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1. IMPLEMENTATION OF PERVASIVE SEMANTIC GRID COMPUTING IN HOSPITAL SCENARIO

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Abstract:

Pervasive computing is the means by which the digital world of the Grid couples into our physical world. Both Grid and Pervasive computing are about large numbers of distributed processing elements. Grid computing and pervasive computing are two visions of the future that really do seem to be upon us, and so surely they must be investigated together rather than in isolation. Both complement each other. Pervasive computing benefits Grid computing in collaborative environments. Grid computing helps Pervasive computing in processing higher volumes of data. Semantic Grid may be defined as an extension of the current Grid in which information and services are given well defined meaning, which enables people and computers to work in co-operation. In this paper, we have proposed a scenario which combines the grid and pervasive computing in semantic manner. This combination would lead to an "ambient intelligence", which is the manifestation of semantic grid in physical world.

Keywords - Pervasive, Semantic, Grid, SOA, OGSA, WSRF

I. INTRODUCTION

The underlying premise of pervasive computing is compelling: simplicity of use, and the spending of time by the user for completing the task, not learning the application and how to configure and troubleshoot it. The user experience is the message that the brands of pervasive computing devices will promote. The "authorized access to anytime-anywhere-any network-any device-any data", the 6As model of pervasive computing propounds a new paradigm in convergence and networking. Besides making a user's life more easy and convenient, the global nature of these applications, their 7*24 ubiquitous access on a Palm/PDA or on a PC or cell phone of email, Internet and other data make them an imperative requirement that will enhance revenues, develop customer service and decrease costs in any application.

II. ARCHITECTURE OF PERVASIVE SEMANTIC GRID

Through combining grid and pervasive and semantic we see a comprehensive infrastructure for the vision of 'ambient intelligence'. It is the implementation of the Semantic Grid in the physical world. Remote communication, Fault tolerance, High availability Remote information access, Distributed security are some areas focused by distributed systems and Mobile networking, Mobile information access, Adaptive applications(proxies, trans-coding, agility), Energy-aware systems(goal-directed adaptation, disk spin-down), Location sensitivity(GPS, Waveland triangulation, context-awareness) are some areas focused by mobile computing. Later all these issues and Smart spaces Invisibility, Localized scalability, Uneven conditioning were focused by pervasive computing.

III. EMERGING PERVASIVE TECHNOLOGIES

A. Peer-to-Peer (P2P) networking

The basic idea behind it being the sharing of files and programs and communicating directly with people over the Internet, without having to rely on a centralized server. It creates private workspaces for sharing files, exchanging information, creating databases and communication at the instant. Nowadays, Companies can participate in B2B marketplaces, cut out intermediaries and instead have a direct contact with suppliers. Peers which are on desktop PCs can share files directly over a network. Renting computing power can solve resource problems which occur in smaller companies, which in turn improves the power of web applications.

B. Nano technology

Molecule sized computers can be manufactured to create new materials that can replace steel in all its properties and even withstand temperatures of 6,500 degree Fahrenheit. It is predicted that these materials will soon be used to build automobiles and office buildings. 'A la' - an invisible infrastructure!

A. Chips and the Net

Net-ready chips are a low cost method of getting on to the Internet. They follow all the necessary Internet Protocols and can be embedded in home appliances that can then be easily connected to the Internet. They function as tags that possess comprehensive information about the object that it is tagged on to and include details like the date and place it was manufactured.

B. Wireless technology

Wireless Internet connection helps access the Net through cellular phones, Personal Digital Assistants (PDAs) and Wireless laptops and this technology proposes enormous business opportunities. The sales force can avail real-time access to inventory records; price lists, order and customer account status and can book a sale almost instantaneously. Constant communication with wireless gadgets (that cost many degrees lesser than a laptop) can ensure that there is a constant feedback loop thus ensuring a new way of reaching customers.

C. The tapestry of distributed computing

Distributed computing is the processing power of thousands of PCs aggregated to create a super computer. A centralized server subsidizes a large computing task in to smaller bits. It then assigns those bits to thousands of desktop computers, each of which does a small task and returns the results to the server. Specialists in content delivery, pharmaceuticals, biotechnology and financial services will see the use of distributed computing capabilities soon

D. Voice computing: Tell your computer to switch on!

Voice recognition software will allow users to switch on their computers by just talking to them. Even documents can be edited through voice commands. We'll finally be reaching out to the frontier where man will be able to talk to all his machines and command them to do as he wishes. In effect, we are talking about an e-web or the embedded web where the Internet's role as content provider and shopping assistant morphs into that of companion and advisor. The embedded web with its swarm of sensors and appliances (an insect colony with worker bees) places machines at our beck and call and will take us to the ultimate end in convenience.

