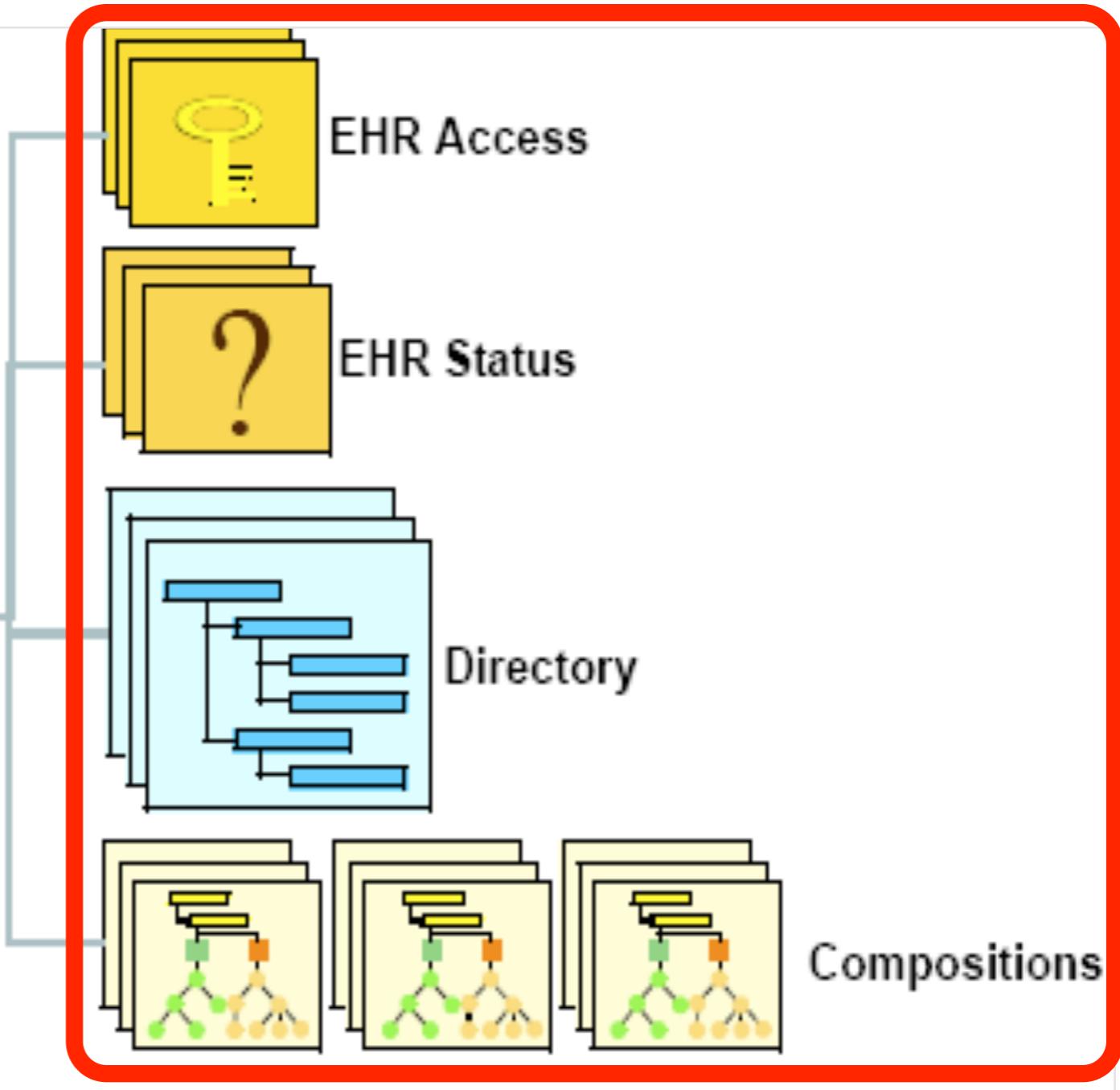
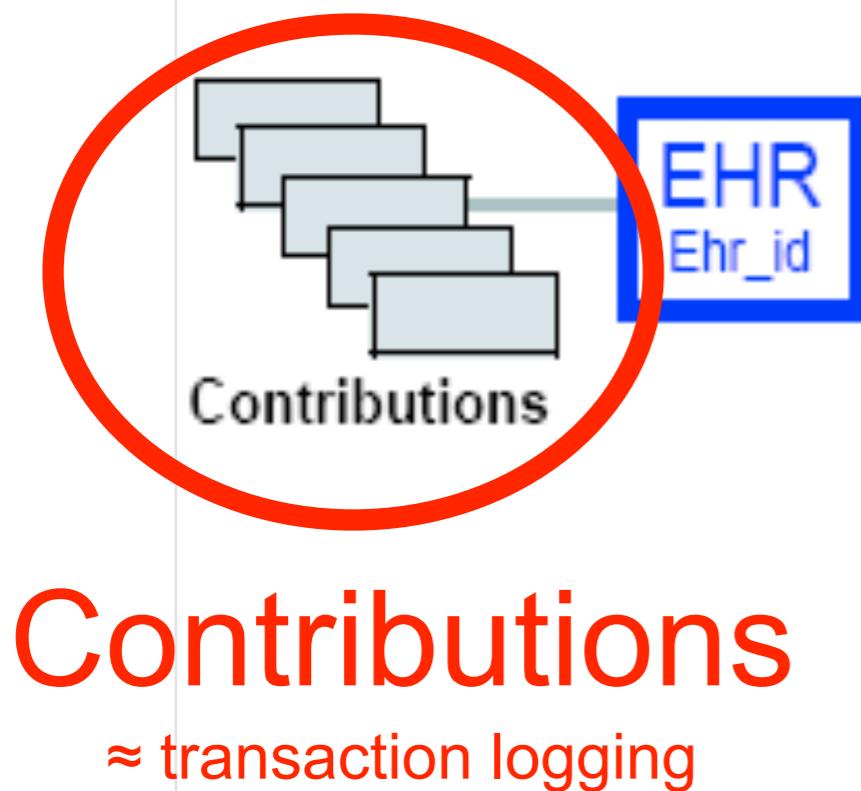
protocol

Site of measurement

protocol

Respirations

Blood gas assessment



Versioned objects

Contributions

xxxx = COMPOSITION

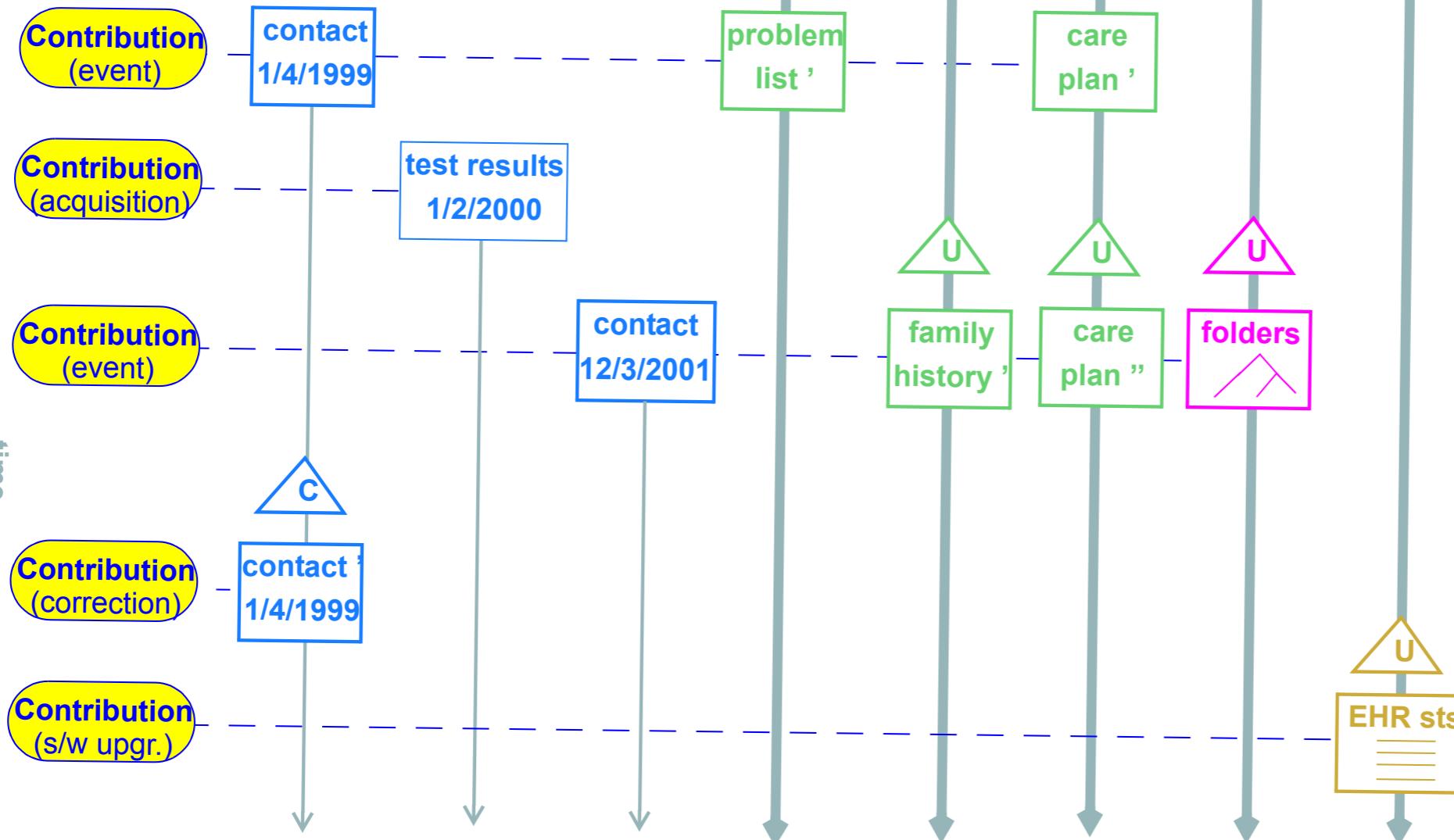
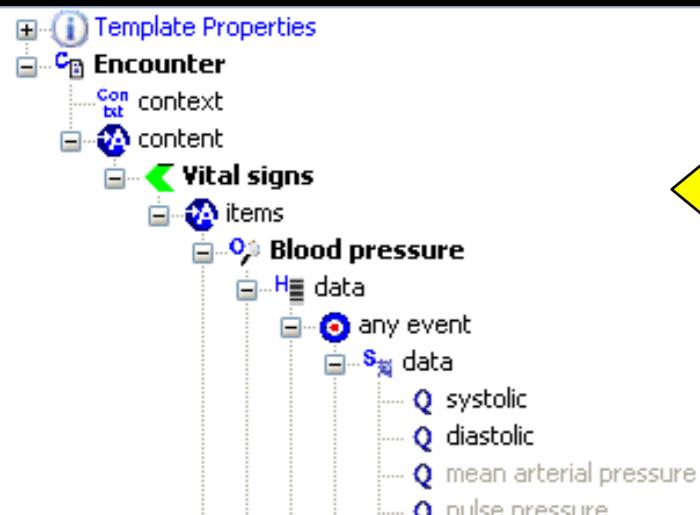


FIGURE 8 Contributions to the EHR

LiU
expanding reality

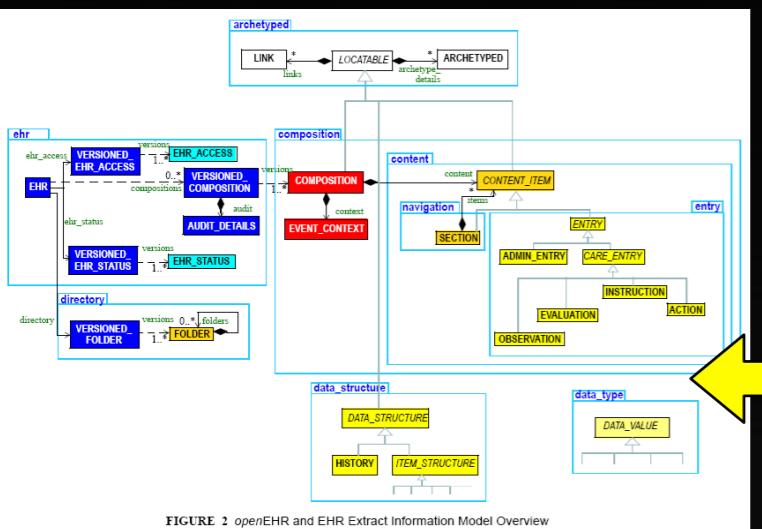
Many ways to represent openEHR semantics



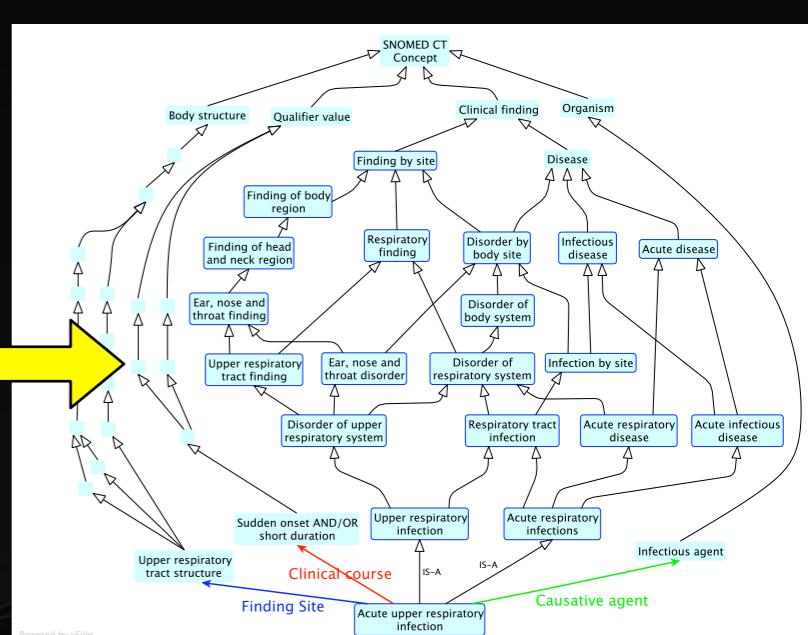
- Entered data internally
mostly resembles a **tree** technically,
- but many prefer to think of it and present it as a structured **document**.

