Homogeneity-Driven Technology Independence in HL7 Paradigms

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BACKGROUND: The Medical fraternity and the healthcare service sector have long acknowledged the need for smart, IT-based, interoperable healthcare systems. Semantic Interoperability is key which is the regulated, authorized, meaningful exchange, storage, management, and access to valued healthcare information. This cues in Health Level Seven (HL7), the predominant global healthcare standard in operation today. Introduced in 1987 by the HL7 International Inc., its current version 3 has been found to be complex and difficult to implement and maintain. Global semantic interoperability termed International Interoperability herein, an inceptive goal of the HL7 standard, is still an illusion.

OBJECTIVE: This study focuses on the belief that the achievement of true International Interoperability and associated Inclusive Efficiency during operation is rooted at the labyrinths of specifications development sub-processes. Infusing simplicity and uniformity in the paradigmatic modelling phase derives optimal analytic, design, and semantic interoperability, which would permeate to true International Interoperability in application. Modelling paradigmatic Artifacts using the newly-devised, techno-platform independent Unified Data Atom (UDA*) representation infuses simplicity, brevity, and versatility into the design process. This would also promote and enhance numerous allied activities such as domain requirements cross-checking, audit, and consensus, to kindred system development verification and validation. This paper therefore propounds a significant first step which is the injection of homogeneity-driven technology independence in HL7 paradigmic representations.

METHOD: The HL7 v3 specifications creation continuum is tri-paradigmatic, consisting of Messages, Clinical Document Architecture (CDA), and Services, all presently modelled using the Extended Markup Language (XML). XML, which was introduced by the World Wide Web Consortium (W3C) in 1996, is a Markup language used for formatting human and machine readable documents. Our proposed solution remodels all XML-based paradigmic artifacts using the UDA vocabulary, either first-hand or as a single-step transliteration. This creates overarching homogeneity across all three HL7 paradigmic landscapes and their nascent specification development sub-processes, and is therefore a leapfrog in all current HL7 implementation goals. The result is the achievement of true sub-process interoperability during design and development which in turn would promote the development of efficient, globally-interoperable system specifications.

Typical XML Message Segment – derived from [1]

<?xml version="1.0" encoding="UTF-8" ?>
<PRPAJN101001UV01 ITSVersion="XML-1.0"
xmni="urn:hl7-org:v3"
xmni="http://www.w3.org/2001/XMLSchema-instance">
  <receiver>
    <device>
      <id extension="922" root="2.16.840.1.113883.19.9"/>
      <name>Master MPI</name>
      <representedOrganization>
        <id extension="1002003" root="2.16.840.1.113883.19.200"/>
        <name>Alpha Hospital</name>
      </representedOrganization>
    </device>
  </receiver>
</receiver>
RESULTS: If $U'$ denotes the set of transliterated, target DataAtoms $\{u, u', u, u, \ldots, u\}$ as a result of the Equivalence relation $T$ acting on the source XML informational schema $X$ (either a Message, Document, or Service), then

$$T: X \rightarrow U' \rightarrow (1)$$

where $X$ - Problem domain XML super schema and $U'$ - Problem-related target UDA' super schema

$$U' \in U_{(u, u', u, u, \ldots, u)} \rightarrow (2)$$

where $U'$ : set of target DataAtoms with implicit, complete interconnectivity, and $U$: union of bidirectionally inter-connected, target DataAtom pairings.

This proposed solution successfully proved that $T'$ is an Equivalence relation being Reflexive, Symmetric, and Transitive. This confirms that the mapping $T'$ produces a target set $U'$ equivalent to the source set $X$. In addition, it was also proved that the algorithm $T'$ is Complete and Exhaustive.

DISCUSSION AND CONCLUSIONS: This paper focused on excavating and capitalizing on the abounding interoperability potential afforded by core paradigm-related specification development processes, and synergistically aggregating to achieve this exigent goal. Our proposed solution remodels all HL7 paradigmic artifacts in the techno-platform independent UDA' representation, either first-hand or as a single-step transliteration, with a view to accruing the inclusive benefits of simplicity, brevity, and versatility over the previous XML representation. Principally significant is that analysis and design interoperability amongst all stakeholders also derived as a fillip in addition to providing a secure approach to actualize overarching, ubiquitous exchange.

REFERENCES: