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1 Introduction

Using Archetypes in HL7 V2 allows for representation of rich clinical data structures within compliant HL7 messages. It also provides rich semantic interoperability and by using the existing standards is backwards compatible with existing applications. Further, the data can be displayed without specific reference to the archetype.

The scheme presented here is base on the CEN EN 13606-1 and 13606-2 standards. OpenEHR is an extension of these standards and can use this scheme. CEN is designed to encode any clinical data structures in a generic way. In its introduction the standard says:

> The challenge for EHR interoperability is to devise a generalised approach to representing every conceivable kind of health record data structure in a consistent way. This needs to cater for records arising from any profession, speciality or service, whilst recognising that the clinical data sets, value sets, templates etc. required by different health care domains will be diverse, complex and will change frequently as clinical practice and medical knowledge advance. This requirement is part of the widely acknowledged health informatics challenge of semantic interoperability.

An intent of this scheme is to allow HL7 V2 messages to support EN 13606-1 in HL7 by defining how the CEN data structures are mapped to HL7 V2. This includes encoding archetyped data as well as mapping other model elements.

The CEN data model defines several layers of structure with the top level being an "EHR_EXTRACT" and the lowest level being an "ELEMENT" which contains a single data value. A mapping of the main CEN elements to HL7 appears below.

EHR HIERARCHY COMPONENT	DESCRIPTION	EXAMPLES	MAPPED TO
EHR_EXTRACT	The top-level container of part or all of the EHR of a single subject of care, for communication between an EHR Provider system and an EHR Recipient.		**HL7 BATCH** A batch of REF messages, which each REF message representing a Folder is an EHR extract. A discharge summary may contain one message.
FOLDER	The high level organisation within an EHR, dividing it into compartments relating to care provided for a single condition, by a clinical team or institution, or over a fixed time period such as an episode of care.	Diabetes care, Schizophrenia, Cholecystectomy, Paediatrics, St Mungo's Hospital, GP Folder, Episodes 2000-2001, Italy.	**REF Message** Folders are virtual and with a REF message query standard the query would define what the folder represents. eg "All Patient Notes from 2005"

COMPOSITION	The set of information committed to one EHR by one agent, as a result of a single clinical encounter or record documentation session.	Progress note, Laboratory test result form, Radiology report, Referral letter, Clinic visit, Clinic letter, Discharge summary, Functional health assessment, Diabetes review.	**OBR** The OBR segment matches well with the CEN definition. It contains the Times and the composer and other participants. With the HL7 Digital signature it can also be the container for the Attestation information. The MSH of the message the OBR was received with, combined with the message level security attributes (eg Signer of message) contains the committal info.
SECTION	EHR data within a COMPOSITION that belongs under one clinical heading, usually reflecting the flow of information gathering during a clinical encounter, or structured for the benefit of future human readership.	Reason for encounter, Past history, Family history, Allergy information, Subjective symptoms, Objective findings, Analysis, Plan, Treatment, Diet, Posture, Abdominal examination, Retinal examination.	**OBX** The section can break up a composition into logical sections. It contains no actual data as such but is useful for logical display. It is encoded using the OBX-3 CE of '**SECTION^^EN 13606'**. An archetype can describe the section contents
ENTRY	The information recorded in an EHR as a result of one clinical action, one observation, one clinical interpretation, or an intention. This is also known as a clinical statement.	A symptom, an observation, one test result, a prescribed drug, an allergy reaction, a diagnosis, a differential diagnosis, a differential white cell count, blood pressure measurement.	**OBX** The entry start point is identified by the code ' **ENTRY^^EN 13606'** This corresponds to the most common archetypes seen. eg The blood pressure archetype. OpenEHR subtypes ENTRY in several subclasses but the can all be coded under entry.

CLUSTER	The means of organising nested multi-part data structures such as time series, and to represent the columns of a table	Audiogram results, electro-encephalogram interpretation, weighted differential diagnoses.	**OBX** Clusters are identified using **'CLUSTER^^EN 13606'** OpenEHR subclasses clusters but the parent code can be used.
ELEMENT	The leaf node of the EHR hierarchy, containing a single data value.	Systolic blood pressure, heart rate, drug name, symptom, body weight.	**OBX** This level represents the atomic data and is encoded using a Name=Value schema. The CEN datatypes are mapped to the appropriate HL7 datatypes.