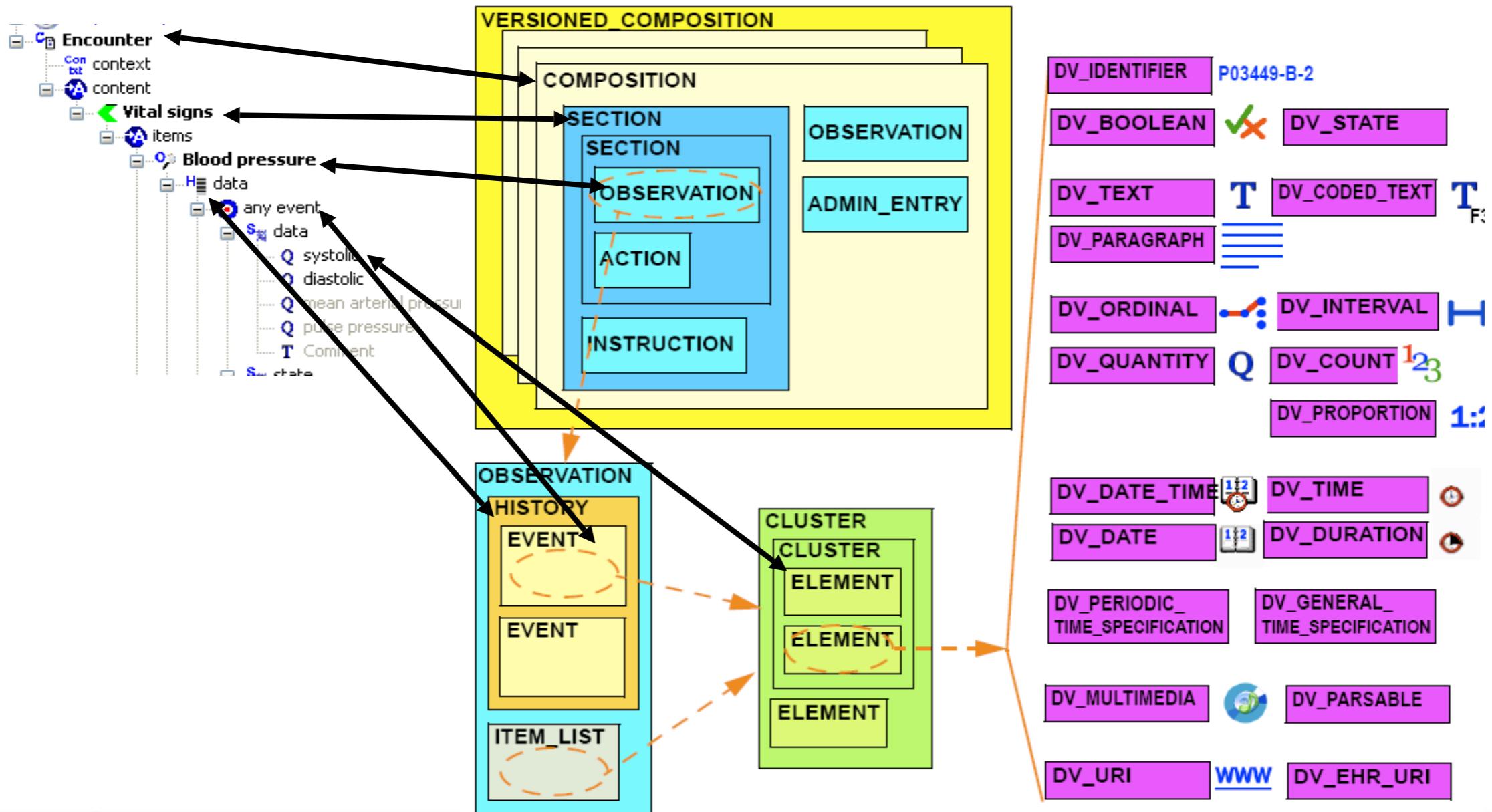
This screenshot shows a structured document interface for entering vital signs. It includes fields for 'Blood pressure', 'any event' (with a date and time input), and 'data' fields for 'systolic' and 'diastolic' values, each with a unit of 'mm[Hg]'.

- The semantics of the reference model (RM) used is specified as an **object** oriented model.



- openEHR data can contain pointers to **graph** content such as terminology system codes





□ **Document** - Traditions, clinical context, authorship etc. matter.

> EHR > Compositions > Sections > Entries > Data structures > Values

□ **Tree** - Paths are convenient for queries, processing etc.

> `ehr://1234567/87284370-2D4B-4e3d-A3F3-F303D2F4F34B@latest_trunk_version/content[openEHR-EHR-SECTION.v1]/items[openEHR-EHR-OBSERVATION.heart_rate-pulse.v1]/data/events[at0006]/data/items[at0004]/value/magnitude`

□ **Objects** - Easily implementable in IT systems (somewhat consistently)

storing openEHR data

but how?

Documents and Graphs and Atoms

- ⦿ Structured documents
 - XML
 - JSON
 - YAML
 - dADL
 - ...
- ⦿ Objects / object graphs
 - Object databases
 - Network databases
 - ...
- ⦿ Fine grained data atoms
 - Mapped to Relational Database (SQL)
 - RDF in a triple store / DB
 - ...
- ⦿ Depends on major use case (single vs. multi), indexing etc
 - Initial EEE implementation: XML documents in XML database with indexing.
Why?
 - > openEHR XML schemas exist (easy start)
 - > XQuery is powerful for path-based queries
 - > ...but other storage formats are also expected within an EEE ecosystem

XML-database

Databases known to support XQuery, XQJ, XML:DB, or a RESTful API

XML Database	License	Language	XQJ API	XML:DB API	RESTful API	Transaction Support
Apache Xindice  (no longer maintained  <td>Open source, free</td> <td>Java</td> <td>No</td> <td>Yes</td> <td>No</td> <td>No</td>	Open source, free	Java	No	Yes	No	No
BaseX  	Open source, free	Java	Yes	Yes	Yes	Yes
Gemfire Enterprise	Commercial	Unknown	No	Yes	No	Yes
DOMSafeXML	Commercial	Unknown	No	Yes	No	Yes
eXist  	Open source, free	Java	No	Yes	Yes	No
MarkLogic Server	Commercial	C++	No	No	Yes	Yes
MonetDB/XQuery 	Open source, free	C++	No	Yes	No	No
myXMLDB 	Open source, free	Java	No	Yes	No	Unknown
OZONE 	Open source, free	Java	No	Yes	No	Yes
Sedna  	Open source, free	C++	 Yes 	 Yes 	No	Yes
Software AG's Tamino	Commercial	Unknown	No	Partial	No	Unknown
TeXtML 	Commercial	Unknown	Unknown	Unknown	No	Yes

- Many more with xQuery support (and QQJ?) e.g. Oracle
- Source: http://en.wikipedia.org/wiki/XML_database

REST

Representational State Transfer

REST (Representational State Transfer)

Web principles

- The terms "representational state transfer" and "REST" were introduced in 2000 in the doctoral dissertation of Roy Fielding, one of the principal authors of the Hypertext Transfer Protocol (HTTP) specification.

⌚ Predefined "verbs" (next slide)...

 ... act on "resources" identified e.g. by URLs (below)

Resources can return different "representations"

- > E.g. xml (openEHR, RDF), html, json, protobuf, plain text, serialised java objects

Example: <http://www.google.se/search?q=openehr&ie=utf-8&oe=utf-8>

REST verbs

Predefined "verbs" act on "resources" (e.g. URL identifiers)

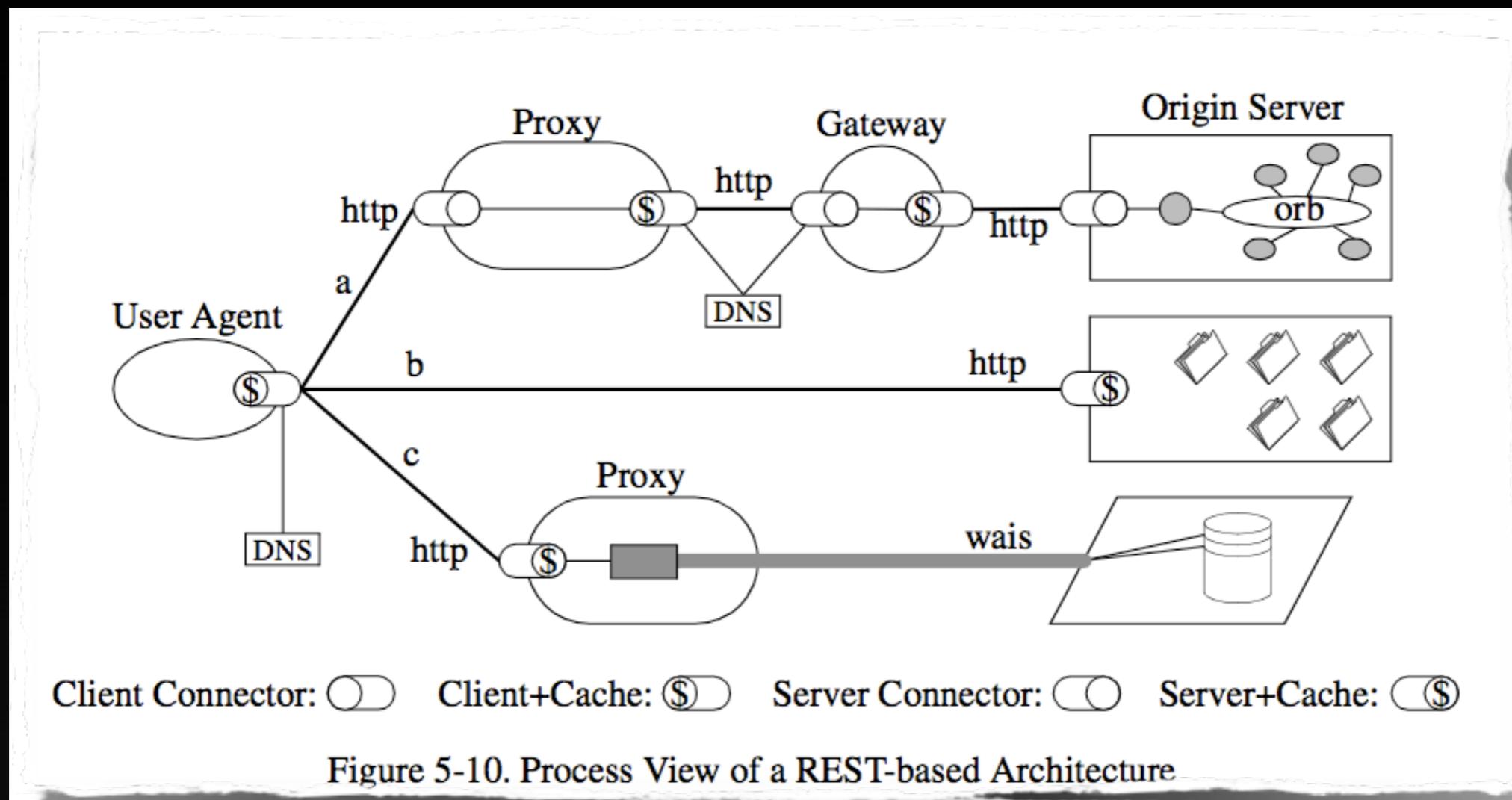
- > A **GET** to an identifier requests a copy of the information in the supplied content type.
- > A **PUT** to an identifier replaces the information. The supplied content type determines how it is to be interpreted.
- > **POST** adds information.
- > **DELETE** eliminates information.

Database Operations	REST/HTTP Equivalents
CREATE	PUT
READ	GET
UPDATE	POST (update) or PUT (replace)
DELETE	DELETE

Partial source: <http://hadoop.apache.org/hbase/docs/current/api/org/apache/hadoop/hbase/stargate/package-summary.html>

REST (Representational State Transfer)

- REST Buzzwords: Low Entry-barrier, Extensibility, Distributed Hypermedia(?), Internet-scale...



Source: Roy T. Fielding.

