Towards an Utility Computing and Communications Infrastructure

Peter Komisarczuk, Kris Bubendorfer

Peter.komisarczuk@vuw.ac.nz, Kris.Bubendofer@vuw.ac.nz

School of Mathematics, Statistics and Computer Science, Victoria University of Wellington,
PO Box 600, Wellington, New Zealand

***Abstract*—The future of the Internet may be the conjunction of Grid computing and service overlays hosted over Next Generation Internet (NGI) technologies, consisting of both wireline and wireless networks. This Work In Progress submission discusses aspects of our initial work in this area.**

***Index terms*—business models, resource description, NGI, GRID/utility computing**

A. INTRODUCTION

The Grid and overlay networks can be seen as a key service layer of the future where the combination of computing and communication resources is dynamically allocated to virtual organizations on demand to enable optimal service and business deployment. The network overlay abstraction provides a flexible, extensible, application level paradigm to easily and incrementally deploy services despite heterogeneous underlying network technology. If we combine overlay networks with utility computing/Grid infrastructure plus advanced networking using NGI technology we could enable experiment in the provision of an infrastructure for networked services.

It has been postulated that utility computing service providers [1][2] could be the basis for cost effective, easily extensible solutions for enterprises and service providers in general, including network service providers. Today "On demand Computing" is typically bounded in terms of type and number of resources under control and is usually limited to the data centre. Typical solutions provide aspects of:

- Resource Management
- Load Balancing
- Asset Assignment
- Pay for additional resources – metered resources on demand

Currently the resources managed are processor blades, virtual machines or storage that are assigned on demand and charged on some metered basis [3]. The Enterprise viewpoint is that of investment proofing their IT infrastructure, whilst the service provider viewpoint is obtaining maximum revenue for their deployed assets through efficient use of the provisioned IT infrastructure – by maximizing resource sharing/contention.

Extending utility computing concepts to include the resource allocation of underlying communications infrastructure as well as disparate computing resources could enable ubiquitous overlay service provisioning, where utility computing communications providers [UC^2P], lease resources to Virtual Organisations [VO] that are created to provide services to users or the network. Rather than thinking of the VO in the pure grid context [4], we want to view the VO in a larger business context, where it is "*applicable in social as well as in information systems*" [5]. A unified field theory equivalent for the description of VO's in all its myriad of combinations and facets: computer, communications, operations, data/value and workflows, management, business relationships, right through to human personalities is being to be explored

The VO or service overlay needs to dynamically and expressively construct descriptions of network, computing and ad hoc resources, then locate and reserve these in a timely and ordered manner to provide the services required by the network users. Such an infrastructure could for example enable:

- An Enterprise infrastructure to expand or shrink dynamically as required
- Provide pervasive computer and network services allow you to orchestrate your services and connectivity
- You could always get the best price for the services you want when you want them

To enable this we could enhance the Grid and utility computing business models, specifically extending the communications models in the first instance. Some work towards this has been undertaken in some of our previous work in the development of virtual organizations [6].

B. BUSINESS MODEL DIVERSITY REQUIREMENTS

There could be many business models that might be enabled in the future, two examples of which are highlighted here. The first is the TINA business model, which represents the height of the standard telecommunications industry model [7]. A TINA broker acts as a means for locating services and service providers, a Retailer sells services to Consumers by interacting with 3rd party service providers, e.g. content providers, and providing QoS enabled connectivity through communications providers. Extension of the TINA Business Model to the UC^2P model is envisaged to encompass computing resources, as shown in Figure 1.