While it is desirable to use common archetypes to describe the same clinical data structure CEN realizes that there is a need to be flexible and allow new data items to be created for specific circumstances and this is the basis of the "Two Level Modeling" strategy. Using the CEN archetype standard it is possible to define archetypes for any data structure. eg The NEHTA discharge summary could be archetyped using CEN archetypes. An openEHR system, should be able to use these archetypes for decision support as this is the perceived advantage of two level modeling, ie the system is flexible and can handle new data structures. In the 13606-2 (Archetype) standard these comments are made in regard to this:

```
Comprehensive, multi-enterprise and longitudinal electronic health records will often in
practice be achieved through the joining up of multiple clinical applications, databases (and
increasingly devices) that are each tailored to the needs of individual conditions,
specialties or enterprises.

This requires that EHR data from diverse systems be capable of being mapped to and from a
single comprehensive representation, which is used to underpin interfaces and messages within
a distributed network (federation) of EHR systems and services. This common representation has
to be sufficiently generic and rich to represent any conceivable health record data,
comprising part or all of an EHR (or a set of EHRs) being communicated. The approach adopted
in this standard, underpinned by international research on the EHR, has been to define a
rigorous and generic Reference Model that is suitable for all kinds of data and data
structures within an EHR, and in which all labelling and context information is an integral
part of each construct. An EHR Extract will contain all of the names, structure and context
required for it to be interpreted faithfully on receipt even if its organisation and the
nature of the clinical content have not been “agreed” in advance.

However the wide-scale sharing of health records, and their meaningful analysis across
distributed sites, also requires that a consistent approach is used for the clinical
(semantic) data structures that will be communicated via the Reference Model, so that
equivalent clinical information is represented consistently. This is necessary in order for
clinical applications and analysis tools safely to process EHR data that have come from
heterogeneous sources.
```

While standardization is important, so is innovation and applications that are fit for purpose. Ideally the standard structures will be archetyped early and as new needs arise innovators will develop new and specific archetypes that can be brought into the standards process once they are established. All archetypes that are used for data transmission to others should be made publicly available and need to be reliably versioned so as not to invalidate existing data.

By defining a generic way to encode Archetypes in V2 interoperability with openEHR is achieved in the way intended by the CEN standard - by allowing mapping between different representations. It is

not an implementation of OpenEHR in HL7 but and implementation of CEN 13606 in HL7 v2 which allows interoperability to occur. Using common archetypes is the obvious way to reduce the effort in mapping but is not a prerequisite for interoperability.

2 The High Level Structure

Using OBR segments as the composition allows for multiple OBR-OBX groups to be included in a single REF message. Each OBR is the Report header for the composition and provided a viewport for the recipient. A composition is analogous to a single document, but not necessarily a single page document.

A discharge summary would typically contain a summary document under the first OBR and this document would contain an outline of the patients Presenting and general history, along with Family history and relevant physical findings etc and progress in hospital. This would usually be structured by the use of nested "SECTIONS". Other details such as allergies and Medications already have specific places in the message and the CEN model for these could easily be reverse engineered from the HL7 model. To interoperate with eg openEHR these specific areas will require mapping in both directions or openEHR to use the CEN model derived from the HL7 V2 model of Allergies and Medications.

A discharge summary would also contain copies of operation reports and radiology and Lab data which would be structured in the familiar OBR-OBX group. The actual discharge referral that appears as the first OBR is no different to these in structure and could be represented as an ORU message in a hospital system. To produce the REF message for transmission to a GP or a shared EHR a query that extracted the relevant ORU documents (QRY-ORF in fact) would be performed and the medication data extracted from the medication system, along with any allergy data. These pieces would then be assembled in a REF message and this may well be sent to several parties, possibly with some content filtering in specific cases. The REF message allows the sender to define the reason and intended responsibilities in the transfer of the data. Quite possibly at the receiving end the data contained in a REF message would be split apart again and filed in appropriate places. The MSH and specific REF message segments (egRF1) that were transmitted, along with the message level digital signature could be used to provide the attestation information for the recipient system.

The main reason for looking at using archetypes in HL7 V2 occurs below the COMPOSITION level and relates to structuring documents to allow semantic interoperability in areas such as Patient diagnoses and Vital signs etc. These data structures are described by archetypes and it is important that the scheme used is generic and is applicable to both the current archetypes and any future ones that may be produced. Immediate targets are Patient past history and Microbiology and Histology reports. Currently there is no reliable, interoperable way to transmit this information as atomic data as there are no HL7 standards to constrain the representation. While archetypes do not specifically constrain the representation, they do describe it and allow the atomic data to be read by computer systems and are useful for advanced decision support. This ability would be a major advance. The more standard the archetypes are, the easier it would be to apply this in general use, but without archetypes it is not possible at all, except for closely coupled systems.

3 Archetype Identifiers

Every Archetype needs to be uniquely identified and currently this is done with a string identifier which is unconstrained in length.

This represents a problem in HL7 V2 as a unique coding system is required to make the "at" codes unique. The CE coding system is limited to 20 Characters which is too short for a MD5 hash even if this is base64 encoded. It is proposed to add a unique identifier to every archetype to counter this but as a short to medium term measure using a hash of the archetype name is a potential solution.

