Comprehensive Cloud Management via an Open Marketplace

Haydn Mearns, John Leaney, Artem Parakhine, John Debenham and Dominique Verchere
Centre for Quantum Computation and Intelligent Systems, University of Technology Sydney and Alcatel-Lucent

Introduction

The relatively recent introduction of Cloud Computing has opened up a wealth of possibilities in terms of data management, application processing and scalability. Amazon's EC2 public clouds allow service providers to rapidly increase and decrease the availability of their service, with relatively low overhead. The obvious advantages of this technology has seen the Cloud Computing environment rapidly expand, with already established public clouds such as Amazon offering increased services, space and availability, and telecommunication companies starting to leverage their infrastructure to provide hybrid cloud models. It is not hard to imagine that it is just a short step to the existence of an environment where the number of cloud environments allows real competition in the market place.

Service Management in Inter-Clouds

The *reservoir* federated cloud [1] is an architecture for the combination of various cloud providers through their Service Manifest SLA's and service management agents into one federated cloud, in order to manage the service across the providers. While this system could manage the failure of providers in the federation, the management would come at a cost, as the federated cloud requires that its service manager agents run continuously across the infrastructure providers, even when not being utilised. The *cloudbus* project [2] also proposes an architecture for the interaction with multiple cloud providers, through a market orientated cloud exchange, that would allow services to be negotiated through SLA's to increase the scalability and performance of provisioned services. However, this version of the federation of cloud providers does not consider the necessity of guaranteeing the service connection between the cloud providers and coordinating the bandwidth interaction.

Agents and Cloud Computing and Telecommunications

The inherent distribution of a telecommunications network and the multiple services that they provide, corresponds well with a multi-agent systems' ability to cooperate towards multiple goals . All of the previously mentioned systems for service management in the inter-cloud, such as the *reservoir* project, *cloudbus*, and SORMA [3] utilise agents implicitly with individual Service Manager agents interacting co-operatively towards a Service Manifest in the case of reservoir, Cloud brokers interacting with the cloud co-ordinator in the case of *cloudbus*, and bidders and sellers in the case of SORMA.

Auctions and Negotiation For Cloud Services

There have been various approaches to creating an open-market for clouds and grids, such as SORMA, *cloudbus*, and *GridWay* with the current proposals are utilising various combinatorial auction strategies such as Continuous Double Auction, Zero-intelligence plus and Q-Strategy. There is currently however, no consensus on the most appropriate strategy for the market, and the pricing strategy is only one part of issues surrounding the implementation of a global open market. Further issues include a common structure for the negotiated SLA's language. Previous work in our research group has built an ontology for SLA negotiation [5], which covers the information required for the low level provisioning of complex services by agents.

System Design and Architecture

Figure 1 shows the overall architecture for bundled services in an open marketplace.

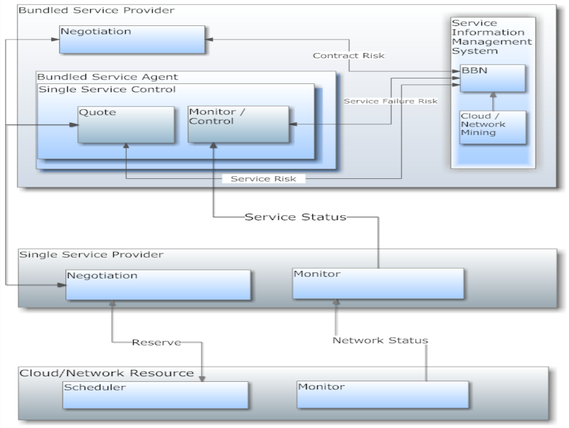

Figure 1

Bundled Service Providers: (BSP) are responsible for negotiating the use of the single service providers
Bundled Service Agent: (BSA) monitor and manage the failure of single services in the bundle.
Service Information Management System: (SIMS) is used for judging risk, and long term monitoring of performance.
Single Service Agent : (SSA) is responsible for provisioning and scheduling the resource across the Service Resource.
Single Service Resource: (SSR) All resources are modelled as abstract resources, divided into four components of differing QoS. Greater utilisation of the Cloud/Network resource results in poorer overall performance affecting lower quality services first.

Agent Interaction – new Contract

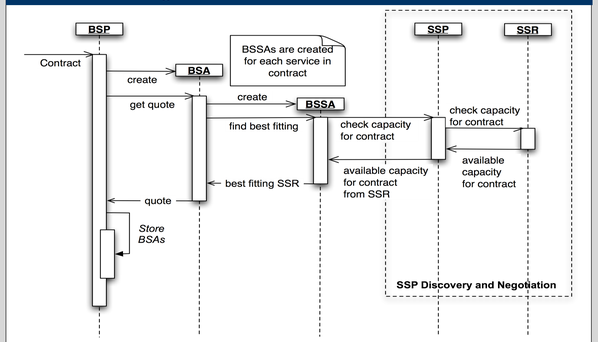

Figure 2

Figure 2 shows the bundled service provider sequence diagram for acceptance of a new contract. The bundled service provider creates a bundled service agent to manage the bundled service. The bundled service agent then assigns single service modules to each service. These single service modules then negotiate on the market with the single service providers to obtain a quote for the service. The BSA's buying strategy is determined by the customers expectation, the services historical performance, the services future requests availability (both provided by the SIMS) and the services reliability and cost.

