

A SEMANTIC DATA MEDIATOR FRAMEWORK TO SUPPORT
AUTOMATION OF WEB SERVICES DATA MEDIATION

KANMANI A/P MUNUSAMY

A thesis submitted in fulfilment of the
requirements for the award of the degree of
Doctor of Philosophy (Computer Science)

Faculty of Computer Science and Information Systems
Universiti Teknologi Malaysia

JULY 2013

To my husband Mr. Sugumaran and
sons Sarveshaah and Avhineshah

ACKNOWLEDGEMENT

I would like to express my deepest appreciation my principle supervisor, Associate Prof. Dr. Suhaimi Ibrahim and co-supervisor Prof. Dr. Sapiyan Baba for their continued support and invaluable constructive comments which have helped me in completing this research on time. I am also indebted to Dr. Sayed Gholam Hassan Tabatabaei who inspired me in selecting this research area, and Dr. Mohd Naz'ri Mahrin for his vivacious discussions that kept my focus on the research problems at hand.

I also thank my two special colleagues Ms. Hazlifah Mohd Rusli and Dr. Mansoor Abdullateef for their stimulating conversations and taking interest in my research work. I am also thankful to University Malaya and Ministry of Higher Education for funding my studies for this PhD programme. My special gratitude goes to my mother, parents-in-law, sisters, brothers and friends, Shanthi Marie and Thana for their encouragement at all times. My special thanks also go to all the staff at AIS, co-researchers at UTM and colleagues at PTM, University Malaya who have helped me in my ways complete this research.

At last and most importantly, this programme would not have been possible without the support of my husband, Mr. Sugumaran. I am thankful for his endless patience and love, consistent support and motivation for me to be where I am at present.

ABSTRACT

Most businesses nowadays use Web Services (WS) technology as a platform to facilitate interaction between service providers and requestors. Data mediators in these services play an important role in ensuring successful interactions; however, the Semantic Web Service (SWS) still faces great challenges in providing the mediation actions that are necessary for smooth WS interactions and is thus open for further research exploration and automation in discovery, selection and composition. Many existing data mediation approaches focus on automated ontology mapping that provides only limited discussions on mediating actual instances. As such, current approaches suffer from insufficient mediation knowledge for related domains to mediate messages correctly at run time. The objective of this thesis is to construct a data mediation framework for the SWS and its associated processes that can establish data mediation automatically for WS interactions at run-time. The Semantic Data Mediator Framework (SDMF) is proposed to manage interactions between source messages and target messages by expressing the data mediation knowledge of developers in the form of semantic knowledge representation. The research steps in *engineering method* research methodology are adopted to identify the required improvement and design the SDMF data mediation solution. A data mediation component that mediates messages during a WS interaction between scholarly databases and local universities is developed using the proposed SDMF. The evaluation results on the semantic data mediator component using the SDMF are benchmarked with an existing middleware application that is used to support the data mediation. The evaluation results prove that semantic descriptions of the Web service message content through the SDMF are able to enhance the correctness and automation during the run time of a WS interaction.

ABSTRAK

Kebanyakan perniagaan kini menggunakan teknologi Perkhidmatan Web (PW) sebagai platform untuk membolehkan interaksi antara pembekal dan peminta perkhidmatan. Pengantara data dalam PW memainkan peranan penting untuk memastikan interaksi yang berkesan. Perkhidmatan Web Semantik (PWS) telah memberi ruang yang lebih banyak kepada penerokaan penyelidikan ke arah mengautomatiskan pemilihan, penemuan dan komposisi PW. Walaubagaimanapun, PWS masih menghadapi cabaran yang besar dalam menyediakan tindakan pengantaraan yang diperlukan bagi melancarkan interaksi PW. Kebanyakan pendekatan pengantaraan data yang sedia ada, memberi tumpuan kepada pemetaan ontologi secara automatik dan hanya menyediakan perbincangan secara terhad bagi pengantaraan data dengan nilai sebenar. Oleh yang demikian, pengetahuan pengantaraan data semasa bagi sesuatu domain tidak mencukupi untuk menjana pengantara mesej secara automatik pada masa larian. Objektif tesis ini adalah untuk membina rangka kerja pengantaraan data bagi PWS dan proses yang berkaitan dengannya bagi mewujudkan pengantara data secara automatik semasa interaksi PW. Rangka kerja Pengantara Data Semantik (RPDS) adalah dicadangkan untuk menguruskan interaksi antara mesej sumber dan mesej sasaran dengan menyatakan data pengantaraan pengetahuan untuk pembangun sistem mewakilkannya sebagai pengetahuan semantik. Langkah-langkah yang terkandung dalam kaedah kejuruteraan telah digunakan sebagai kaedah penyelidikan untuk mengenalpasti penambahbaikan yang diperlukan dan merekabentuk pengantaraan data RPDS. Satu komponen pengantaraan data yang berfungsi sebagai pengantara mesej PW semasa interaksi antara pangkalan data ilmiah dan universiti tempatan telah dibangunkan menggunakan RPDS. Hasil penilaian ke atas komponen pengantaraan semantik data menggunakan RPDS diukur dengan membandingkan dengan aplikasi perisian tengah yang sedia ada untuk menyokong pengantaraan data. Keputusan penilaian membuktikan bahawa perwakilan pengetahuan semantik bagi kandungan mesej PW melalui RPDS dapat dipertingkatkan ketepatannya dan mengautomatiskan interaksi PW.