In the current trial implementation presented here a Int64 has is used, hex encoded. It is prefixed with

99A- to comply with later versions of the standard.

eg openEHR-EHR-OBSERVATION.barthel.v1.adl becomes 99A-1A5F0DBE540AEAE2

The algorithm used as a stop gap measure is:

```
var p:^int64;
    hash,temp:int64;
    i: Integer;
begin
  Result := '';
  if s <> '' then
  begin
    p := @s[1];
    hash := length(s);
    for i := 1 to length(s) div 8 do
    begin
      hash := (hash shl 1) xor P^;
      inc(p);
    end;
    if length(s) mod 8 <> 0 then
    begin
      temp := 0;
      move(p^,temp, length(s) mod 8);
      hash := (hash shl 1) xor temp;
    end;
    Result := '99A-' +  IntToHex(hash, 16);
  end;
```

When an Archetype is declared in an OBX, a RP(Reference Pointer) value type is used as it will accommodate the full Archetype name and it also provides a place to declare the value of this hash. eg:

```
OBX|1|RP|ENTRY^^EN 13606|1|MO-EHR-ENTRY.LymphomaRegistration.v1^Registration details&
99A3925FDF87DA84FE7&L^TX^Octet-stream||||||F
```

The RP datatype allows:

A pointer: MO-EHR-ENTRY.LymphomaRegistration.v1

and a HD value to declare the Hash value and display name (Namespace ID) for this Archetype

A HD for application: Registration details&99A3925FDF87DA84FE7&L

The use of the RP is appropriate as the archetype is not included in the HL7. To use the data semantically it is required and this segment marks the start of an archetype and includes a reference pointer so that the archetype can be obtained. It is vital the the start of an archetype and the Archetype ID be transmitted with the data. The SubID of the RP segment corresponds to the root definition node of the archetype and the SubID of the RP segment is the root of the contained Archetype OBX segments. For embedded archetypes this may not be a single digit.

4 Non Terminal Nodes (CLUSTERS)

Below an entry there are CLUSTERS and ELEMENTS. In openEHR clusters are further subtyped but can be encoded as the more generic CEN CLUSTERS.

These are encoded in an OBX and a distinction needs to be made between them as they are semantically different.

This is an example of how a CLUSTER is encoded:

```
OBX|31|CE|8267-7^^LN^CLUSTER^^EN 13606|5.2|at0003^Relevant Symptoms^99A238809302733||||||F
```

The "CLUSTER^^EN 13606" is used to indicate that this is a cluster and this is combined with a LOINC report comment code to indicate that this is not to be displayed and only the Group name ie " Relevant Symptoms" is to be displayed to the user. The LOINC code makes no semantic contribution but is used to provide some assistance with display for applications that do not have access to the archetype or are compliant with the HL7 display conventions but are not archetype aware. This complies with the normal Name=Value convention of Archetypes. It says this is a non-terminal and here is its value. Potentially the actual non-terminal class name eg. 'EVENT' could be used with the 'EN 13606' coding scheme to indicate the exact class of the non terminal.

In many archetypes there are multiple unnamed structural non-terminal nodes which do not require transmission. The decision to transmit an OBX for a non-terminal is not critical semantically but makes a difference to user display. Current archetypes do mark non terminals as structural in the ontology and this can be used to make the decision as to whether to include the non-terminal code in the HL7 but it is non-critical semantically. It is however needed to allow meaningful display in non-archetype aware systems and allows Archetype aware systems to display archetyped data without referring to the archetype at runtime. The system producing the archetyped data can decide to include or exclude the Non Terminal in the HL7 based on its template specification. Given the current status of 99.9% non Archetype aware systems it is suggested that this be done by the producing system.

5 Terminal Nodes (ELEMENTS)

Elements represent a single atomic data value. This maps to one OBX per data value is is the case in HL7 V2 normally.

This is represented in the normal Name=Value scheme with the name in OBX-3 and the value in OBX-5. The datatypes in CEN can be mapped to HL7 V2 datatypes although in some cases a convention is required.

eg:

```
OBX|20|CE|80515008^Large liver^SNOMED-CT^at0006^Large liver^99A119404650397|4.2.1|
31874001^True^SNOMED-CT||||||F
```

OBX-3 is a CE (Coded Entry) value for the name and the 'at' codes are placed in the second triplet with the Ontology supplied value, in this case there is a SNOMED-CT value in the first triplet. If there is no Ontology mapping the first triplet can either repeat the second or just contain the text and no identifier or coding system.

The value data type varies but in this case is a CE value type and contains a SNOMED-CT code also. Values can also include the 'at' codes in the second triplet optionally.

Common Mappings:

CODED_TEXT maps to CE

OBX|7|CE|^Position^^at0008^^99A-A892E160ECDB6613|1.2.1.1.1|at1001^Sitting^99A-A892E160ECDB6613||||||F

TEXT to ST or FT

OBX|6|ST|^Comment^^at0033^^99A-A892E160ECDB6613|1.1.1.1.1.1.1.1.3|This is a test Comment||||||F

ED to ED

OBX|1|ED|^Device positioning^at0023^^99A-28639ABDC4E568FC|1.1.2.4.1|
^IM^JPEG^Base64^/9j/4AA../4wD/2Q==||||||F|||200411180844

Date Times to TS/DT/TM/ST

OBX|4|DT|^Date of initial onset^^at0003^^99A303279665198797|1.1.1.1.3|20070519||||||F

URI to RP

OBX|1|RP|^Reference^^at0123^^99A-28639ABDC4E568FC|1.1.3.5.2|http://www.medical-objects.
com.au/index.html^TX^Octet-stream|||||F

CODED_ORDINAL to CE with the second triplet of CE having a coding scheme of 'ORDINAL' and the numeric value in the alternate identifier.

