The Health Level 7 Approach to Semantic Interoperability

Jobst Landgrebe and Barry Smith

jobst@cognotekt.com, phismith@buffalo.edu
# The RIM-based approach to semantic interoperability has failed and driven HL7 into a crisis

## An introduction to HL7

### HL7 v2

- Syntactic interoperability standard for the exchange of health care data with 1:1 messaging paradigm, no distributed computing.

- Merely a syntactic exchange format allowing applications to parse contents of an electronic message reliably.

  *Very successful in practice*, high vendor uptake, dominating health data exchange standard in healthcare in the US today.

### Since 1996: HL7 v3

- Development of HL7v3 with the goal to support semantic interoperability.

- Semantic interoperability, defined as “the ability of two or more computer systems to communicate information and have that information properly interpreted by a receiving system *in the same sense as was intended by the transmitting system*”

- HL7 approach to this was the development of the Reference Information Model and models derived from it. *1:1 messaging paradigm was kept.*

### This approach failed

- Total disconnect from end-users, not requirements-driven
- Lack of proper ontological foundations
- Major technical issues

  - Scant acceptance among end users and vendors

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A system cannot intend anything. What is meant here is a *processing of information* according to the needs and expectations of the users with a high degree of automation.
To overcome this crisis, the HL7 leadership decided to start the “Services Aware Interoperability Framework”

HL7 SAIF at a glance
Quoted from the „Canonical SAIF“ May 2011 Edition

<table>
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<tr>
<th>Goal</th>
<th>The <strong>goal</strong> of SAIF is to enable Working Interoperability</th>
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<tbody>
<tr>
<td>Scope</td>
<td>The <strong>scope</strong> of SAIF is the interoperability space between business objects, components, capabilities, applications, systems and enterprises [...] among distributed systems that may involve information exchanges.</td>
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<tr>
<td>Approach</td>
<td>The <strong>approach</strong> of SAIF is to organize and manage architectural complexity with a set of constructs, best practices, processes, procedures and categorizations.</td>
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<tr>
<td>Focus</td>
<td>The <strong>focus</strong> of SAIF is on managing and specifying architectural artefacts that explicitly express the interoperability specification characteristics of <em>software components</em>.</td>
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<tr>
<td>Technical objective</td>
<td>The <strong>technical objective</strong> of SAIF is to create and manage easy-to-use, coherent and traceable Interoperability Specifications (ISs) for systems [...] including message, document or service interoperability-paradigms.</td>
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Descriptive categories not mutually exclusive and collectively exhaustive
To assess the SAIF, we analysed it against two sets of necessary but not sufficient principles

Approach to an assessment of SAIF

Compile general framework principles

Compile interoperability framework principles

Assess HL7 SAIF against these principles

Conclusion

In this talk we give a brief overview and then focus on selected aspects.
General principles are the basis for defining an interoperability framework, but are not realised by SAIF

<table>
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<tr>
<th>General framework principles</th>
<th>Description</th>
<th>Level of realisation in SAIF</th>
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<tr>
<td><strong>Domain boundaries</strong></td>
<td>A SIF must be associated with a single, coherent domain in which it is declared to be valid, and it must define explicitly the boundaries of this domain.</td>
<td>SAIF scope is software engineering and IT as a whole – no restriction to the health care domain.</td>
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<td>Knowledge reuse</td>
<td>A SIF must build upon established scientific and technical knowledge and best practices.</td>
<td>Insufficient re-use of existing frameworks and approaches in the area of information and knowledge modelling, behaviour specification and architecture.</td>
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<td>Level of abstraction</td>
<td>A SIF must be sufficiently abstract that it can support systems implemented across a broad spectrum of technical alternatives.</td>
<td>Core information framework RIM does not separate logical modelling layer from underlying technology.</td>
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A SIF needs to cover requirements, information/ontology, behaviour and architecture/conformance ...

Principles for semantic interoperability frameworks (SIF) in distributed computing

Enterprise requirements

Information model and ontology

Computational model

Architecture framework and conformance model

How to model and store content

How to compute on the content
... but the SAIF fails to realise these principles

Overview of the findings for the semantic interoperability framework principles

<table>
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<tr>
<th>Enterprise requirements</th>
<th>HL7 has no process or formalism to define requirements. This situation reflects well the detachment of HL7 from the market participants, the health care professionals.</th>
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<tr>
<td>Information model and ontology</td>
<td>RIM advocated as upper ontology and information model, but not usable for either purpose in practice – more details on the next pages.</td>
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<tr>
<td>Computational model</td>
<td>The behavioural framework is inconsistent and not comprehensive. The job of defining computational models has been accomplished in computer science between the late 1960s and the mid 1990s [references 1-6], but HL7 chose to re-do this on its own instead of using the established knowledge.</td>
</tr>
<tr>
<td>Architecture framework and conformance model</td>
<td>The meaningful relationship between architecture and conformance is reversed. The architecture artefact definition is inconsistent and cannot be instantiated – more details on the next pages.</td>
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In the SAIF, HL7 advocates the RIM as an upper ontology, but RIM cannot fulfil this role ...

RIM is described and advocated as upper ontology, but RIM only contains the categories Act (an intentional action performed), Role and Entity (something containing molecules as parts) plus a set of relationships and “specialisations” of the three types obtained by deleting properties of the types (!)

- These categories are insufficient to describe reality, even diseases cannot be described using these types
- The way the categories are designed makes it very hard to author and read the models

“One can think of a reference information model as an upper ontology that describes the static semantics of all possible real world information.”
... and can neither be used in its more traditional role as an information model

SAIF approach to information modelling and ontology

- An information modelling language should allow domain coverage, be modular and allow technical implementation while shielding the user from technology issues

But …

- RIM contains a large number of message-interchange-related (actually behavioural) attributes built into the core of the RIM, thus cluttering the models
- Lexical instantiation (aka “terminology binding”) with the RIM is very problematic and not scalable
- RIM is hard to implement technically as it disregards existing technology
- RIM exposes design properties of the XML technology to the end user

► SAIF misses the chance to decommission the RIM and to move HL7 to a contemporary ontology and information modelling framework
The approach to architecture and conformance is inconsistent and not usable for engineering

SAIF approach to architecture:
The ECCF “SS” (Specification Stack)

1. SAIF states that conformance comes before architecture – but conformance needs to be stated against something.
2. No formal approach to requirements traceability.
3. ECCF matrix is singular – matrix cannot be instantiated with artefacts in a meaningful manner. Matrix does not provide set of instructions that can be used.

Architecture approach inconsistent and not usable for software engineering
We conclude that HL7 SAIF can not save HL7 v3

Conclusions and recommendations

1. Because the SAIF does not meet the needs of an interoperability framework, it will not be successful in overcoming the crisis of HL7.

2. We recommend replacing the SAIF by an approach that is based on a more fundamental reassessment of HL7v3. The new approach should be in compliance with the interoperability design principles presented above.

3. This does not require the development of new frameworks and methodologies: almost all of the needed components, including requirements formalisms, can be taken from existing standards and frameworks.

4. Those components which genuinely need to be healthcare specific fall under the heading of what we have called ‘information model and ontology’. To obtain useful results here, we recommend that HL7 adopt a tested upper-level ontology framework and an efficient, scientifically well founded, modular domain-specific modelling language.
Selected bibliography