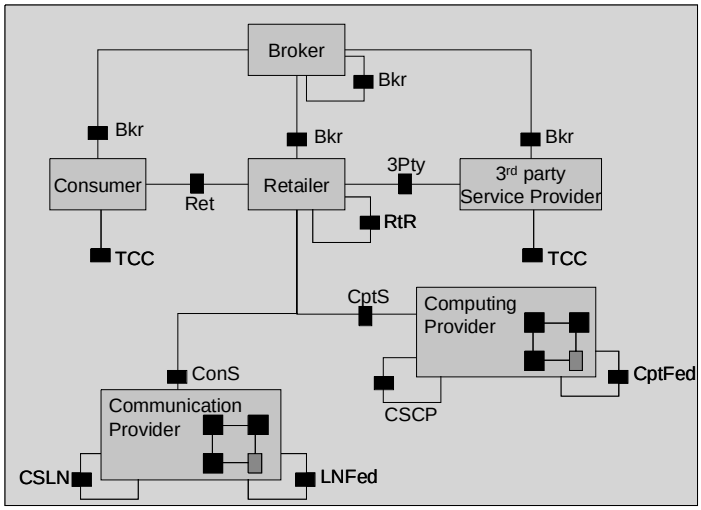

Figure 1 TINA Business Model Extension

An alternative business model to be considered is the model from Ambient Networks [8] which is a "beyond 3G" network scenario from the Wireless World Initiative. The model is of extreme flexibility and dynamic interconnectivity. In the Ambient network the individual can act as a service provider and as a consumer. The Ambient network enables ad hoc mesh networking potentially creating horizontally structured mobile systems. Relationships can be ad hoc network (e.g. on a train) through to long term; e.g. with your home environment, your workplace (VPN etc.), through to the wireless communication service providers.

Through ad hoc capabilities Ambient Network entities negotiate connectivity and access to services through the ANI and ASI interfaces on the fly to dynamically compose networks. What we need to be able to capture is:

- How do we describe what's going on?
- How do we describe who we communicate with?
- What resources do we want?
- When do we want the resources?
- What service level agreement is required?
- What is the service going to cost us and what's the best price I can get that service for?

There are many other properties of frameworks that need to be provided to effectively enable these visions of a flexible UC^{2}P based service overlays, including:

- Flexibility – from large complex virtual organizations though to single user services
- Scalability – large numbers of users, VO's, network elements, networks and networks of networks, and applications/services
- Deployment/Lifecycle Management – cross domain with commercial constraints
- Resiliency – both service and network related resiliency such as overcoming network failures to providing service platform failover.
- Security – integrated from the network layer to the service layer
- FCAPS (Fault Configuration Accounting, performance and Security) management – Intra- and Inter-domain management
- Flexible business model support – as future business models may not be the same as today's telecommunication /Internet models
- To these can be added Grid and overlay specific framework aspects, such as:
  - Co-ordination of resource allocation from services to network
  - Overlay and grid computing support

Quality of service (QoS) is a key component of the UC^{2}P based service overlays, which encapsulates a wide variety of non functional properties such as reliability, performance, security, and timing, which are also aspects of our current work.

C. FURTHER WORK

This paper has provided a brief overviewed potential business and service architecture in future NGI deployments, consisting of Utility and Grid computing resources and overlay networks. The creation of value added services through to the combination of computing resources and QoS network resources can enable virtual organizations, potentially scaling from an individuals requirements through to large organizations. Our work in this area aims to analyse and develop the framework for an extended model in the context of Grid computing and overlay networks. The work aims to extend resource descriptions, economic models for resource allocation, middleware services, development of virtual organisations and business models.

D. REFERENCES

[1] T. Dimitrakos, et al. "An Emerging Architecture Enabling Grid Based Application Service Provision", 7th IEEE International Enterprise Distributed Object Computing Conference EDOC 2003, Brisbane Australia, September 16-19, 2003.

[2] Grid-based Application Service Provision (GRASP) http://eu-grasp.net/english/ last access 24 July 2004

[3] M. Kallahalla, M. Uysal, R. Swaminathan, D. E. Lowell, M. Wray, T. Christian, N. Edwards, C. I. Dalton and F. Gittler, SoftUDC: A Software-Based Data Centre for Utility Computing, IEEE Computer, November 2004, Volume 37, Number 11, pp38-46.

[4] I. Foster, C. Kesselman, S. Tuecke, "The Anatomy of the Grid: Enabling Scalable Virtual Organizations", International Journal of Supercomputer Applications, volume 15(3), 2001.

[5] Abbe Mowshowitz, Virtual Organization, Communications of the ACM, September 1997, Vol. 40 No. 9.

[6] P. Komisarczuk, K. Bubendorfer, K. Chard, Enabling Virtual Organisations in Mobile Worlds, IEE 3G2004 conference, 18-20 October 2004, London, UK.

[7] Hendrik Berndt, Takeo Hamada, and Peter Graubmann, TINA: Its Achievements and its Future Directions, IEEE Communications Surveys and Tutorials, First Quarter 2000, Vol. 3, No. 1

[8] Norbert Niebert, Hannu Flinck, Robert Hancock, Holger Karl, Christian Prehofer, Ambient Networks - Research for Communication Networks Beyond 3G, 13th IST Mobile and Wireless Communications Summit 2004, Lyon, France, 27-30 June 2004.