Architectural styles and the design of network-based software architectures.
PhD Thesis, University of California, Irvine, 2000.



openEHR + REST = true love?

EEE Main Components

- = Resources accessible via HTTP calls to URIs
- = Services accessible via interfaces (mostly Java currently)

EEE main components

Decision support

Trigger handler
(during entry)

Validators &
Converters

Trigger
handler (on
commit)

Export
(e.g. replication)

Decision support

Contribution
builder

Contribution

Client

Client

Contribution
builder

Validators &
Converters

Single record
access router

Log

Custom
resources

Client

Client

Multi record
access router

Log

Versioned
object

AQL-Query

Query
translators

Query
(DB native QLs)

basic
DB write

basic
DB read

Native DB
calls

Versioned objects
(compositions etc)

Contributions

EHR Access
control settings

Tools & utilities:

Bulk loader

Instance
builder

Log extractor

Admin
(users etc)

Grouping of use-cases: single vs aggregate EHR access

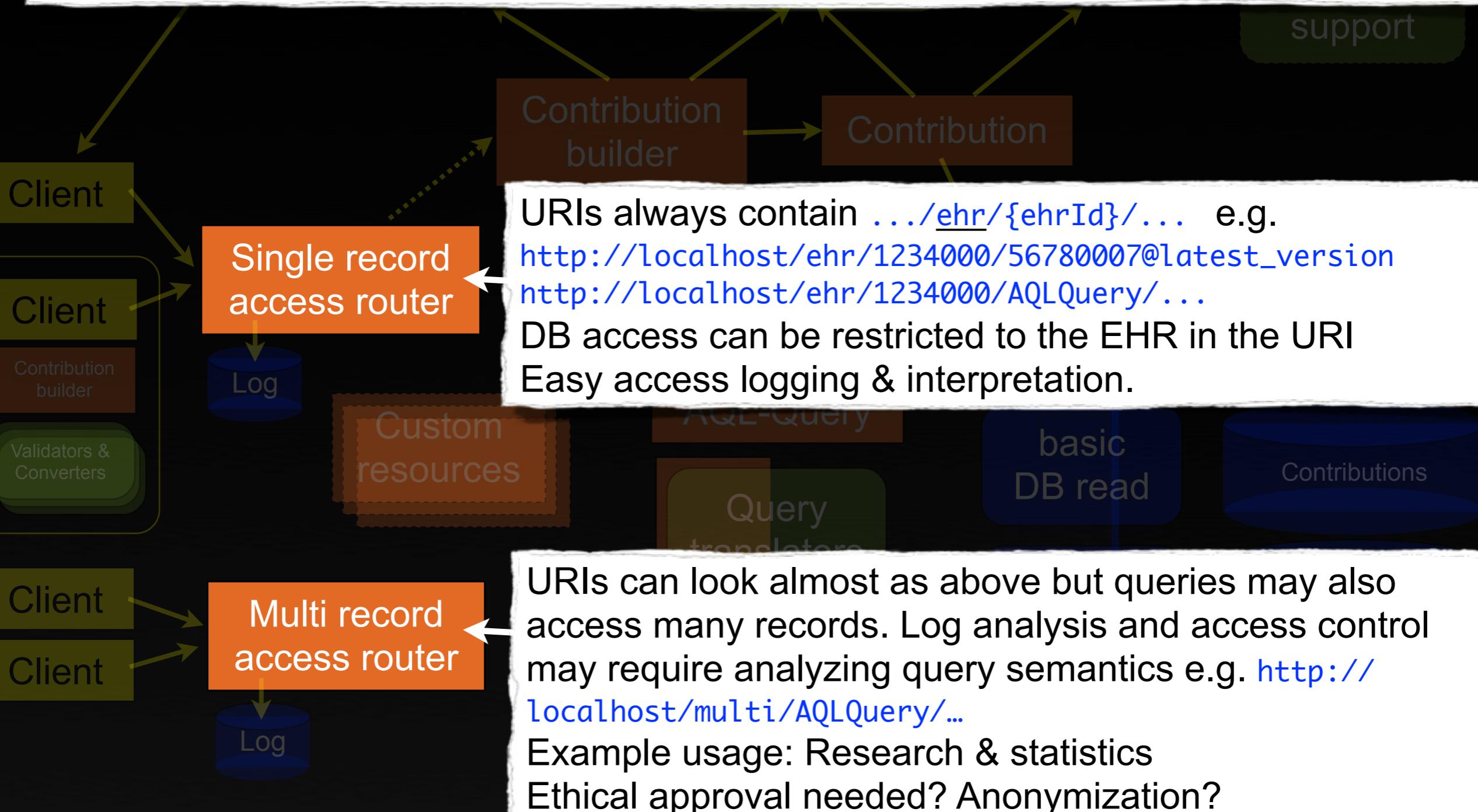
Export

Often different requirements & user categories

- permissions, logging, patient identity handling etc.

Easier to redirect to optimized databases & query engines.

support

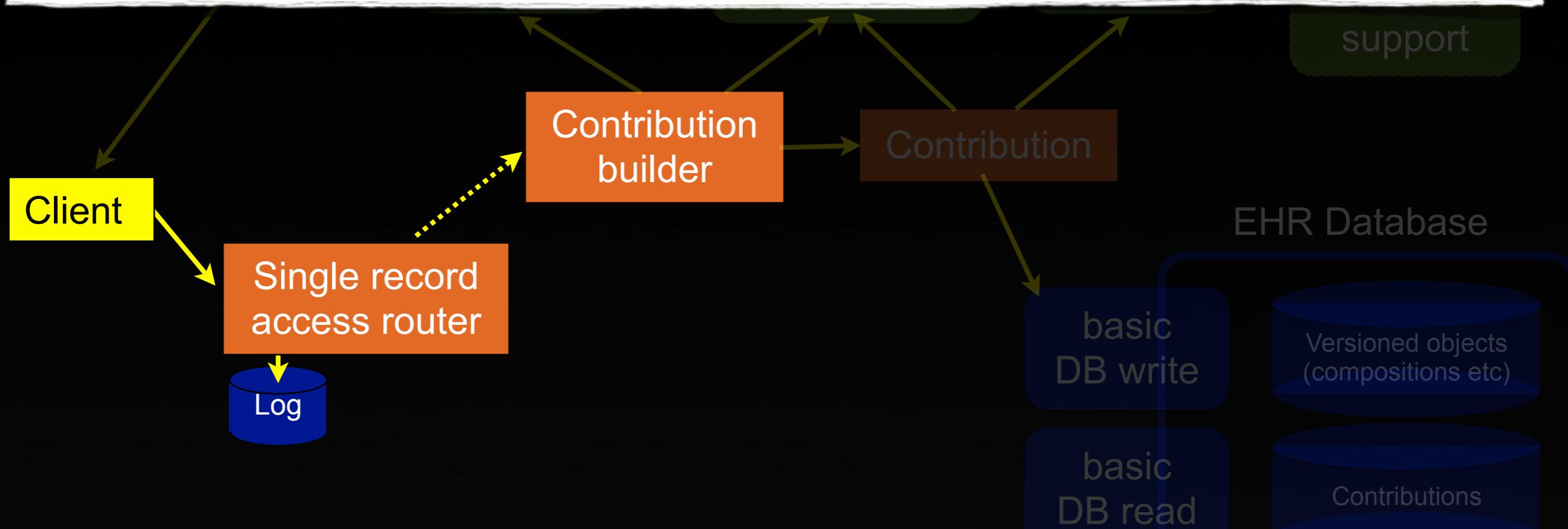


Adding data using Contribution Builder (I)

Export

Purpose: Lowering entry-barrier, simplify development

- Allow incremental learning (also via examples).
- Detect misunderstandings & errors early.



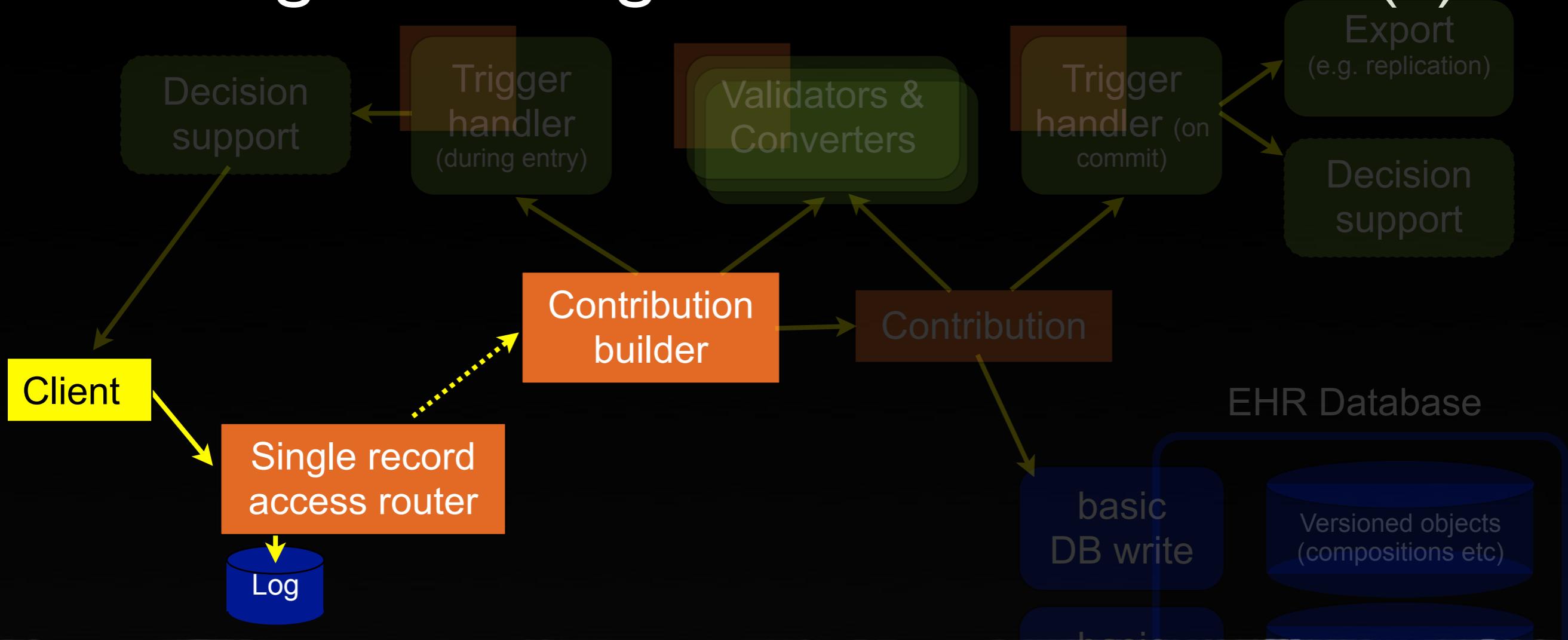
URIs contain `.../contributionBuilder/{composerId}/{ehrId}/...` e.g.

`http://localhost/contributionBuilder/dr_who/1234567/generateContributionBuildID`

The generated ID serves as a temporary "writing area" where e.g. compositions can be added(PUT), changed(POST), read(GET) or deleted(DELETE) under URIs like

`/contributionBuilder/{composerId}/{ehrId}/{tempContributionId}/{tempObjectId}/...`

Adding data using Contribution Builder (2)



Parameters regarding versioning etc can be given via the URI matrix and/or query

```
.../contributionBuilder/{composerId}/{ehrId}/{tempContributionId}/{tempObject{matrix-  
variable}name1=value1;m-var2=val2?query-var3=value3&q4=v4...
```

Example:

```
.../contributionBuilder/dr_who/1234567/b734db36-30a7-43d6-b9ec-51cb389871b6/vital-  
signs;change_type=creation;object_type=COMPOSITION?lifecycle_state=incomplete...
```

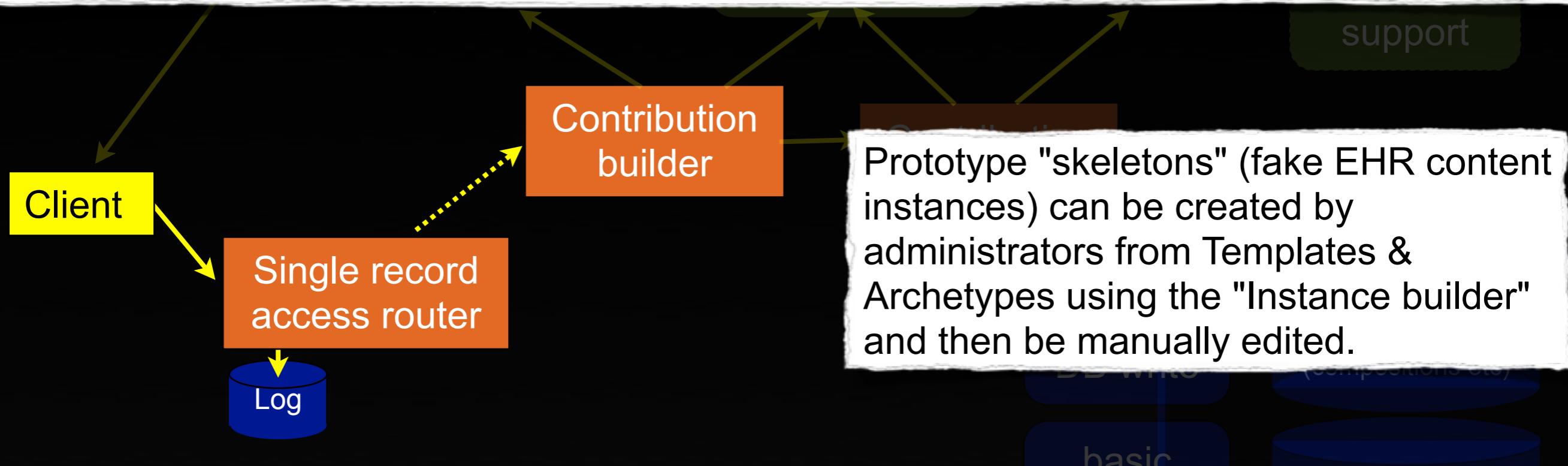
Parameters can also be passed between resources via "request attributes" or be contained in the incoming representation (e.g. an XML or json document via POST)