I. TECHNOLOGIES THAT ADDRESS PERVASIVE SEMANTIC GRID

Now that the requirements have been identified, we turn to five of the key technologies that are being used to address them.

A. Web Services

The key to bringing structured content to life is to run services over it. What these might look like can begin to be seen in a variety of Semantic Web applications. In more detail, recent efforts around SOAP, WSDL, and UDDI enable software applications to be accessed and executed via the Web based on the idea of Web Services. Such Web Services significantly increase the Web architecture's potential, by providing a way of automated program communication, discovery of services, etc. In this view, Web Services connect computers and devices with each other using the Internet to exchange and combine data in new ways. Effectively, Web Services provide on-the-fly software composition through the use of loosely coupled, reusable software components.

At the same time as the Web community began to embrace Semantic Web technologies, Web Services were achieving increasing prominence as an industry-led solution to a service-oriented architecture for e-business.

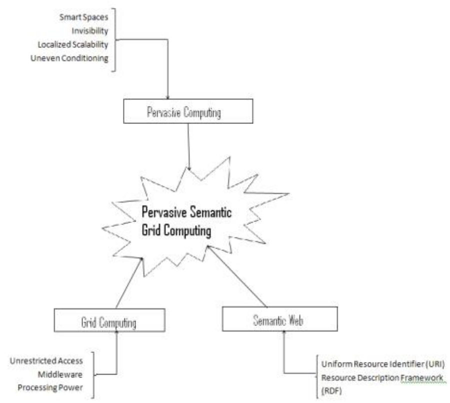

Fig 3: Technologies that address Pervasive Semantic Grid

Building on this, the Open Grid Services Architecture (OGSA) was published, describing a service-oriented architecture for the Grid, and the Open Grid Services Infrastructure (OGSI) working group in GGF specified the conventions to which a Web Service must cohere to be a Grid Service. The enhancements for Grid services include the creation of new services on demand, service lifetime management, service groups, state handling and notification.

Conceived as an enhancement of Web Services to meet the special requirements of Grid computing, OGSI was seen by some researchers to diverge from important Web Service practices, particularly in the approach to state-full service interactions and a more natural mapping to Web Services was sought. Subsequently, IBM and Globus, together with a number of other companies, presented a proposal for an evolution of OGSI based on a set of new Web Service specifications called WS-Resource Framework (WSRF) and WS-Notification (WSN).

B. Software Agents

Multiagent systems research addresses a problem space which is closely aligned to that of the Semantic Grid. In particular, software agents bring the dynamic decision-making, decentralization, coordination, and autonomous behavior needed to realize virtual organizations. Fundamentally, agent-based computing is a service-oriented model– agents are producers, consumers and brokers of services – and hence there is a close relationship between agent-based computing and Web Services, which maps directly into service-oriented Grids.

First, the notion of autonomy needs to be brought into the conception of Grid services. Thus, services are not always available to be invoked by any entity within the system. This autonomy means that some service invocations may fail – because, for example, the entity delivering the service is unable or unwilling to provide the service at the current moment or under the proposed terms and conditions. This view of services as autonomous is a fundamental mind shift from the present conception, but is essential if Grids are to operate effectively in resource-constrained or open systems.

Second, and following on from the autonomy of the services, is the fact that the de facto means of provisioning a service will be some form of negotiation (a process where the relevant parties attempt to come to a mutually acceptable agreement about the terms and conditions of the service's execution). This view is now starting to be recognized in the Grid and Web communities. It deals with two main facets: (i) how to structure the encounter such that the ensuing negotiation process and outcome have particular properties (e.g. maximal efficiency, maximum social welfare, fairness) and (ii) given a particular mechanism, what strategy should the agent employ in order to achieve its negotiation objectives. In the former case, considerable attention has been placed on various forms of auctions since these are known to be an effective means of allocating resources in decentralized and open systems.

Third, the notion of virtual organizations as dynamically formed teams that have a particular collective aim has long been studied in agent-based computing. This has resulted in a large number of models, methods and techniques for establishing cooperation between autonomous problem solvers, for ensuring the actions of collectives are appropriately coordinated, for selecting an appropriate set of partners to participate in the team, and for modeling trust and reputation in open systems.

C. Metadata

The growing body of literature on the Semantic Web has a substantial component that deals with issues of ontology and reasoning, reflecting the burgeoning research activity in this area (indeed the Semantic Web is sometimes perceived as being synonymous with ontology). However, before we get to ontological reasoning, there is a significant, but apparently mundane, step of moving into a metadata-enabled world.

