10021 Abstracts Collection
Service-Oriented Architecture and (Multi-)Agent Systems Technology
— Dagstuhl Seminar —

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Abstract. From 10.01. to 15.01.2010, the Dagstuhl Seminar 10021 "Service-Oriented Architecture and (Multi-)Agent Systems Technology" was held in Schloss Dagstuhl – Leibniz Center for Informatics. During the seminar, several participants presented their current research, and ongoing work and open problems were discussed. Abstracts of the presentations given during the seminar as well as abstracts of seminar results and ideas are put together in this paper. The first section describes the seminar topics and goals in general. Links to extended abstracts or full papers are provided, if available.

Keywords. Service-oriented computing (SOC), Service-oriented architecture (SOA), multi-agent systems (MAS), engineering complex distributed systems, governance, adaptability, dynamism, flexibility, autonomy

10021 Executive Summary – Service-Oriented Architecture and (Multi-)Agent Systems Technology

Service-Oriented Architecture (SOA) stands for a standards-based and technology-independent distributed computing paradigm and architectural style which is especially suited to meet the demands of today's dynamic business applications. Based on a comprehensive set of independent or at most loosely-coupled and network-available software services SOA is supposed to provide a platform for an efficient and effective publication, discovery, binding, and assembly of these services. Intelligent agents can be regarded as autonomous, problem-solving

computa-tional entities with social abilities that are capable of effective pro-active behav-ior in open and dynamic environments. If the term entity is re-placed by service the substantial overlap in interests between both communities can easily be imagined. Nevertheless, right now the main research focus of each community seems to be different. The SOA community concentrates mainly on developing service engineering methodologies. Active topics in the multi-agent systems community are collaboration, self-organization, adaptability, flexibility, pro-activeness, and interoperability. The overlap between those two communities and the fact that they concentrate on different research topics can definitely be seen as a huge chance since it means that each community may be able to bene-fit from the research efforts of the other. This seminar brought members from both communities together in order to identify such areas of mutual benefit. Af-ter extensive general discussions the seminar concentrated on three topics, namely the engineering of complex distributed systems, its governance, and its adaptability and requirements for dynamism.

Keywords: Service-oriented computing (SOC), Service-oriented architecture (SOA), multi-agent systems (MAS), engineering complex distributed systems, governance,adaptability, dynamism, flexibility, autonomy

Joint work of: Calisti, Monique; Leymann, Frank; Dignum, Frank P.; Kowalczyk, Ryszard; Unland, Rainer

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2010/2845

A revision of the SOA and MAS paradigms from the e-business perspective

Stanislaw Ambroszkiewicz (Polish Academy of Sciences - Warsaw, PL)

Classic versions of the paradigms SOA and MAS have their origins in software engineering. From the point of view of e-business processes (that are supposed to be also software applications), the concept of service need not be related to RPC (remote procedure call) where a service is passive and is waiting for a client to be invoked, as it is in SOA.

In other words, a service may be active and looking by itself for clients tasks that can be accomplished. This corresponds to the reverse auctions in business practice. A business service has well founded structure where its operations (corresponding to request-quote, order-contract, invoice-payment) are related to each other. These relations can not be expressed in WSDL. Hence, the concept of service in SOA should be discussed.

As to the MAS paradigms, the concept of agent, in the e-business (economic) context, should be much more related to the notion of player in Game Theory.

Generally, from the e-business perspective the following problems seem to be important:

1. Service architecture.

2. Agent (player) architecture.
3. Communication protocols in e-business processes.

These problems must be solved by providing standards necessary for creating open, heterogeneous and scalable systems for realizing complex e-business processes. All this above is expected to be discussed during the presentation.

Using SLA Mapping to Increase Market Liquidity

Ivona Brandic (TU Wien, AT)

Research into computing resource markets has mainly considered the question of which market mechanism provides a fair resource allocation. It has not been discussed how a large variety of resource types influences the liquidity of resources in the market. Markets containing large numbers of buyers and sellers for heterogeneous resources suffer from a low likelihood of matching offers and requests (defined through contracts, SLAs). These markets are less attractive for traders because of the high risk of not being able to trade resources (liquidity). We suggest a solution that derives SLA templates from a large number of heterogeneous SLAs in the market, and, by using these templates instead of the original SLAs, facilitate SLA mapping (i.e. mapping of offers to requests). The usefulness of this approach is demonstrated through simulation results and a comparison with an alternative approach in which SLAs are predefined.

MAST: Multi Agent System for Structural Design

In this presentation we will introduce a Multi-Agent System for Structural Design Optimisation. We shall commence by introducing design and optimisation and a best "possible" design. Next, we will present the structural optimisation problem and the three layered approach.

We will then state the progress of the project so far and the mutual coupling of the three layers and the technologies involved, and work towards the architecture of the Multi-Agent System and the Design of the Framework to accomplish our goals. We will conclude with a list of milestones, state our future work.

Joint work of: Branki, Cherif ; Bitterbeg, Tilmann

Organizing Web Services to develop Dynamic, Flexible, Distributed Systems

Frank Dignum (Utrecht University, NL)

Web services are increasingly behaving as nodes in a digital, dynamic ecosystem. On the one hand, this new situation requires flexible, spontaneous and opportunistic collaboration activities to be identified and established among (business) parties.

On the other hand, it also requires engineering approaches able to integrate new functionalities and behaviours into running systems and active, distributed, interdependent processes. In this paper we present a multilevel architecture, combining organisational and coordination theories with model driven development, for the implementation, deployment and management of dynamic, flexible and robust serviceoriented business applications.

Joint work of: Dignum, Frank; Dignum, Virginia; Padget, Julian; Vazquez-Salceda, Javier

OperettA: Organization-Oriented Development Environment

Virginia Dignum (TU Delft, NL)

The increasing complexity of distributed applications requires new modeling and engineering approaches. Such domains require representing the regulating structures explicitly and independently from the acting components (or agents). Organization computational models, based on Organization Theory, have been advocated to specify such systems. In this paper, we present the organizational modeling approach OperA and a graphical environment for the specification and analysis of organizational models, OperettA. OperA provides an expressive way for defining open organizations distinguishing explicitly between the organizational aims, and the agents who act in it. That is, OperA enables the specification of organizational structures, requirements and objectives, and at the same time allows participants to have the freedom to act according to their own capabilities and demands. OperettA takes a Model Driven Engineering approach combining different formal methods and enables model checking.

Joint work of: Dignum, Virginia; Aldewereld, Huib

Bridging Testing Techniques and Model-Driven Service Engineering Methodologies

Antonio García Domínguez (University of Cádiz, ES)

There is a wide array of techniques for testing services in the context of SOA. However, combining them is difficult, as each of them usually requires a partial specification of the system in its own notation. Incidentally, most service engineering methodologies require the same sort of information, though at a lower level of detail. We propose extending a model-driven service engineering methodology to include the information required for test generation and evaluation. We show our first results on modeling and estimating performance constraints in UML activity diagrams and discuss some of our future work.

Keywords: Service engineering, SOA, testing, model-driven engineering, model-driven architecture, load tests, unit tests

From agents to SOA and BPM - different sides of the same coin?

Benjamin Hirsch (TU Berlin, DE)

This contribution consists of two main parts. To lay the ground work and ensure a common understanding I will present the service oriented agent framework JIAC and its tools that is the basis of many of the ideas that follow. Once the state-of-the-art is reached, I discuss the integration of BPM techniques in agents, but also the application of agents in enterprise environments.

I hope that with the other participants we will be able to work towards a roadmap for agent supported process management.

Programming Service Oriented Agents

Benjamin Hirsch (TU Berlin, DE)

This paper introduces a programming language for service-oriented agents. JADL++ combines the ease of use of scripting-languages with a state-of-the-art service oriented approach which allows the seamless integration of web-services. Furthermore, the language includes OWL-based ontologies for semantic descriptions of data and services, thus allowing agents to make intelligent decisions about service calls.

Keywords: Service oriented architectures, agents, agent programming language, semantic services

Joint work of: Hirsch, Benjamin; Konnerth, Thomas; Burkhardt, Michael; Albayrak, Sabin

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2010/2815

Reliability of Service-Based and Agent-Based Systems

Michael N. Huhns (University of South Carolina, US)

The use of services in *static* SOA-based systems has been successful in many application domains. However, the use of *dynamically* discovered, configured, deployed, engaged, and maintained services has not been successful.

The problem is that current service standards, which are necessary for the widespread usage of services, are unable to describe anything other than the simple syntax and formatting of service invocations; they are thus insufficient for characterizing the rich usage and interactions required throughout the *lifetimes* of service-based applications. Moreover, service-based architectures will need to become more flexible and accommodate peer-to-peer interactions, as well as client-server interactions.

The Web has been successful largely because its founding principles and protocols are simple and minimal. Also, when uncertainties arise, they are overcome by relatively simple indexing, ranking, and redundancy. None of these techniques has been exploitable for services. In addition, the simplicity of services applies only to their structure, and not to their function and behavior, which have mostly been ignored in service engineering.

Agents exacerbate the problems, while—surprisingly—also providing the only reasonable solutions to them. The autonomy of agent-based services makes them less predictable, but also enables them to self recover and to avoid deadlocks and livelocks, thereby making them more reliable. Their ability to learn can increase their robustness by being able to adapt to changing interaction environments, but also can increase their unpredictability. Their abilities to negotiate and reconcile semantics can enable them to reestablish connections and relationships among services and ameliorate uncertain execution environments. The peer-to-peer interactions of agents can improve the efficiency of agent-based services, particularly when they are deployed in clouds. Finally, agents can exploit redundancy.

Keywords: Service deployment, service manageability, service reliability, agent reliability

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2010/2554

Reliability of Service-Based and Agent-Based Systems

Michael N. Huhns (University of South Carolina, US)

A description of the current problems of service-oriented architectures and service-oriented computing and how the solutions will come from using agent technology. That is, serevices will have to become more agent-like in order to succeed fully in the marketplace.

Keywords: Service-oriented computing, multiagent systems

Agent-based Management of Quality-assured Provision of Complex Services

Ryszard Kowalczyk (Swinburne Univ. - Melbourne, AU)

The assurance of quality-of-service (QoS) is critical for the successful deployment of service-oriented applications, especially in open, dynamic and distributed cross-organisational environments. This paper address the adaptive management of the QoS assured provision of composite services as required for more reliable, fault-tolerant and flexible service delivery in such environments. After an overview of the current state and trends in QoS management, the presentation will focus on agent-based QoS management across the whole lifecycle of composite service provision. It includes automated composition planning, service discovery, service level agreement (SLA) negotiation and contracting, service enactment and QoS monitoring, and adaptive exception handling with dynamic re-selection, re-negotiation and re-planning to ensure the required end-to-end QoS of composite services. A sample reference architecture of an autonomic management platform realised with web services and software agents is outlined and demonstrated with selected application scenarios in telecommunication, internet service provision, logistics and virtual environments.

An Agent Based Approach for the Decentralised Compensation of Business Processes

Tim Lessner (University of the West of Scotland - Paisley, GB)

An automated execution of business processes, composed of Web Services, also requires a reliable error handling and in the case of failures at least parts of a process need to be recovered. One way to enable a forward oriented recovery is compensation which allows to semantically undo effects even "long" time after the process –a long running transaction– commits. Usually, compensation as for example applied in BPEL (Business Process Execution Language), requires that all compensation steps associated with the business process perform successfully. Also, the conditions for a compensation are not considered and it is not dynamic. In some business scenarios, e.g. a complex production process involving several partners, compensation is a commitment under certain conditions. These conditions in turn can be dynamic and interdependent. Often, a lot of human effort is required to perform compensation. Agents in turn, can enable a decentralised compensation in which agents negotiate a commitment to find a proper compensation strategy. Especially in highly dynamic environment this enables on the one hand a dynamic compensation, and on the other it can support human decision finding in case of failure.

Keywords: Compensation, Business Processes, Agents, Commitment

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2010/2552

Intelligent Healthcare System

Wathiq Mansoor (American University in Dubai, AE)

The challenges facing the current healthcare system is so enormous due to the advancement of the healthcare infrastructure from the technology point of view.

That has lead to huge amount of information of healthcare environment such people, equipments, and premises. The current healthcare information system is lacking the ability to deal with this huge amount of information. The main aim of this project is to enhance the current information system with the capability of storing the information efficiently and querying them semantically taking into account the context of users. The project aims to develop an intelligent system that fully exploits the existing technologies for health care environment like semantic web technologies, context aware computing among others. This system is intended to be integrated into the planned national wide health care system.

RESEARCH OBJECTIVES & EXPECTED OUTCOMES:

There is a growing need for intelligent health care system due to problems that current health care systems are facing like delay in getting information to the right person due to the inefficient information storage. This project aims at developing an intelligent system that fully exploits the existing technologies for health care environment like semantic web technologies, context aware computing among others. This system is intended to be integrated into the planned national wide health care system from Cerner Corporation. The main challenge would be to develop some kind of guidelines that will make use of the available data. One guideline is how to store the huge amount of information semantically rather than syntactically as in the existing health care system worldwide. The other guideline is how to enquire and discover the appropriate piece of information through producing semantic queries. Context information that is rapidly changing within the health care environment needed to be captured and represented semantically. A proper computer platform is going to be developed that could accommodate the knowledge about the health care data.

Ad hoc mobile network technologies needed to be integrated into the platform since doctors and nurses are always on move provided with mobile devices. The system will adopt agent system technologies since they have been proven efficient for ubiquitous intelligent system due to their reliability, scalability, and distributions. The system will be supported with decision making capabilities to assist the medical staff confidence in diagnosis and procedures practice. The project will focus on the United Arab Emirates national health care system and will be in collaboration with the ministry of health. This project is inspired by the vision of the UAE leaders for top quality health care system for UAE nationals and residence.

Objectives:

Pervasive information represents the major challenge to be resolved. This is due to the fact that the availability of information to clinical staff needs to be there anywhere in the hospital and outside the hospital as long as they carry their mobile devices.

The major objectives of the project are as follows:

a) The design of a platform that could accommodate the various information system components.

b) The clinical documentation in such a way that can be found syntactically or semantically.

c) The design of various services available to the clinical staff in form of web services or the ability for searching for the available web services from a third parties.

d) Web services description needs to be semantically rather than syntactically.

This means that medical staff can search the required services using any term since semantic web services is able to find the appropriate service that match the meaning of the term rather than the exact term match as the syntactic web services do.

e) The deployments of the sensors that will provide the context information.

Again the description of the services provided by these sensors should be described semantically.

f) A special platform for mobile devices that could accommodate the software agents that going to be developed to provide the medical staff with necessary information.

This project is focusing on meeting these objectives. The expected tangible accomplishments of the project are as follows:

1. Study the existing healthcare system in UAE and addressing the major drawback due the lack of knowledge representations.
2. Investigate the clinical information ontology that does exist in the industry and academia.
3. Write requirements specification for the health care system from the semantic web services perspective.
4. Development of the semantic web services based on the requirements specification and by going through the various software process phases.
5. Development of Agents system to automate the discovery and access of web services. We are planning to use our agents platform of previous projects implemented by me [6].

BACKGROUND & LITERATURE REVIEW:

Web services have been proven to be a successful to provide various services through the internet. Web services have overcome the limitations of the distributed systems such as CORBA, DCOM through its supported standards of the World Wide Web. These standards are XML, WSDL [1], and SOAP [2]. These standards have overcome the inter-operability problem of the previously mentioned distributed systems technologies. However, the main short come of the web services are that they heavily depends on the human interventions and the necessity for the exact terms used for describing the web services to find the appropriate web services. A new notion for the web called semantic web has been proposed by the inventor of the web Lee[3]. Within the semantic web an

intelligent way is used to describe the web services. This way is using the ontology language. Ontology is a language that is used to describe properties and their relationships. Through these ontologies [3], various web services that use different terms for their descriptions of a certain application can be found and compared to choose the required web services. In other word, semantic web is the single database web. However, the existing technologies are far toward that aim and the real world does not allow such single store web because of various domains available in the real world of applications, so the semantic web has the ability to merge information from different domains.

There are various projects that aimed to use semantic web technologies for health care systems. A brief description of each of them is as follows:

1. Artemis [4]: Artemis project has provided the interoperability of medical information systems using semantic web technologies. It allows the sharing of patient records from different health organizations. They have developed AMEF (Artemis Message Exchange Framework) that is used to exchange of clinical information among healthcare providers through semantic mediation.
2. HEALTHFINLAND [5]: this system is using ontologies and semantic web technologies for presenting health information from different publishers in such a way that can be searched efficiently. The user of the system can search for information using any word since the system will semantically fetch the appropriate answer by using the meaning of the word rather than the word itself.

RESEARCH METHODOLOGY:

The steps that going to be followed to complete the project is as follows:

1. Literature survey for semantic and context aware healthcare systems.
2. Design a framework for semantic web.
3. Developing an appropriate ontology for a certain application in the health system. This is going to be decided.
4. Implement a semantic web using OWL-s technology.
5. Performance measurements for the system.

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Keywords: Semantic web, e health, context aware system

Design and Implementation of Distributed Production Control Systems: An Agent and Service based Perspective

Lars Moench (FernUniversität in Hagen, DE)

In this talk, we report on the design and the development of a distributed hierarchical production control system for the high technology domain. In this domain, we have to deal with complex job shops that are characterized by a large number of jobs, parallel machines, sequence-dependent setup times, reentrant flows of the jobs, frequent machine breakdowns, and large number of different products. Semiconductor wafer fabrication facilities are a specific example for complex job shops. We describe the architecture and the offered scheduling capabilities of the hierarchically organized multi-agent-system FABMAS. Then we discuss a second prototype that is based on web services and offers a complementary way to implement distributed hierarchical production control systems. Finally, we discuss the advantages and limitations of the two proposed methods and analyze ways to integrate them.

Adapting Web Services for Multiple Devices: a Model-Driven, Aspect-Oriented Approach

Guadalupe Ortiz-Bellot (University of Cadiz, ES)

Mobile devices have become an essential element in our daily lives, even for connecting to the Internet. Web Services have become extremely important when offering services through the Internet.

However, current Web Services are very inflexible as regards their invocation from different types of device, especially if we consider the need for them to be adaptable when being invoked from a mobile device. In this paper, we will propose several alternatives for the creation of flexible web services which can be invoked from different types of device, and compare the different proposed approaches. Aspect -Oriented Programming and Model-Driven Development have been used in all proposals to reduce the impact of service adaption, not only for the service developer, but also to maintain the correct code structure.

This work has been developed thanks to the support of MEC (contract TIN2008-02985).

Keywords: Web Services, Mobile Devices, Aspct-Oriented Programming, Model-Driven Development

Joint work of: Ortiz-Bellot, Guadalupe; García de Prado, Alfonso

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2010/2812

Full Paper:
http://portal.acm.org/citation.cfm?id=1591529

See also: Proceedings of the 2009 Congress on Services - I - Volume 00. Pages 754-761. 2009

Monitoring and Reputation in Service Level Agreements

Thomas Quillinan (Thales Netherlands, NL)

A Service Level Agreement (SLA) is an agreement between a client and a provider in the context of a particular service provision. SLAs may be between two parties, for instance, a single client and a single provider, or between multiple parties, for example, a single client and multiple providers. SLAs specify Quality of Service (QoS) properties that must be maintained by a provider during service provision - generally defined as a set of Service Level Objectives (SLOs). Often an SLA is only relevant when a client directly invokes a service (rather than through an intermediary - such as a broker). Such direct interaction also implies that the SLOs need to be measurable, and must be monitored during the provision of the service.

From an economics perspective, one may associate a cost with an SLA - which is the amount of money a client needs to pay the provider if the agreement has been adhered to (i.e. the requested quality has been met). The cost needs to be agreed between a client and a provider - and may be based on a posted price (provider publishes), or negotiated through single/multi-round auctions (English, Dutch, Double, etc). How this price is set has been considered elsewhere, although the mechanism for doing this can also be determined through equilibrium pricing (based on supply-demand) or through auctions (based on client need). An SLA must also contain a set of penalty clauses specifying the implications of failing to deliver the pre-agreed quality. This penalty may also be defined as a cost - implying that the total revenue made by a provider would be the difference between the cost paid by the client and the discount (penalty) imposed on the provider. This type of analysis assumes that failure to meet an SLA is a non-binary decision - i.e. an SLA may be "partially" violated, and that some mechanism is in place to determine how this can be measured.

Although significant work exists on how SLOs may be specified and monitored, not much work has focused on actually identifying how SLOs may be impacted by the choice of specific penalty clauses. A trusted mediator may be necessary to resolve conflicts between involved parties. The outcome of conflict resolution depends on the situation: penalties, impact on potential future agreements between the parties and the mandatory re-running of the agreed service, are examples. While it may seem reasonable to penalize SLA non-compliance, there are a number of concerns when issuing such penalties. For example, determining whether the service provider is the only party that should be penalized, or determining the type of penalty that is applied to each party. Enforcement in

the various legal systems of different countries can be tackled through stipulating a 'choice of law clause', that is a clause indicating expressly which countries' laws will be applied in case a conflict between the provider and the client would occur. Automating conflict resolution process could provide substantial benefits. Broadly speaking there are two main approaches for contractual penalties in SLAs: reputation based mechanisms and monetary fines. It is useful to note that often obligations within an SLA are primarily centered on the provider towards the client. An SLA is therefore an agreement between the provider to offer particular QoS to a client for some monetary return. We do not consider scenarios where there is also an obligation on the client towards the provider. An example of such a scenario could be where a provider requires the client to make input data available by a certain time frame to ensure that a particular execution time target is met. If the client is unable to meet the deadline for making such data available, the penalty incurred by the provider would no longer apply.

The use of reputation-based mechanisms to promote data integrity in distributed architectures has been explored in the past. Knowing the reputation of a client can provide insight into what access may be granted to that client by a provider. Maintaining a measure of each client's reputation allows clients to make decisions regarding the best service provider for a specific task. In this case, reputation is a numerical value quantifying compliance to one or more SLAs. This value represents the previous behaviour of the provider in the system, and can be used by other clients to determine whether or not to interact with that provider. The higher this value, the more likelihood that the provider will act correctly in the future. Applying a numerical weight to users allows a more informed decision to be made when negotiating SLAs in the future. As users (clients and providers) interact with one another in the system, their reputation changes to reflect how they perform. For example, if a service provider consistently provides poor service (that is, violating its SLAs), its reputation will decline.

While reputation based mechanisms work relatively well in community based environments - where each participant monitors and judges other participants Ű in commercial environments reputation based mechanisms are rarely used. This can partly be attributed to the unbalanced nature of the relationship between clients and service providers. Monetary fines give a higher degree of expected QoS for service providers and (especially) clients. Monetary fines are also used in this paper. Such approaches are not new, other works in this area provide only a partial solution to this problem. For example, they do not have a mechanism for conflict resolution.

Joint work of: Rana, Omer; Warnier, Martijn; Quillinan, Thomas; Brazier, Frances

Crisis Management in the ALIVE Project

Thomas Quillinan (Thales Netherlands, NL)

Crisis management is a challenge, especially when crises escalate. The numbers of organisations involves increases, communication lines change, roles change. Simulations provide a means to study the consequences of escalation of crises with respect to structures involved. As a crisis escalates, organisational structures are systematically updated to reflect the changes in the nature of the crisis and the number of parties involved. In the real world, simulations are enacted using active personnel, real people. However, such simulations are expensive, both in terms of the cost of execution and the cost of the time required for the emergency service personnel involved.

The Netherlands has an extensive crisis management structure to respond to disasters. This structure is based on the severity of the disaster, and allows local, regional and national authorities to take action when necessary. Most incidents are relatively minor, and do not require much cross-organisational interactions. However, when a more complex crisis does arise, this structure defines how first responders within a safety region, that is, the police, Fire and medical services, municipal governments and other services, are to cooperate.

A simple scenario can be used to illustrate organisational change during crisis management. This scenario, describing the rescue procedures in the case of a flooding situation, contains sufficient detail to discuss the organisational transitions needed. The scenario assumes that a major storm is emerging above the North Sea after a long period of dry weather. The storm is expected to peak during high tide above the West coast of the Netherlands, raising the water levels on the coasts to dangerous heights. Advance notice allows crisis management teams to determine the risks and their consequences, in particular the risk of dike breaches. Crisis teams are mobilised and informed of potential problems. As the disaster progresses, several dikes are breached, flooding northern Rotterdam. Due to recent weather conditions several inland dikes outside of Rotterdam have dried out completely. Sudden inundation of water causes them to weaken and breach as well.

Programming Multiagent Systems without Programming Agents

Munindar Singh (North Carolina State University, US)

We consider the programming of multiagent systems from an architectural perspective. Our perspective emphasizes the autonomy and heterogeneity of agents, the components of multiagent systems, and focuses on how to specify their interconnections in terms of high-level protocols. In this manner, we show how to treat the programming of a multiagent system as an architectural endeavor, leaving aside the programming of individual agents who might feature in a multiagent system as a secondary concern.

Keywords: Architecture, open systems

Joint work of: Singh, Munindar; Chopra, Amit

Full Paper:
http://www.csc.ncsu.edu/faculty/mpsingh/papers/mas/aamas-promas-invited-09.pdf

See also: Proceedings of ProMAS 2009 (invited paper)

Commitment-Based Service-Oriented Architecture

Munindar Singh (North Carolina State University, US)

Existing service-oriented architectures are formulated in terms of lowlevel abstractions far removed from business services. In a new SOA, the components are business services and the connectors are patterns, modeled as commitments, that support key elements of service engagements.

Keywords: Commitments, agents

Joint work of: Singh, Munindar; Chopra, Amit; Desai, Nirmit

Full Paper:
http://www.csc.ncsu.edu/faculty/mpsingh/papers/mas/computer-09.pdf

See also: IEEE Computer, Nov 2009

Integrating Marine Observatories into a System-of-Systems: Messaging in the US Ocean Observatories Initiative

Munindar Singh (North Carolina State University, US)

The Ocean Observatories Initiative (OOI) will implement ocean sensor networks covering a diversity of oceanic environments, ranging from the coastal to the deep ocean.

Construction will begin in Fall 2009, with deployment phased over five years. The integrating feature of the OOI is a comprehensive Cyberinfrastructure (CI), whose design is based on loosely-coupled distributed services, and whose elements are expected to reside throughout the physical components; from seafloor instruments to autonomous vehicles to deep sea moorings to shore facilities to computing and storage infrastructure. The OOI-CI provides novel capabilities for data acquisition, distribution, modeling, planning and interactive control of oceanographic experiments. The architecture comprises six subsystems: four elements address the oceanographic science- and education-driven operations

of the OOI integrated observatory, and two elements provide core infrastructure services for the distributed, message-based, service-oriented integration and communication infrastructure, as well as the virtualization of computational and storage resources. All OOI functional capabilities and resources represent themselves as services to the observatory network, with precisely defined service access protocols based on message exchange. This paper presents an overview of the OOI services and focuses on the strategy for service-oriented integration and the publish-subscribe model for communication.

Keywords: Oceanography, agents, distributed systems

Joint work of: Arrott, Matthew; Chave, Alan; Farcas, Claudiu; Farcas, Emilia; Kleinert, Jack; Krueger, Ingolf; Meisinger, Michael; Orcutt, John; Peach, Cheryl; Schofield, Oscar; Singh, Munindar; Vernon, Frank

Full Paper:
http://www.csc.ncsu.edu/faculty/mpsingh/papers/mas/Oceans-09-OOI-Messaging.pdf

See also: Proceedings of Oceans, the MTS-IEEE Conference on Marine Technology for our Future: Global and Local Challenges October 2009.

Flexible Procurement of Unreliable Services

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Emerging service-oriented technologies allow software agents to automatically procure distributed services to complete complex computational tasks. However, service providers in large distributed systems are typically self-interested, possibly malicious, agents that are not under the consumer's direct control. Therefore, their behaviour may be highly uncertain - some providers may defect from service level agreements, others may overstate their capabilities, in order to win more business.

In this talk, we will present a number of techniques to address this uncertainty. First, the consumer can introduce redundancy into its workflows, to ensure that all tasks are completed successfully despite individual service failures. However, in doing this, the benefit of increased redundancy must be explicitly balanced with the associated costs.

Second, we will show how techniques from the field of mechanism design can be applied to service-oriented systems. Using appropriate payments and penalties, we will demonstrate that service providers can be incentivised to reveal their capabilities truthfully to the service consumer.