Adding data using Contribution Builder (3)

Export

Initial content (intended to later be modified e.g. by a GUI) can be loaded from the EHR:

```
./contributionBuilder/{composerId}/{ehrId}/{contributionId}/medication-list/  
load=56780007::ehr.us.lio.se::2;change_type=modification;...
```



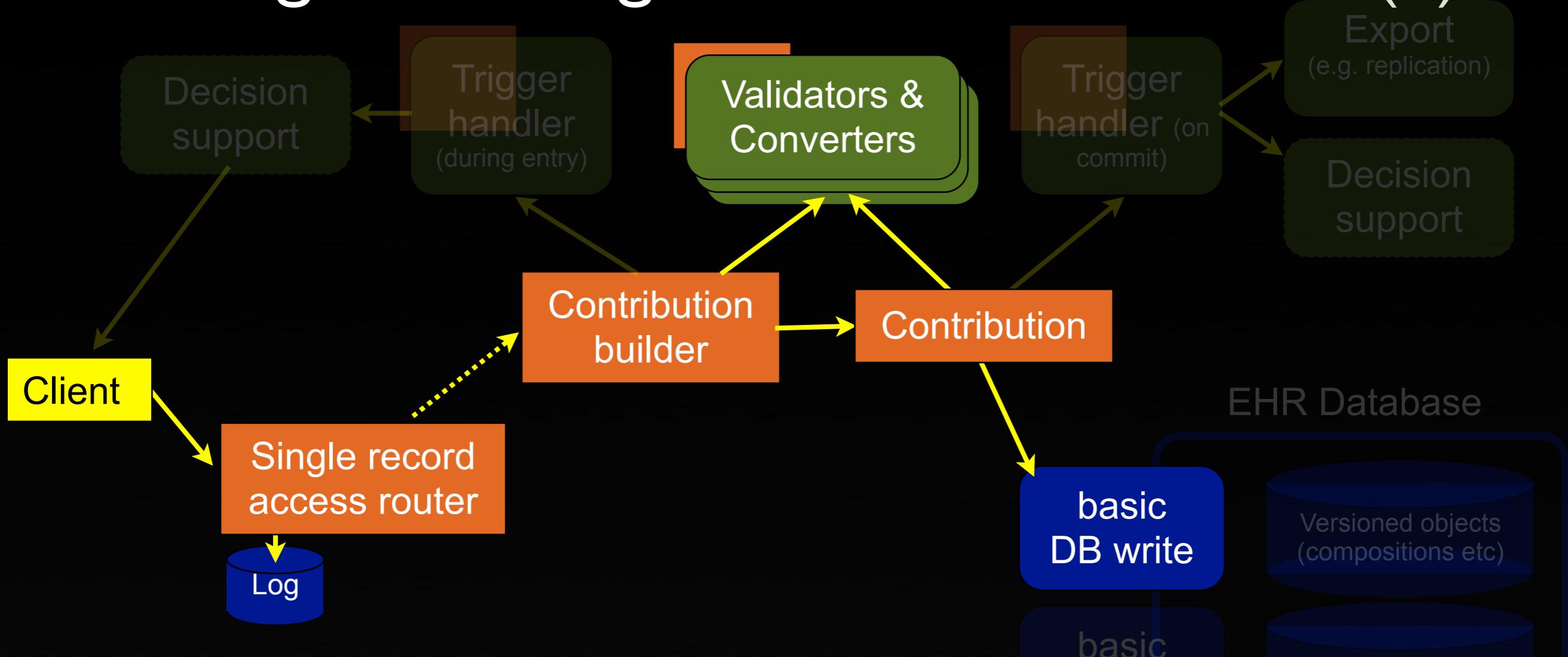
Content can also be loaded from a prototype document:

```
.../contributionBuilder/{composerId}/{ehrId}/{contributionId}/{tempObject}load-prototype=  
{prototype-uri};change_type=creation...
```

optionally the prototype can be run through engines like Freemarker or Velocity

```
.../load-freemarker-prototype={prototype-uri};change_type=creation?optional-param1-to-  
prototype-engine=value1...
```

Adding data using Contribution Builder (4)

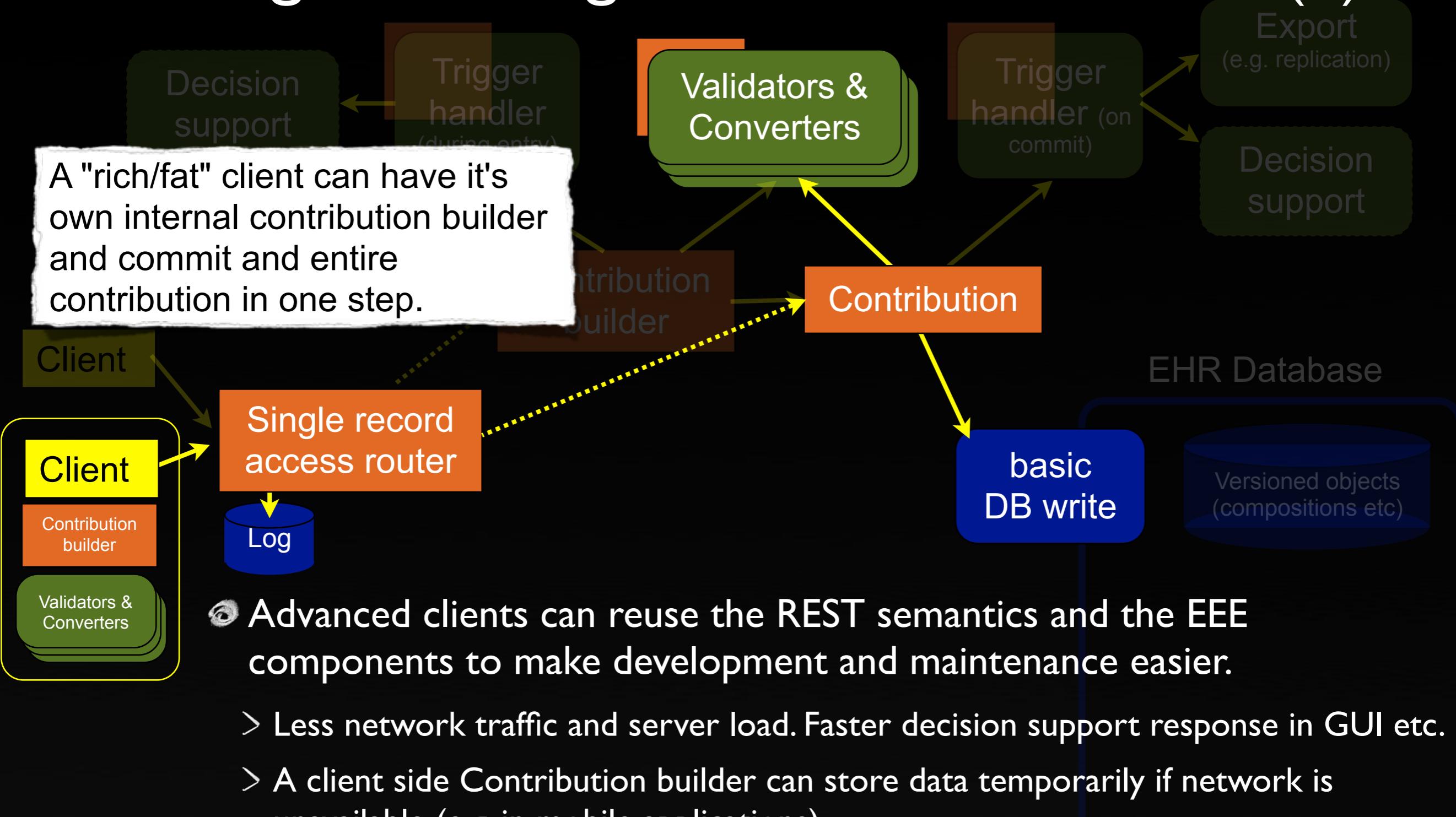


Content can (e.g. during development) be run through specific validators & converters.
(New openEHR Java ref-impl enables archetype based validation.)
Expected first (easy) EEE-formats: XML, json, DADL,

When the entire contribution build is finished it can be committed to the database
[`.../contributionBuilder/{composerId}/{ehrId}/{contributionId}/commit...`](#)

it will first be run through the validators & convertes chosen by system administrators

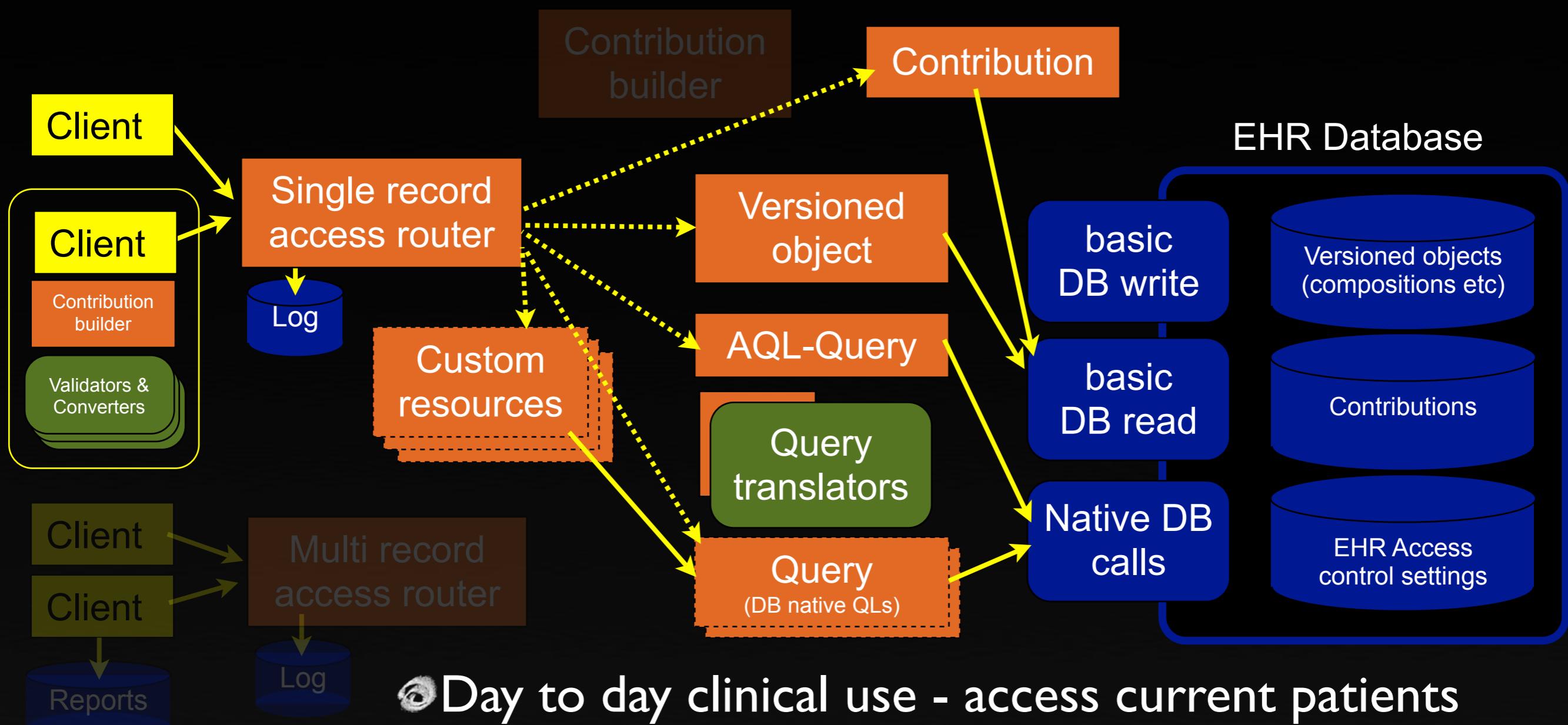
Adding data using Contribution Builder (5)



EEE read access - single record

Commonly occurring scenario:

- A query produces a list containing hyperlinks. The query might come from a custom resource like <http://localhost/ehr/1234000/MaternityOverview/> More on queries in later slides...
- Some of the hyperlinks pointing to versioned objects are followed fetching details, e.g. <http://localhost/ehr/1234000/87284370-2D4B-4e3d-A3F3-F303::ehr.us.lio.se::2/>

