Asian Journal of Information Science and Technology (AJIST)
Vol.4.No.1. 2016 pp 1- 6
available at: www.goniv.com
Paper Received :08-04-2016
Paper Accepted:22-04-2016
Paper Reviewed by: 1. R. Venkatakrishnan 2. Dr.G.Ramesh
Editor :Prof. P.Muthukumar

A SURVEY ON VERIFICATION OF COMPOSED WEB SERVICES

R. Rajeswari, PG Scholar
Dept. of Information Technology
Sri Manakula Vinayagar Engineering College
Puducherry, India.

N. Thilagavathi, Assistant Professor
Dept. of Information Technology
Sri Manakula Vinayagar Engineering College
Puducherry, India.

ABSTRACT

A Web services are proliferated because of its massive support and uses in the industries and research areas. Usages of the web services are unavoidable in the software industry for its reusability and interoperability. For more reusability, web services are integrated together to form the composition. Hence the compositions of web services are widely done and getting benefit from it. Various methods have been found out for composition and still it is enhancing. Apart from few methods such as Petrinets, stacked automata using SPIN tool, and UPPAL, correctness of the system is not verified. The state space explosion, correctness and the duplication of the non deterministic composed services are not verified. In this paper, a survey is made for the verification methods for the correctness of the composed web services.

Index Terms --- Web services composition, Petrinets, SPIN, UPPAL, state space explosion.

I. INTRODUCTION

Web services are software components which can be published, located and invoked through the web. Web services can be used by the software and research industries which has the main advantage of the reusability. The web services can be created in which the framework contains communication protocols, service discovery, service description and specifications. Web services can be developed by different organization, which use different concepts models for the description of services. However there is no unique language for the web services evaluation. Composition is the collection of autonomous services which are combined together to perform multifaceted task to wrap the services. Web services can be composed using two techniques such as or chestration and choreography. In orchestration, a single point service controls the processes involved in the composition. The flow of communication will be done to the central process by every process.

The involved processes may or may not know that they are participating in the composition. In choreography, there will be no central process to coordinate all process. Here web services that are involved have to know when to become active and whom to collaborate. In comparison, orchestration is more efficient and flexible than choreography.

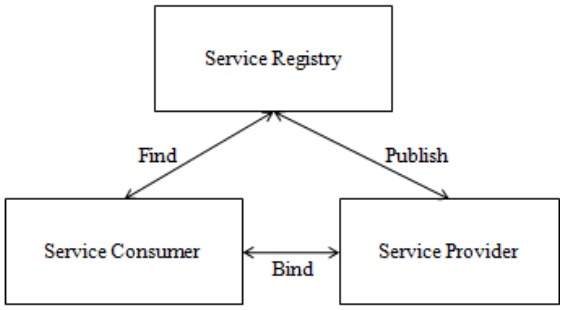

Fig 1: Web service architecture

Composition of web services can be verified by various methodologies which guarantee the correctness of the system. From the survey, the verification is done mostly for the deterministic systems. Verification for the non deterministic system which contains number of output states is done limitedly. So far the correctness of the non deterministic system will be calculated based on the properties like dead transition, liveness, safety, deadlock, emptiness, safety, state space explosion.

In deterministic systems, numbers of methods have been introduced to solve the above issues. Timed automata, interface automata, orchestration on computation via timed automata, colored petrinet method refinement checking method are some of the methods for deterministic systems. But in non deterministic system, less research had done to solve the issues. Modified Muller automata are implemented for non deterministic system.

II. RELATED WORK

Web services which are composed by the software are composed for the reusability purpose and efficient usage of the services. But the composition of the web services using various methods does not result in the accuracy, compactness, and completeness of the system. Various techniques used for verification of composed services are surveyed for research contribution.

A. *Validation and verification of web services choreographies by using timed automata [1] proposed by M. E. Cambronero.*

The paper suggested Timed Automata which is a mathematical model used to represent the behaviour of the system and to describe states and behaviour of single activity. It uses a dense time model in which the clock variable validates a real number. The clocks are progresses synchronously. For service composition verification the Timed Automata uses Web Service Translator Tool. The WSCDL is transformed into Timed Automata (TA) which is finally verified by UPPAAL Tool. The Reachability problem is verified using this approach. But the approach does not solve emptiness, state explosion, deadlock, etc.