Fundamentally, much of the Semantic Web's added value comes from accumulating descriptive information about the various artifacts and resources in the application domain. As different stages of the scientific process work with the same referents—perhaps a sample for analysis, a piece of equipment, a chemical compound, a person, or a publication—metadata can be recorded in various stores, in databases or on Web sites. Thus this distributed metadata is effectively interlinked by the objects it describes.

Building on this, the scaling of the Semantic Web depends on a network effect being reached in "information space" – allowing the sharing and linking of machine readable content, and gaining power by linking to, extending, or even disagreeing with, that specified in another Semantic Web document. However to achieve this effect we need shared, unique URIs for the objects (real and virtual), and appropriate assertions of the relationships (including equivalence) between them. Thus for Semantic Web technologies to take hold, more communities must recognize the importance of linking their resources and make more of them nameable on the Web.

D. Ontology and Reasoning

Ontology determines the extension of terms and the relationships between them. For most practical purposes ontology is simply a published, more or less agreed, conceptualization of an area of content. The ontology may describe objects, processes, resources, capabilities or whatever. Given this, it can be seen that ontology provides the basis of metadata. Thus any kind of content can be "enriched" by the addition of ontological annotations (e.g. it may indicate the origin of content, its provenance, value or longevity). The Semantic Grid requires ontology as a fundamental building block.

Of course, a significant set of challenges are encountered in developing, deploying and maintaining ontology. These include the fact that ontology are often highly implicit in scientific and business practice and that they vary as the task or role varies. Furthermore, integrating across multiple ontology is difficult, as is their maintenance in the face of changing characterizations of a domain. Nevertheless the upside is that they clearly facilitate interoperability, both for machines and people, they do enhance reuse, and they are evidently becoming part of the distributed scientific infrastructure.

However providing content enrichment and metadata is only the first phase in exploiting the common conceptualization that is ontology. Since ontology encodes relationships between classes of object, inferences can be drawn between instances of these classes. To this end, reasoning has been affected in the OWL standard using a variety of description logic inference engines. For ontology distributed across locations and containing many thousands of instances it becomes likely that, in addition to rule based reasoning over this content, it will be necessary to exploit probabilistic and stochastic methods. Thus, in general, reasoning can be regarded as a special case of a Semantic Web service and it is to developments in this area that we now turn.

E. Semantic Web Services

The level of abstraction currently involved in invoking a Web Service is relatively low. Thus technology around UDDI, WSDL, and SOAP only provides limited support in mechanizing service recognition, service configuration and combination, service comparison and automated negotiation. The ambition for Semantic Web services, therefore, is to raise the level of description such that services are detailed in a way that indicates their capabilities and task achieving character.

To this end, the Web Ontology Language for Services encodes rich semantic service descriptions in a way that builds naturally upon OWL. The Semantic Web Services Initiative extends this work by relaxing the constraint of using description logic formalism for defining service workflow, instead using first-order logic based language. The Web Services Modeling Framework (WSMF) is an alternative approach for semantically annotating Web Services, aimed at resolving semantic and protocol interoperability problems faced by Web Service composition. Extending earlier work on the Unified Problem Solving Method Development Language (UPML) framework, logical expressions defined in goals, mediators, ontology and Web Services are expressed using frame logic.

UPML distinguishes between domain models, task models, problem solving methods and bridges, and is also the basis of the Internet Reasoning Service (IRS). A knowledge-based approach to Semantic Web Services, IRS provides a means for ontology-based Web Service selection using reasoning, by describing them semantically. Here domain models are effectively the domain ontology, while the task models provide a generic description of tasks to be solved. Problem solving methods provide implementation-independent descriptions of tasks, while the bridges map between the various components. It takes a task-centric view, where the client asks for a task to be achieved, and the IRS broker calls the appropriate problem solving method.

Now with such descriptions in place, automatic brokering and composition of services become possible. This, in turn, draws upon agent-based technology (as above) in order to bring together and coordinate the discovery, composition and enacting of such services.

AN EXAMPLE SCENARIO

The diagram shown below is the hospital scenario in which pervasive semantic grid computing concept is implemented. In this scenario we make use smart phones, ultrasonic location sensor which lead people to interact with the monitors, surroundings etc. By integrating the smart phone with smart environment people can control the equipments. Patients are tagged with RFID (radio frequency identification) bands and doctors, nurse carry RFID tag with their ID cards. At left corner of the figure, the nurse portal which holds the information about the patients i.e. list of patients in his/her ward and the list are sorted by seriousness of the current alerts. The alerts are context information originating in various devices that monitor each patient, such as blood pressure, heart rate or body temperature. This information is processed by a context weaver composer that encapsulates medical knowledge for evaluating the seriousness of the patient and generate appropriate alert. Two portals can be accessed by the user through a client web browser. The various equipments used are sensors, smart phone is the user device; medicine cart is the controlled device, and monitor is the networked device.