OBX|9|CE|^Mobility^^at0017^^99A-1A5F61DA3524EA62|1.1.1.1.1.1.1.1.7|at0019^Wheel chair independent^99A-1A5F61DA3524EA62^ **1^^ORDINAL**||||||F

PHYSICAL_QUANTITY(+/- IVL) to NM or SN with units valued

OBX|4|NM|163030003^systolic^SNOMED-CT^at0004^systolic^99A-A892E160ECDB6613|
1.1.1.1.1.1.1.1.1|160|mm(Hg)^^ISO+|||||F

BOOLEAN values Map to CE and use SNOMED-CT codes for True/False/Unknown

OBX|8|CE|80515008^Large liver^SNOMED-CT^at0006^Large liver^99A-A892E160ECDB6613|1.2.1|
31874001^True^SNOMED-CT||||||F

In most of these case some mapping is required to ensure the data is HL7 compliant but in most cases this is straight forward.

Elements that repeat the Dotted SubID have another level, as if there was a CLUSTER above the element. When locating the relevant ADL node this path will still lead to the relevant ELEMENT node in the ADL.

6 Representing Structure

The structure of the data is of prime importance as there are likely to be many archetypes in one composition and some archetypes will contain other archetypes. While XML like paths are used in openEHR this does not work well with the HL7 encoding because of field length restrictions and nesting of archetypes. Path shortening algorithms are dependant on unique naming conventions that are not part of the CEN standard and cannot be relied on in archetypes generated in the future.

It is necessary that any OBX in a message can be mapped with absolute certainty to the equivalent node in the Archetype itself. Once this is done then the path can be regenerated and saved in a database if this is what is required by a particular implementation.

This scheme using the dotted subID notation represents the structure of the data within the whole composition and can handle multiple nested archetypes without any ambiguity or requirements for special naming conventions. This structure is also useful to non or partially archetype aware systems as the structure can be echoed in the display, without requiring the archetype to be loaded. It also

ensures that every OBX is unique with reference to the combination of the values of OBX-3 and the SubID. It also removes any need to place OBX segments in the order they appear in the ADL. Multiple OBX segments of the same Section, but different Data instances can be grouped together to produce a familiar display. eg In histology reports it is common to have multiple specimens and it is usual to group the Macro and Micro for each specimen in a common section. Using the observation SubID, the OBX segments can be ordered to achieve this display but allow the system to decompose the data into two instances of the Histology archetype encoded data.

The SubID is used for this exact purpose and this represents an extension of its use that complies with the original intention and adds further value. The HL7 standard refers to and shows examples of the use of a dotted SubID and as a result systems should not be surprised by its presence.

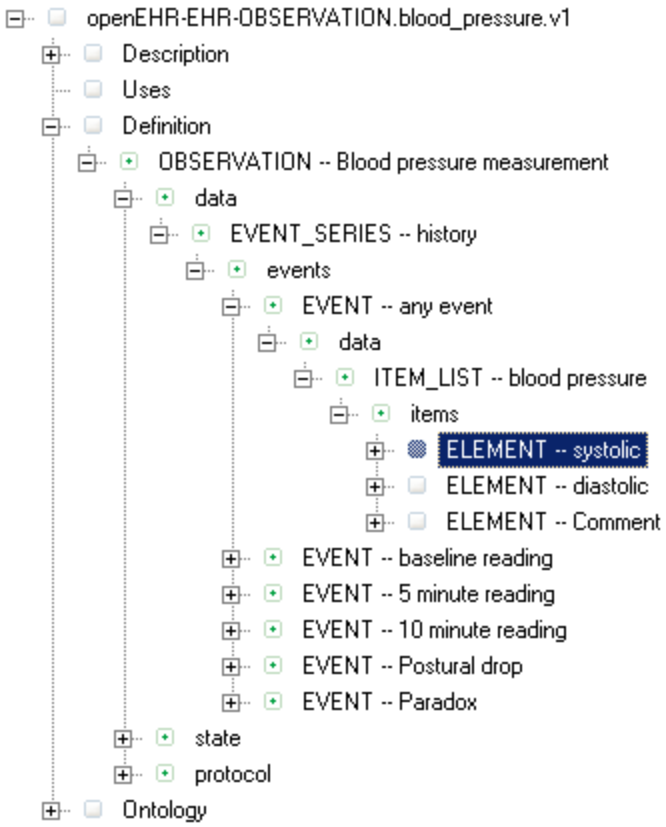
To find the matching Archetype Node that is represented by the OBX you start at the root of the archetype definition and navigate the tree using the values in the subID to select nodes at each level. This is an extremely fast and efficient tree walking algorithm and is faster than using a path, which requires string matching.

