Agent-Based QoS Management for Web Service Compositions

A thesis submitted for the degree of

DOCTOR OF PHILOSOPHY

Xuan Thang Nguyen B.E. (Hons.), Dip.Prac,

Swinburne University of Technology

Jun, 2008

Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; and, any editorial work, paid or unpaid, carried out by a third party is acknowledged.

Xuan Thang Nguyen
Faculty of Information and Communication Technologies
Swinburne University of Technology
Jun, 2008

Acknowledgments

I would firstly like to thank my supervisor, Professor Ryszard Kowalczyk, for his support and guidance throughout my candidature. To me, he has been an excellent mentor and friend. His constant encouragement and positive attitude were the main driving forces that kept me motivated. My thanks also to Professor Jun Han for agreeing to act as an associate supervisor. His comments and suggestions were always helpful.

My warm thanks to my research colleagues in the Intelligent and Multi-Agent System group for making the work environment more friendly and enjoyable. Thanks to Jian Feng Zhang and Tino Schlegel for countless hours spent discussing intelligent agents and constraint satisfaction techniques. I am also grateful to Mohan Baruwal Chhetri, Juliana Wong and Kathie Farn for proof reading this thesis and their valuable and constructive feedbacks. A special thank to my girl friend, Khoi Anh Phan, for her love, her patience and support during the difficult time that I had been through.

Finally, I am indebted to my parents and my sister for many years of hard work they have made to support me. Without them, this thesis would never have started.

Credits

Portions of the material in this thesis have previously appeared in the following publications:

1. X. T. Nguyen, R. Kowalczyk, On Solving Distributed Fuzzy Constraint Satisfaction Problems with Agents. IEEE/WIC/ACM International Conference on Intelligent Agent Technology (IAT-07) , Silicon Valley, USA . (to appear)

2. J. F. Zhang, X. T. Nguyen, R. Kowalczyk, A Graph-based Multi-agent Planning Algorithm with QoS guarantees. IEEE/WIC/ACM International Conference on Intelligent Agent Technology (IAT-07) , Silicon Valley, USA (to appear).

3. X. T. Nguyen, R. Kowalczyk, M. B. Chhetri, and A. Grant, (2005), WS2JADE: A Tool for Run-time Deployment and Control of Web Services as JADE agent services. In M. Calisti, M. Klusch and R. Unland (Eds.) Software Agent-based Applications, Platforms and Development Kits. Whitestein Technologies AG, pp. 223–252.

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5. X. T. Nguyen, Adaptive QoS Management for Web services using Asynchronous Distributed Searches, pp. 37–42, In Proceedings of the IBM PhD Symposium at the 4th International Conference on Service Oriented Computing (ICSOC-06), USA, December 4-7, 2006

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15. X. T. Nguyen, Demonstration of WS2JADE, pp.135-136, In Proceedings of the 4th International Joint Conference on Autonomous Agents and Systems (AAMAS2005), Utrecht, the Netherlands, July 25–29, 2005

Note

Unless otherwise stated, all fractional results have been rounded to the displayed number of decimal figures.

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Abstract

Service oriented computing (SOC) is fast becoming the core platform for software applications and integrations. In SOC, applications are modeled as collections of loosely-coupled, interacting services that communicate using standardised interfaces and protocols. These services can be combined together to form new value-added services, or compositions which potentially span across many administrative boundaries.

Managing the quality of Web service compositions is important. However, it is difficult in practice. The difficulty lies in the complexity of composition dependencies such as sharing computing resources or component services. The distributed nature of Web services presents another challenge where a service composition may involve service providers from different organizations and administrative domains. A viable collaboration between these service providers is necessary for any successful management.

This thesis studies the Quality of Service (QoS) management for multiple service compositions. Despite many approaches having been proposed for the management recently, those approaches are limited to an individual composition and management functionalities executed by a single organization. This thesis aims at providing solutions for those limitations. It has the following contributions:

- A new framework supporting a distributed approach to solve the QoS management problem for multiple inter-related compositions is proposed. This problem has not been well investigated in the current Web service research. In the thesis, fresh ideas from Distributed Constraint Satisfaction (DisCSP) research are employed and applied practically to the Web service environments.

- Extensions and improvements to existing DisCSP algorithms are suggested. This enables existing DisCSP algorithms to be used practically in the framework. In the adaptations and improvements, existing DisCSP algorithms are reviewed. Their possible limitations when being used in the Web service environments are analysed and addressed adequately.

- New DisCSP algorithms to solve the QoS management problem are proposed. These newly proposed algorithms can model different preference levels of service providers and work in dynamic environments where compositions and constraints on QoS variables can be added or removed. Optimization of preferences of service providers can also be achieved by using some of the algorithms.

- A novel verification mechanism, for checking the conformance of service providers to a DisCSP algorithm, is developed, and thus allowing the algorithm to be used practically in an untrusted environment such as that of the Web services.