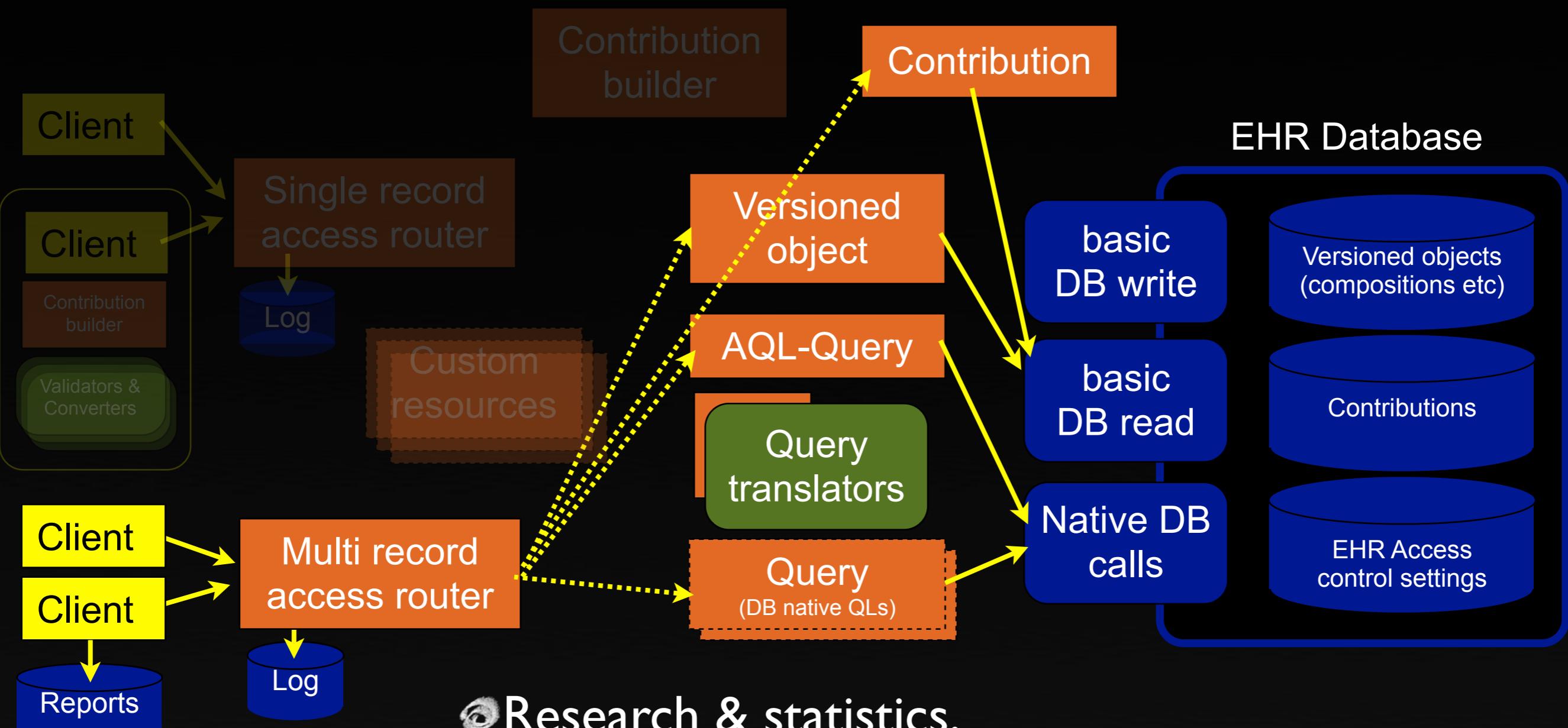


EEE read access - multiple records

Likely scenario:

- Ad-hoc or stored queries produce lists or reports, sometimes containing hyperlinks.
- Some of the hyperlinks pointing to versioned objects can be followed fetching details, e.g.
<http://localhost/multi/ehr/1234000/87284370-2D4B-4e3d-A3F3-F303::ehr.us.lio.se::2/>

support



⌚ Research & statistics.

⌚ Ethical approval needed? Anonymization?

Queries

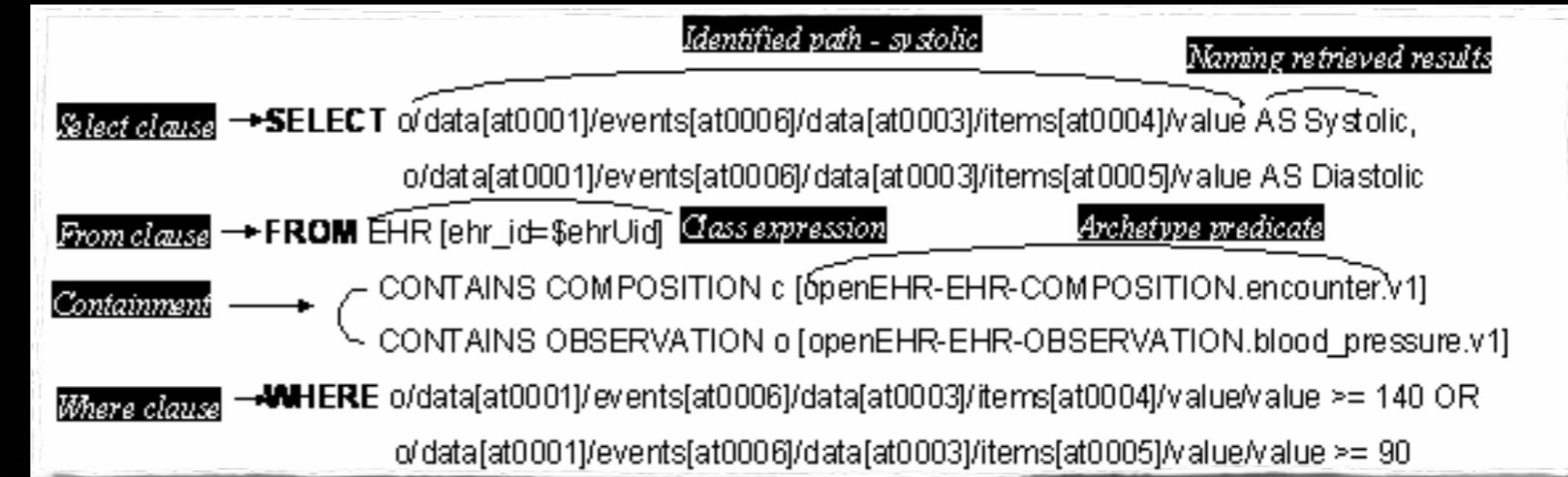
*QL

AQL

Archetype Query Language

Variables in green

Paths in yellow



```
SELECT e/data[at0001]/items[at0002..1]/value/defining_code/code_string
FROM EHR [uid = I2I2I2-I2I2]
CONTAINS COMPOSITION c [openEHR-EHR-COMPOSITION.epicrisis.v1]
CONTAINS EVALUATION e [openEHR-EHR-EVALUATION.problem-diagnosis.v1]
```

```
SELECT c
FROM EHR [uid=$ehrUid]
CONTAINS COMPOSITION c
CONTAINS INSTRUCTION i [openEHR-EHR-INSTRUCTION.medication.v1]
CONTAINS ITEM_TREE it [openEHR-EHR-ITEM_TREE.medication.v1]
WHERE (it/items[at0012]/value/defining_code/terminology_id = "SNOMED"
AND it/items[at0012]/value/defining_code/code_string
matches {'350162003', '350162003'})
```

More info: <http://www.openehr.org/wiki/display/spec/Archetype+Query+Language+Description>

Embedded AQL-queries

⌚ How?

- Translate AQL to other query-languages, then run query
- Note: Chosen storage structures affects translation
- EEE's initial tool used: JavaCC
- EEE's initial target query language: XQuery
 - > An EEE implementation storing data as RDF might instead translate AQL to SPARQL. The AQL result can also be embedded in a SPARQL query instead of in an XQuery.

⌚ Why?

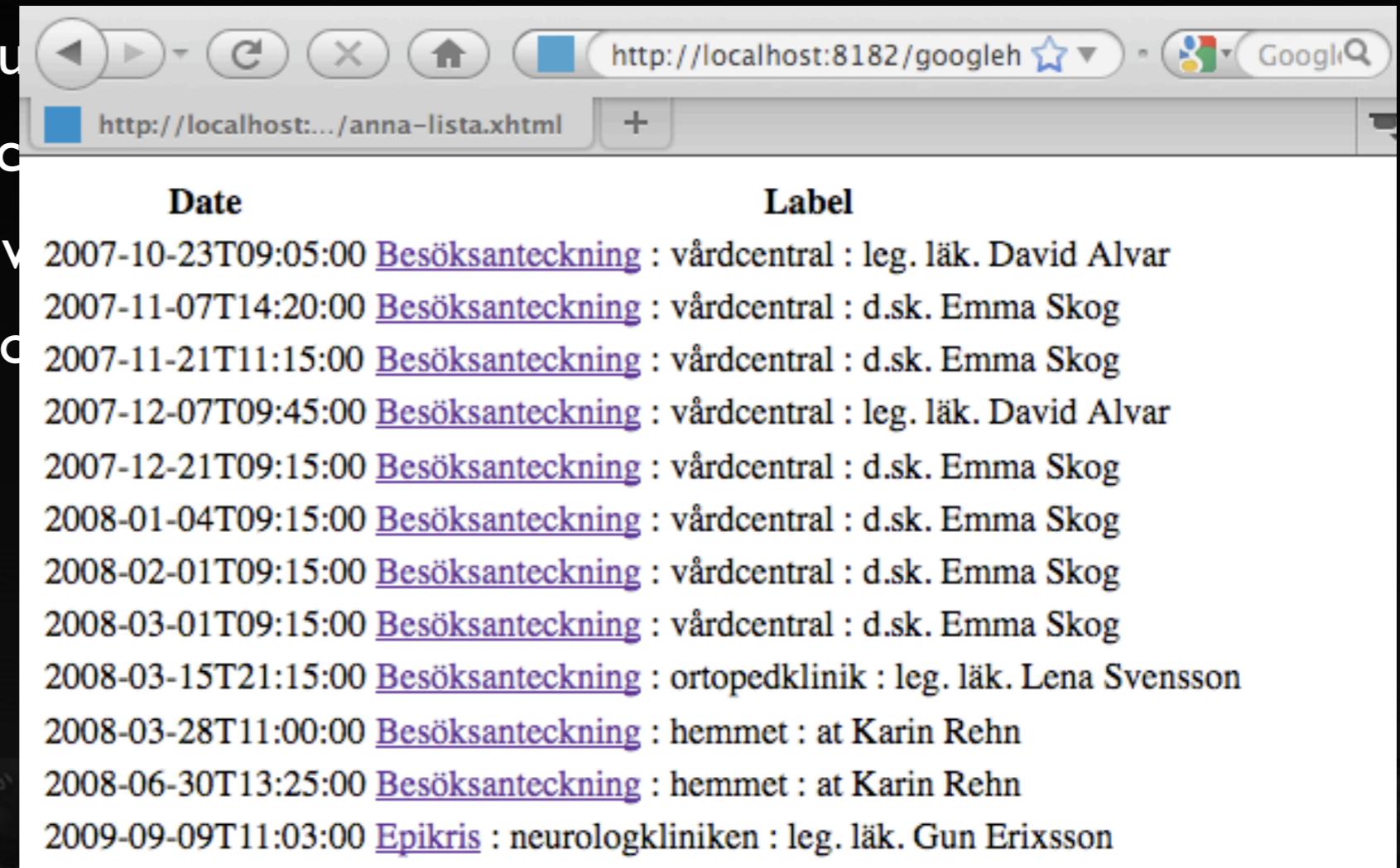
- Use powerful query optimizers available in databases
- AQL does not specify any return format, but some query languages do have very flexible return formats

AQL embedded in xQuery

- ⌚ XQuery results can be formatted and embedded in different file and document types
 - e.g. outputting results inside any XML dialect, Javascript or Adobe Flash
- ⌚ Examples
 - HTML openEHR COMPOSITION list
 - RDF Generation (DebugIT experiment by Daniel Karlsson)
 - Google earth KML placemark generation + Adobe Flash
 - HTML 5 + SVG based visualisations
 - (Old proven) tab- or comma-separated lists

AQL embedded in xQuery

- ⌚ XQuery results can be formatted and embedded in different file and document types
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- ⌚ Examples
 - HTML openEHR COMPOSITION list
 - RDF Generation (Debug)
 - Google earth KML place
 - HTML 5 + SVG based viewer
 - (Old proven) tab- or csv



The screenshot shows a web browser window with the URL <http://localhost:8182/googleh> in the address bar. The page displays a table of XQuery results. The table has two columns: "Date" and "Label". The "Date" column lists various dates from 2007-10-23 to 2009-09-09. The "Label" column contains corresponding labels such as "Besöksanteckning" and names like "David Alvar", "Emma Skog", and "Lena Svensson".

Date	Label
2007-10-23T09:05:00	Besöksanteckning : vårdcentral : leg. läk. David Alvar
2007-11-07T14:20:00	Besöksanteckning : vårdcentral : d.sk. Emma Skog
2007-11-21T11:15:00	Besöksanteckning : vårdcentral : d.sk. Emma Skog
2007-12-07T09:45:00	Besöksanteckning : vårdcentral : leg. läk. David Alvar
2007-12-21T09:15:00	Besöksanteckning : vårdcentral : d.sk. Emma Skog
2008-01-04T09:15:00	Besöksanteckning : vårdcentral : d.sk. Emma Skog
2008-02-01T09:15:00	Besöksanteckning : vårdcentral : d.sk. Emma Skog
2008-03-01T09:15:00	Besöksanteckning : vårdcentral : d.sk. Emma Skog
2008-03-15T21:15:00	Besöksanteckning : ortopedklinik : leg. läk. Lena Svensson
2008-03-28T11:00:00	Besöksanteckning : hemmet : at Karin Rehn
2008-06-30T13:25:00	Besöksanteckning : hemmet : at Karin Rehn
2009-09-09T11:03:00	Epikris : neurologkliniken : leg. läk. Gun Erixsson

AQL in xQuery in XHTML

- Integration by preparsing (and later postparsing) custom EEE-tags
- All code below is valid xQuery, thus xQuery editors and validators can be used.

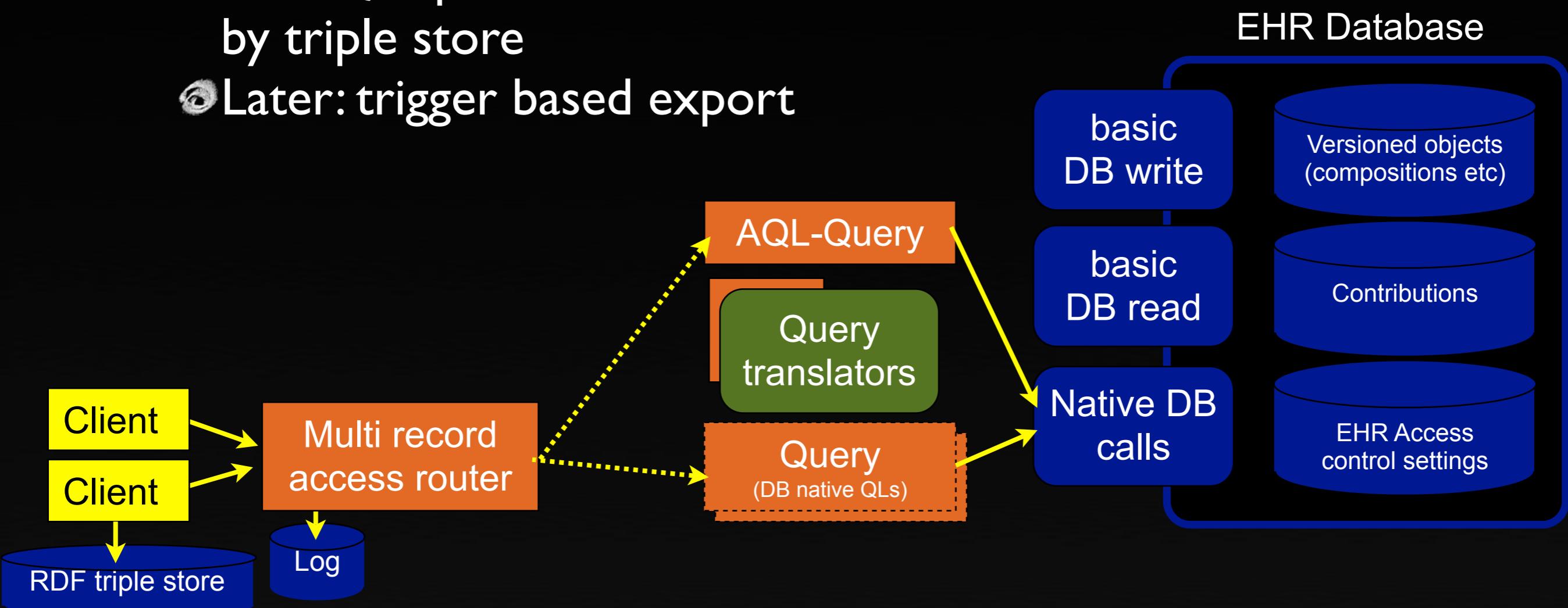
```
<h:html xmlns:h="http://www.w3.org/1999/xhtml"
         xmlns:eee="http://www.imt.liu.se/mi/ehr/2010/EEE-v1.xsd"
         xmlns="http://schemas.openehr.org/v1">
<h:head><h:title>Composition list</h:title></h:head>
<h:body><h:table>
  <h:tr><h:th>Date</h:th><h:th>Label</h:th></h:tr>
{ let $aqlFiltered :=
  <eee:AQL>SELECT c FROM Ehr [uid=$ehrUid] CONTAINS COMPOSITION c</eee:AQL>
for $version in $aqlFiltered/..
let $comp := $version/data
order by $comp/context/start_time/value/text()
return <h:tr><h:td>{$comp/context/start_time/value/text()}</h:td><h:td>
<h:a href="/ehr/AnnaTest-v3/{$version/uid/value}">
  {$comp/name/value/text()}</h:a> : {$comp/context/setting/value/text()} :
  {$comp/composer/name/text()}</h:td></h:tr>
</h:table>
</h:body></h:html>
```

AQL embedded in xQuery

- ⌚ XQuery results can be formatted and embedded in different file and document types
 - e.g. outputting results inside any XML dialect, Javascript or Adobe Flash
- ⌚ Examples
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 - HTML 5 + SVG based visualisations
 - (Old proven) tab- or comma-separated lists

EEE DebugIT converter experiment

- RDF-generating queries extract DebugIT-relevant data to triple store
- SPARQL queries executed by triple store
- Later: trigger based export



AQL in xQuery in RDF

- All code below is valid xQuery, thus xQuery editors and validators can be used.
Custom EEE-tags delimit AQL.

```
<rdf:RDF
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:xs="http://www.w3.org/2001/XMLSchema#"
  xmlns:ddoliu="https://lincoln.imt.liu.se:8443/vocab/resource/liu_ddo#">
{
  for $c in
<eee:AQL>SELECT c FROM Ehr [uid=$ehrUid] CONTAINS COMPOSITION c</eee:AQL>
return
  <rdf:Description rdf:about="/ehr/{$ehrUid}/{$c/./uid/value}">
    <ddoliu:hasStartTime rdf:datatype="xs:datetime">
      {data($c/context/start_time/value)}
    </ddoliu:hasStartTime>
  </rdf:Description>
}
</rdf:RDF>
```

AQL in xQuery in RDF - result

```
<rdf:RDF xmlns:ddoliu="https://lincoln.imt.liu.se:8443/vocab/resource/liu_ddo#" xmlns:xs="http://www.w3.org/2001/XMLSchema#" xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">

<rdf:Description rdf:about="/ehr/AnnaTest/4317453e-7f32-442a-a2e8-0fcaef11deed::test2.eee.mi.imt.liu.se::1">
    <ddoliu:hasStartTime rdf:datatype="xs:datetime">2008-03-30T10:25:00</ddoliu:hasStartTime>
</rdf:Description>

<rdf:Description rdf:about="/ehr/AnnaTest/7ef31236-3a94-4dea-a9c5-8321250dc8ae::test2.eee.mi.imt.liu.se::1">
    <ddoliu:hasStartTime rdf:datatype="xs:datetime">2008-04-03T11:45:00</ddoliu:hasStartTime>
</rdf:Description>

<rdf:Description rdf:about="/ehr/AnnaTest/625b730f-574c-45e7-9068-95b7b1def20::test2.eee.mi.imt.liu.se::1">
    <ddoliu:hasStartTime rdf:datatype="xs:datetime">2008-06-02T09:15:00</ddoliu:hasStartTime>
</rdf:Description>

<rdf:Description rdf:about="/ehr/AnnaTest/1926354a-144d-4edd-aec0-2b0cf125acba::test2.eee.mi.imt.liu.se::1">
    <ddoliu:hasStartTime rdf:datatype="xs:datetime">2008-06-30T13:25:00</ddoliu:hasStartTime>
</rdf:Description>

<rdf:Description rdf:about="/ehr/AnnaTest/7e943f85-3b7a-43dd-8d40-b4a33df33b92::test2.eee.mi.imt.liu.se::1">
    <ddoliu:hasStartTime rdf:datatype="xs:datetime">2008-03-15T21:15:00</ddoliu:hasStartTime>
</rdf:Description>

...results shortened here...

</rdf:RDF>
```

AQL embedded in xQuery

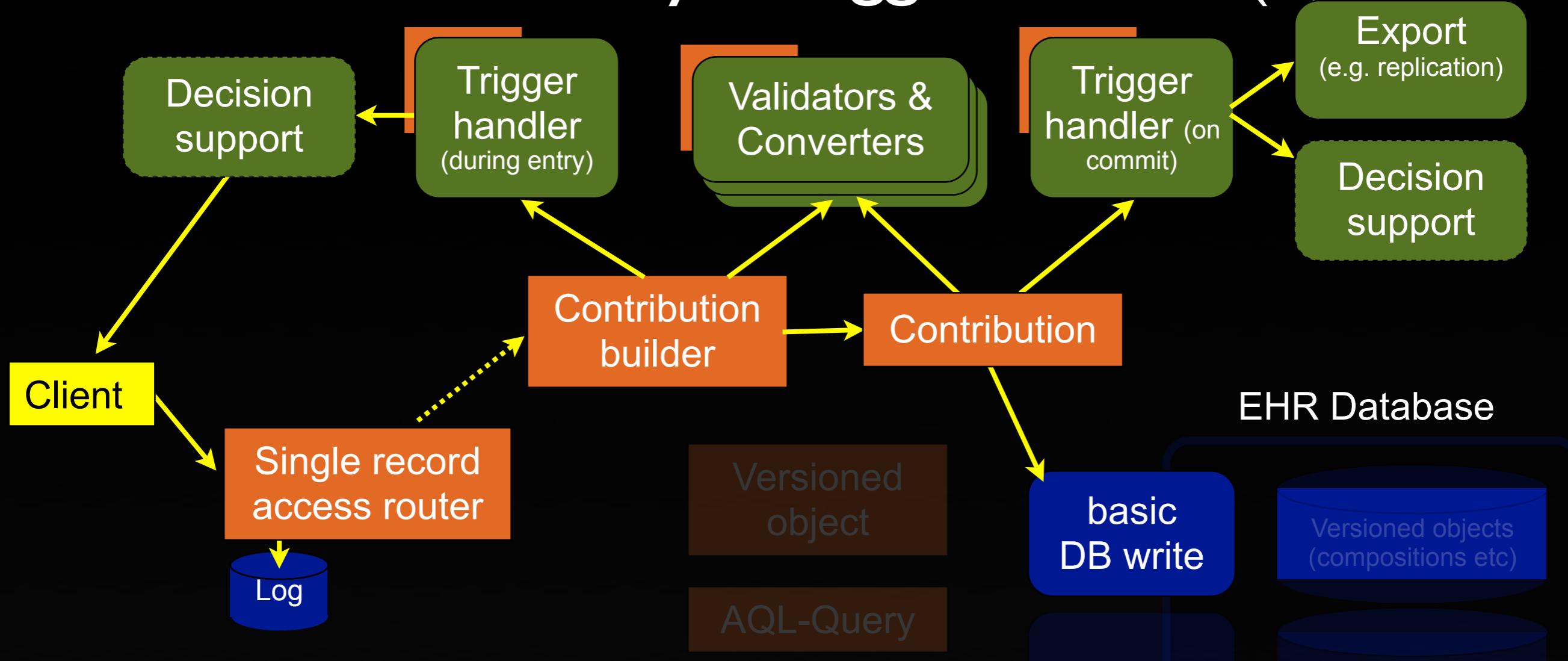
- ⌚ XQuery results can be formatted and embedded in different file and document types
 - e.g. outputting results inside any XML dialect, Javascript or Adobe Flash
- ⌚ Examples
 - HTML openEHR COMPOSITION list
 - RDF Generation (DebugIT experiment by Daniel Karlsson)
 - Google earth KML placemark generation + Adobe Flash
 - HTML 5 + SVG based visualisations
 - (Old proven) tab- or comma-separated lists

Decision support integration

Decision support integration

- ⌚ In the GUI code (nice but hard to reuse between systems)
- ⌚ At monitorable REST calls (reusable) via trigger handlers
 - ☐ ContributionBuilder interactions - no system wide visibility
(To log or not to log?)
 - > When? (configurable)
 - Continuous or...
 - ...when validation is requested
 - ☐ Contribution interactions - system wide visibility, logged
 - > At commit (incomplete, complete)
 - > At attestation