B. *The model checker SPIN [2] proposed by G. Holzmarm.*

This paper discusses about SPIN model checker which deals with verification scheme for distributed software system models. Design errors are detected and the paper presents design and structure of verifier's overview. Yet it lacks to avoid emptiness problem and deadlock.

C. *Interface Automata based formal model for BPEL4WS Web Services composition [3] proposed by Su, H., Huang, Z., Liu, L.*

It discusses a type of I/O automata which is called as interface automata. It interacts through synchronization for checking its compatibility. BPEL4WS is used for composition and then it is mapped into interface automata. It is then altered into Promela and given as input for SPIN tool to verify composed web services. The property of state space explosion and correctness is verified to some extent. It couldn't solve emptiness problem, deadlock and dead transition.

D. *A Petri Net Approach to Analysis and Composition of Web Services [4] proposed by P. Xiong, et.*

It uses a formal model called petrinet which is used widespread to describe services, and later gives modelling, analysis and verification of service composition. As a result of its structure the description of the control flow of service composition is limited. By combining the data flow and control flow the description

of the service composition will be more specific.

E. Sword: A Developer Toolkit for Web Service Composition [EB/OL] [5] proposed by S. R. Ponnekanti and A. Fox.

This paper uses the system called SWORD. It is the service composition method which uses the Entity Relationship model for service creation. This method has an disadvantage which could not make analyse and verify service composition process.Yet it couldn't guarantee the correctness of service composition.

F. Adaptive and Dynamic Service Composition in eFlow[EB/OL] [6] proposed by F. Casat, S. and I. Krishnamoorthy.

This paper proposed a mechanism called eFlow. It is a platform for service composition based on workflow. It gives service definition, creation and control of the service composition.

G. Verifying Web Services Composition based on LTL and Colored Petri Net [7] proposed by J. Zhu et al.

It gives an idea to use colored Petri Net (CPN) which is the extension of the ordinary Petri Net model. It is the combination of the Petri Net and the programming language and it describes the concurrent system briefly.

H. A Logical Formal Model for Verification of Web Service Choreography [8] proposed by Zahra Madani, Naser Nematbakhsh.

This paper proposed a method using first order logic notation related to partial order planning problems. This provides the interaction between the participants for a common understanding of interaction rules.this model is useful to check the Reachability of ideal and safe states. The verification of the interaction is done through the prolog tool.

I. Event-Based Design and Run-time Verification of Composite Service Transactional Behaviour, Services Computing [9] proposed by Gaaloul, W.; Bhiri, S.; Rouached, M.

This paper proposed an event driven approach for the validation of the recovery mechanisms consistency, or after runtime to report execution deviations and repair designs errors. Therefore it ensures the service execution reliability. It also provides the logical foundation for the execution reliability.

J. Describing and Verifying Semantic Web Service Composition with MDA [10] proposed by Zhengdong Zhu, Ronggui Lan, Ruifang Ma Yanping Chen.

This paper proposed an approach to describe amd compose semantic web service with the Unified Modeling Language. A mechanism for verification is imported to ensure the correctness of semantic web service composition. Promela was used to verify the correctness of web service composition using automated verification tool called SPIN.

K. Validation of Web Service Compositions [11] proposed by L. Baresi, D. Bianculli, C. Ghezzi, S. Guinea, P. Spoletini.

In this paper a language called an assertion language for BPEL process interactions (ALBERT) is used. It is used to specify the functional and non functional properties. It also has the environment which supports the design time verification of ALBERT assertions for BPEL through model checking is also verified. Software monitoring is also used to verify the required properties.

L. Model-based Verification of Web Service Compositions [12] Howard Foster, Sebastian Uchitel, Jeff Magee, Jeff Kramer.

This paper proposed a model based approach for web service implementations .It supports the verification for the specification models and later assigns the semantics for the implementation models for the desired results.