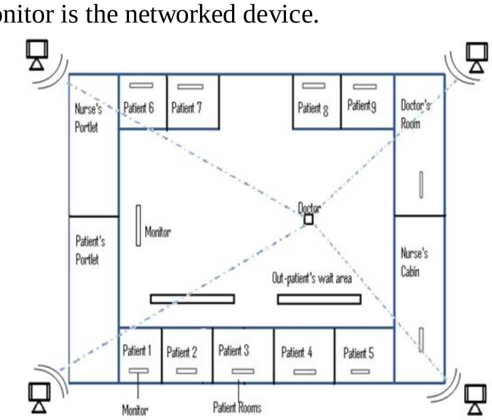

Fig 4: A Hospital Scenario

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The below shown is the demonstration of the hospital scenario.The diagram describes about the execution of the nurse and patient portal

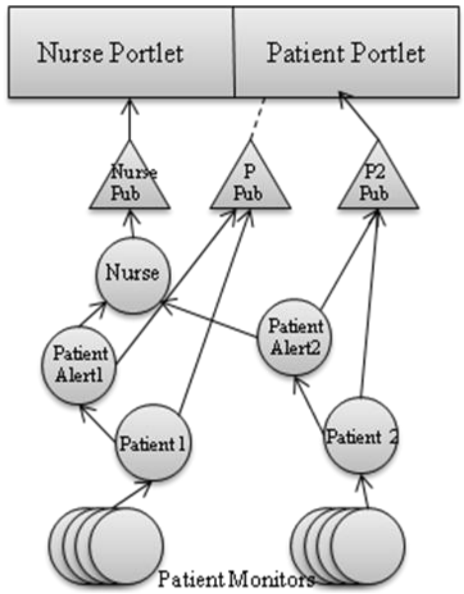

Fig 5: Demonstration

II. CONCLUSION

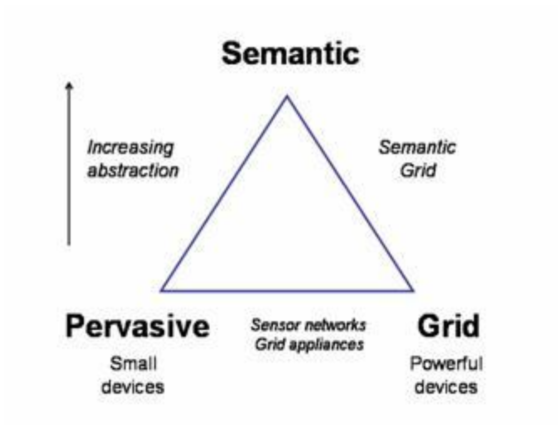

Fig 6: Pervasive Semantic Grid (PSG) Triangle

We have developed a particularly powerful combination of Grid and pervasive computing in that we do not just have the Grid meeting the physical world through the pervasive devices, but rather we have the physical world intersecting with the Semantic Grid. Here the devices capturing experimental conditions do so in the form of semantic annotation; and interaction with the information is seen as annotation, that is, as enrichment through use. We could consider pervasive computing as a part of ambient intelligence. Moore's Law tells us that if you keep the box the same size then a series of computers will get increasingly powerful over time. However if you only want the same power then you can work with smaller and smaller devices, and more of them. Broadly then, this gives us the world of the Grid and the world of pervasive computing, respectively. Both are important and inevitable technological trends that therefore need to be considered together, but we suggest that Grid and pervasive computing have another very important relationship: pervasive computing provides the manifestation of the Grid in the physical world. Grid and pervasive computing complements each other. In common with the Grid, we can also argue that the full richness of the pervasive vision needs the Semantic Web technologies. Again this is about semantic interoperability: we need service description, discovery and composition, and indeed research areas such as Semantic Web Services are being applied both to Grid and to Pervasive computing. Hence the Semantic approach sits above the large scale distributed systems of Pervasive and Grid computing, as illustrated in figure.

Conclusion and Future Direction

We could create Automated Virtual Organization and Formation and Management Service and Negotiation and Contracts could be done through PSG scenario. Moreover, we also believe that many of the issues, technologies and solutions developed in the context of e-Research can be exploited in other domains where groups of diverse stakeholders need to come together electronically and interact in flexible ways. Thus we believe that it is important that relationships are established and exploitation routes are explored with domains such as e-Business, e-Commerce, e-Education, and e-Entertainment.

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