Agent Interaction – Failure

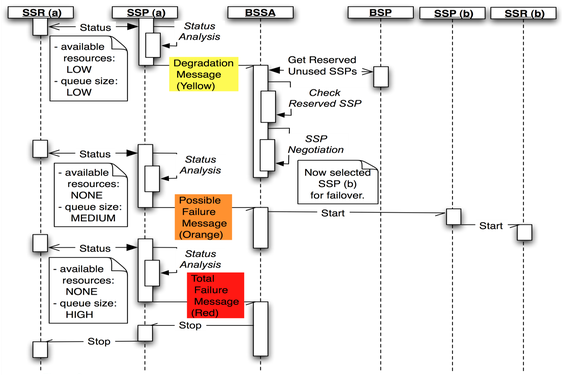

Figure 3

Figure 3 is a sequence diagram of failure. In order to manage failure from the bundled services point of view, the BSA utilizes both renegotiation of, and, the lowering of quality requirements for the service. Renegotiation swaps providers upon the receipt of performance information from the single service providers. For the required quality level of the service to be maintained, the BSA again utilises the SIMS to determine the probable risk of engaging a particular single service provider for service recovery. Then the BSA negotiates a new contract with the chosen SSA for the remaining time period.

Simulation

We have used simulation to explore the complexity of dealing with interacting agents and resources, and to evaluate the required performance criteria of resilience and scalability. To test the performance of the architecture the model was run through a series of simulations. The results of the simulation was then examined to see whether:

- The bundled service providers and agents, effectively utilise the network resources assigned to them and are relatively scalable.
- And that the Bundled service providers are cost effective, in that they maintain their cost margin across multiple resources.

Effective Utilisation

Figure 4 simulation was run continuously with multiple bundled service providers, against a five network resources with a high generation of simultaneous contracts.
The purpose of this simulation is to test evaluate the bottlenecks on dynamic service provisioning.

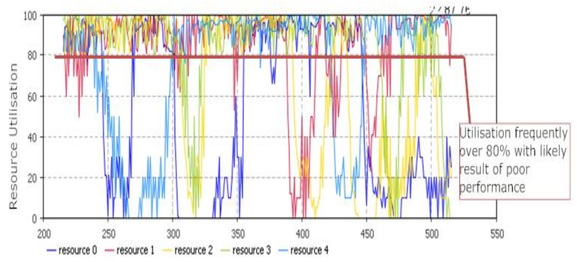

Figure 4

Cost Effectiveness

Figure 5 describes a simulation with five agents accepting contracts over a simulated period of 20 hours, setting quotations for the contracts and calculating the cost to the BSP. The BSP's quotes have a standard 10% addition to cover the cost of reprovisioning if necessary.

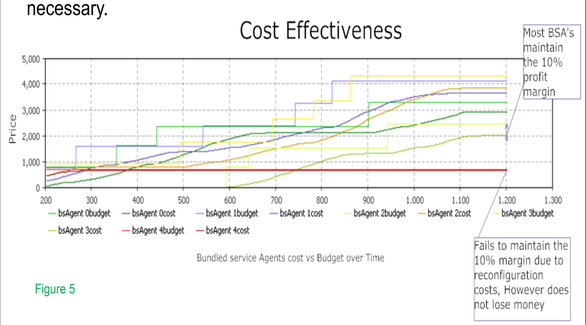

Figure 5

Conclusion

Our overall aim is for the management to accept responsibility for the complex service in an open marketplace. Responsibility is, firstly, defined by aiming to cover the totality of modern complex services, managing both the connectivity and virtual infrastructure. Secondly, responsibility is defined as managing risk and resilience in the provisioning and operation of the complex service.

In accepting the responsibility for the service, and providing a guarantee that the services contracted will be delivered and managed from end to end, the bundled service provider adds resilience (for the user) to the services which has been missing from current contracted services. Further, the use of an open market place for the negotiation of these services allows a degree of flexibility in service choice which is lacking in today's industry.

References

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Contact information

Centre For Quantum Computing and Information Systems
Faculty of Engineering and Information Technology
University Of Technology, Sydney

235 Jones Street, Broadway
(PO Box 123, Broadway)
NSW Australia 2007

+61 29514 2353
Haydn .Mearns@uts.edu.au