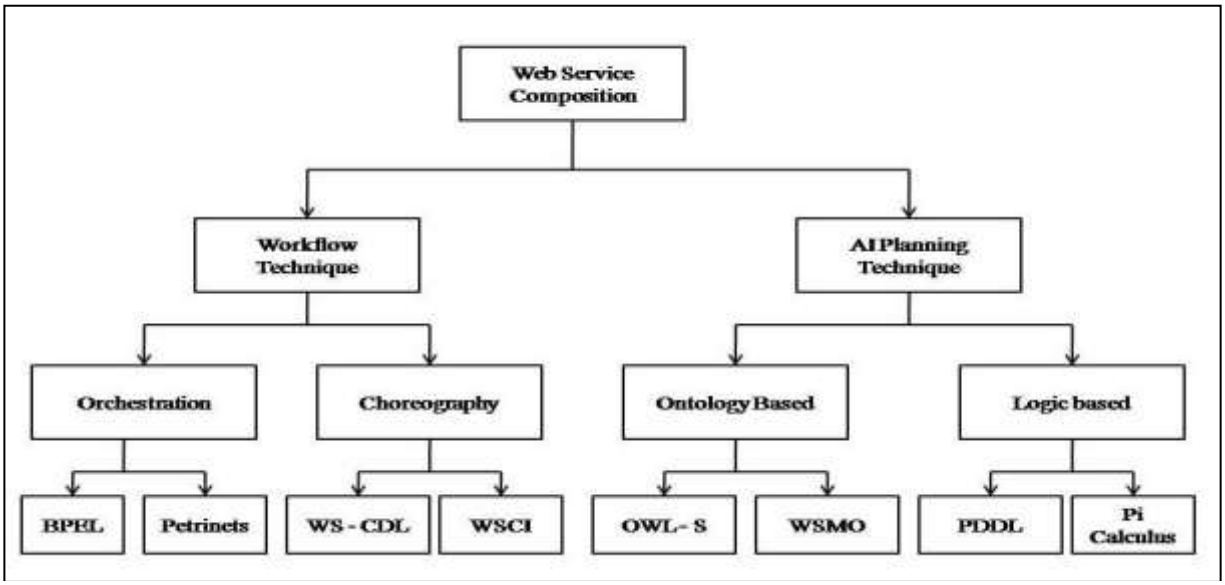

Fig 2: Flow of web service composition

The approach provides a way to improve the verification of BPEL4WS implementation. It is done by analysing and determining compensation action, the effect of fault tolerance reliability and availability.

M. *Simulation, verification and automated composition of web services [13] proposed by Narayanan S, McIlraith SA.*

This paper focused on automating the web service composition, simulation and verification. DAML + OIL is used to describe the web services and then the Petri Net is used for the simulation and verification of the composition. It makes the composition automatic.

N. *Clarke EM, Klieber W, Nováček M, Zuliani P. Model checking and the state explosion problem. InTools for Practical Software Verification 2011 Sep 4 (pp. 1-30). Springer Berlin Heidelberg.*

The paper addresses state explosion problem which is an issue in model checking. Model checking where it is an automatic verification method for verifying hardware and software which are at its final state. When state variable increases the state space too gets increased. An early research in model checking generates numerous techniques for this problem. Of all these techniques, Bounded Model Checking is found to provide better solution. The Bounded model checking finds counter in circuits.

III. DISCUSSION

This reviews on the verification methods on the composed web services surveys various techniques which are available to verify the composition. Yet there is a limited contribution in the verification of the web service composition. More number of tools that are available was unable to find the syntax errors which are impossible to eliminate the logical errors completely. And also problems such as Emptiness, deadlock, liveness, and safety are not fully solved by many of the above mentioned techniques.

Only few contributions by the researchers on implementation of the state space explosion problem [3] were executed. The figure (Fig.2) gives the flow of the web service composition. Web service composition is the process of combining and linking the existing web services which is

used to create new web processes to provide value to the new web service. The below table (table.1) depicts the comparative analysis of existing models which fails to state space explosion problem addressed.

And also many researchers have found solution for the deterministic system which consists of single input and single output. Few contributions are made on the Non deterministic system, which consists of single input and n number of outputs. The verification method for the web service maneuvering is available at design level. But the implementation level on the above mentioned problem is in lacks and is yet to be identified to provide optimal solution.

TABLE. 1. COMPARATIVE STUDY OF EXISTING MODELS FOR VERIFICATION

S No	Model Checking Used	Emptiness	Deadlock	Reachability	Correctness	Safety	State Space Explosion	Type of system	Language used	Tools used	Level of development
1	Timed automata	Yes	No	No	No	No	No	Deterministic system	WSCDL	WST and UPPAAL	Design level
2	Interface automata	Yes	No	No	No	No	At certain level	Deterministic system	BPEL Promela	SPIN	Implementation level
3	Orchestration computation via timed automata	Yes	No	No	No	No	No	Deterministic system	LTL	UPPAAL	Design level
4	Colored petrinet	No	No	Yes	Yes	No	No	Deterministic system	BPEL	CPN	Implementation level
5	Refinement checking	No	No	No	Yes	No	No	Deterministic System	BPEL	UPPAAL	Design level
6	Modified Muller automata	No	Yes	Yes	Yes	Yes	No	Deterministic & Non Deterministic	WSCDL	SPIN	Implementation level

IV. RESEARCH DIRECTIONS

The verification of the composed web services is not yet fully implemented by solving the problems such as Emptiness, Deadlock, Safety, and State Space Explosion. Even though there is available methods that are only for Deterministic systems.