It will tolerate the addition of nodes at any level in the archetype definition and is only sensitive to the deletion or alteration of the definition of archetype definition nodes. This is a change that would be associated with a change in version of the archetype and because of this it is a safe, fast and reliable scheme. This statement is made about revisions of Archetypes in CEN 13606-2:

```
NOTE: revision of an archetype should be limited to modification of the descriptive
information, adding language translations and/or term bindings. If the definition part of an
archetype is no longer valid it should instead be replaced with a new archetype to ensure that
corresponding EHR data instances each conform to the same archetype specification.
```

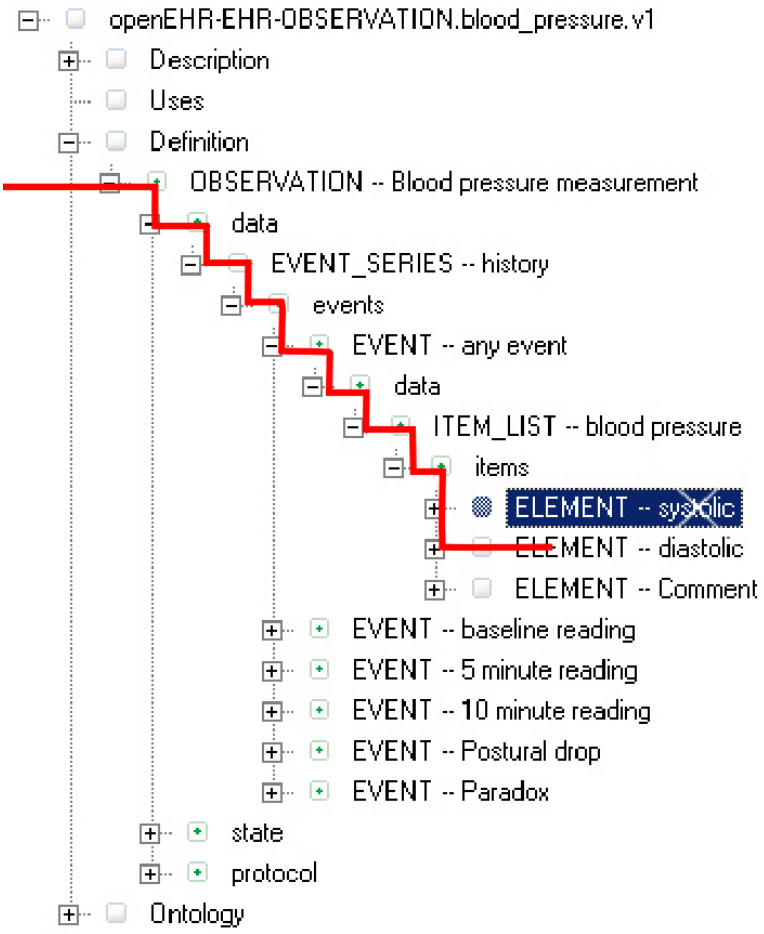
To use OBX-4 the Observation SubID you start the first archetype with "1" and then as nodes are added you add the dotted path that describes the position of the ADL metadata which corresponds to this OBX segment. If there is an embedded archetype then it will start with the its position in the parent and the position within the child archetype will be added to this in the same way. In this way any complexity of nesting can be represented.

To illustrate to use of the SubIDs the blood pressure archetype will be used:



This is complicated by nodes with > 1 occurrences as the node in question can repeat and the path will add a ".1" for the first instance and a ".2" for the second instance of the repeating node. when there are no non-terminal nodes with occurrences of > 1 then the path will path exactly to the structure as pictured above, but as the archetype spec specifies 2 places where repeats can occur the algorithm has to examine the occurrences value of the non-terminal (and terminal Elements) as it walks the tree. In effect the path echos the object structure of the archetyped data with all missing values accounted for. When data is created using this archetype then the SubID will reflect the path to the eg Systolic Blood Pressure has a path of "1.1.1.1.1.1.1.1.1" and by tracing the first level children from the root this node is reached. By convention the Definition has a single root node and the first number of the path always refers to the root definition node but will change depending on how many archetypes are in the composition. eg in a second Blood Pressure archetype the systolic pressure would have a path of "**2**.1.1.1.1.1.1.1.1". The "2" is the archetype instance number and always maps to the root definition node. In this example Diastolic blood pressure has a SubID path of "1.1.1.1.1.1.1.1.**2**"

This is illustrated for the diastolic blood pressure below, as 'any event' has > 1 occurrences it consumes 2 levels:



This is the full blood pressure archetype (not all possible values have been entered) when encoded in HL7 V2:

```
OBX|1|RP|ENTRY^^EN 13606|1|openEHR-EHR-OBSERVATION.blood_pressure.v1^Blood pressure measurement&99A-A892E160ECDB6613&L^
OBX|2|CE|15431-0^^LN^EVENT^^EN 13606|1.1.1.1.1.1|^any event^^at0006^^99A-A892E160ECDB6613||||||F
OBX|3|CE|8251-1^^LN^ITEM_LIST^^EN 13606|1.1.1.1.1.1.1.1|364090009^blood pressure^SNOMED-CT^at0003^blood pressure^99A-A8
OBX|4|NM|163030003^systolic^SNOMED-CT^at0004^systolic^99A-A892E160ECDB6613|1.1.1.1.1.1.1.1.1.1|100|mm[Hg]^^ISO+|||||F
OBX|5|NM|163031004^diastolic^SNOMED-CT^at0005^diastolic^99A-A892E160ECDB6613|1.1.1.1.1.1.1.1.1.2|60|mm[Hg]^^ISO+|||||F
OBX|6|CE|8262-8^^LN^EVENT^^EN 13606|1.1.1.1.1.2|^any event^^at0006^^99A-A892E160ECDB6613||||||F
OBX|7|CE|8264-4^^LN^ITEM_LIST^^EN 13606|1.1.1.1.1.2.1.1|364090009^blood pressure^SNOMED-CT^at0003^blood pressure^99A-A8
OBX|8|NM|163030003^systolic^SNOMED-CT^at0004^systolic^99A-A892E160ECDB6613|1.1.1.1.1.2.1.1.1.1|110|mm[Hg]^^ISO+|||||F
OBX|9|NM|163031004^diastolic^SNOMED-CT^at0005^diastolic^99A-A892E160ECDB6613|1.1.1.1.1.2.1.1.1.2|70|mm[Hg]^^ISO+|||||F
OBX|10|CE|8265-1^^LN^EVENT^^EN 13606|1.1.1.1.1.3|^any event^^at0006^^99A-A892E160ECDB6613||||||F
OBX|11|CE|8266-9^^LN^ITEM_LIST^^EN 13606|1.1.1.1.1.3.1.1|364090009^blood pressure^SNOMED-CT^at0003^blood pressure^99A-A
OBX|12|NM|163030003^systolic^SNOMED-CT^at0004^systolic^99A-A892E160ECDB6613|1.1.1.1.1.3.1.1.1.1|120|mm[Hg]^^ISO+|||||F
OBX|13|NM|163031004^diastolic^SNOMED-CT^at0005^diastolic^99A-A892E160ECDB6613|1.1.1.1.1.3.1.1.1.2|80|mm[Hg]^^ISO+|||||F
OBX|14|CE|8267-7^^LN^EVENT^^EN 13606|1.1.1.1.1.3|^5 minute reading^^at0029^^99A-A892E160ECDB6613||||||F
OBX|15|ST|^^99A-A892E160ECDB6613|1.1.1.1.3.1|Offset:P5m|||||F
OBX|16|CE|8268-5^^LN^ITEM_LIST^^EN 13606|1.1.1.1.3.2.1|364090009^blood pressure^SNOMED-CT^at0003^blood pressure^99A-A89
OBX|17|NM|163030003^systolic^SNOMED-CT^at0004^systolic^99A-A892E160ECDB6613|1.1.1.1.3.2.1.1.1|130|mm[Hg]^^ISO+|||||F
OBX|18|NM|163031004^diastolic^SNOMED-CT^at0005^diastolic^99A-A892E160ECDB6613|1.1.1.1.3.2.1.1.2|90|mm[Hg]^^ISO+|||||F
```

This message also illustrates having SNOMED-CT mappings in the ontology for a proportion od 'at' codes. A decision was made to put the "at" codes in the second triplet of OBX-3 as a convention which is why the OBX-3 codes are represented the way the are when there is no terminology mapping in the ontology. It also illustrates using the Hashed ArchetypeID as the coding system. The

