

A CLOUD SERVICE BASED MODELING & SIMULATION FRAMEWORK

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ABSTRACT

Modeling & simulation takes a crucial role in the development process of practical industry and cloud based service is becoming more and more widespread popularity. So it is essential to research the combination between them. In this paper, we give a conceptual outlook on behalf of cloud service based modeling & simulation framework and state a business model ensuring the execution of cloud service based modeling and simulation. At the same time, two factors aroused from this new framework, namely security and cost, are highlighted in our work.

Keywords: cloud service; modeling and simulation; business model; security; cost

1. INTRODUCTION

In the field of modeling and simulation, the problem of fusing module, model, application to form System of Systems(SoS) has been addressed for the last two decades. Up to now, a large number of simulation systems have realized interoperability and communication based on high level architecture (HLA) since it was proposed by United States Department of Defense (DoD) in 1990s. However, it is coarse-grained because HLA regards federation as the basic integration unit, and lacks the ability of combination among components and models when develop and run the simulation system.

This issue has been resolved to some extent in Discrete Event Simulation Specification (DEVS) proposed by Zeigler(Zeigler 2013). DEVS provides a modular, hierarchical systems modeling and simulation execution framework, in which each subsystem is regarded as a model with independent internal structure, behavior and explicit input and output interface. Various models can be composed into a coupled model, which can also be used as an element model for other couplings. In this way the hierarchical and modular description of model is formed.

However, large-scale distributed simulation systems are faced with problems of low model reusability, short of networked component specifications and lack of low-cost integration platforms etc.

Meanwhile, expanding simulation scale and system structure require simulation system to be realized in a more easy-to-use and cheaper platform. Actually, with

the rapid development of advanced mode like cloud computing and its related technologies (such as cloud build platform of open source), most enterprises and scientific research institution are building their own private cloud platform or renting public cloud platform (such as amazon's EC2) and use IaaS (Infrastructure as a Service), PaaS (Platform as a service), SaaS (Software as a service) provided by cloud platform (Cayirci 2013a; Cayirci 2013b; Hwang, Fox and Dongarra 2011; Laborde, Barrere and Benzekri 2013; Rosetti and Chen 2012). Based on this, Cayirci(Cayirci 2013) proposed the concept of modeling and simulation as a service(MSaaS) and noted that the simulation services based on cloud computing framework can also have the advantages in the aspects of allocating resource on-demand, high-speed Internet, fast response featured by cloud. But the thorough process of cloud based modeling and simulation was not elaborated and the problems aroused from cloud service were not put into consideration.

The reminder of this paper is organized as follows. Section 2 presents the cloud service based modeling & simulation framework and the business model of using it, the security issues are discussed in Section 3. Section 4 highlights the cost concerns. A case is presented in Section 5 whereas the conclusion is summarized in Section 6.

2. CLOUD SERVICE BASED MODELING & SIMULATION FRAMEWORK AND ITS BUSINESS MODEL

Cloud based service has become a popular and universal paradigm for service oriented computing where computing infrastructure and solutions are delivered as a service(Foster, Zhao, Raicu and Lu 2008). In order to allow the efficient sharing of modeling and simulation resources, it is essentially to encapsulate modeling and simulation resources into cloud services. When the task of modeling and simulation is encapsulated into Cloud based service, the advantages of cloud computing such as on-demand use, pay-per-use, broad network access, scalability can be reflected in cloud service based modeling and simulation.

In order to attain a better understanding and a common conceptualization, we have developed a cloud service based modeling & simulation framework as shown in figure 1, which learned from literature(Tsai, Fan and

Chen 2006). In this framework, all processes are encapsulated into service.

First, users should transfer their tasks into model and scenario by using modeling service which can provides unified model and specification language; then model checking service checks if the model can meet the requirements of completeness and consistency; finally, code generation service can generates code for simulation according to the right model. In most instances, users' requirements cannot be satisfied by only one model, so it is necessary to combine several models into a complex function. In this condition, simulation engines or bus is needed to provide communication between different models.