Using the Turing machine in the verification of composed web services have the possibility of giving the solution to the above problems. Using automated turing machine, the verification process of the composition may also helps in the automation of the system.

In spite of choreography, orchestration makes the verification of the system more efficient and flexible, since alternative scenarios can be put in place in case of error occurs.

Use of Multi stack turing machine may leads to the efficient usage of the memory and the verification of the composition earlier. It can make the automation unambiguous.

There is a need of system which verifies the composed web services by meeting the above mentioned issues mainly focusing on the state space explosion for both deterministic and non deterministic system.

V. CONCLUSION

This paper surveys the techniques and tools that are available for the verification of the composed web services to meet the correctness of the desired system. This paper discusses various techniques and methods to solve the issues such as deadlock, safety, state space explosion, emptiness, correctness etc. Even though solutions are found for the above mentioned issues, an optimal solution has to be identified yet.

VI. REFERENCES

[1] M. E. Cambronero et al., "Validation and verification of web services choreographies by using timed automata", The Journal of Logic and Algebraic Programming, 80 (2011), Elsevier, 2011, pp.25-49

[2] G. Holzmarm, "The model checkers SPIN", IEEE Transactions on Software Engineering. vol.1, 1997, pp.279-95.

[3] H. Su. et al., " Interface automata based formal model for BPEL4WS Web services composition", Application Research of Compliers (in Chinese). vol. 26, 2009, pp. 1774-77.

[4] P. Xiong, et al. "A Petri Net Approach to Analysis and Composition of Web Services", IEEE Transactions on systems, man, and cybernetics—part a: Systems and Humans, vol. 40, no. 2, march 2010, pp.376-387.

[5] S. R. Ponnekanti and A. Fox, "Sword: A Developer Toolkit for Web Service Composition [EB/OL]", In Proceedings of the Eleventh World Wide Web Conference, 2002, pp.83-107.

[6] F. Casat, S. and I. Krishnamoorthy, "Adaptive and Dynamic Service Composition in eFlow[EB/OL]", Software Technology Laboratory HP Laboratories, 2000.

[7] J. Zhu et al. "Verifying Web Services Composition based on LTL and Colored Petri Net", IEEE, The 6th International Conference on Computer Science & Education (ICCSE 2011), SuperStar Virgo, Singapore, August 3-5, 2011, pp. 1127-1130.

[8] Zahra Madani, Naser Nematbakhsh "A Logical Formal Model for Verification of Web Service Choreography", Proceedings of 2009 12th International Conference on Computer and Information Technology (ICCIT 2009) 21-23 December, 2009, Dhaka, Bangladesh.

[9] Gaaloul, W.; Bhiri, S.; Rouached, M., Event-Based Design and Run-time Verification of Composite Service Transactional Behaviour, Services Computing, IEEE Transactions on , vol.3, no.1, pp.32 - 45, Jan.-March 2010.

[10] Describing and Verifying Semantic Web Service Composition with MDA Z. Zhu , , Xi"an ; R. Lan ; R. Ma ; Y. Chen, E-Business and Information System Security, 2009. EBISS '09.

[11] L. Baresi, D. Bianculli, C. Ghezzi, S. Guinea, P. Spoletini "Validation of Web Service Compositions" IET Softw., 1(6):219-232, December 2007.

[12] Foster H, Uchitel S, Magee J, Kramer J. Model-based verification of web service compositions. InAutomated Software Engineering, 2003. Proceedings. 18th IEEE International Conference on 2003 Oct 6 (pp. 152-161). IEEE.

[13] Narayanan S, McIlraith SA. Simulation, verification and automated composition of web services. In Proceedings of the 11th international conference on World Wide Web 2002 May 7 (pp. 77-88). ACM.

[14] Clarke EM, Klieber W, Nováček M, Zuliani P. Model checking and the state explosion problem. InTools for Practical Software Verification 2011 Sep 4 (pp. 1-30). Springer Berlin Heidelberg.