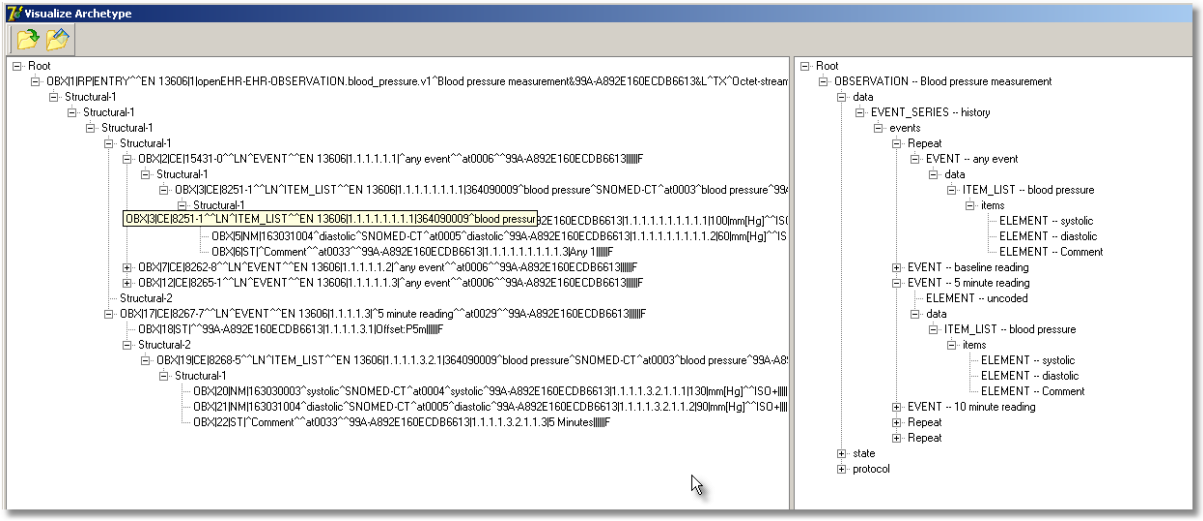
equivalence of the ArchetypeID and Hash representation can be computed for equality at run time. In the long run a defined coding scheme, possibly in SNOMED-CT, as part of the archetype definition would be better as the uniqueness of the hash is only statistical.

To illustrate the structure that the SubIDs create this is the pictorial representation of this data in tree form:

```
OBX|1|RP|ENTRY^^EN 13606|1|openEHR-EHR-OBSERVATION.blood_pressure.v1^Blood pressure measurement&99A-A892E160ECDB6613&L^TX^Octet-st
  data
    EVENT_SERIES
      events 1
        occurrences repeater  <-This allows for repeats of 'any event'
          OBX|2|CE|15431-0^^LN^EVENT^^EN 13606|1.1.1.1.1.1|^any event^^at0006^^99A-A892E160ECDB6613|||||F
            data
              OBX|3|CE|8251-1^^LN^ITEM_LIST^^EN 13606|1.1.1.1.1.1.1.1|364090009^blood pressure^SNOMED-CT^at0003^blood pressure^99A
                items
                  OBX|4|NM|163030003^systolic^SNOMED-CT^at0004^systolic^99A-A892E160ECDB6613|1.1.1.1.1.1.1.1.1.1|100|mm[Hg]^^ISO+|
                  OBX|5|NM|163031004^diastolic^SNOMED-CT^at0005^diastolic^99A-A892E160ECDB6613|1.1.1.1.1.1.1.1.1.2|60|mm[Hg]^^ISO+
          OBX|6|CE|8262-8^^LN^EVENT^^EN 13606|1.1.1.1.1.2|^any event^^at0006^^99A-A892E160ECDB6613|||||F
            data
              OBX|7|CE|8264-4^^LN^ITEM_LIST^^EN 13606|1.1.1.1.1.2.1.1|364090009^blood pressure^SNOMED-CT^at0003^blood pressure^99A
                items
                  OBX|8|NM|163030003^systolic^SNOMED-CT^at0004^systolic^99A-A892E160ECDB6613|1.1.1.1.1.2.1.1.1.1|110|mm[Hg]^^ISO+|
                  OBX|9|NM|163031004^diastolic^SNOMED-CT^at0005^diastolic^99A-A892E160ECDB6613|1.1.1.1.1.2.1.1.1.2|70|mm[Hg]^^ISO+
          OBX|10|CE|8265-1^^LN^EVENT^^EN 13606|1.1.1.1.1.3|^any event^^at0006^^99A-A892E160ECDB6613|||||F
            data
              OBX|11|CE|8266-9^^LN^ITEM_LIST^^EN 13606|1.1.1.1.1.3.1.1|364090009^blood pressure^SNOMED-CT^at0003^blood pressure^99
                items
                  OBX|12|NM|163030003^systolic^SNOMED-CT^at0004^systolic^99A-A892E160ECDB6613|1.1.1.1.1.3.1.1.1.1|120|mm[Hg]^^ISO+
                  OBX|13|NM|163031004^diastolic^SNOMED-CT^at0005^diastolic^99A-A892E160ECDB6613|1.1.1.1.1.3.1.1.1.2|80|mm[Hg]^^ISO
        events 2
        OBX|14|CE|8267-7^^LN^EVENT^^EN 13606|1.1.1.1.3|^5 minute reading^^at0029^^99A-A892E160ECDB6613|||||F
          OBX|15|ST|^^99A-A892E160ECDB6613|1.1.1.1.3.1|Offset:P5m|||||F
          data
            OBX|16|CE|8268-5^^LN^ITEM_LIST^^EN 13606|1.1.1.1.3.2.1|364090009^blood pressure^SNOMED-CT^at0003^blood pressure^99A-A8
              items
                OBX|17|NM|163030003^systolic^SNOMED-CT^at0004^systolic^99A-A892E160ECDB6613|1.1.1.1.3.2.1.1.1|130|mm[Hg]^^ISO+|||
                OBX|18|NM|163031004^diastolic^SNOMED-CT^at0005^diastolic^99A-A892E160ECDB6613|1.1.1.1.3.2.1.1.2|90|mm[Hg]^^ISO+|||
```

Because 'any event' can repeat it gains an extra level of nesting as compared with the '5 minute reading' which cannot repeat. A similar added level of nesting occurs when Elements repeat. By walking the structure of the data and doing the same traversal of the Archetype tree, taking into account occurrences a map can built up between the data and the archetype. A single archetype node can map to multiple data items as this is allowed in the ADL standard.