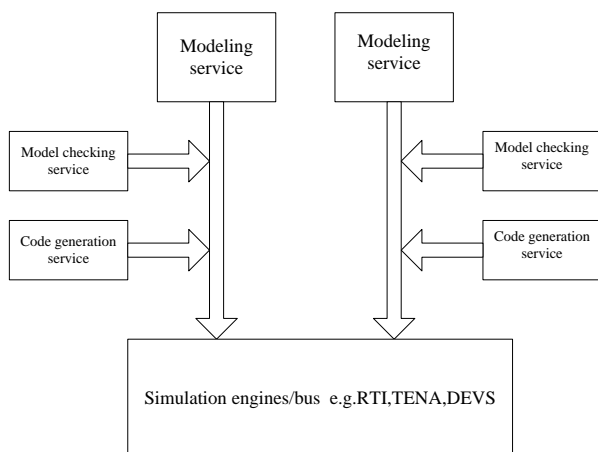


Figure 1: Cloud Service Based Modeling & Simulation Framework

All the aforementioned components can be registered into cloud-based resources pool since they are already encapsulated into services, in which model can be leased and released by modeling users. Customers can use modeling resources provided by cloud pool and pay according to use. On the other hand, the resources of cloud pool can be re-used as soon as they are released by other users, which can improve the utilization of model resources. Meanwhile, for a particular user, they do not have to possess extraordinary expertise pertaining to cloud technologies and domain knowledge about modeling and simulation, so it lowers the threshold of modeling and simulation.

After the process components of modeling & simulation are already encapsulated into cloud based services, there are two forms using the services in cloud pool, which we call it business models, namely download services and running services. Download services refer to the services that can be downloaded into local station and users can run their function locally. The other way is that users run their function in sever side without downloading services, which is called running services. Different model can induce different issues.

3. SECURITY ISSUES IN CLOUD SERVICE BASED MODELING & SIMULATION

Despite the tremendous advantages of Cloud based service, the obstacles and risks, such as user privacy,

authentication, data security, interfacing with internal systems, system availability, business continuity, and ownership of content and other legal requirements (Raval 2010), should not be neglected. In this chapter, security is the most concerned areas since it is the most important factor that users care.

Security is one of the top concerns and is also one of the most important barriers to widespread use for cloud service based modeling & simulation. Some research efforts have been injected to counter this issue.

Cloud security not only encompasses the common computing security, which includes the design of security architectures, minimization of attack surfaces, protection from malware, and enforcement of access control, but also entails some special aspects, such as the cloud is typically a shared resource and easy to be attacked; Cloud-based data is usually intentionally widely accessible by potentially insecure protocols and APIs across public networks; Data in the cloud is vulnerable to being lost, etc.(Ryan 2013). So if cloud service based modeling & simulation realizes to be widely used, the problem of security must be resolved.

In (Sun, Chang and Sun 2011), the author summaries security issues in cloud computing environments from six sub-categories, which include: (a) how to provide safety mechanisms, (b)how to keep data confidentiality for all the individual and sensitive information, (c) how to avoid malicious insiders illegal operation under the general lack of transparency into provider process and procedure environments, (d) how to avoid service hijacking, where phishing, fraud and exploitation are well known issues in IT, (e) how to management multi-instance in multi-tenancy virtual environments,(f) how to develop appropriate law and implement legal jurisdiction. Since cloud based modeling & simulation service is a kind of cloud computing services, so the security issues of cloud computing are also considered in cloud based modeling & simulation service, especially when users choose to realize their function on the cloud server side. In (Subashini and Kavitha 2011), the author points out that the best security solution is to develop a development framework that has tough security architecture. As described in this paper, though there are many advantages in using a cloud-based service, there are still many practical and potential issues that have to be solved. In(Zissis, and Lekkas 2012), the author proposes using a trusted third party within a cloud environment by enabling trust and using cryptography to ensure the confidentiality, integrity and authenticity of data and communications, while attempting to address specific security vulnerabilities. In order to handle the security in cloud service based modeling & simulation, the common or similar methods should be employed since cloud service based modeling & simulation is an extension of cloud computing, but some specific features should be emphasized as there are different parts between them.

