Global Computing Centre of Excellence

– a new research centre for Grid, Peer-to-Peer, and Service Oriented Architectures –

This document introduces *Global Computing Centre of Excellence* – a new joint industry/academia research centre for service-oriented computing. The centre is located in Stockholm, Sweden, and constituted by some of the world's leading researchers in the fields of Grid computing, Service-oriented computing, and Peer-to-Peer computing, based at Royal Institute of Technology (KTH), Swedish Institute of Computer Science (SICS), and Swedish Defence Research Agency (FOI).

Initially, the participating research groups will cooperate on defining a joint research vision, establishing industry partnerships, and pursuing funding opportunities. The clear ambition of the research partners is to initiate a number of exciting projects, in close cooperation with industry.

In addition to research projects, potential forms of collaboration with industry include mentoring of industry PhD students, master's thesis projects, seminars, and courses. In other words, industry partners will be able to utilize the centre as a resource in strategic research projects, as well as for training and development of personnel.

Global Computing

In the coming years, provisioning of computing, communication, and information resources as electronic services will grow significantly. New technology will enable individuals, organisations, and applications to create, discover, provide, combine, access, personalise, support, and use all kinds of resources as services. This vision of service-oriented computing is also embraced in the fields of Grid computing and Peer-to-Peer computing. Until now, each research community has focused on different aspects, but we argue that these research fields have complementary strengths and will develop in a common direction.

We envision a Global Computing environment, which extends well beyond today's Grid, Peer-to-Peer systems, and Service oriented Architectures, and eventually will eliminate the distinctions between them. This environment will combine elements of resource management and coordination from Grid, inter-operability from Service Oriented Architectures, and self-management and scalability aspects from Peer-to-Peer overlay networks. The new environment will enable the creation of services that are scalable, fault-tolerant, and self-organising, and that can be accessed securely with different levels of quality-of-service through a consistent set of interfaces and protocols.

Global Computing will enable companies to integrate systems and information both internally and externally. It will help companies to cut cost through more efficient resource usage and it will open up new business opportunities, for users as well as providers of information and communication technology.

Founding research groups

The proposed new centre of excellence gathers some of the world's leading academic researchers in the fields of Grid, P2P, and Service Oriented Architectures. The core research groups are:

KTH / SEDIC (Royal Institute of Technology / Software Engineering and Distributed Computing). The SEDIC group at KTH consists of three groups headed by Professors Seif Haridi, Mihhail Matskin, and Rassul Ayani. Seif Haridi´s group has developed a self-organising overlay network architecture and associated middleware, and devised various

innovative techniques for self-repairing large-scale distributed systems. Mihhail Matskin and his group have extensive experience and results in Web Service composition, mobile services, and technology to support formation of virtual enterprises. Rassul Ayani's group has many years of experience in simulation and modelling of distributed systems, and has developed a framework for collaborative distributed simulation applications. The framework makes extensive use of P2P and grid techniques for decentralised resource management.

KTH / PDC (Royal Institute of Technology / Centre of Parallel Computers). The PDC group at KTH operates one of six nodes in the Swedish national computational grid – SweGrid. The group is headed by Professor Lennart Johnsson and is a pioneer in the area of Grid Computing. PDC is one of two European founding member institutions of Globus Alliance, which is the organisation that developed the de facto standard Grid middleware Globus Toolkit. Lennart Johnsson and Olle Mulmo from PDC act as founding board members of Globus Alliance and are also co-founders of the European Grid Support Centre. Furthermore, Mulmo is the Director for the security area within the Global Grid Forum (GGF).

KTH / XpaX (Royal Institute of Technology / Complex Proactive Extreme). The XpaX research group at KTH, Kista, is led by Professor Magnus Boman. The group has extensive experience of agent modelling and programming. In particular, agent systems development from an active end-user perspective is emphasized. Social networks of users, companies, governance representatives and more are represented in the spatially explicit agent models built. More than nine million artificial agents lead their lives in the largest of these computationally efficient executable models, developed for epidemiological applications.

SICS / Userware. (Swedish Institute of Computer Science / Userware Laboratory). The Userware group at SICS is led by Professor Magnus Boman. Computer science areas covered include machine learning, text analysis, service development, and autonomous processes. The lab strives to produce fully-functioning software for real-time recommendations, mobile information access, and novel forms of information retrieval.

SICS / DSL (Swedish Institute of Computer Science / Distributed Systems Laboratory). The DSL group at SICS is headed by Professor Seif Haridi and Dr. Per Brand. The group has a long experience in the distributed systems area, and were deeply involved in the development of the Mozart and Erlang programming systems. More recently, the group has developed a language independent middleware for networked programming and a structured Peer-to-Peer system currently being used in research projects with Swedish Defence.

SICS / SPOT (Swedish Institute of Computer Science / Security POlicy and Trust). The SPOT group at SICS is headed by Dr. Babak Sadighi. The group has developed technology for secure and decentralised management of authorizations in highly distributed systems, and is currently working with Swedish Defence to define the security model for Network Based Defence.

FOI / DSM (Swedish Defence Research Agency / Department of Systems Modelling). The DSM group at FOI is headed by Farshad Moradi. On behalf of Swedish Defence, the group has been investigating the impact of network technologies and distributed computing techniques on modelling and simulation. The focus has been on component-based model development, distributed resource management, collaborative model development and execution, and distributed execution of simulation models using Grid computing, Web Services and P2P technology.

Research agenda

The primary focus of the centre will be to develop methods, technologies, tools and applications for a Global Computing environment in close cooperation with industry. A preliminary research agenda has been developed, comprising:

Service model. Specification of the syntax and semantics of service interfaces, common predefined interfaces for service functionality, semantic web services, ontology for service interoperability, etc.

Service composition. Efficient selection and integration of inter-organisational and heterogeneous services both at design and at runtime. Service specification languages, service validation, software architecture for service selection and composition, etc.

Social Service Sharing. The drivers for socially sharing services in the global computing environment require study. These include end-to-end recommendations and user-driven extensions of the service model.

Scalability. Currently, Grid systems are based on the traditional client-server paradigm, which is known not to scale. The goal of this research is to design, prototype, verify, and evaluate scalable peer-to-peer overlay networking-based approaches for key system components, such as resource discovery engines, service selection mechanisms, schedulers, storage services, and security mechanisms.

Self-management. Existing P2P systems demonstrate that some basic services can self-manage without any external intervention to events such as node joins, node leaves, node failures, and load imbalance. Today's Grids and the WWW have no such mechanisms for self-organisation. We will develop methods and technologies to support higher level services with overlays that self-organise.

Dependability. One of the main challenges for the Global Computing environment is to tolerate failures and recover from them in a transparent way. Particular topics include fault-detection, check-pointing and recovery, software management, and scheduling for fault-tolerant execution.

Service Level Agreements (SLAs) and Quality of Service (QoS). Today's Grid and Web services provide best-effort services. We need languages for specifying SLAs, system monitoring services, and violation detection services.

Security and Trust. End-to-end interaction and sharing of resources between multiple domains requires secure mechanisms for establishing trust relationships, authentication and authorization, delegation of authorizations, etc.

Software Engineering. The consortium partners have extensive experience in developing software and one of the main activities of the centre will be to use state-of-the-art technology, tools, and techniques to produce architectures and to implement high-quality software, applications as well as middleware, which provide the abovementioned services. We will also consider expressive and concurrent programming models that are well-integrated with the service-model in the design and implementation of services.

More information

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