This image illustrates the HL7 structure against the ADL data model. The ADL data model takes into account Non-Terminals and Terminals with occurrences > 1.



7 Summary of Conventions

<table>
<tr><td>EHR_EXTRACT</td><td>maps to a Batch of REF messages (commonly one)</td></tr>
<tr><td>FOLDER</td><td>maps to the yet to be define query for an EHR extract and the details of what is in the extract would be defined by the query. A query for REF would echo the QRD segment back in the message and this would contain the parameters controlling the contents.</td></tr>
<tr><td>COMPOSITION</td><td>maps to OBR-OBX group in a REF message. Medications and Allergies are mapped to a CEN Archetype reverse engineered from the HL7 standard for allergies and Medications. An Archetype identifier for a composition would need to be encoded into the OBR-4 Universal Service ID using the Hash notation and the First OBX would contain the RP OBX segment pointing to the COMPOSITION archetype.</td></tr>
<tr><td>SECTION</td><td>maps to OBX. Is included in the SubID dotted notation. Similar to Cluster eg:

OBX|7|CE|8251-1^^LN^SECTION^^EN 13606|1.2|^History of Presenting Complaint^^at0003^^99A73763262AB3DF||||||F</td></tr>
<tr><td>ENTRY</td><td>maps to OBX. This is the level of eg Blood Pressure Archetype.

OBX|1|RP|ENTRY^^EN 13606|1|openEHR-EHR-OBSERVATION.blood_pressure.v1^Blood pressure measurement&99A-A892E160ECDB6613&L^TX^Octet-stream||||||F

<table>
<tr><td>OBX-2 Value Type</td><td>RP - Reference Pointer that identifies the Archetype about to be represented</td></tr>
<tr><td>OBX-3 Observation Identifier</td><td>CE - ENTRY^^EN 13606 This marks the start of an Archetype</td></tr>
<tr><td>OBX-4 Sub ID</td><td>1 - may be more complex with embedded archetype eg 1.3.4 - this is the root of this archetype</td></tr>
<tr><td>OBX-5 RP Data</td><td></td></tr>
<tr><td>OBX-5.1 Pointer</td><td>openEHR-EHR-OBSERVATION.blood_pressure.v1</td></tr>
<tr><td>OBX-5.2 Application ID (HD)</td><td></td></tr>
<tr><td>OBX-5.2.1 NamespaceID</td><td>Blood pressure measurement - this is the Text of the at0000 code</td></tr>
<tr><td>OBX-5.2.2 Universal ID</td><td>99A-A892E160ECDB6613 - this is the Unique ID for the archetype, at this stage a Hash of the name</td></tr>
<tr><td>OBX-5.2.3 Universal ID Type</td><td>L - This is a local coding scheme</td></tr>
<tr><td>OBX-5.3 Type of data (ID)</td><td>TX or TEXT</td></tr>
<tr><td>OBX-5.4 Subtype (ID)</td><td>Octet-stream - is most appropriate type</td></tr>
</table>
</td></tr>
<tr><td>CLUSTER</td><td>maps to OBX. The fact that it is a CLUSTER is indicated in OBX-3 and the value of the CLUSTER is in OBX-5 All Clusters would be of CE datatype.

OBX|8|CE|15431-0^^LN^CLUSTER^^EN 13606|1.1.1.1.8|at0011^Location^99AID-303279665198797||||||F

If Clusters have been subclassed then the CLASS name of the cluster can be used eg 'EVENT' The LOINC comment code is optional but is recommended to assist with display in non-archetype aware systems.</td></tr>
</table>

<table>
<tr><td>ELEMENT</td><td>maps to OBX. The CEN datatypes map to HL7 datatypes as in the previous section.
<table>
<tr><td>OBX-2 Value Type</td><td>Varies</td></tr>
<tr><td>OBX-3 Observation Identifier</td><td>The 'at' code and Hash of Coding system goes into the second triplet. If there is an Ontology mapping it goes into the first triplet. If there is no Ontology mapping, the entire triplet is repeated or just the Text is valued.</td></tr>
<tr><td>OBX-4 SubID</td><td>This reflects the Position of the cADL node in the archetype definition</td></tr>
<tr><td>OBX-5 Observation data</td><td>Varies depending on the data type. 'at' codes can be used here as well.</td></tr>
</table></td></tr>
</table>