4. COST ISSUES IN CLOUD SERVICE BASED MODELING & SIMULATION

The increase of simulation scale and the refinement of granularity require a larger scale computing resource. Cloud computing system has reduced the cost. However, cost calculation model has not been unified in cloud platform service and existing large-scale simulation framework less concerns cost factor. The cost elements include: electricity, hardware, software, human resources, business prospects, cloud services quality, and deployment, etc. (Altmann and Kashef 2014)

Altmann and Kashef (Altmann and Kashef 2014) propose a comprehensive cost model deploying simulation service for cloud platform. The total cost function is divided into four subfunctions: data transfer cost function, service deployment cost function, fixed cost function and change cost function. Data transfer cost is mainly computing in/out cloud data and transfer data; fixed cost is the fees of purchasing hardware, software and network facility; the changing cost is mainly the use-cost of resource including electricity cost, labor maintenance costs and the cost of network connections. And the cost model, when applying federated hybrid clouds, was discussed in (Altmann and Kashef 2014).

For the system of cloud service based modeling and simulation, when the components in it are encapsulated into service and are putted into cloud pool, the migrate cost, as one factor of cost model, should be considered. The costs of server usage, data transfer and storage usage should also be concerned. In addition to these factors, the cloud service can be used in two forms as mentioned above: download services and run service, so different cost and business model should be shown which is appropriate for different business model.

5. USE CASE

In order to realize service based modeling & simulation framework proposed in section 2, we developed a Complex system Modeling and Simulation Language (CMSL) (Song, Chai and Zhang 2010, Song, Zhang, He, and Ren 2012) based modeling service and a CMSL compiler service which act as code generation service. The detailed process can be shown in the following figure.

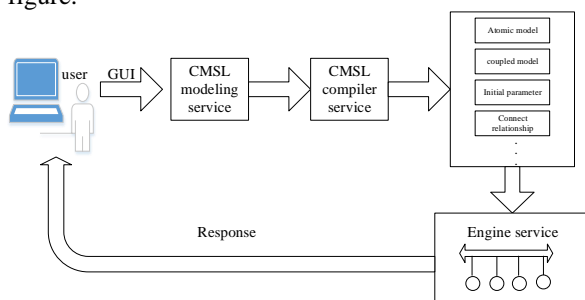


Figure 2: Use Case About Service Based Modeling & Simulation Framework

First, users submit their model or scenario in the form of CMSL by GUI. Second, service compiler transfers CMSL-based model into several component services coded by executable language, namely C++. These components and models can be atomic model, coupled model, initial parameters, connect relationship, etc. Finally, engines service can be combine these model components into a simulation federation that can fulfill user's demand, and the simulation result is returned back to users. The aforementioned services are all encapsulated in a cloud service pool. When a certain service is used, it can be invoked from cloud service pool.

6. CONCLUSION

In this paper, we summaries the framework of modeling and simulation and encapsulate them into cloud based services as well as point to two business models. Despite cloud service based modeling and simulation has offered several advantages, the security concerns and cost issues fostered by it should not be neglected in that they hamper the widespread popularity of cloud based service. Some more efficient counter measures should be carried out by cloud organization and users.

7. ACKNOWLEDGEMENT

The research in this paper was supported by grants 61374199 and 61473013 from the Natural Science Foundation of China and grant 4142031 from Beijing Natural Science Foundation, and grant 2013AA041302 from the National High-tech R&D Program. The authors thank the reviewers for their comments.

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