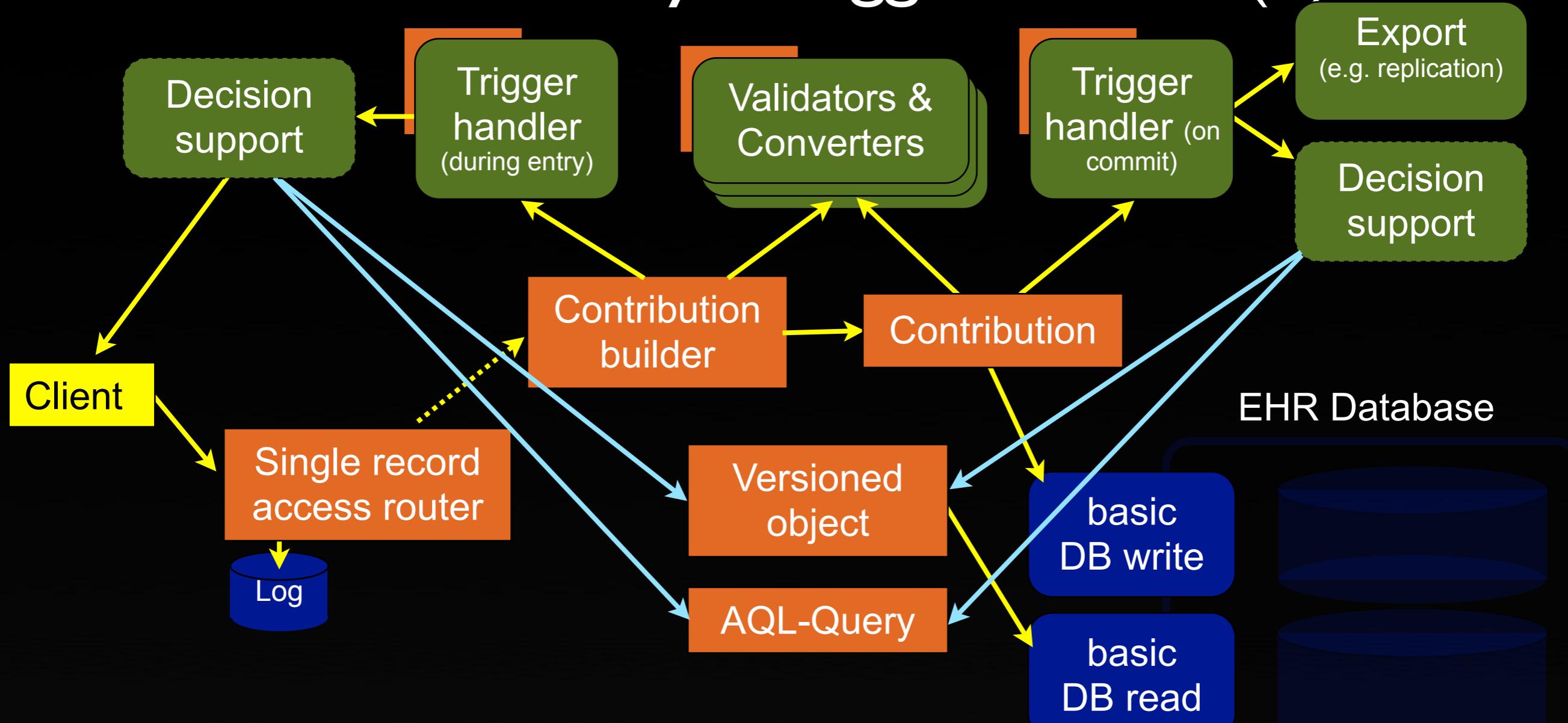
EEE data entry - Triggers, how? (I)



Trigger Handlers using e.g Apache ActiveMQ (not REST)

- Allows subscription based on filters, e.g.
 - > archetypes used, terminology codes used in data, EHR ID etc.
- STOMP, JMS, XMPP, REST, WS-notification interfaces allowing clients using e.g.
 - > Java, C, C++, C#, Ruby, Perl, Python, PHP, ActionScript/Flash, Smalltalk

EEE data entry - Triggers, how? (2)



Trigger listeners can access further info via GET calls

- Classical example: Look up allergies & interactions during prescription
- To make Decision support modules reusable use pure AQL-Query and standard resources (e.g. Versioned object).
Don't use queries containing native query languages (e.g. Xquery). Don't let listeners read via custom resources.

Distributed & scalable backends

- ⦿ Use case: population-wide queries

- Epidemiology, statistics, patient safety (GTT?)

- ⦿ Implemented e.g. using map-reduce

- A REST interface with query logging

- ⦿ Apache Hadoop (open source map-reduce framework)

- HBase, Pig Latin and other query languages

- ⦿ Amazon Elastic Compute Cloud (EC2)

- ⦿ Google App Engine (Bigtable, ...)

- ⦿ Xadoop, xQuery for Hadoop might become a shortcut...

- <http://www.xadoop.org/index.html>

- Alternative Hadoop language next to PigLatin, Hive etc.

Why believe it can scale?

- ⦿ Semantics in URLs (e.g. EHR id or versioned object ID) makes sharding (partitioning e.g.storage and load) between physical machines easy and straight forward
- ⦿ OpenEHRs append-only (or "never physically delete") principle combined with timestamped operations... + timewindow... makes replication easier
- ⦿ Web deployments properly following REST principles have been shown to scale.
- ⦿ But: The "messaging part" might not scale to "web size" (but hopefully "enterprize size") if the interactions chosen in setup are complex and intertwined.



Linköping University

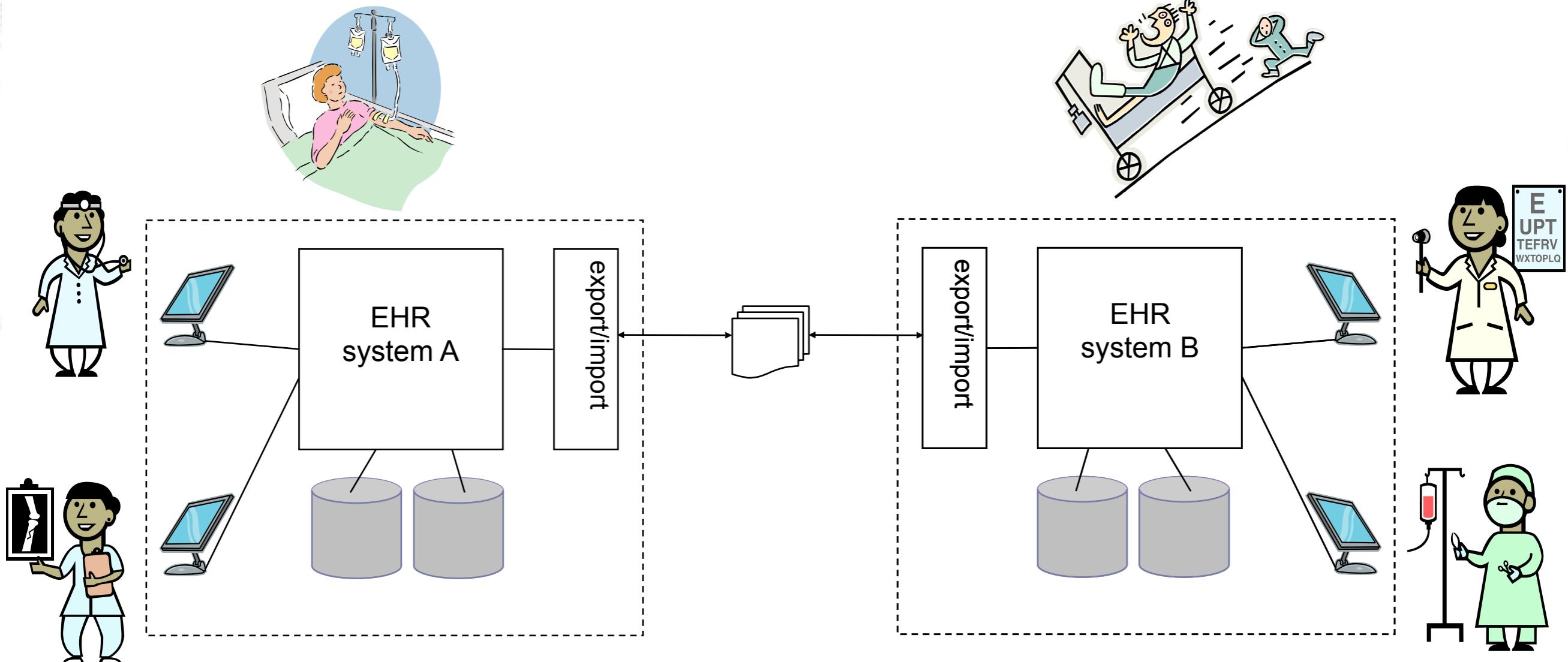
expanding reality

www.liu.se

openEHR

why bother?

(EHR = Electronic Health Record)



What is possible...

- For a computer system? For a human?
- For an organization? For multiple organizations?
- Does it scale? Is it manageable? Man-hours? (Costs & competence)
- Is data quality effected?

Archetypes, two layer modeling

Domain Content Models
archetypes & templates

- Change when new clinical needs arise.
- By Clinicians
Medical (Informatics) knowledge?

Information Representation Models
openEHR reference model

- By IT system vendors etc.
Computer Science knowledge?
- Implemented as software
(in Java, .NET etc.)
- Storage, transactions etc.
- Stable

openEHR

in too short time

(Extra material not presented as part of EEE)

Encounter

Vital signs

Blood pressure

any event

den 25 maj 2008

data

systolic mm[Hg]

diastolic mm[Hg]

Pulse

Any event

den 25 maj 2008

Findings

Rate

Rate /min

Respirations

Any event

den 25 maj 2008

data

Rate /min

Blood gas assessment

Any event

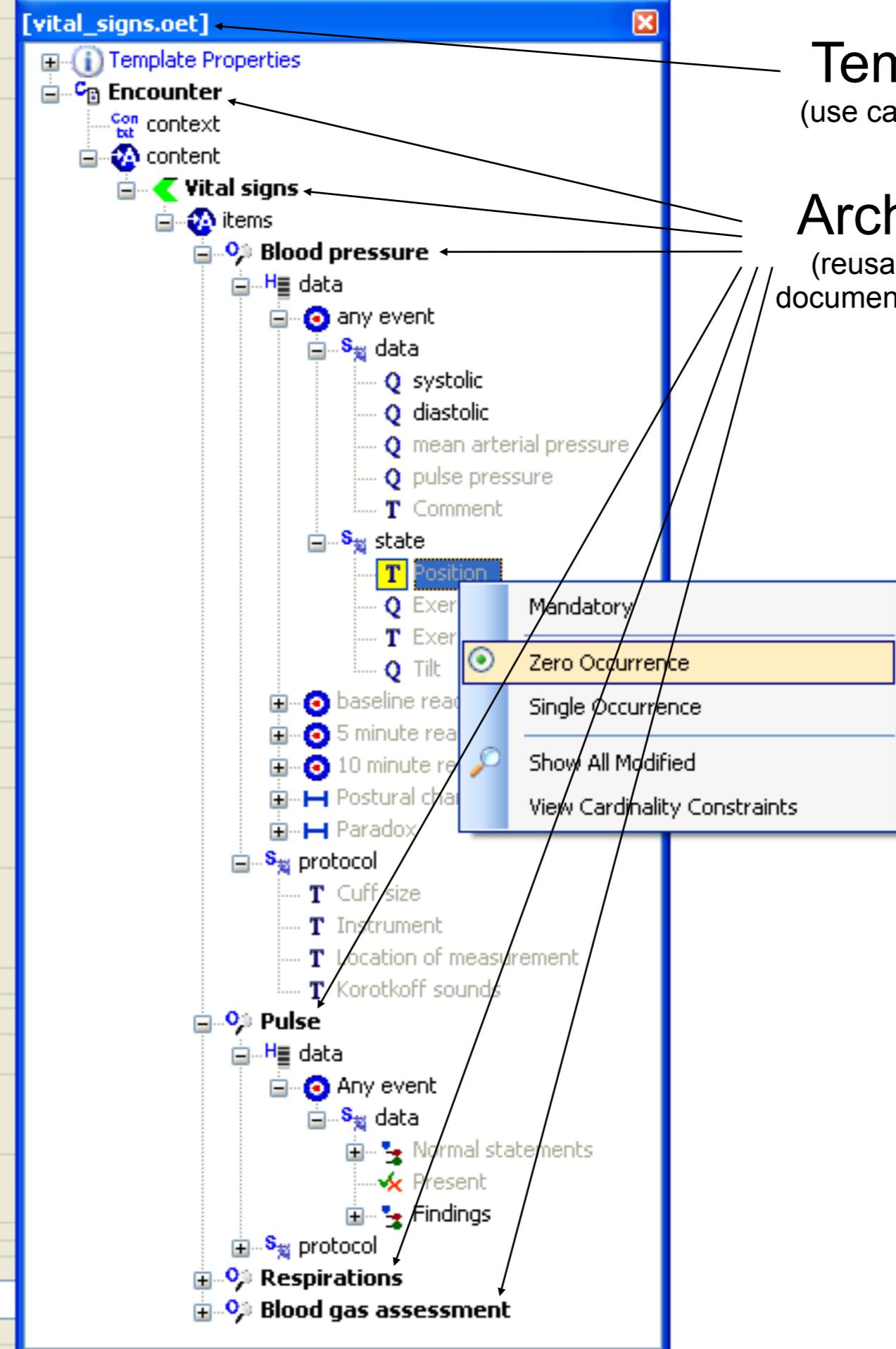
den 25 maj 2008

Arterial

SaO₂ %

protocol

Site of measurement



Template
(use case specific)

Archetypes
(reusable pieces of documentation patterns)

Archetype editing sidetrack.

Description

General	Translations	Revision history
Concept & Original Author		
Concept	Blood pressure	
Long Concept	the measurement by any means (invasive or non-invasive) of systemic arterial blood pressure which is deemed to represent the actual systemic blood pressure	
Author	Sam Heard	E-mail sam.heard@oceaninformatics.biz
Organisation	Ocean Informatics	Date 22/03/2006
Details		
Version	v1	
Status	AuthorDraft	
Package URI		
Legal rights		
Original Resource URI		
Other Contributors		
Keywords		
observations blood pressure measurement		
Usage & Purpose		
Use	All blood pressure measurements are recorded using this archetype. There is a rich state model for use with exercise ECGs and Tilt Table measurements.	
Misuse	Not to be used for intravascular pressure.	
Purpose	To record the systemic blood pressure of a person. The measurement records the systolic and the diastolic	

Archetype editing sidetrack.

Definition

Subject Protocol State State with history

Data Protocol

History List Person State

Data structure

Edit
Add
Delete
Comment

Any Boolean Choice Count Date/Time Duration Interval Count Interval Date/Time Interval Quantity Multimedia Ordinal Proportion Text URI

systolic

General Constraints

Occurrences Min 0 Max 1 Unbounded

Runtime name constraint

Description the peak systemic arterial blood pressure over one cycle - measured in systolic or contraction phase of the heart cycle

Quantity Constraints

Property Pressure
Units mm[Hg]

Add Remove

Unit values Precision -1
Set minimum value
Set maximum value 1 000,000
Set assumed value

New Open Save Description Definition Terminology Formats Interface

Archetype editing sidetrack.

New Open Save Description Definition Terminology Formats Interface

Terminology

Term Bindings Term Definitions Constraint Definitions

Term Definitions

Code ▲	Text	Description
at0000	Blood pressure	the measurement by any means (invasive or non-invasive) of systemic arterial blood pressure which is deemed to represent ...
at0001	history	history Structural node
at0002	baseline reading	baseline event in event history
at0003	blood pressure	@ internal @
at0004	systolic	the peak systemic arterial blood pressure over one cycle - measured in systolic or contraction phase of the heart cycle
at0005	diastolic	the minimum systemic arterial blood pressure over one cycle - measured in the diastolic or relaxation phase
at0006	any event	other event in event history
at0007	state structure	@ internal @
at0008	Position	The position of the patient at the time of measuring blood pressure
at0009	Exertion level	The level of exertion at the time of taking the measurement
at0010	Exercise	The classification of the exercise level
at0011	list structure	list structure
at0012	Instrument	the instrument used to measure the blood pressure
at0013	Cuff size	the size of the cuff if a sphygmomanometer is used
at0014	Location of measurement	The site of the measurement of the blood pressure
at0015	Adult	A cuff that is standard for an adult
at0016	Wide adult	A cuff for adults with larger arms
at0017	Paediatric	A cuff that is appropriate for a child or thin arm
at0022	At rest	The person is at rest and not in the recovery phase from exertion
at0023	Post-exercise	Measurement is taken immediately after exercise
at0024	During exercise	The measurement is taken during exercise

Add Remove Edit

Archetype editing sidetrack.

New Open Save Description Definition Terminology Formats Interface

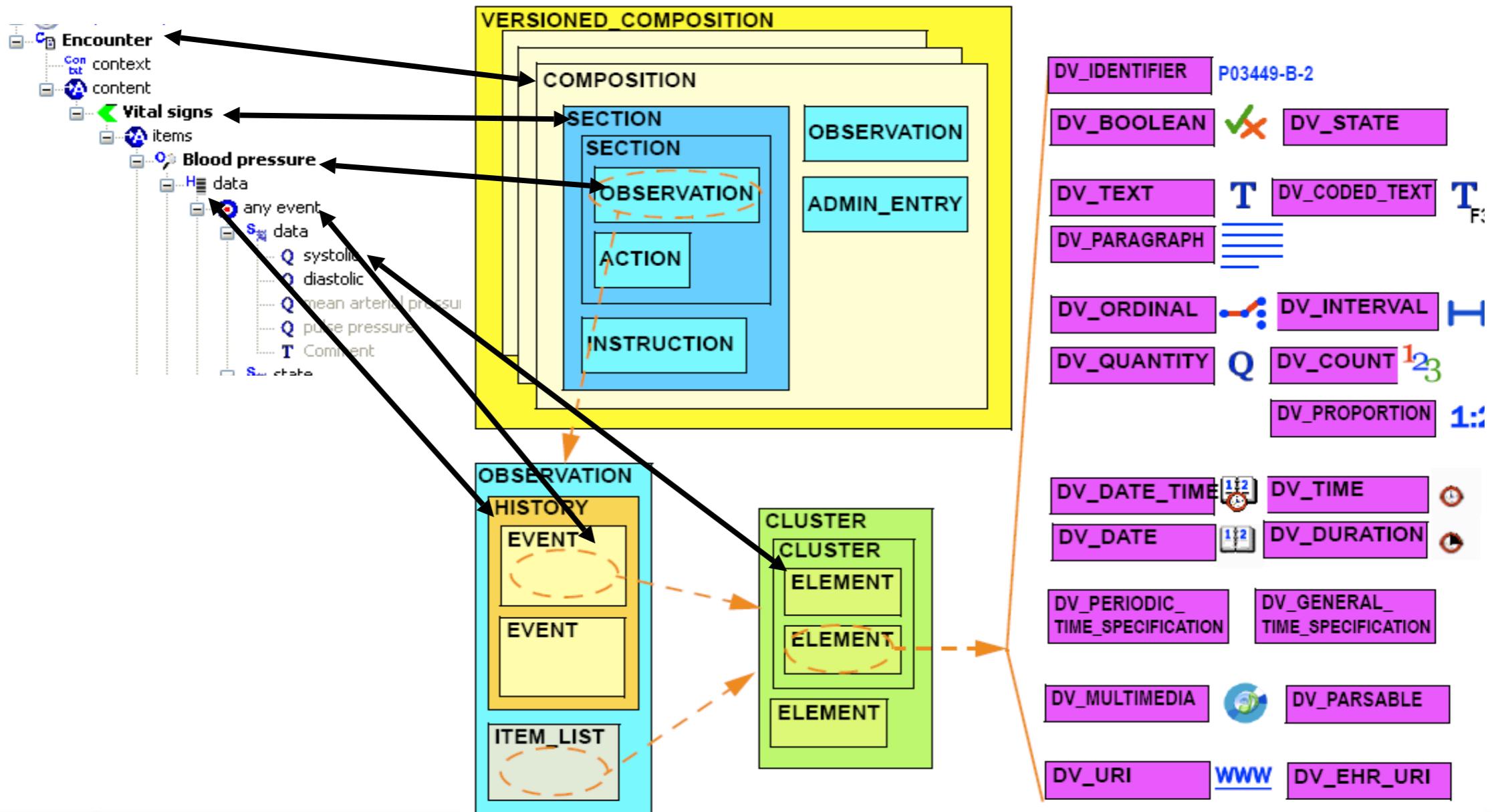
Terminology

Term Bindings Term Definitions Constraint Definitions

Term Definitions

Code ▲	Text	Description
at0000	Blutdruckmessung	Die Messung des systemischen arteriellen Blutdrucks, die als geeignet angesehen wird, den tatsächlichen systemischen Blut...
at0001	Historie	Historie
at0002	Basismessung	Basismessung
at0003	Blutdruck	*@ internal @(en)
at0004	systolisch	Der höchste arterielle Blutdruck eines Zyklus - gemessen in der systolischen oder Kontraktionsphase des Herzens.
at0005	diastolisch	Der minimale systemische arterielle Blutdruck eines Zyklus - gemessen in der diastolischen oder Entspannungsphase des Her...
at0006	unbestimmtes Ereignis	anderes unbestimmtes Ereignis
at0007	*state structure(en)	*@ internal @(en)
at0008	Position	Die Position des Patienten zum Zeitpunkt der Blutdruckmessung
at0009	Anstrengungsniveau	Das Anstrengungsniveau zum Zeitpunkt der Messung
at0010	körperliche Belastung	Die Beschreibung, ob und wann eine Leibesübung durchgeführt wurde bzw. eine körperliche Belastung bestand.
at0011	Listenstruktur	Listenstruktur
at0012	Instrument	Das Instrument, das zur Blutdruckmessung benutzt wird
at0013	ManschettengröÙe	Die Größe der Manschette des benutzten Sphygmomanometers
at0014	Ort der Messung	Ort der Blutdruckmessung
at0015	Erwachsener	Eine normale Manschette für Erwachsene
at0016	Erwachsener (weit)	Eine Manschette für Erwachsene mit dickeren Armen
at0017	Pädiatrisch	Eine Manschette geeignet für ein Kind mit dünnen Armen
at0022	In Ruhe	Die Person ist in Ruhe und nicht in der Erholungsphase von einer Anstrengung
at0023	Nach Leibesübung/körperlicher Belastung	Die Messung wird unmittelbar nach einer Leibesübung/körperlicher Belastung durchgeführt
at0024	Während Leibesübung/körperlicher Belas...	Die Messung wird während einer Leibesübung/körperlicher Belastung durchgeführt

Add Remove Edit



□ **Document** - Traditions, clinical context, authorship etc. matter.

> EHR > Compositions > Sections > Entries > Data structures > Values

□ **Tree** - Paths are convenient for queries, processing etc.

> `ehr://1234567/87284370-2D4B-4e3d-A3F3-F303D2F4F34B@latest_trunk_version/content[openEHR-EHR-SECTION.v1]/items[openEHR-EHR-OBSERVATION.heart_rate-pulse.v1]/data/events[at0006]/data/items[at0004]/value/magnitude`

□ **Objects** - Easily implementable in IT systems (somewhat consistently)

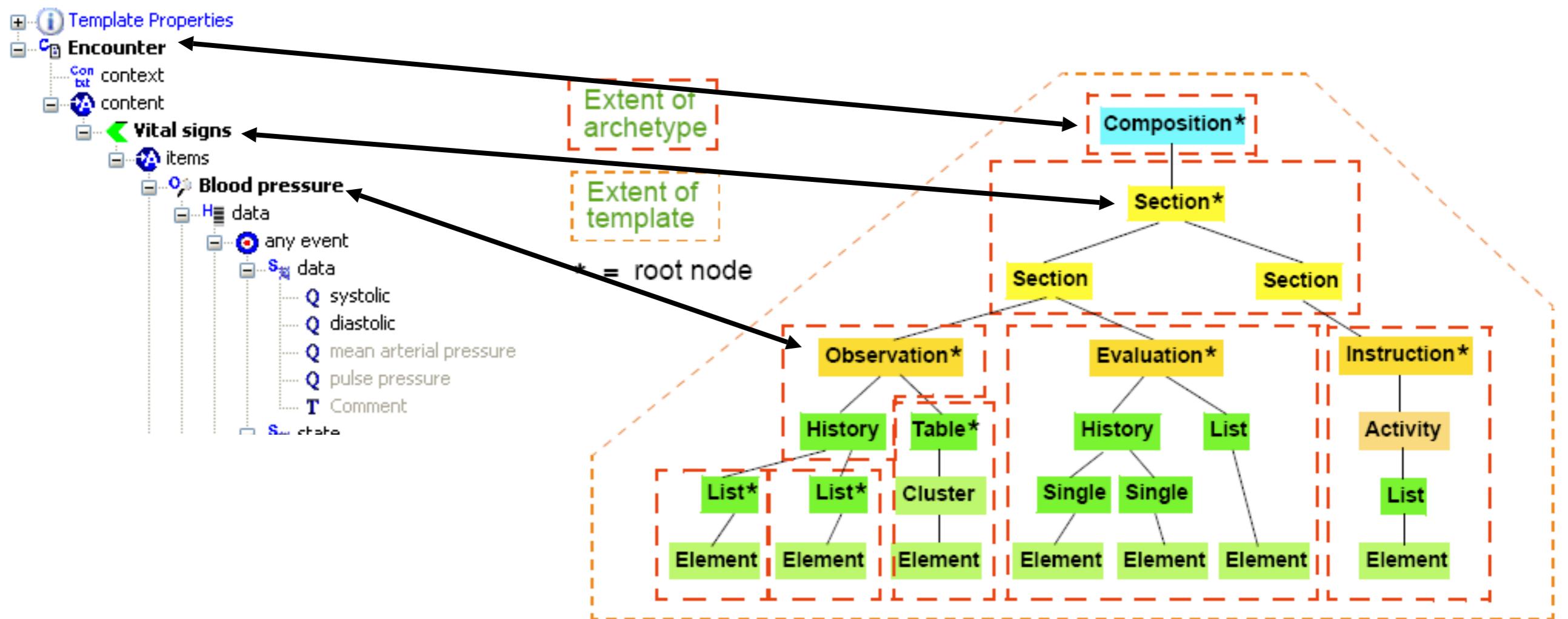


FIGURE 30 How Archetypes apply to Data

LiU
expand in re