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Complete interoperability in healthcare : technical, semantic and process interoperability through ontology mapping and distributed enterprise integration techniques

Amanda Joanne Ducrou

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COMPLETE INTEROPERABILITY IN HEALTHCARE

Technical, Semantic and Process Interoperability through Ontology Mapping and Distributed Enterprise Integration Techniques

A thesis submitted in fulfilment of
the requirements for the award of the degree

DOCTOR OF PHILOSOPHY

from

UNIVERSITY OF WOLLONGONG

by

AMANDA JOANNE DUCROU

BE (software), MDigMMedia (distinction)

FACULTY OF INFORMATICS

2009

Certification

I, Amanda J. Ducrou, declare that this thesis, submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Informatics, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. This document has not been submitted for qualifications at any other academic institution.

Amanda J. Ducrou
25th May, 2009

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List of Abbreviations

HIF-J	Health Interoperability Framework – Jini
ADL	Archetype Description Language
ADT	Admission, Discharge, Transfer
AHML	Australian Healthcare Messaging Laboratory
AMR	Association of Medical Receptionists
ANSI	American National Standards Institute
ARC	Australian Research Council
CAP	College of American Pathologists
CDA	Clinical Document Architecture
CEN	European Committee for Standardisation
CIS	Clinical Information System
CMT	Convergent Medical Terminology
CTv3	Clinical Terms version 3
DICOM	Digital Imaging and COmmunication in Medicine
DMIM	Domain Message Information Model
DSS	Decision Support System
EDI	Electronic Data Interchange
EHR	Electronic Health Record
ePOC	electronic Point-Of-Care
ESB	Enterprise Service Bus
FLWOR	For, Let, Where, Order by, Return
GEHR	Good European Health Record
GP	General Practitioner
HL7	Health Level Seven
HMD	Hierarchical Message Description
HSB	Health Service Bus
ICD	International Classification of Diseases
IEEE	Institute of Electrical and Electronics Engineers
IHTSDO	International Healthcare Terminology Standards Development Organisation
ISO	International Organisation for Standardisation
ITS	Implementable Technology Specification
JCA	J2EE Connector Architecture
Jini	Jini Is Not Initials
JMS	Java Message Service
JMX	Java Management eXtensions
JVM	Java Virtual Machine
LOINC	Logical Observation Identifier Names and Codes
MeSH	Medical Subject Headings

MSMQ	Microsoft Message Queue
NHS	National Health Service (UK)
NLM	National Library of Medicine (US)
OWL	Web Ontology Language
PACS	Picture Archiving and Communication Systems
PAS	Patient Administration System
PDA	Personal Digital Assistant
RIM	Reference Information Model
RMIM	Refined Message Information Model
SCTID	SNOMED CT Identifier
SDO	Standards Development Organisation
SESAHS	South East Sydney and Illawarra Area Health Service
SNOMED	Systemised Nomenclature of MEDicine
SNOMED CT	SNOMED – Clinical Terms
SNOMED RT	SNOMED – Reference Terminology
SOA	Service-Oriented Architecture
SOAP	Simple Object Access Protocol
SQL	Structured Query Language
TACT	The Ambulatory Care Team
UML	Unified Modelling Language
UMLS	Unified Medical Language System
WHO	World Health Organisation
XML	eXtensible Markup Language
XPath	XML Path Language
XQuery	XML Query Language
XSLT	eXtensible Stylesheet Language Transformations

Abstract

Interoperability in healthcare is a requirement for effective communication between entities, to ensure timely access to up-to-date patient information and medical knowledge, and thus consistent patient care. This thesis focuses on the development of an interoperability solution for health by employing design science research methods to arrive at a final solution.

First, background topics including Health Informatics standards and formats are covered, which leads to three major Health Informatics standards being used throughout the remainder of this work – HL7 for messaging, *openEHR* for patient records, and SNOMED CT as a standard terminology to facilitate clarity of information, and to discourage ambiguity between communicating entities.

Ontology mapping methods between these standards designed to promote interoperability by using the standards in conjunction with each other are then presented, leading to a solution for semantic interoperability.

A technical interoperability solution is required for sending these semantically interoperable messages, which leads to the development of a framework which uses a tuple-space paradigm to share messages. This framework is shown to have some scalability issues, which leads to the final solution – a scalable interoperability framework based on the Enterprise Service Bus methodology of enterprise integration which provides a real-world answer to communication in healthcare.