2009 IEEE ICWS & SERVICES-I & 2009 CLOUD-I

ADVANCE PROGRAM

IEEE International Conference on Web Services (ICWS 2009)
http://conferences.computer.org/ICWS/2009

IEEE Congress on Services (SERVICES-I 2009)
http://www.servicescongress.org/2009/1/

First International Conference on Cloud Computing (CLOUD-I 2009)
http://thecloudcomputing.org/2009/1

2009 Summer School on Services Computing (SERVICES UNIVERSITY)

Sponsored by IEEE Technical Committee on Services Computing
http://tab.computer.org/tcsc

July 6 (SERVICES UNIVERSITY) and July 7-10 (ICWS & SERVICES-I & CLOUD), 2009

Los Angeles Airport Marriott
5855 West Century Boulevard, Los Angeles, CA 90045, USA
Phone: 1-800-228-9290  Fax: 1-310-337-5358
# 2009 Summer School on Services Computing (SERVICES UNIVERSITY)

**Room: Scottsdale**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>8:00-9:30</td>
<td><strong>Session 1</strong>: Concepts of Services and Services Computing (Dr. Liang-Jie Zhang, IBM, USA)</td>
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<td><strong>Session 2</strong>: Services and Services Systems (Dr. Liang-Jie Zhang, IBM, USA)</td>
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<tr>
<td>9:30-10:00</td>
<td><strong>PM Coffee Break (Room: Foyer)</strong></td>
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</table>
| 10:00-12:00| **Session 3**: Business Process Integration & Mgmt, Business Grid, and Cloud Computing (Dr. Min Luo, IBM, USA)  
             | **Session 4**: Consulting methodology & Enterprise modeling (Dr. Min Luo, IBM, USA)        |
| 12:00-13:00| Lunch (not included)                                                                       |
| 13:00-15:00| **Session 5**: Software as a Service (SaaS) (Dr. Ephraim Feig, Innovations-to-Market, USA) |
|            | **Session 6**: SOA (Modeling, Publishing, Invocation, Relationship, & Standards) (Prof. Jia Zhang, Northern Illinois University, USA) |
| 15:00-15:30| **PM Coffee Break (Room: Foyer)**                                                          |
| 15:30-17:30| **Session 7**: Services Computing Course Offering Best Practices (Prof. Zhixiong Chen, Mercy College, USA)  
             | **Session 8**: Test, Evaluation, & Certificate Presentation (Prof. Jia Zhang, Northern Illinois University, USA) |
| 18:00-21:00|                                                                                           |

1. No planned conference activities for conference participants  
2. Editorial Board Meeting for JWSR & IJBPI (Invitation Only)
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<th>Time</th>
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<td>7:30-9:30</td>
<td>Registration</td>
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<tr>
<td>9:30-10:00</td>
<td>CLOUD 2009 Opening</td>
<td>(Room: Marquis 1-3)</td>
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<tr>
<td>10:00-11:30</td>
<td>ICWS/SERVICES/CLOUD Tutorial 1</td>
<td>Scottsdale, Atlanta, Boston, Chicago, Dallas, Denver, Imperial Ballroom D</td>
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<td>10:00-11:30</td>
<td>WS-Testing 2009 (SERVICES)</td>
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<td>10:00-11:30</td>
<td>IWCS 2009 (CLOUD)</td>
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<td>SIC 2009 (CLOUD)</td>
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<td>Lunch (not included)</td>
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<td>12:30-14:00</td>
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<td>WS-Testing 2009 (SERVICES)</td>
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<td>14:00-14:15</td>
<td>PM Break</td>
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<td>14:15-15:45</td>
<td>ICWS/SERVICES/CLOUD Tutorial 2</td>
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<td>14:15-15:45</td>
<td>SHWS 2009 (SERVICES)</td>
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<td>14:15-15:45</td>
<td>SIC 2009 (CLOUD)</td>
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<td>15:45-16:30</td>
<td>PM Break with Freshments (Room: Foyer)</td>
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<td>16:30-18:00</td>
<td>ICWS/SERVICES/CLOUD Tutorial 2</td>
<td>Scottsdale, Atlanta, Boston, Chicago, Dallas, Denver, Imperial Ballroom D</td>
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<td>16:30-18:00</td>
<td>SHWS 2009 (SERVICES)</td>
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<td>16:30-18:00</td>
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<td>16:30-18:00</td>
<td>SEASS 2009 (SERVICES)</td>
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<td>16:30-18:00</td>
<td>SCCM 2009 (CLOUD)</td>
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<td>18:30-21:00</td>
<td>No planned conference activities for conference participants</td>
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<td>7:30-8:00</td>
<td>Breakfast (Room: Foyer)</td>
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<td>8:00-9:30</td>
<td>ICWS/SERVICES 2009 Opening (Liang-Jie Zhang, Paul Hofmann, and Ephraim Feig)</td>
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<td></td>
<td>ICWS/SERVICES/CLOUD 2009 Keynote 1 (Room: Marquis 1-3)</td>
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<tr>
<td></td>
<td>Cloud Computing for The Enterprise (Maria Azua, IBM Enterprise Initiative, USA)</td>
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<td>Chair: Ernesto Damiani, University of Milan, Italy</td>
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<td>9:30-10:00</td>
<td>AM Break (Room: Foyer)</td>
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<td>10:00-17:00</td>
<td>IEEE Body of Knowledge on Services Computing Initiative</td>
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<td>Internet Access Services</td>
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<td>Scottsdale    Atlanta           Boston       Chicago    Dallas    Denver    Imperial Ballroom D</td>
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<tr>
<td>10:00 - 11:30</td>
<td>Research Session 1          Research Session 2          Application and Industry Session 1          Application and Industry Session 2          SERVICES Session 1          ICWS/SERVICES/CLOUD Tutorial 3          Cloud Computing Innovation Showcase</td>
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<tr>
<td>11:30-12:30</td>
<td>Lunch (not included)</td>
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<tr>
<td>12:30-14:00</td>
<td>Research Session 3          Research Session 4          Application and Industry Session 3          Application and Industry Session 4          SERVICES Session 2          ICWS/SERVICES/CLOUD Tutorial 3          Cloud Computing Innovation Showcase</td>
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<td>14:00-14:15</td>
<td>PM Break</td>
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<tr>
<td>14:15-15:45</td>
<td>Research Session 5          Research Session 6          Application and Industry Session 5          Application and Industry Session 6          SOA Solutioning Session 1          SOA Industry Summit Session 1          ICWS/SERVICES/CLOUD Panel 1</td>
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<td>15:45-16:30</td>
<td>PM Break with Freshments (Room: Foyer)</td>
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<tr>
<td>16:30-18:00</td>
<td>Research Session 7          Research Session 8          Application and Industry Session 7          Application and Industry Session 8          SOA Solutioning Session 2          SOA Industry Summit Session 2          ICWS/SERVICES/CLOUD Panel 5</td>
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<td>ICWS/SERVICES/CLOUD 2009 Banquet Keynote 2: Networked Games &amp; Services at Sony PlayStation</td>
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<td></td>
<td>Ken Miyaki, Director of the Online Technology Group, Sony, USA</td>
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<td>Chair: Ephraim Feig, Innovations-to-Market, USA</td>
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<td></td>
<td>SERVICES COMPUTING CURRICULMN Update (LJ Zhang, Chair of TC on Services Computing)</td>
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<td>Congress Banquet (Room: Marquis 1-3)</td>
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### July 9, 2009 (Thursday)

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<tr>
<td>7:30-8:00</td>
<td>Breakfast (Room: Foyer)</td>
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<td>8:00-9:30</td>
<td>ICWS/SERVICES/CLOUD 2009 Keynote 3 (Room: Marquis 1-3)</td>
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<td></td>
<td>The Impacts of Cloud Computing in the Real World (Ming-Chien Shan &amp; Paul Hofmann, SAP Research, USA)</td>
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<td>Chair: Rong N. Chang (IBM T.J. Watson Research Center)</td>
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<tr>
<td>9:30-10:00</td>
<td>AM Break (Room: Foyer)</td>
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</table>
| 10:00 - 11:30 | Room
| Scottsdale | Research Session 9                                                |
| Atlanta    | Research Session 10                                                 |
| Boston     | Application and Industry Session 9                                   |
| Chicago    | Application and Industry Session 10                                  |
| Dallas     | Research Session 21                                                 |
| Denver     | ICWS/SERVICES/CLOUD Tutorial 4                                       |
| Imperial Ballroom D | Services Cup Session 1                             |
| 11:30-12:30 | Lunch (not included)                                                |
| 12:30-14:00 | Room
| Scottsdale | Research Session 11                                                |
| Atlanta    | Research Session 12                                                 |
| Boston     | Application and Industry Session 11                                  |
| Chicago    | Application and Industry Session 12                                  |
| Dallas     | ICWS/SERVICES/CLOUD Panel 2                                         |
| Denver     | ICWS/SERVICES/CLOUD Tutorial 4                                       |
| Imperial Ballroom D | Services Cup Session 2                             |
| 14:00-14:15 | PM Break                                                             |
| 14:15-15:45 | Room
| Scottsdale | Research Session 13                                                |
| Atlanta    | Research Session 14                                                 |
| Boston     | Application and Industry Session 13                                  |
| Chicago    | Application and Industry Session 14                                  |
| Dallas     | Services Computing Curriculum wiki update                            |
| Denver     | ICWS/SERVICES/CLOUD Tutorial 5                                       |
| Imperial Ballroom D | Services Cup Session 3                             |
| 15:45-16:30 | PM Break with Freshments (Room: Foyer)                              |
| 16:30-18:00 | Room
| Scottsdale | Research Session 15                                                |
| Atlanta    | Research Session 16                                                 |
| Boston     | Application and Industry Session 15                                  |
| Chicago    | Application and Industry Session 16                                  |
| Dallas     | ICWS/SERVICES/CLOUD Panel 3                                         |
| Denver     | ICWS/SERVICES/CLOUD Tutorial 5                                       |
| Imperial Ballroom D | Services Cup Session 4                             |
| 18:30-23:00 | No planned conference activities for conference participants          |
|            | SERVICES, ICWS, and CLOUD Organization Committee Meeting (Invitation Only) |
**July 10, 2009 (Friday)**

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<td>7:30-8:00</td>
<td>Breakfast (Room: Foyer)</td>
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<td>8:00-9:30</td>
<td>ICWS/SERVICES/CLOUD 2009 Keynote 4 (Room: Marquis 1-3)</td>
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<td>Back to the Future: Challenges in Cloud-Based Service Computing (Calton Pu, Georgia Tech, USA)</td>
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<td>Chair: Hemant Jain, University of Wisconsin - Milwaukee, USA</td>
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<td>9:30-10:00</td>
<td>AM Break (Room: Foyer)</td>
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<td>10:00-11:30</td>
<td>Research Session 17</td>
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<td>Research Session 18</td>
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<td>Application and Industry Session 17</td>
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<td>WSSM 2009 (CLOUD)</td>
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<td>SWF 2009</td>
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<tr>
<td>11:30-12:30</td>
<td>Lunch (not included)</td>
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<td>12:30-14:00</td>
<td>Research Session 19</td>
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<td>Research Session 20</td>
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<td>Application and Industry Session 19</td>
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<td>Application and Industry Session 20</td>
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<td>SSMM 2009 (CLOUD)</td>
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<td>SWF 2009</td>
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<td>14:00-14:15</td>
<td>PM Break</td>
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<td>14:15-15:45</td>
<td>Innovation Showcase</td>
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<td>SSMM 2009 (CLOUD)</td>
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<td>Ph.D. Symposium</td>
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<td>SWF 2009</td>
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<tr>
<td>15:45-16:15</td>
<td>Announcement of the 2009 IEEE Services Cup Contest</td>
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<td>Closing Remarks and 2010 Planning</td>
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<tr>
<td>16:15</td>
<td>Have A Great Trip Back Home!</td>
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<tr>
<td>14:00-22:00</td>
<td>Editorial Board Meeting for IEEE Transactions on Services Computing (Invitation Only)</td>
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<td></td>
<td>Chair: Liang-Jie Zhang (Editor-in-Chief, IEEE Transactions on Services Computing)</td>
</tr>
</tbody>
</table>
Joint SERVICES-1, ICWS 2009, and CLOUD 2009 Keynote 1
Cloud Computing for the Enterprise (Congress2009-1001)

Maria Azua
Vice President of Cloud Computing Enablement, IBM Enterprise Initiative, USA

Abstract:
In this talk, some strategic directions on the implementation, deployment and operations of internal cloud computing offerings as well as external development clouds will be presented. This talk will also cover the creation of a vibrant and engaged community of ISVs, Business Partners, and technical community to foster cloud computing IT methodologies and programming models.

About the Speaker:
Maria Azua is vice President of Cloud Computing Enablement, Enterprise Initiatives at IBM. She reports to IBM CTO of Enterprise Initiatives. Prior to this position, she was the vice president of technology and innovation for the IBM Corporation. She was responsible for improving the productivity of employees by identifying and integrating new technologies and solutions into the workplace.

Maria graduated with honors and a bachelor's degree in math and physics from the University of Puerto Rico. She also obtained a master's in computer science from the University of Miami and an MBA from Florida Atlantic University. She joined IBM in 1989 and held a variety of technical staff and management positions before reaching her current executive position. As an engineer, Maria has garnered the most prestigious technical recognition available at IBM. She is a Distinguished Engineer and Master Inventor with 45 approved patents and another 43 applications pending. She also is a member of the IBM Academy of Technology, an elite think tank of 300 of IBM's top technologists and scientists.

Joint SERVICES-1, ICWS 2009, and CLOUD 2009 Keynote 2
Networked Games & Services at Sony PlayStation (Congress2009-1002)

Ken Miyaki
Director, Sony, USA

Abstract:
In 2002, the launch of the PlayStation network adapter changed the face of console games forever. This paradigm shift shook the very foundation of the business, and was responsible for the re-evaluation of fundamental operating processes. Little did we know just how much the change would impact the future of disc-based games. See and learn about the journey that online games have had within Sony, and get a glimpse into the technologies driving the online experience in PlayStation.

About the Speaker:
Ken Miyaki is Director of the Online Technology Group within Sony Computer Entertainment Worldwide Studios. He has been with the company since 2002, and has worked with many of the premiere Sony game development studios to create cutting edge online game titles on the PlayStation platforms. His current role focuses on driving various network-related initiatives forward, and ensuring that business needs are met with appropriate and timely technologies.

Joint SERVICES-1, ICWS 2009, and CLOUD 2009 Keynote 3
The Impacts of Cloud Computing in the Real World (Congress2009-1003)

Ming-Chien Shan, Ph.D.
Vice President, SAP Research, USA

Paul Hofmann, Ph.D.
Vice President Research, SAP Labs, USA

Abstract:
The emerging cloud computing seems to become one of the mainstream of underlying infrastructure supporting business IT operations. It presents new business opportunities as well as technical challenges not only for new Web applications but also for traditional business applications like ERP. In this talk, we will discuss what is needed to run enterprise applications in a cloud computing environment. We will start with the tradeoffs of the different classes of cloud computing for biz applications. What are the advantages of hardware virtualization ala Amazon at the one end and framework virtualization ala Google and Salesforce at the other end? We will highlight the challenges on the enterprise software stack for on-demand operations. Finally, we will discuss what role the web services will play in this new era.

About the Speakers:
Dr. Ming-Chien Shan is a Vice President at SAP Research. Currently, he assumes the responsibility of SAP DBMS and Business intelligence research and SaaS pilot development. Dr. Shan started his career at IBM in 1977 leading the DB2 technology transfer from research lab to product division. He then joined HP in 1985 and took various senior management positions at HP to supervise research programs and product developments, including object-oriented DBMS, heterogeneous DBMS, business process management and business intelligence. Dr. Shan received his PhD degree in computer science from University of California, Berkeley. He has published more than 100 research papers and been granted 40 software patents. He served US National Science Foundation as University Grant Examiner for Intelligent database management, workflow and
Dr. Paul Hofmann is Vice President Research at SAP Labs at Palo Alto. Before joining SAP Research Paul worked for the SAP Corporate Venturing Group. Paul joined SAP 2001 as Director Global Strategic Supply Chain Management Initiative EMEA. His pre-sales team designed and rolled out the SCM Value Based Selling Approach for EMEA and supported many crucial Supply Chain sales for SAP in EMEA. Prior to joining SAP, he was Senior Plant Manager at BASF’s Global Catalysts Business Unit in Ludwigshafen, Germany. After joining BASF 1989 Paul headed the development of object-oriented production planning and scheduling software for BASF’s plants in the IT division of BASF. In collaboration with OO veterans like Bertrand Meyer and Edward V. Berard he and his team designed a Manufacturing Execution System for BASF; one of the first big object oriented software projects in German industry. Later Paul headed the team that implemented R/3 at BASF’s Intermediate Division. Paul was Researcher and Assistant Professor at top German and US Universities, like Northwestern University in Evanston/Chicago, Illinois, USA and at Technical University in Munich, Germany. At Northwestern he did molecular simulations to explain molecular beam reactions. He used the Cray supercomputers extensively for this work and collaborated with Sir John Pople (Nobel Prize Laureate). At Munich Paul used Associative Memory Systems -AMS- (Neuronal Networks) to predict chemical reactions in mass spectrophotographs. Paul studied Chemistry and Physics at the University of Vienna, Austria. He received a Bachelor in biotechnology and a master’s degree in Chemistry from the University of Vienna. He did his Ph.D.in Physics at the Darmstadt University of Technology, Germany. At Darmstadt he wrote SW for the design of molecules (drugs) using computer graphics. He was part of a team that developed SW for Silicon Graphics MOLCAD. His thesis is on non-linear quantum dynamics and chaos theory. He is the author of numerous publications and books, including a book on SCM and environmental information systems as well as Performance Management and Productivity of Supply Chains.

**Joint SERVICES-1, ICWS 2009, and CLOUD 2009 Keynote 4**

**Back to the Future: Challenges in Cloud-Based Service Computing** *(Congress2009-1004)*

Calton Pu, Ph.D.
Professor and John P. Imlay, Jr. Chair in Software
Georgia Tech, USA

**Abstract:**

Computing clouds offer information technology infrastructure as services with promises of economy of scale and low start-up costs. However, the management of modern N-tier applications contains significant challenges due to several factors that include growing and evolving complexity of applications, non-stationary workloads, virtualization and consolidated environments, and dynamic service composition. Furthermore, paramount to mission-critical service applications are extra-functional quality of service (QoS) properties such as predictable performance, continuous availability, end-to-end dependability, power consumption, privacy and security. These challenges far exceed the capability of current analytical models for capacity planning and system management. As a starting point towards cloud-based service computing, we describe an observational large-scale performance study of N-tier application benchmarks in the Elba project. More generally, we advocate an experimental approach to help N-tier applications achieve desired QoS, for example, performance goals specified in service level agreements. Meeting the challenges of QoS is an important and necessary step in the co-evolution of both Cloud Computing and Service Computing.

**About the Speaker:**

Dr. Calton Pu was born in Taiwan and grew up in Brazil. He received his PhD from University of Washington in 1986 and served on the faculty of Columbia University and Oregon Graduate Institute. Currently, he is holding the position of Professor and John P. Imlay, Jr. Chair in Software at the College of Computing, Georgia Institute of Technology. He has worked on several projects in systems and database research. His contributions to systems research include program specialization and software feedback in the Synthesis, Synthesix, and Infosphere projects. His contributions to database research include extended transaction models and their implementation such as Epsilon Serializability and Reflective Transaction Framework. His recent research has focused on event processing (Continual Queries over the Internet), automated system management (Elba project) and services computing (dependable systems software). His collaborations include applications of these techniques in scientific research on macromolecular structure data, weather data, environmental data, and health care. He has published more than 50 journal papers and book chapters, 150 conference and referred workshop papers, and served on more than 100 program committees, including the co-PC chairs of SRDS’95, ICDE’99, COOPIS’02, SRDS’03, DOA’07, DEBS’09, and co-general chair of ICDE’97, CIKM’01, ICDE’06, DEPSA’07, CEAS’07, SCC’08, CollaborateCom’08.

- 8 -
Panel 1

**Industry Advances in Cloud Computing:**

**Technical challenges and Business Implications** *(Congress2009-1005)*

**Chair:** Geng Lin, Chief Technology Officer, IBM Alliance, Cisco Systems

**Abstract:**

In 2008, the business concept of cloud computing was recognized as a true market transformation in the IT industry. The three-tier cloud model—infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS)—is becoming widely accepted as the common taxonomy across the industry for cloud services. In 2009, the focus is now on how to solve critical technology and business issues in order to build and deliver cloud services. In other words, the discussion around clouds has shifted from “what and why” to “how and when.”

In this panel session, we invite industry technology experts and business leaders to discuss the latest technology advances and business challenges in cloud computing. The audience will have a first-hand opportunity to discuss with technology experts and business leaders on issues such as cloud middleware architecture, multi-tenant cloud service architecture, cloud-enabling network architecture, private-public cloud integration, Intercloud service interoperability, and cloud standards. The panel will also examine cloud-related business implications stemming from the fundamental technological paradigm shifts such as the cloud-centric programming model vs. the client-server programming model, network intelligence in delivering cloud services vs. network as layer-3 connectivity, Internet-scale data mining and processing vs. enterprise scale data mining and processing, just to name a few.

The audience of this panel is targeted at advanced researchers and practitioners in cloud computing.

**About Moderator:**

Geng Lin is the Chief Technology Officer of IBM Alliance at Cisco Systems where he is responsible for technology strategy of the joint Cisco-IBM solutions world wide, covering the areas of data center, unified communications, video/digital media, and NMS/OSS. Prior to Cisco, he was Vice President of Software Engineering at Netopia Inc, a Motorola company. Netopia was a leader in IP broadband services and rich media applications and was acquired by Motorola. Geng has more than 16 years of industry experience in networking, Internet-based communications software and rich media solutions.

Geng is a frequent speaker at various conferences and tradeshows in communications software and distributed computing. He served on the editorial boards of two research journals in Web Services, SOA and large-scale software systems. He holds B.Sc. and M.Sc. degrees from Peking University and a Ph.D. degree from University of British Columbia, all in Computer Science.

Panel 2

**From SaaS to XaaS: Evolution and Outlook of Software Cloud** *(Congress2009-1006)*

**Chair:** Tony Shan, Chief Architect/Strategist & Practice Lead, CTS Inc., USA

**Panelists:**

- Paul Hofmann, Vice President Research, SAP Labs, USA
- Ephraim Feig, President, Innovations-to-Market, USA
- Jia Zhang, Assistant Professor, Northern Illinois University, USA

**Abstract:**

As Software-as-a-Service (SaaS) has evolved to other cloud computing solutions such as Platform-as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS) over the last few years, a question is raised as to how it will further expand and what will constitute the cloud computing model. It can be foreseen that the engineering practices will be adopted and enabled in the strategization and operationalization of cloud computing in the enterprise environments. Now, is the engineering of cloud computing a disruptive innovation? In other words, is the discipline of cloud engineering a convergence of the traditional IT-related engineering practices, such as software engineering, systems engineering, web engineering, service engineering, and platform engineering? Or is the cloud engineering in its own domain, dealing with the unique challenges faced by the cloud computing, like multitenancy as an example?

The purpose of this panel is to present a set of perspectives to position the technologies in cloud computing in relation to established solutions and disciplines. The session will be focused on identifying the synergy and interlocks as well as interoperations, including topics on, for instance, SOA versus cloud, SQL versus Dynamo/BigTables, taxonomy, interoperability, and other relevant subjects.

**About the moderator:**

Tony Shan is a renowned expert and technology visionary working in the computing field for 20+ years with extensive experience and guru-level knowledge on systems designs, architecture engineering, portfolio rationalization, product development, process standardization, and SDLC. Holding three advanced degrees and multiple industry certifications as a chief/enterprise architect, he has directed the lifecycle design and development of large-scale award-winning distributed systems on diverse platforms. He has initiated advanced applied research and prototyping on emerging computing technologies and methodology, and has played a crucial role of a hands-on strategist in leading establishing IT strategies and architecture blueprints, coupled with pragmatic technology roadmaps and enterprise architecture standards/policies, for IT governance and portfolio/asset management in Fortune 100 international organizations. He serves as a mentor/advisor on leading-edge technologies in various technical committees and advisory boards, and teaches courses as an adjunct professor. In addition to dozens of top-notch refereed technical publications, he has co-authored over 10 books on next-generation technologies. He is a member of numerous professional associations and honorary society, a frequent keynote speaker and Chair/Panel/Advisor/Organizing Committee in prominent conferences/workshops, an editor/editorial advisory board member of respected IT research journals/books, and a founder of several user groups and forums.
Panel 3  
Application Clouds: Deployment, Testbeds, Benchmarking, and Practices (Congress2009-1007)  

Chair: Dejan Milojicic, HP Labs, USA  

Abstract:  
Cloud Computing is changing the data centers and computing models paradigm. However, most of the Cloud Computing discussions today revolve around defining it at the high level. In this panel, we will discuss the use of today’s examples of Cloud Computing infrastructure and services. In particular, we will focus on the deployments of Cloud Computing, the testbeds, and the benchmarking. This panel will address some real deployment issues, such as cost, return on investment, supporting clouds, developing and using cloud software stack, etc. We will also discuss and compare clouds deployments among themselves as well with other technologies in the past, such as clusters, Grids, and high performance computing.

About the Moderator:  
Dr. Dejan Milojicic is a senior researcher and a senior manager at HP Labs, where he leads a number of projects and programs. Currently he works on serviceability architecture of HP products and also technically leads the Open Cirrus Cloud Computing testbed, a collaboration between HP, Intel, Yahoo, UIUC, KIT, and IDA. He has worked in the area of operating systems, distributed systems, and service management for more than 20 years. He has been the program chair of the IEEE Agent Systems and Applications Symposium (ASA/MA’99) and of the first USENIX Workshop on Industrial Experiences with System Software (WIESS’2000). Dr. Milojicic published in many journals and at various events. He is currently on the editorial board of IEEE Internet Computing and he is an inaugural editor of IEEE Computing Now, a front end to all IEEE magazines. He has been engaged in various standardization bodies, such as OMG and Global Grid Forum. He is a member of the ACM, IEEE, and USENIX and an ACM distinguished engineer. He received his BSc and MSc from University of Belgrade and his PhD from University of Kaiserslautern. Prior to HP Labs, Dejan worked at Institute “Mihajlo Pupin”, Belgrade and at OSF Research Institute, Cambridge, MA.

Panel 4  
Business and Enterprise Cloud (Congress2009-1008)  

Chair: Calton Pu (Georgia Institute of Technology)  

Abstract:  
Cloud computing has evolved from data centers and grid computing to fill the entire spectrum ranging from raw physical infrastructure to end-user software as a service. For example, one class of applications that run well on clouds is the parallel processing of large data sets such as MapReduce on BigTable or Hadoop for web search and time series analysis. These applications fall into the “embarrassingly parallel” category, achieving scalable resource scheduling with ease. Similarly, the non-mission-critical nature of these applications requires modest recovery facilities.

In contrast, business and enterprise applications (e.g., N-tier e-commerce applications involving web servers, application servers, and database servers) are characterized by interdependencies among the system components, non-stationary workloads, and extra-functional requirements such as service level agreements on performance and business continuity on availability. Many research and practical challenges arise due to these enterprise application requirements. For example, the interdependencies and asymmetry among the various servers of N-tier applications make their performance prediction much more difficult than achievable by typical assumptions made in queuing theory models. This is a serious challenge when strict response time requirements are imposed by service level agreements. Similarly, typical enterprises require business continuity availability, which cannot be easily achieved by virtual machine movement facilities alone.

This panel will discuss the research and practical challenges in the development of cloud computing environments to support business and enterprise applications in service computing. Topics of discussion start at the base level with the complexity due to business application requirements beyond the embarrassingly parallel scalability and evolution of business applications on clouds, and accountability due to legal and mission-critical constraints. At the second level, the automation of business application resource management through growth and evolution add to the base level complexity. At the third level, the guarantees offered by a cloud for executing automated and complex business applications require significant progress in static and dynamic validation of service-based system properties. At the fourth level, the integration of interoperation of automated, complex, and guaranteed business applications in a cloud environment present both challenges and opportunities for services computing.

About the Moderator:  
Dr. Calton Pu was born in Taiwan and grew up in Brazil. He received his PhD from University of Washington in 1986 and served on the faculty of Columbia University and Oregon Graduate Institute. Currently, he is holding the position of Professor and John P. Imlay, Jr. Chair in Software at the College of Computing, Georgia Institute of Technology. He has worked on several projects in systems and database research. His contributions to systems research include program specialization and software feedback in the Synthesis, Synthetix, and Infosphere projects. His contributions to database research include extended transaction models and their implementation such as Epsilon Serializability and Reflective Transaction Framework. His recent research has focused on event processing (Continual Queries over the Internet), automated system management (Elba project) and services computing (dependable systems software). His collaborations include applications of these techniques in scientific research on macromolecular structure data, weather data, environmental data, and health care. He has published more than 50 journal papers and book chapters, 150 conference and refereed workshop papers, and served on more than 100 program committees, including the co-PC chairs of SRDS’05, ICDE’06, CLOUD’07, ECOOP’02, SRDS’03, DOA’07, DEBS’09, and co-general chair of ICDE’07, CIKM’01, ICDE’06, DEPSA’07, CEAS’07, SCS’08, CollaborateCom’08.
Modernizing Civil Aviation Services with Services Computing

Chair: Casey Fung, Boeing Phantom Works, USA
Panelists:
- Timothy M. Mitchell, Boeing, USA
- Patrick C. K. Hung, University of Ontario Institute of Technology, Canada
- Chi Hung Chi, Tsinghua University, Beijing, China
- Mansour Rezaei Mazinani, SITA, France

Abstract:
The civil aviation system is a global enterprise that includes airframe, engine and component manufacturers, airlines, maintenance organizations, regulatory agencies, airports, air traffic control authorities and millions of service providers that must work together effectively to ensure cargo and passengers get to their destinations as scheduled, while traveling safely and efficiently. The system includes a bewildering array of commercial and custom developed systems for monitoring and controlling the operations of the participant.

The news has been filled with examples of operations not working as smoothly as we all hope. Passengers have been stranded on taxi-ways, flights cancelled for weather and maintenance inspections and crowds of passengers complaining of lost baggage have become common as civil aviation grows. The growth has been rapid and shows no signs of abating. To cater the new decade of this competitive Web 2.0 world, we need to find ways to:

- Improve communications between manufacturers, airlines and regulatory agencies to defend the civil aviation industry’s unmatched safety records in the face of increasing traffic.
- Orchestrate and streamline workflow among the hundreds of collaborating organizations that keep civil aviation functioning.
- Improve the services the civil aviation industry provides a diverse flying public to increase their enjoyment of the travel experience.

Services Computing is believed to provide a means of enhancing communications between heterogeneous systems that make up the civil aviation transportation systems. A Web service is a software component that supports interoperable component-to-component interaction over a network. Each service makes its functionality available through well-defined or standardized XML interfaces. Web services do not work together by coincidence. Smoothly interacting systems in a network of the scale described here will require initial investment in building an enabling platform. Crafting a services computing architecture is the first step towards this infrastructure. Openness and standardization are key ways to accumulate resources and spread the risk of capitalization. This panel will focus on finding a vision and roadmap for initiating an interoperable and scalable civil aviation with services computing that is sustainable and self-actuating in the long run.

About the Moderator:
Casey K. Fung is Associate Technical Fellow in Boeing Research and Technology. He is principal investigator for projects such as Wireless Ground Services at Airport, Open Aviation Services Platform, Mobile Maintenance Assistant and other Web services related research projects. Casey is the lead inventor of a methodology for the development of mobile wireless services that are resilient to attacks, failures, or accident. He was Affiliate Professor at University of Washington, Seattle. He obtained B.S. in Electrical Engineering from Ohio University, Ph.D. in Computer and Information Science from Ohio State University, Columbus.
Cloud Computing: Architecture, Business Value, and Innovation Opportunities
Liang-Jie Zhang, Ph.D.
IBM T.J. Watson Research Center, USA

Abstract:
As an innovative services delivery platform in the field of Services Computing, Cloud Computing has been evolved as a major enabling environment to support the virtualization of everything as a service. It has found its role in facilitating the business and technical professionals in the industry. There are many questions asked by the members in the community. For example, what is Cloud Computing? Why do we need to leverage Cloud Computing? Where do we need to use it? How to leverage Cloud Computing? How to build a private Cloud Computing platform? How to enable interactions between clouds? How to design, develop, deploy, and manage applications for Cloud Computing?

Yes, there is no clear definition and scope about Cloud Computing today. This tutorial will help address all those questions you may have and share with you the technical challenges and business value of Cloud Computing in a systematic way. Specifically, the resource sharing scenarios have been categorized at levels of infrastructure sharing, software sharing, application sharing, and business process sharing in this tutorial. I will share with you the technical challenges of building, operating, and managing a scalable and extensible Cloud Computing platform first. Then this tutorial will present “architectural thinking” of the Cloud Computing and its value-added services. Major architectural principles and architectural modules will be presented to guide business leaders and practitioners to explore the business value of Cloud Computing in a disciplined approach. Strategic planning and entry points will be illustrated to lead Cloud Computing transformation initiatives based on the service-oriented consulting methodologies and enterprise modeling methods in the field of Services Computing.

Case studies on infrastructure cloud offering, business cloud offering, social network cloud offering based on a unified Cloud Computing architecture will be presented in the tutorial as well. After the introduction of the technical vision and business value analysis, this tutorial will summarize a set of innovation opportunities that address technical challenges and business value exploration by integrating the power of service-oriented architecture (SOA) and virtualization of hardware and software. Are you ready to lead the weaves of Cloud Computing in the industry? “Change we can lead” is the expected outcome of this tutorial.

About the speaker:
Dr. Liang-Jie Zhang is a research staff member (RSM) and program manager of application architectures and realization at IBM T.J. Watson Research Center. Currently, he leads the creation of Cloud Computing Open Architecture and associated methods/tools. He is the worldwide leader of IBM’s SOMA Modeling Environment (SOMA-ME), which is the model-driven SOA (Service-Oriented Architecture) solution design platform from IBM. He is also the worldwide co-leader of IBM’s SOA Solution Stack (a.k.a. SOA Reference Architecture) project. He is the lead author of book “Services Computing” published in 2007 by Springer. He has published more than 100 technical papers in journals, book chapters, and conference proceedings. He has received 2 IBM Outstanding Technical Achievement Awards, 10 IBM Plateau Invention Achievement Awards, an Outstanding Achievement Award by the World Academy of Sciences, and an Innovation Leadership Award from Chinese Institute of Electronics. Dr. Zhang has 36 granted patents and 20 pending patent applications. As the lead inventor, he holds federated Web services discovery and dynamic services composition patents. He is the founding chair of IEEE Computer Society Technical Committee on Services Computing and IBM Research Services Computing Professional Interest Community (PIC). Dr. Zhang currently serves as the Editor-in-Chief of IEEE Transactions on Services Computing (TSC) and chairs the program committee of the 2009 IEEE International Conference on Cloud Computing (CLOUD 2009).

Mashups: From Hosted Web Content to the Edge, Peer-to-Peer, and Beyond
Krzysztof Ostrowski
Cornell University, USA

Abstract:
In the past few years, the Web has been revolutionized by technologies such as Web Services, AJAX, and Rich Internet Application frameworks such as Adobe Flex/AIR, JavaFX, and Microsoft Silverlight; what all these technologies have in common is that they facilitate mashups, composition, and reuse of different types of content or services. The ability to easily mix and juxtapose, share and collaborate, combine and replace components, documents, and media has been the essential factor responsible for this success. Underlying these developments were the same object-oriented design principles that revolutionized programming desktop applications a few decades earlier: the idea that different types of content, services, and resources could be embedded and treated uniformly within the same programming environment.

Today, the Web is on the verge of another major evolutionary step; the need for scalability will stimulate convergence between existing client-server platforms and technologies such as edge or peer-to-peer computing. This will give rise to entirely new types of Web applications that can take advantage of direct peer-to-peer connectivity and enable tens of thousands of users to share their interactive experience. Object-oriented principles are again at the core of this process. The convergence requires new kinds of tools that allow hosted and peer-to-peer content to be handled uniformly and composed within the same integrated environment. Technologies that can facilitate this have already started emerging.

In this tutorial, we offer an integrated perspective on the state of the art and emerging mashup and component integration technologies for the Web. At the end of this tutorial, the audience should have a grasp of the relative strengths and weaknesses of the existing platforms, and a solid understanding of how edge and peer-to-peer technologies can be used to build scalable Web applications. The tutorial doesn’t require familiarity with any existing platforms or languages.

The first part of the tutorial focuses on surveying and comparing state of the art web development technology, including WS-* and SOA standards, JavaScript/AJAX, and Rich Internet Application toolkits such as Microsoft Silverlight. We contrast these technologies with object-oriented technologies such as .NET, Java/J2EE, OLE/COM/ActiveX, and Jini. We discuss the issues that arise when applying current technologies in the context of edge and peer-to-peer computing.

The rest of the tutorial introduces Live Distributed Objects, an emerging programming model and platform for the Web that applies a uniform object-oriented perspective across hosted and peer-to-peer content, and allows different types of content to be seamlessly combined into rich interactive applications. Rather than on a platform itself, we focus on the architectural principles, design methodology, and programming patterns; hence, the lessons learned should be applicable to other emerging technologies in this space. In particular, we explain how peer-to-peer
Service-Oriented Model-Driven Solution Architecture Design, Rationalization, and Practices (Congress2009-1012)

Tony Shan
IBM Global Technology Services, USA

Abstract:
This tutorial is aimed at presenting a high-level overview of the underlying complexity at different levels of architecture models in an IT solution, and offering a pragmatic set of approaches to holistically manage the architecture design concerns and considerations in a systematic fashion. A wide variety of important aspects in SOA solution development are addressed with regard to the architecture design, rationalization, integration and practices (DRIP) from a practitioner’s perspective. Firstly, dozens of architecture methods and frameworks are reviewed and assessed, to illustrate the state of the art of the landscape and the trend of unification. Secondly, a multidisciplinary view of the design tenets, idioms, principles and styles (TIPS) in the IT architecting practices are investigated, focusing on the fundamental doctrines in SOA development. Thirdly, a comprehensive method is presented, which comprises four dimensions of architecting activities: Requirement Analysis, Specification, Validation, and Planning (RSVP). The progressive process is broken down to 11 interrelated models: Meta-Architecture, Contextual Architecture, Conceptual Architecture, Logical Architecture, Physical Architecture, Deployment Architecture, Management Architecture, Security Architecture, Information Architecture, Aspect Architecture, and Component Architecture. Fourthly, a 2-D matrix is defined as a blueprint to denote a step-by-step procedure to produce and manage the architectural artifacts and deliverables in the lifecycle of systems architecture analysis, design, development and governance. Fifthly, a SOA transformation strategization and operationalization approach, named SORT, is presented, to demonstrate a model-driven architecture reengineering case study in a large organization. Lastly, the standards and specifications related to SOA are examined in-depth in the format of a stack composed of layers and pillars.

The characteristics and features of the constituent elements in this overarching framework are drilled down in great detail. Real-life project experience, practical examples, patterns, best practices, practitioner guide, gaps, challenges, recommendations and future trends are also discussed in the context. The synergy of SOA and emerging technologies, such as Cloud Computing, is also articulated. The framework helps build high-quality service-oriented solutions tailored for different domains, and in the meantime keeps the agility, flexibility and adaptiveness of the overall method.

About the speaker:
Tony Shan is a renowned expert and technology visionary working in the computing field for 20+ years with extensive experience and guru-level knowledge on systems designs, architecture engineering, portfolio rationalization, product development, process standardization, and SDLC. Holding three advanced degrees and multiple industry certifications as a chief/enterprise architect, he has directed the lifecycle design and development of large-scale award-winning distributed systems on diverse platforms. He has initiated advanced applied research and prototyping on emerging computing technologies and methodology, and has played a crucial role of a hands-on strategist in leading establishing IT strategies and architecture blueprints, coupled with pragmatic technology roadmaps and enterprise architecture standards/policies, for IT governance and portfolio/asset management in Fortune 100 international organizations. He serves as a mentor/advisor on leading-edge technologies in various technical committees and advisory boards, and teaches courses as an adjunct professor. In addition to dozens of top-notch refereed technical publications, he has co-authored over 10 books on next-generation technologies. He is a member of numerous professional associations and honorary society, a frequent keynote speaker and Chair/Panel/Advisor/Organizing Committee in prominent conferences/workshops, an editor/editorial advisory board member of respected IT research journals/books, and a founder of several user groups and forums.

Serviceability, State of the Art and Trends (Congress2009-1013)

Dejan Milojicic
HP Labs, USA

Abstract:
In this tutorial, we present the state of the art of the serviceability for commercial computing systems. We use HP support organization, tools and technologies as an example of how industry today supports enterprise grade systems. In particular, we evaluate support automation, call centers, field engineers, and parts supplies. We then analyze opportunities for improvement through more extensive use of approaches, such as self-healing, unified serviceability, automated learning, and analysis engines. We dissect how improvements can be achieved by moving between reactive, deferred, and proactive service delivery.

As a case study, we evaluate how serviceability will evolve in Cloud Computing environments. We explore Cloud providers perspective, as well as transition path for traditional enterprise organizations. We evaluate the trends of average incident cost for value, volume, and Cloud systems; we compare “break-fix”, software, applications, and services. Finally, we compare industrial support organizations and the way they deliver service of incidents. We also draw some analogies with other industries, such as automotive, railroad, and aircrafts. We derive some directions for serviceability of the future and what it means for end-users as well as serviceability providers.

About the speakers

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Dr. Dejan Milojicic is a senior researcher and a senior manager at HP Labs, where he leads a number of projects and programs. Currently he works on serviceability architecture of HP products and also technically leads the Open Cirrus Cloud Computing testbed, a collaboration between HP, Intel, Yahoo, UIUC, KIT, and IDA. He has worked in the area of operating systems, distributed systems, and service management for more than 20 years. He has been the program chair of the IEEE Agent Systems and Applications Symposium (ASA/MA’99) and of the first USENIX Workshop on Industrial Experiences with System Software (WIES’2000). Dr. Milojic published in many journals and at various events. He is currently on the editorial board of IEEE Internet Computing and he is an inaugural editor of IEEE Computing Now, a front end to all IEEE magazines. He has been engaged in various standardization bodies, such as OMG and Global Grid Forum. He is a member of the ACM, IEEE, and USENIX and an ACM distinguished engineer. He received his BSc and MSc from University of Belgrade and his PhD from University of Kaiserslautern. Prior to HP Labs, Dejan worked at Institute "Mihajlo Pupin", Belgrade and at OSF Research Institute, Cambridge, MA.

**Tutorial Session 5**

**Business-Driven Management and Governance of Service-Oriented Systems**

Claudio Bartolini  
HP Laboratories, USA  
arnd University of Ferrara, Italy

Patrick C.K. Hung  
University of Ontario Institute of Technology, Canada  
and University of Waterloo, Canada

**Abstract:**

Management (monitoring and control) of service-oriented systems is needed to ensure their regular operation, attain guaranteed quality of service (QoS), and accommodate changes. Monitoring measures technical QoS (e.g., response time, availability) and/or business value metrics (e.g., profit, return on investment, customer satisfaction). Control ensures (reactively and/or proactively) that there are no faults and that the measured quantities are within desired boundaries. IT (information technology) governance is a set of organization’s policies, plans, and processes that direct how its IT resources are used over a longer time. To be successful, management and governance issues should be considered not only during deployment and run-time, but also during design-time software engineering activities.

We present how service-oriented software systems can be made more successful from the business viewpoint by using governance and management that maximizes business value metrics. The tutorial first clarifies importance of these topics and why the widely used basic Web service technologies are not enough. Then, it explains theoretical principles for specification, monitoring, and control of QoS and business value metrics. It also provides a critical analysis of several important research achievements and industrial products in this area. Then, we present an introduction to business-driven IT management (BDIM) and possible approaches to extend management solutions maximizing QoS into solutions maximizing business value metrics. Furthermore, we overview the major IT governance frameworks and discuss their relevance for value-based software engineering of service-oriented systems. At the end, a number of open topics and resources for further study are identified.

**About the speakers:**

**Claudio Bartolini** is a Principal Researcher at HP Laboratories in Palo Alto, USA. His background is on architecture and design of software systems and frameworks. His current research interest is in methodologies for business and IT alignment. In addition to many journal, conference, and workshop papers and book chapters, he co-authored the W3C WSCL specification and holds a number of patents in various countries. He chaired a number of conferences and workshops and presented tutorials at several international conferences. Claudio envisioned, founded and chairs the series of IEEE workshops on business-driven IT management (BDIM) since 2006. His Web site is located at [http://www.hpl.hp.com/personal/Claudio_Bartolini](http://www.hpl.hp.com/personal/Claudio_Bartolini).

**Patrick Hung** is an Associate Professor and IT Director at the Faculty of Business and Information Technology in UOIT, Canada and an Adjunct Assistant Professor at the Department of Electrical and Computer Engineering in University of Waterloo. He is an executive committee member of the IEEE Computer Society's Technical Steering Committee for Services Computing, a steering member of EDOC "Enterprise Computing,“ and an associate editor/editorial board member/guest editor in several international journals such as the IEEE Transactions on Services Computing, International Journal of Web Services Research (IJSR) and International journal of Business Process and Integration Management (IJBPIM). His web site is located at [http://www.cs.ust.hk/~cshck/](http://www.cs.ust.hk/~cshck/).
Markov-HTN Planning Approach to Enhance Flexibility of Automatic Web Services Composition

Kun Chen, Jiayan Xu, Stephan Reiff-Marganiec
(ICWS2009-0002)

Automatic Web services composition can be achieved by using AI planning techniques. HTN planning has been adopted to handle the OWL-S Web service composition problem. However, existing composition methods based on HTN planning have not considered the choice of decompositions available to a problem which can lead to a variety of valid solutions. In this paper, we propose a model of combining a Markov decision process model and HTN planning to address Web services composition. In the model, HTN planning is enhanced to decompose a task in multiple ways and hence be able to find more than one plan, taking both functional and non-functional properties into account. Furthermore, an evaluation method to choose the optimal plan and some experimental results illustrate that the proposed approach works effectively.

Control Flow Requirements for Automated Service Composition

Piergiorgio Bertoli, Raman Kazhamiakin, Massimo Paolucci, Marco Pistore, Heorhi Raik, Matthias Wagner
(ICWS2009-0003)

Automated composition of services is a key functionality for the adoption of the service-oriented development paradigm. Solving this problem in practice requires the ability to consider asynchronous stateful services and to express complex composition requirements which may span different phases of the life-cycle of component services. In this paper we present a novel automated service composition approach which addresses these challenges by associating so-called objects to services, and by introducing a simple yet powerful notation to express composition requirements on them. We recast this view of the problem as a specific form of planning; our experiments on a prototype implementation witness the ability of our approach to deal with realistic scenarios and requirements that cannot be tackled by other current approaches.

A Plug-in Architecture for Self-Adaptive Web Service Compositions

Anis Charfi, Tom Dinkelaker, Mira Mezini
(ICWS2009-0005)

Several approaches have been proposed to introduce self-management capabilities for web service compositions. However, most of these works are limited as they are not extensible, i.e., new self-adaptation features cannot be supported, and even if that is possible then still this cannot be done dynamically while the composite services are running. In addition, many of these works are not based on the servicecomposition standard WS-BPEL. In this paper, we propose a plug-in architecture for self-adaptive web service composition, in which self-adaptation features are well-modularized in aspect based plug-ins. Our approach supports application-specific/adaptation scenarios, is easily extensible, and allows self-adaptation logic to be hot-deployed on running process instances. We have implemented this architecture and several plug-ins using the dynamic aspect-oriented workflow language AOPBPEL.

Selective Querying for Adapting Hierarchical Web Service Compositions Using Aggregate Volatility

John Harney, Prashant Doshi
(ICWS2009-0006)
Environments in which Web service compositions (WSC) operate are often dynamic. We address the problem of which service to query for up-to-date information in order to adapt a hierarchical WSC, given that queries are not free. Previously, the value of changed information (VOC) has been proposed to select those services for querying whose revised non-functional information is expected to bring about the most change in the composition. In this paper, we present an approach for utilizing VOC in the context of a WSC composed of services and lower level WSCs, which induces a natural hierarchy over the composition.

**Research Track 3 – Services Change Management**

**Session Chair: Scott Tilley, Florida Institute of Technology, USA**

**What are the Problem Makers: Ranking Activities According to their Relevance for Process Changes**

*Chen Li, Manfred Reichert, Andreas Wombacher*  
(ICWS2009-0007)

Recently, a new generation of adaptive process management technology has emerged, which enables dynamic changes of composite services and process models respectively. This, in turn, results in a large number of process variants derived from the same process model, but differing in structure due to the applied changes. Since such process variants are expensive to maintain, the process model should be evolved accordingly. In this context, we need to know which activities have been more often involved in process adaptations than others, such that we can focus on them when reconfiguring the process model. This paper provides two approaches for ranking activities according to their involvement in process adaptations. The first one allows to precisely rank the activities, but is expensive to perform since the algorithm is at NP level. We therefore provide as alternative an approximation ranking algorithm which computes in polynomial time. The performance of the approximation algorithm is evaluated and compared through a simulation of 3600 process models. Statistical significance tests indicate that the performance of the approximation ranking algorithm does not depend on the size of process models, i.e., our algorithm can scale up.

**Distributed Cross-Domain Change Management**

*Bruno Wassermann, Heiko Ludwig, Jim Laredo, Kamal Bhattacharya, Liliana Pasquale*  
(ICWS2009-0008)

Distributed systems increasingly span organizational boundaries and, with this, system and service management domains. Web services are the primary means of exposing services to clients, be it in electronic commerce, Software-as-a-Service (SaaS) or on cloud platforms and are being used and integrated with customer-managed applications as well as in complex mashups. Maturing cross-domain relationships and an increase in loose coupling and ad-hocness makes managing configuration changes, e.g., changes in interfaces or endpoints, increasingly relevant. Traditional service management processes within organizations, in particular change management, relies on a central configuration management database (CMDB) to assess the impact a change has on other components of the system. However, this approach does not work in a cross-domain environment, due to the lack of a central CMDB, centralized management processes, and knowledge by service providers which clients depend on their respective services. This paper proposes the Change 2.0 approach to cross-domain change management based on an inversion of responsibility for impact assessment and the facilitation of cross-domain service process integration. We present the requirements imposed by cross-domain change management, the Change2.0 architecture, and a brief evaluation of its benefits.

**Applying Sanitizable Signature to Web-Service-Enabled Business Processes: Going Beyond Integrity Protection**

*Kar Wai Tan, Robert H. Deng*  
(ICWS2009-0009)

This paper studies the scenario where data in business documents is aggregated by different entities via the use of web services in streamlined business processes. The documents are transported within the Simple Object Access Protocol (SOAP) messages and travel through multiple intermediary entities, each potentially makes changes to the data in the documents. The WS-Security provides integrity protection by allowing portions of a SOAP message to be signed using eXtensible Markup Language (XML) signature scheme. This method however, has not considered the situation where a portion of the data may be modified by another entity, therefore a need to allow the originating system to control which intermediary entity is authorized to change which portion of the data. The XML signature scheme also does not provide the final recipient the trust for intermediary entities. We show how the proposed scheme can be incorporated into the existing standards and be customizable to achieve flexible use of both the vanilla and sanitizable signatures as required in a business scenario. With the proposed technique, IT systems can be more loosely coupled and reap the benefits of distributed systems, such as delegation of work and encapsulation of business logic.
Wrap Scientific Applications as WSRF Grid Services using gRAVI
Kyle Chard, Wei Tan, Joshua Boverhof, Ravi Madduri, Ian Foster
(ICWS2009-0011)
Web service models are increasingly being used in the Grid community as way to create distributed applications exposing data and/or applications through self describing interfaces. Scientific research is one key field in which the benefits are apparent as individual services can be orchestrated into experimental workflows that model the research process and facilitate verification and extension. However, many applications are not web enabled and the task of creating services from scratch is cumbersome in part due to the range of complex technologies, tools, standards and languages involved. In this paper we present gRAVI, a WSRF Web service wrapping tool that allows scientists to rapidly expose applications, scripts and workflows as Web services. gRAVI generated services include GSI security, Grid scheduling, state notifications, persistence and data staging. All service code, scripts and definition files are created automatically without any developer input. gRAVI services are created in standard Grid Archive files and are able to be moved and deployed to any compliant container with no requirement for any gRAVI or Grid infrastructure on the target machine. gRAVI supports deployment to the open science cloud Nimbus, whilst also being able to parse Taverna workflow definition files to create strongly typed services.

Web Service Mashup Middleware with Partitioning of XML Pipelines
Eric Wohlstadter, Peng Li, Brett Cannon
(ICWS2009-0012)
Traditionally, the composition of Web services to create mashups has been achieved by using an application server as a mediator between a client browser and services. To avoid this bottleneck, mashups are sometimes implemented so that Web service composition takes place directly from the end user’s browser. Creating such implementations is difficult because developers must manage the separation of software into various distributable pieces, in different languages, and coordinate their communication. In this paper we describe a middleware for managing Web service mashups in a disciplined, and flexible way. We build upon the established abstraction of XML pipelines, but describe a new approach for selectively partitioning pipeline components between a browser client and application server. We provide a performance evaluation for a common mashup application scenario.

Towards Probabilistic Estimation of Quality of Online Services
Le-Hung Vu, Karl Aberer
(ICWS2009-0013)
Accurate estimation of quality of online services is both an important and difficult problem, since a service has many interdependent quality attributes influenced by several contextual factors. It is even more challenging as quality ratings come from sources with unknown reliability, each source may rate a service on different quality aspects. Although several solutions have been proposed, there is little work addressing all these issues thoroughly. In this paper, we show that domain knowledge on service structure and related constraints, such as causal dependencies among quality attributes and contextual factors, while widely available, can be exploited to effectively address the above issues in a theoretically-sound framework. Theoretical analysis shows that computational cost of the approach is acceptable, and accurate evaluation of service quality requires a reasonable number of user feedback, provided services have a small number of quality attributes and contextual factors.

Towards Scalability of Quality Driven Semantic Web Service Composition
Freddy Lécué, Nikolay Mehandjiev
(ICWS2009-0014)
Optimizing semantic web service compositions is known to be NP-hard, so most approaches restrict the number of services and offer poor scalability. We address the scalability issue by selecting compositions which satisfy a set of constraints rather than attempting to produce an optimal composition. Firstly, we define constraints within an innovative and extensible quality model designed to balance semantic fit (or functional quality) with quality of service (QoS) metrics. The semantic fit criterion evaluates the quality of semantic links between the semantic description of Web services parameters, whilst QoS focuses on nonfunctional criteria of services. Coupling these criteria allows us to further constrain and select valid compositions. To allow the use of this model in the context of millions of services as foreseen by the strategic EC-funded project SOA4All, we i) formulate the selection problem as a Constraint Satisfaction Problem and ii) test the use of a stochastic search method. Finally we compare the latter with state-of-the-art approaches.

Flexible Probabilistic QoS Management of Transaction based Web services Orchestration
Sidney Rosario, Albert Benveniste, Claude Jard
(ICWS2009-0015)
In this paper we extend our previous work on soft probabilistic contracts for QoS management, from the particular case of “response time”, to general QoS parameters. Our study covers composite QoS parameters dealing not only with time aspects but also with Quality of Data. We also study contract composition (how to derive QoS contracts for an orchestration from the QoS contracts with its called services), and contract monitoring. Our approach supports comprehensive and flexible QoS management within a probabilistic framework.

Research Track 5 – Services QoS Management
Session Chair: Dejan Milojicic, HP Labs, USA
Towards Probabilistic Estimation of Quality of Online Services
Le-Hung Vu, Karl Aberer
(ICWS2009-0013)
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Research Track 6 – Services Modeling
Session Chair: Jia Zhang, Northern Illinois University, USA
Scenario-Driven Approach for Business Process Modeling
Anna Ruokonen, Lasse Pajunen, Tarja Systä
(ICWS2009-0016)
The development of services-based systems starts from defining goals for business processes to be implemented, e.g., as a Web service orchestrations specified in WS-BPEL. In this paper, we propose a scenario-driven approach for modeling business processes. We aim for simplicity in the notation and leverage example-like modeling principles in order to improve process sketching. The first step in our approach is to identify the essential business requirements and model them using a simple scenario notation. The scenarios, given as UML sequence diagrams,
are synthesized into a state machine, which is translated into a WS-BPEL flavored process skeleton given as UML activity diagram. The process skeleton can be further refined into executable process model.

**Privacy Time-related Analysis in Business Protocols**
Karina Mohktar, Salima Benbernou, Mohsen Rouached, Mohand-Said Hadid and Frank Leymann
(ICWS2009-0018)

To automate the analysis of service descriptions, [9] proposed a simple and expressive business protocol model (the specification of possible message exchange sequences) based on state machines, supporting rich timing constraints. Furthermore, developers of client applications need to be aware not only of functional aspects but also of non-functional aspects including privacy. In fact, the major concerns of a client are the disclosure of its personnel data conveyed during the message exchange. The aim of the paper is to study the ability of business protocol to handle the privacy and its time-related properties.

**Behavioral Attestation for Business Processes**
Masoom Alam, Mohammad Naaman, Xinwen Zhang, Tamleek Ali, Patrick C.K. Hung
(ICWS2009-0034)

Service Oriented Architecture (SOA) is an architectural paradigm that enables dynamic composition of heterogeneous, independent, multi-vendor business services. A prerequisite for such inter-organizational workflows is the establishment of trustworthiness, which is mostly achieved through non-technical measures such as legislation, and/or social consent that businesses, or organizations simply pledge themselves to adhere. In our viewpoint, a business process can only be trustworthy if the behavior of all services in it is trustworthy. Trusted Computing Group (TCG) has defined a set of specifications for the establishment of trustworthiness through a hardware root-of-trust. This paper has three objectives: firstly, the behavior of individual services in a business process is formally specified. Secondly, in order to overcome the inherent weaknesses of trust management through software alone, a hardware root-of-trust devised by the TCG, is used for the measurement of the behavior of individual services in a business process. Finally, a verification mechanism is detailed through which the trustworthiness of a business process can be verified.

**Research Track 7 – Web Services Discovery**
Session Chair: Hesham H. Hallal, CRIM, Montreal, Canada

**Discovery of Optimized Web Service Configurations Using a Hybrid Semantic and Statistical Approach**
Maciej Zaremba, Jacek Migdal, Manfred Hauswirth
(ICWS2009-0019)

We present a Semantic Optimized Service Discovery (SemOSD) approach capable of handling Web service search requests on a fine-grained level of detail where we augment semantic service descriptions with statistically built predictor functions. Our approach combines ontologies and mathematical functions built using statistical regression over previous Web service interactions. In the search requests we allow for arbitrary, independent and dependent constraints and user preferences expressed using objective functions. Our approach maps to standard Operational Research global optimization problem where algorithms of Simulated Annealing and Differential Evolution are used. It is capable of finding the optimal combination of service input and output parameters (a configuration) to a user request with rich preferences. Our approach is applied to an international package shipment scenario where real (Web)services are used and mined to create price prediction models. We show that the chosen regression method provides price prediction models of high accuracy and our approach supports expressive and complex search requests.

**An Efficient Service Discovery Algorithm for Counting Bloom Filter-Based Service Registry**
Shuxing Cheng, Carl K. Chang, Liang-Jie Zhang
(ICWS2009-0020)

The service registry, the yellow pages of Service-Oriented Architecture (SOA), plays a central role in SOA-based service systems. The service registry has to be scalable to manage large number of services along with their requirements on storage and discovery. Based on our previous work on feature-based services quantification, we characterize services according to their diverse functional and non-functional requirements, and represent them as string formats which can be stored, probed, and indexed by efficient data structures, such as hash table and Bloom filter. Then, we propose a comprehensive service-storage solution using the counting Bloom filter (CBF). The application of CBF enables us to structure candidate services into separate groups, resulting in an accelerated services discovery process. The contributions of this research work include a new approach to manage large number of services based on quantified service features, and a storage architecture design to support service discovery. Experimental results strongly support these claims.

**Exploiting Metrics for Similarity-based Semantic Web Service Discovery**
Stefan Dietze, Alessio Gugliotta, John Domingue
(ICWS2009-0021)

Semantic Web Services (SWS) aim at the automated discovery and orchestration of Web services on the basis of comprehensive, machine-interpretable semantic descriptions. However, heterogeneities between distinct SWS representations pose strong limitations w.r.t. interoperability and reusability. Hence, semantic level mediation, i.e., mediation between concurrent semantic representations, is a key requirement to allow SWS matchmaking algorithms to compare capabilities of distinct SWS. In that, semantic level mediation requires to identify similarities across distinct SWS representations. Since current approaches to mediate between distinct service annotations rely either on manual one-to-one mappings or on semi-automatic mappings based on the exploitation of linguistic or structural similarities, these are perceived to be costly and error-prone. We propose a mediation approach enabling the implicit representation of similarities across distinct SWS by grounding these in so-called Mediation Spaces (MS). Given a set of SWS and their respective MS grounding, a general-purpose mediator automatically computes similarities to identify the most appropriate SWS for a given request. A prototypical application illustrates our approach.

**Research Track 8 – RESTful Services**
Session Chair: Mikio Aoyama, Nanzan University, Japan

**Towards a Model Driven Process for Designing ReSTful Web Services**
Markku Laitkorpi, Petri Selonen, Tarja Systät
(ICWS2009-0022)

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Representational State Transfer (ReST) architecture provides a set of constraints that drive design decisions towards architectural properties such as interoperability, evolvability and scalability. Designing a ReSTful service API involves finding resources and their relationships, selecting uniform operations for each resource, and defining data formats for them. It is often a non-trivial exercise to refine a functional specification, expressed in terms of arbitrary actions, to a resource-oriented, descriptive state information content. We argue that this process can be described as a series of model transformations, starting from service functionality and gradually refining the phase products until a ReSTful service API is reached. This paper outlines the process phases, transformations and intermediate models based on our experiences in developing ReSTful services and service APIs at Nokia Research Center. The process captures our understanding on how to systematically transform functional specifications into ReSTful Web service interfaces.

RETRO: A Consistent and Recoverable RESTful Transaction Model
Alexandros Marinos, Amir Razavi, Sotiris Moschouyannis, Paul Krause
(ICWS2009-0023)

With REST becoming a popular paradigm for web services, more and more use cases are applied to it, including some that require transactional guarantees. We propose a RESTful transaction model that satisfies both the constraints of transactions as well as those of the REST architectural style. We provide formal proof of consistency and recoverability in the proposed framework and show the robustness of its properties in the presence of concurrent transactions.

Towards Automated RESTful Web Service Composition
Haibo Zhao, Prashant Doshi
(ICWS2009-0024)

Emerging as the popular choice for leading Internet companies to expose internal data and resources, RESTful Web services are attracting increasing attention in the industry. While automating WSDL/SOAP-based Web service composition has been extensively studied in the research community, automated RESTful Web service composition in the context of service-oriented architecture (SOA), to the best of our knowledge, is less explored. As an early paper addressing this problem, this paper discusses the challenges of composing RESTful Web services and proposes a formal model for describing individual Web services and automating the composition. It demonstrates our approach by applying it to a real-world RESTful Web service composition problem. This paper represents our initial efforts towards the problem of automated RESTful Web service composition. We are hoping that it will draw interests from the research community on Web services, and engage more researchers in this challenge.

Research Track 9 – Web Services Testing and Analysis
Session Chair: Kenneth Hopkinson, Air Force Institute of Technology, USA

Efficient Testing of Service-Oriented Applications Using Semantic Service Stubs
Senhitil Mani, Vibha Singhal Sinha, Saurabh Sinha, Parkaj Dhoolia, Debdeep Mukherjee, Soham Chakraborty
(ICWS2009-0025)

Service-oriented applications can be expensive to test because services are hosted remotely, are potentially shared among many users, and may have costs associated with their invocation. In this paper, we present an approach for reducing the costs of testing such applications. The key observation underlying our approach is that certain aspects of an application can be tested using locally deployed semantic service stubs, instead of actual remote services. A semantic service stub incorporates some of the service functionality, such as verifying preconditions and generating output messages based on postconditions. We illustrate how semantic stubs can enable the client test suite to be partitioned into subsets, some of which need not be executed using remote services. We also present a case study that demonstrates the feasibility of the approach, and potential cost savings for testing. The main benefits of our approach are that it (1) reduce the number of test cases that need to be run to invoke remote services, (2) ensure that certain aspects of application functionality are well-tested before service integration occurs.

An Abstract GFSM Model for Optimal and Incremental Conformance Testing of Web Services
Li Li, Wu Chou
(ICWS2009-0026)

Web service conformance testing checks the correctness of a black box service implementation, and it is the basis of other testings. An efficient formal method for conformance testing is the Chinese Postman traversal algorithm [2] that can find minimum-cost test sequences. However, the applicability of this algorithm is in question if data dependencies are present in the protocol specification. Also, it suffers from the limited observability problem which is not uncommon in web services. Despite its optimality, the traversal algorithm does not take advantages of the special patterns in web service interfaces observed by developers. To address these issues, we propose an abstract GFSM (Guarded Finite-State Machine) model that unifies and augments the commonly used Moore and Mealy machines with data flows. Using this abstract model, we formalize the conditions under which the tours with complete data and control coverage are guaranteed, and address the limited observability problem using the equivalence of Moore and Mealy machines. Furthermore, we propose a Recursive Descent traversal algorithm that explores the inverse operation pattern of web services to facilitate incremental development of web services.

Timed Model Checking Based Approach for Web Services Analysis
Nawal Guermouche, Claude Godart
(ICWS2009-0027)

Web services are the main pillar of the Service Oriented Computing (SOC) paradigm which enables the application integration within and across business organizations. One of the important features of the Web services is the choreography aspect which allows to capture collaborative processes involving multiple services. In this context, one of the important investigations is the choreography compatibility analysis. We mean by the choreography compatibility the capability of a set of Web services of actually interacting by exchanging messages in a proper manner. Whether a set of services are compatible depends not only on their sequences of messages but also on quantitative properties such as timed properties. In this paper, we investigate a model checking based approach that deals with checking the compatibility of a choreography in which the Web services support asynchronous timed communications. Particularly, in this paper we are using the model checker UPPAAL. We propose a set of required abstractions that allow to use the model checker UPPAAL to deal with timed asynchronous communicating services.
BPEL'n'Aspects: Adapting Service Orchestration Logic
Dimka Karastoyanova, Frank Leymann

The need for flexibility in process-based applications, in particular during their execution, places the demand for enabling adaptability of processes. AOP is considered to be one of the approaches to flexibly switch on and off functionality on per-instance basis in applications during their execution; analogously, this paradigm can be applied in a BPEL environment to enable adaptation of running orchestrations. In the presented approach we strive towards reusing as much concepts and technology already available in a Web service (WS) environment as possible. We combine standard BPEL, the publish/subscribe paradigm and WS-Policy so that WS operations play the role of aspects with respect to BPEL processes. We present the syntax for such aspects as an extension of the WS-Policy framework. We introduce the architecture of the supporting infrastructure and a prototypical implementation. The approach draws on the combined benefits of service orientation and the AOP paradigm to improve the state-of-the-art techniques for flexibility of service orchestrations in a non-intrusive manner.

Dynamo + Astro: An Integrated Approach for BPEL Monitoring
Luciano Baresi, Sam Guinea, Marco Pistore, Michele Trainotti

In the literature, there exist several approaches for monitoring the execution of BPEL processes. They concentrate on different properties, adopt different languages, work at different levels of abstraction, and assume different perspectives. Even if the field is rather new, we do not think that this diversity is a limitation of current solutions; rather it is intrinsic in the problem itself. We claim that, instead of working on the definition of the ultimate approach for BPEL monitoring, we should push a cooperative approach based on the integration of different solutions. In this paper, we present a first step in this direction, and describe a monitoring framework which is obtained by integrating two well-known approaches, namely Dynamo and Astro. This integration, which happens both for the language used for expressing the properties to be monitored, and for the architecture of the monitoring framework, allows to combine the advantages of the two approaches and to obtain a general, comprehensive solutions for BPEL monitoring.

Service Supervision: Coordinating Web Services in Open Environment
Masahiro Tanaka, Toru Ishida, Yohi Murakami, Satoshi Morimoto

A composite Web service designed based on abstract Web services, which define only interfaces, allows an application developer to select services required for his application only by setting endpoints for the atomic Web services. In open environment, however, the composite Web service syntactic definition in this manner may fail due to unique behaviors of the selected services. It is difficult for the designer of the composite Web service to prevent the failure because he does not know which services are selected and how they behave. On the other hand, the application developer is not authorized to modify the composite Web service due to the need to protect intellectual rights. Our solution is Service Supervision, which monitors and controls execution of composite Web services. Service Supervision makes the following possible. 1) An application developer can control the behavior of a composite Web service by changing the execution state, even if he is not authorized to modify the composite Web services. 2) A control pattern for coordinating Web services can be applied to various composite Web services in order to reduce the load imposed by designing control processes. In order to realize Service Supervision, we introduce meta-level control of a composite Web service. Moreover, we then use the choreography to define the interaction protocols for the controls. The proposed framework is based on existing standard languages, WS-BPEL and WSCDL. Therefore, we can exploit existing tools and expertise of SOA engineers.
An Automated Method for Web Service Orchestration based on Reusable Building Blocks
Frank Alexander Kraemer, Haldor Samset, Roly Braek
(ICWS2009-0033)

We describe a complete and largely automated method for the development of systems from web services, which comprises the encapsulation of services, as well as their composition, verification and subsequent implementation in a model-driven manner. The paper follows the steps of the method: In a first phase, we import WSDL descriptions automatically as UML 2.x activities and provide them as building blocks, with some optional, manual adaptations. In a second phase, these building blocks can be used to compose an application that orchestrates web services. The building blocks have behavioral contracts that enable automated, incremental verification based on compositional model checking. We demonstrate the approach by a subscription-based service to receive SMS messages.

Research Track 12 – Business Process Modeling and Analysis
Session Chair: Jerry Gannod, Miami University, USA

From Workflow Models to Executable Web Service Interfaces
Armin Haller, Mateusz Marmolowski, Walid Gaaloul, Eyal Oren, Brahmananda Sapkota, Manfred Hauswirth
(ICWS2009-0034)

Workflow models have been used and refined for years to execute processes within organisations. To deal with collaborative processes (choreographies) these internal workflow models have to be aligned with the external behaviour advertised through Web service interfaces. However, traditional workflow management systems (WFMS) do not offer this functionality. Simply sharing and merging process models is often not possible, because workflow management lacks a widely accepted standard theory for workflow models. Multiple research and standardisation efforts to integrate different workflow theories have been proposed over the years. XPDL is the most widely used standard for process model interchange and supported by over 80 systems. However, XPDL also lacks the possibility to relate a workflow model to its possible choreography interface abstractions. To remedy this situation, we propose to abstract the XPDL model to a higher-level model, perform the integration and the compaction algorithms at that level and then ground it back to the desired choreography models. We develop and use an integrated ontology which is based on the XPDL standard for this purpose. To facilitate the abstraction and grounding, we present a mapping procedure to automatically translate XPDL and BPMN workflow models into this ontology. After translation, these models are annotated with a parameterised role model and other collaborative properties. We present a compaction procedure that automatically maps the annotated models into external choreography interfaces that expose only the relevant information for a particular partner collaboration. Our procedure is agnostic with respect to the target choreography model. We demonstrate our approach using WSMO choreographies which enables us to automatically generate interface models from any WFMSs that supports XPDL export.

QoS-Driven Adaptation of BPEL Scenario Execution
Karethiotis Chritisos, Costas Vassilikis, Efstaithos Rouvas, Panayiotis Georgiad
(ICWS2009-0035)

BPEL/WSBPEL is the predominant approach for combining individual web services into integrated business processes, allowing for the specification of their sequence, control flow and data exchanges. BPEL however does not include mechanisms for considering the invoked services Quality of Service (QoS) parameters and thus BPEL scenarios can neither tailor their execution to the individual user’s needs or adapt to the highly dynamic environment of the WEB, where new services may be deployed, old ones withdrawn or existing ones changing their QoS parameters. Moreover, infrastructure failures in the distributed environment of the web introduce an additional source of failures that must be considered in the context of QoS-aware service execution. In this work we propose a framework for addressing the issues identified above; the framework allows the users to specify the QoS parameters that they require and it undertake the task of locating and invoking suitable services. Finally, the proposed framework intercepts and resolves faults occurring during service invocation, respecting the QoS restrictions specified by the consumer.

Interoperability Changes in an Adaptive Service Orchestration
Marcel Hiel, Hans Weigand
(ICWS2009-0036)

Business Processes realized by services rely on the functionality of these services. Maintaining the interoperability when services evolve independently is therefore an important and challenging problem. If adaptation is to happen automatically, then determining and categorizing changes and their solutions is crucial. In this paper, we make the following contributions: (1) We provide an overview of previously defined mismatches and provide a common representation based on model management operators. (2) We present a categorization of changes with the categories non-effective, solvable and problematic and validate our categorization. (3) We provide solutions for changes that fall under the solvable category in terms of adaptation operators and describe the process of (self-)adaptation.

Research Track 13 – Services Reputation
Session Chair: Dirk Habich, Dresden University of Technology, Germany

Reputation Propagation in Composite Services
Surya Nepal, Zaki Malik, Athman Bouguettaya
(ICWS2009-0037)

This paper investigates the problem of reputation management in composite services. Our focus is on developing a method of distribution of reputation received by a composite service to its component services. The proposed method enables the composite service to provide a fair distribution of reputation values so that a component service is neither penalized nor awarded for the bad and good performances respectively, of other component services. Experiment results show that the proposed technique propagates the “fair share” of reputation from the composite service to its component services.

An Approach to Incentive-based Reputation for Communities of Web Services
Babak Khosravifar, Jamal Bentahar, Philippe Thiran, Ahmad Moazzen, Adrien Guiot
(ICWS2009-0038)
Community of web services (CWS) is a society composed by a number of functionally identical web services. The communities always aim to increase their reputation level in order to obtain more requests. In this paper, we propose an effective mechanism dealing with reputation assessment for communities of web services. The proposed mechanism is based on after-service feedbacks provided by the users to a run-time logging system. The proposed method defines the evaluation metrics involved in reputation assessment of a community, and supervises the logging system in order to verify the validity and soundness of the feedbacks provided by the users. In this paper, the proposed framework is described, a theoretical analysis of its assessment and its implementation along with empirical result discussions are provided. We also show how our model is efficient, particularly in very dynamic environments.

Applying Knowledge Sharing for Business Intelligence Collaboration
Bo Yang, Hao Wang, Fred Douglas
(ICWS2009-0039)

IT services need an automatic and flexible ability to react to dynamic changes in their environment. Managing change effectively and reducing the negative effects of day-to-day operations has become one of the most important tasks in IT service management, which require hiring highly skilled IT professionals with correspondingly high labor costs. There is a challenge to select, implement and integrate the right resources quickly and effectively. Although there is a growing body of research into IT management, many techniques are either too narrow (focusing on a single component rather than the entire system), or they address only configuration data collection and integration. Instead, one needs to scale or respond to special domain knowledge, collaboration and the right data for helping IT professionals to improve their work. In this paper, we propose a knowledge-sharing based collaborating management system for IT service management. It aims to bridge the gap between domain experts’ knowledge and manageable systems. We developed a proof-of-concept of an impact analysis service-based on knowledge-sharing; it establishes an IT service management collaboration ecosystem, leveraging the expert’s rich knowledge and experience to improve the management quality and reduce the cost. A case study driven by customers demonstrates that collaboration with knowledge sharing is effective both at constructing useful system analysis services and in using those services to improve system management.

Research Track 14 – Semantic Web Services
Session Chair: Stephan Reiff-Marganiec, University of Leicester, UK

Discovery of Semantic Web Service Flow Based on Computation
Fangfang Liu, Yuliang Shi, Xiangfeng Luo, Guoning Liang, Zheng Xu
(ICWS2009-0040)

Key-word based researches of service discovery focus on direct match of user’s requirements and often neglect relations between services. While techniques based on conventional semantic offer many kinds of relations, considerable time is spent on reasoning. In this paper, we utilizes E-FCM (Element Fuzzy Cognitive Map) to describe services for the reason that E-FCM can keep the semantic information as much as possible and E-FCM service management can be created for web services. Furthermore, instead of reasoningatically, semantic relations among E-FCM are built based on computation, therefore semantic relations among services can be found out quickly. We focus on the associated semantic relations among services because complex applications always comprise of services with associated functions. The associated link network (ALN) is constructed upon associated relations to generate associated web service flows, which can be used to create complex applications, thus to facilitate discovery efficiency and improve utilization of services.

Efficient Discovery of Collision-Free Service Combinations
Roman Vaculín, Katia Sycara
(ICWS2009-0041)

Majority of service discovery research considers only primitive services as a suitable match for a given query while service combinations are not allowed. However, many realistic queries cannot be matched by individual services and only a combination of several services can satisfy such queries. Allowing service combinations or proper compositions of primitive services as a valid match introduces problems such as unwanted side-effects (i.e., producing an effect that is not requested), effect duplications (i.e., producing some effect more than once) and contradictory effects (i.e., producing both an effect and its negation). Also the ranking of matched services has to be reconsidered for service combinations. In this paper, we address all the mentioned issues and present a matchmaking algorithm for retrieval of the best top k collision-free service combinations satisfying a given query.

SAWSDL-MX2: A Machine-learning Approach for Integrating Semantic Web Service Matchmaking Variants
Matthias Klasch, Patrick Kapahnke, Ingo Zinnikus
(ICWS2009-0042)

In this paper, we present SAWSDL-MX2, a hybrid semantic Web service matchmaking algorithm for SAWSDL services. Building on our initial work in [11], we adopt logic-based as well as text similarity service selection for model references and add a structural approach from [14], which operates on the pure syntactic description of WSDL elements. The integration of these matching variants is accomplished using a Support Vector Machine (SVM) with non-linear kernel, thus automatically adapting an aggregation function based on previously experienced training data. Results of our performance evaluation based on the standard measures recall and precision over the SAWSDL-TC1 test collection as well as an exhaustive example for all basic matching variants are also given.

Research Track 15 – Services Adaptation
Session Chair: Unmesh Bellur, IIT Bombay, India

An Adaptive Tradeoff Model for Service Performance and Security in Service-based Systems
Stephen S. Yau, Yin Yin, Ho G. An
(ICWS2009-0043)

The message-based communication among services in Service Oriented Architecture (SOA) is vulnerable to various security attacks, and has to be well protected by security mechanisms, which may sacrifice service performance due to limited system resources. In this paper, an adaptive tradeoff model for service performance and security in service-based systems is presented. This model can be used to adjust security configurations of services to provide sufficient protection and satisfy service performance requirements for SOA-based systems simultaneously. The construction
Towards Adaptation of Service Interface Semantics
Li Kuang, Shuiguang Deng, Jian Wu, Ying Li
(ICWS2009-0044)

Interoperability promised by Web service makes it a most promising technology for the development of next generation distributed heterogeneous software systems. Services should be compliant at signature, behavioral and semantic level to make the interoperation successful and correct. Service adaptation provides an effective approach to bridge the incompatibility of services to make them interoperate as well as possible. In this paper, we aim to contribute to the definition of a methodology to develop adaptors that are capable of making two incompatible services interoperate not only successfully but also correctly at semantic level. To achieve this goal, we proposed service specifications for both atomic and composite services with semantic dependency between outputs and inputs specified; then we proposed adaptor specification consisting of three parts, which are message mapping, action mapping and treatment for non-mapping messages. Based on service and adaptor specifications, an incremental derivation approach of a concrete adaptor is given.

A Dependency Impact Analysis Model for Web Services Evolution
Shuoying Wang, Miriam A. M. Capretz
(ICWS2009-0045)

As many software systems have been turned as Web services, the evolutionary changes of Web services are becoming an important issue. To understand the way in which the change affects the services, we must ascertain parts of the system that will be effected by the change and examine them for additional impacts. In this paper, we propose an impact analysis model based on service dependency. In particular, the service dependency graph model, service dependency and the relation matrix are examined. Based on the shift and calculation of the matrix, the dependency and impact of the service evolution can be analyzed and its quantity can be ascertained. Furthermore, we also represent an approach for service change annotation and for service evolution process. Overall, these works provide a foundation for the automatic management, control, and evaluation of service evolution.

Research Track 16 – Mobile Services
Session Chair: Lakshmi Ramaswamy, The University of Georgia, USA

Reducing User Perceived Latency with a Middleware for Mobile SOA Access
Andreas Göh, Daniel Schreiber, Louenas Hamdi, Erwin Aitenbichler, Max Mühlhäuser
(ICWS2009-0046)

Network latency is one of the most critical factors for the usability of mobile SOA applications. This paper introduces prefetching and caching enhancements for an existing SOA framework for mobile applications to reduce the user perceived latency. Latency reduction is achieved by proactively sending data to the mobile device that could most likely be requested at a later time. This additional data is piggybacked onto responses to actual requests and injected into a client side cache, so that it can be used without an additional connection. The prefetching is done automatically using a sequence prediction algorithm. The benefit of prefetching and caching enhancements were evaluated for different network settings and a reduction of user perceived latency of up to 31% was found in a typical scenario. In contrast to other prefetching solutions, our piggybacking approach also allows to significantly increase battery lifetime of the mobile device.

A Mobility-based Clustering and Discovery of Web Services in Mobile Ad-hoc Networks
Yoo-Seok Shin, Yeon-Seok Kim, Kyong-Ho Lee
(ICWS2009-0047)

Web services allow devices running on different platforms to communicate with one another using standardized definitions and access ways. Due to recent developments in mobile networks and devices, many researches are on going to apply Web services to mobile network environments. In this paper, we propose an efficient method that discovers services based on a proposed mobility-based clustering in mobile ad-hoc networks. In order to maintain stable clusters and select a proper service discovery architecture, the proposed method uses the mobility of nodes including direction. Experimental results under different mobility models show that the proposed method outperforms a conventional clustering and service discovery method.

Efficient Access to Composite M-services
Xu Yang, Athman Bouguettaya, Xuemin Liu
(ICWS2009-0048)

Wireless Web services, also called Mobile services or M-services, provide access to Web services through wireless networks. In this paper, we propose novel access methods and multi-channel organization for mobile users to effectively access composite M-services in wireless broadcast networks. We define a few semantics for accessing broadcast based M-services and study their impact on access efficiency.

Research Track 17 – Services Implementation Management
Session Chair: M. Brian Blake, University of Notre Dame, USA

Scalable Optimized Composition of Web Services with Complexity Analysis
Rattikorn Hewett, Phongphun Kijsanayothin, Bach Nguyen
(ICWS2009-0049)

This paper addresses a fundamental issue of web service composition. We present a simple but powerful conceptual model that leads to a scalable approach to automatically constructing a composite web service to meet its requirements by using as few services as possible. Our approach is based on a state space model that has a monotone property to allow efficient search along with efficient algorithms for pruning and simple parallelization. We provide both empirical and theoretical analyses of O(n^2), for a repository with n services. However, the approach takes linear time for sequential compositions when service applicability is performed by service discovery and thus, it is shown to give asymptotically
optimal performance. Although optimality in the number of service deployed is not guaranteed, our experiments on public benchmark data sets show correct optimized solutions 100% of the time, with a reduction in the average running time, compared to a well-performed planning-based system, of better than 35% over 207 composition problems.

**Improving Web Services Robustness**
*Nano Laranjeiro, Marco Vieira, Henrique Madeira*  
(ICWS2009-0050)
Developing robust web services is a difficult task. Field studies show that a large number of web services are deployed with robustness problems (i.e., presenting unexpected behaviors in the presence of invalid in-puts). Several techniques for the identification of ro-bustness problems have been proposed in the past. This paper proposes a mechanism that automatically fixes the problems detected. The approach consists of using robustness testing to detect robustness issues and then mitigate those issues by applying inputs verifica-tion based on well-defined parameter domains, includ-ing domain dependencies between different parame-ters. This integrated and fully automatable methodolo-gy has been used to improve three different implemen-tations of the TPC-App web services. Results show that this tool can be easily used by developers to improve the robustness of web services implementations.

**Enforcement from the Inside: Improving Quality of Business in Process Management**
*Hanna Eberle, Stefan Föll, Klaus Herrmann, Frank Leymann, Annapaola Marconi, Tobias Unger, Hannes Wolf*  
(ICWS2009-0051)
In this paper we introduce a new modeling tool for constraint handling in the area of workflow technology. The constraint handlers can be used to improve the quality of business processes but without changing already existing business logic. Todays workflow languages provide no possibility to model constraints and the actions in case the constraints get violated explicitly. Fault and event handling mechanisms to react to events not expected in normal executions are only provided by the BPEL language. Using BPEL as workflow language we integrate the constraint handling extension without changing any existing semantics in a smart way. In our approach we use this fault and event handling mechanisms to extend the BPEL language with a constraint handling mechanism. By integrating this constraint handling tool into the BPEL language we provide an approach for quality driven process modeling with the BPEL language.

**Research Track 18 – Services Provisioning and Auditing**
*Session Chair: Hamid Motahari, HP Labs, USA*

**Scientific Workflows as Services in caGrid: a Taverna and gRAVI Approach**
*Wei Tan, Kyle Chard, Dinanath Salakhe, Ravi Mudduri, Ian Foster, Shuan Soland-Reyes, Carole Goble*  
(ICWS2009-0052)
In scientific collaboration platforms such as caGrid, workflow-as-a-service is a useful concept for various reasons, such as easy reuse of workflows, access to remote resources, security concerns, and improved execution performance. We propose a solution for facilitating workflow-as-a-service based on Taverna as the workflow engine and gRAVI as a service wrapping tool. We provide both a generic service to execute all Taverna workflows, and an easy-to-use tool (gRAVI-t) for users to wrap their workflows as workflow-specific services, without developing service code. The signature of the specific service is identical to the corresponding workflow’s input/output definition and is therefore more self-explained to workflow users. These two categories of services are useful in different scenarios, respectively. We use a tumor analysis workflow as an example to demonstrate how the workflow-as-a-service approach benefits the execution performance. Finally a conclusion is drawn and future research opportunities are discussed.

**SPA: A Comprehensive Framework for Hybrid Solution Provisioning**
*Yuhui Wu, ZhiLe Zou, Ying Chen, Yang Zhao, Qingbo Wang*  
(ICWS2009-0053)
With the emerging technologies like cloud computing and internet scale data centers, radically simplified deployment approaches are critical for the success of the even more complicated solutions. Although there have been many traditional solution deployment approaches, each of them mainly focuses on particular software type or product. In this paper, we propose the next generation solution deployment paradigm as hybrid solution deployment, which enables fast solution deployment from bare metal mode to production mode based on today’s state-of-the-art provisioning tools. Solution Provisioning Automation (SPA) framework is our practice of such deployment paradigm. In SPA, we use solution template to capture the solution components and their dependencies, which exposes only the necessary parameters for users to customize. Provisioning Requests are placed through reservations and scheduled globally for execution. The SPA engine receives provisioning requests from scheduler, interprets the solution template, manages provisioning tasks and performs runtime logging. We also present a real world case to demonstrate the effectiveness of our approach.

**DIALOG: Distributed Auditing Logs**
*Christoph Ringelstein, Steffen Staab*  
(ICWS2009-0054)
Service-oriented systems facilitate business workflows to span multiple organizations (e.g. by means of Web services). As a side effect, data may be more easily transferred over organizational boundaries. Thus, privacy issues arise. At the same time, there are personal, business and legal requirements for protecting privacy and IPR an IPR on data items to request information about how and by whom their data was handled. Managing these requirements constitutes an unsolved technical and organizational problem. We propose to solve the information request problem by attaching meta-knowledge about how data was handled to the data itself. We present our solution, in form of an architecture, a formalization and an implemented prototype for logging and collecting logs in service rented and cross-organizational systems.
As the abundance of Web services on the World Wide Web increase, designing effective approaches for Web service selection and recommendation has become more and more important. In this paper, we present WSRec, a Web service recommender system, to attack this crucial problem. WSRec includes a user-contribution mechanism for Web service QoS information collection and an effective and novel hybrid collaborative filtering algorithm for Web service QoS value prediction. WSRec is implemented by Java language and deployed to the real-world environment. To study the prediction performance, a total of 21,197 public Web services are obtained from the Internet and a largescale real-world experiment is conducted, where more than 1.5 millions test results are collected from 150 service users in different countries on 100 publicly available Web services located all over the world. The comprehensive experimental analysis shows that WSRec achieves better prediction accuracy than other approaches.

**Personalized Web Service Ranking via User Group Combining Association Rule**

We notice that, in the composition of Web services, usability of a service is as important as its performance. Users often have differing experiences with a WS. While trust in a WS is multi-faceted and consists of security and behavioral aspects, our focus in this paper is on the latter. We adopt a formal model for trust in a WS, which meets many of our intuitions about trustworthy WSs. We hypothesize predictors of a positive experience with a WS and conduct a small pilot study to explore correlations between subjects’ experiences with WSs in a composition and the predictor values for those WSs. Furthermore, we show how we may derive trust for compositions from trust models of individual services. We conclude by presenting and evaluating a novel framework, called Wisp, that utilizes the trust models and, in combination with any WS composition tool, chooses compositions to deploy that are deemed most trustworthy.

**Integrating Behavioral Trust in Web Service Compositions**

Sharon Paradisi, Prashant Doshi, Sonu Swaika

Algorithms for composing Web services (WS) traditionally utilize the functional and quality-of-service parameters of candidate services to decide which services to include in the composition. Users often have differing experiences with a WS. While trust in a WS is multi-faceted and consists of security and behavioral aspects, our focus in this paper is on the latter. We adopt a formal model for trust in a WS, which meets many of our intuitions about trustworthy WSs. We hypothesize predictors of a positive experience with a WS and conduct a small pilot study to explore correlations between subjects’ experiences with WSs in a composition and the predictor values for those WSs. Furthermore, we show how we may derive trust for compositions from trust models of individual services. We conclude by presenting and evaluating a novel framework, called Wisp, that utilizes the trust models and, in combination with any WS composition tool, chooses compositions to deploy that are deemed most trustworthy.

**Research Track 20 – Goal-Driven Services Discovery and Composition**

Session Chair: Liang-Jie Zhang, IBM T.J. Watson Research Center, USA

**Modeling Cost-Aware Web Services Composition Using PTCCS**

Fangxiong Xiao, Zhiqiu Huang, Zining Cao, Jun Hu, and Lin Yuan Liu

ICWS2009-0058

Process algebra are a set of formal languages that are suitable to describe concurrent and communication systems including web services. Nowadays, although process algebra have been effectively exploited for modeling and verifying functional aspects of web services composition, non-functional aspects have been ignored due to process algebra lack of capability of modeling them. Since execution of web services need to consume resource (and energy, time, fee, etc), we propose an abstract concept, that is, cost, to model this non-functional aspect. We introduce this abstract concept into TCCS (Temporal Calculus of Communicating Systems) that is a classical process algebra and propose a new process algebra called PTCCS (Priced Temporal Calculus of Communicating Systems). We present syntax and semantics of PTCCS, and prove that PTCCS extends TCCS with cost modeling capability. And an algorithm is proposed to construct cost state space that is used to select web services composition with optimal cost. Experiment results show that PTCCS can model both functional aspects and non-functional aspects of web services composition.

**DHT-Based Range Query Processing for Web Service Discovery**

Yiming Zhang, Ling Liu, Dongsheng Li, Feng Liu, Xicheng Lu

ICWS2009-0059

DHTs are scalable, self-organizing, and adaptive to underlying topology changes, thus being a promising infrastructure for realizing efficient Web service discovery. Range queries play an important role in service discovery, and in recent years a number of DHT-based range query schemes have been proposed. However, most of them suffer from high query delay and high processing cost. This paper presents ERQ, an efficient scheme for delay-bounded Range Query processing over DHTs. We first evaluate the PH structure and design a balanced Kautz (BK) tree to uniformly map the m-dimensional data space onto DHT nodes, and then present a novel algorithm that processes range queries in a parallel fashion, where an on-the-fly space pruning mechanism is adopted to reduce the processing cost. In a DHT with N nodes, ERQ can answer any range query in less than \( \log N(2\log \log N+1) \) hops with low processing cost, irrespective of the queried range, the whole space size, or the number of queried attributes. The effectiveness of ERQ is demonstrated through extensive experiments.

**Service Provenance in QoS-Aware Web Service Runtimes**

Anton Michlmayr, Florian Rosenberg, Philipp Leitner, Schabram Dastdil

ICWS2009-0060

In general, provenance of electronic data represents an important issue in information systems. So far, Service-oriented Computing research has mainly focused on provenance of data. However, service provenance also plays a central role since service providers and consumers want to be aware of the service’s origin and history. In this paper, we present an approach for service provenance that builds on service metadata and various service runtime events. In addition, access control mechanisms are implemented to restrict access to this information. Besides being able to query and subscribe to provenance information, provenance graphs can be used to illustrate the history of services. We give some usage examples of service provenance and show how our approach was integrated into the VRESCo Web service runtime environment.
Gradual Removal of QoS Constraint Violations by Employing Recursive Bargaining Strategy for Optimizing Service Composition

Kaijun Ren, Nong Xiao, Junqiang Song, Chi Yang, Min Zha, Jinjun Chen

A critical issue in service composition area is how to achieve an optimized end-to-end quality of service (QoS) requirements by effectively coordinating QoS constraints for individual services. However, this issue has not yet been well addressed. In this paper, we propose a novel method by employing a recursive bargaining strategy to gradually remove QoS constraint violations for optimizing service composition execution. Our method mainly exploits the hidden market competitive relationships which widely exist in real business world for developing a novel bargaining strategy. Based on this strategy, concessions can be made by service providers to offer better QoS values. By recursively using the bargaining strategy, an initial execution path built by a local optimization policy for service composition, can be continually updated to be close to the optimal one by reselecting better service providers for meeting overall end-to-end QoS requirements. An experiment and evaluation have been made to demonstrate the feasibility and effectiveness of our proposed method.

A Framework for Optimal Decentralized Service-Choreography

Saayan Mitra, Ratnesh Kumar, Samik Basu

We address the problem of optimizing mediator-based service composition where the services and the desired composition (goal) functionality are represented as i/o-automata with loops. The objective of optimization is to minimize the costs of communications and computations necessary to realize the goal from the existing services. We develop an algorithm to compute the minimum cost of an automaton representing the choreographed behavior of services realizing the goal. This forms the central theme of our technique for developing automatically a strategy of decentralized mediation that will result in the optimized composition of services.

Equivalence of Web Services in Process-Aware Service Compositions

Stefanie Rinderle-Ma, Manfred Reichert, Martin Jurisch

Deciding on web service equivalence in process-aware service compositions is a crucial challenge throughout the composition life cycle. Restricting such decisions to (activity) label equivalence constitutes a simplification for many practical applications: if two web services have equivalent labels, does this necessarily mean they are equivalent as well? In many scenarios other factors play an important role. Examples include context information (e.g., input and output messages) and information on the position of web services within compositions. In this paper, we introduce the composition life cycle and discuss specific requirements for web service equivalence along its different phases. We define adequate equivalence notions for design, execution, analysis, and evolution of service compositions. Main focus is put on attribute and position equivalence. Altogether this paper is a first step towards a new understanding and treatment of equivalence notions in service compositions.

Application and Industry Track

Building Collaboration Applications That Mix Web Services Hosted Content with P2P Protocols

Ken Birman, Jared Cantwell, Daniel Friedman, Qi Huang, Petko Nikolov, Krzysztof Ostrowski

The most commonly deployed web service applications employ client-server communication patterns, with clients running remotely and services hosted in data centers. In this paper, we make the case for Service-Oriented Collaboration applications that combine service-hosted data with collaboration features implemented using peer-to-peer protocols. Collaboration features are awkward to support solely based on the existing web services technologies. Indirection through the data center introduces high latencies and limits scalability and precludes collaboration between clients connected to one-another but lacking connectivity to the data center. Cornell’s Live Distributed Objects platform combines web services with direct peer-to-peer communication to eliminate these issues.

Collaborative Scientific Workflows

Shiyong Lu, Jia Zhang

In recent years, a number of scientific workflow management systems (SWFMS) have been developed to help domain scientists synergistically integrate distributed computations, datasets, and analysis tools to enable and accelerate scientific discoveries. As more scientific research projects become collaborative in nature, there is a compelling need of dedicated services to support collaborative scientific workflows on the Internet. This paper reviews the state of the art of the field of scientific workflows towards the support of collaborative scientific workflows, identifies critical research challenges, and presents our ongoing research work aiming to study how to create services supporting collaborative scientific workflows.

Application of Management Frameworks to Manage Workflow-based Systems: A Case Study on a Large Scale E-Science Project

Srinath Perera, Suresh Marru, Thilina Gunarathne, Dennis Gannon, Beth Plale

Management architectures are well discussed in the literature, but their application in real life settings has not been as well covered. Automatic management of a system involves many more complexities than closing the controlloop by reacting to sensor data and executing corrective actions. In this paper, we discuss those complexities and propose solutions to those problems on top of Hasthi management framework, where Hasthi is a robust, scalable, and distributed management framework that enables users to manage a system by enforcing management logic authored by users themselves. Furthermore, we present in detail a real life case study, which uses Hasthi to manage a large, SOA based, E-Science
Identity Attribute-based Role Provisioning for Human WS-BPEL processes
Federica Paci, Rodolfo Ferrini, Elisa Bertino
(ICWS2009-0067)

The WS-BPEL specification focuses on business processes the activities of which are assumed to be interactions with Web services. However, WS-BPEL processes go beyond the orchestration of activities exposed as Web services. There are cases in which people must be considered as additional participants to the execution of a process. The inclusion of humans, in turn, requires solutions to support the specification and enforcement of authorizations to users for the execution of human activities while enforcing authorization constraints. In this paper, we extend RBAC-WSBPEL, a role-based authorization framework for WS-BPEL processes with an identity attribute-based role provisioning approach that preserves the privacy of the users who claim the execution of human activities. Such approach is based on the notion of identity records and role provisioning policies, and uses Pedersen commitments, aggregated zero knowledge proof of knowledge, and Oblivious Commitment-Based Envelope protocols to achieve privacy of user identity information.

Towards More Secure Web Services
Tomáš Knap, Irena Mlýnková
(ICWS2009-0068)

A Web Service The goal of this paper is to formalize various processing approaches to the process of verification of the web services integrity and to show its vulnerability to many attacks. After introducing the necessary terminology, several processing approaches are particularized and its security drawbacks concerning notably XML Signature W3C Recommendation are divided into several areas, analyzed, and the solutions are described and compared. If the solution of the particular problem does not exist, or is not yet fully standardized, it is marked as an open problem and the solution is proposed.

Web Service Architecture for Decentralised Identity- and Attribute-based Access Control
Regina N. Hebig, Christoph Meinel, Michael Menzel, Ivonne Thomas, Robert Warschofsky
(ICWS2009-0069)

The loosely coupled nature of Service-oriented Architectures raises the question how information for access control can be managed in an efficient way. Several specifications for Web Services exist to describe security requirements and to facilitate a provision of identity information. However, the integration of different standards regarding the expression of identity information in policies, claims and assertions comes along with an increased complexity. In order to identify and address the problems occurring with the combined use of standards as XACML, SAML and WS-Trust, we designed and implemented an architecture for identity- and attribute-based access control in decentralised environments. Our implementation provides an automated generation of access control policies in a format called XACML, a way to communicate required user attributes as claims across different domains based on the standards WS-Trust and WS-Policy, and a consistent mapping of retrieved attribute assertions to the XACML attributes in the access control policy.

Application and Industry Session 2 – Services Security
Session Chair: Nils Gruschka, NEC Laboratories Europe, Germany

Application and Industry Session 3 – Services QoS and Analysis
Session Chair: Shiyong Lu, Wayne State University, USA

Design of SOA Based Web Service Systems Using QFD for Satisfaction of Quality of Service Requirements
Xiaoqing (Frank) Liu, Lianzhang Zhu
(ICWS2009-0071)

Service-Oriented Architecture (SOA) is a loosely-coupled architecture designed to meet business needs of an organization. It is becoming a trend for system development and integration where systems group functionality around business processes. Although SOA does not require Web services, Web services are based on accepted standards and drive SOA to the mainstream. There are at least two challenges with quality management of SOA based Web service systems. One of them is how to link explicitly its technical capabilities with customers’ needs to satisfy customers’ functional and nonfunctional requirements. The second is how to determine targets of Web service technical attributes. The first issue is not addressed at all and the second issue is dealt with subjectively in the current practice of development of SOA based web service systems. Quality Function Deployment (QFD) is a major quality management system used to determine product development characteristics from customer requirements. It has found its success in improving quality of complex products, such as automobiles, aircrafts, and consumer electronics, although it has not been used in the development of SOA based Web service systems. In this paper, we analyze a number of quality of Web service requirements and their related technical attributes, and apply the QFD for developing SOA based Web service systems by linking quality of service requirements to Web service design attributes. An impact based linear regression method is used to determine technical targets of design features of SOA based Web service systems for the satisfaction of quality of service requirements.

Analysis of Signature Wrapping Attacks and Countermeasures
Sebastian Gajek, Meiko Jensen, Lijun Liao, Jörg Schwenk
(ICWS2009-0073)
In recent research it turned out that Boolean verification of digital signatures in the context of WSSecurity is likely to fail: If parts of a SOAP message are signed and the signature verification applied to the whole document returns true, then nevertheless the document may have been significantly altered. In this paper, we provide a detailed analysis on the possible scenarios that enable these signature wrapping attacks. Derived from this analysis, we propose a new solution that uses a subset of XPath instead of ID attributes to point to the signed subtree, and show that this solution is both efficient and secure.

**Application and Industry Session 4 – Services Development**

**Session Chair: Serge Shumilo, University of Bonn, Germany**

**Discovery and On-Demand Provisioning of Real-World Web Services**

*Dominique Guainard, Vlad Trifa, Patrik Spiess, Bettina Dober and Stamatis Karnouskos*

(ICCWS2009-0073)

The increasing usage of smart embedded devices is blurring the line between the virtual and real worlds. This creates new opportunities for applications to better integrate the real-world, providing services that are more diverse, highly dynamic and efficient. Service Oriented Architecture is on the verge of extending its applicability from the standard, corporate IT domain to the real-world devices. In such infrastructures, composed of a large number of resource-limited devices, the discovery of services and on demand provisioning of missing functionality is a challenge. This work proposes a process, its architecture and an implementation that enables developers and process designers to dynamically discover, use, and create running instances of real-world services in composite applications.

**Contract-First Design Techniques for Building Enterprise Web Services**

*Youliang Zhong, Jian Yang*

(ICCWS2009-0074)

Based on real development experience, the paper presents a collection of design techniques for building enterprise web services. By applying the techniques to web services development, not only the development increases reusability and productivity, but also the web services improve agility and compatibility. Enterprise web services require high grade of competency in designing web service contracts. A contract of web service formalizes an agreement between web service provider and consumer, in the forms of WSDLs, service schemas and policies. Though contract-first method provides great potential of directly dealing with the contracts, and a number of articles have been published regarding designing WS and XML schemas, however it is still hard for developers to find cookbooks or guidelines concentrated on designing web service contracts with contract-first method. To fill the gap, a set of design techniques are introduced and deployed in practice, incorporating some best practices scattered over the web services community. These techniques cover most of the key aspects of web service, including consolidating service schemas in line with business entities, constructing coarsegrained namespaces, applying versioning over WSDLs and service schemas, and writing fine-grained filters with contracts.

**Rapid Identification Approach for Reusable SOA Assets Using Component Business Maps**

*Islam Elgedawy, Lakshmish Ramaswamy*

(ICCWS2009-0075)

Substantial savings from asset reuse result when the right assets are identified in the very early stages of a client engagement. Unfortunately, advanced identification approaches (known by having high precision and recall, such as behavior-based approaches) cannot be adopted in these early stages, because at these early stages, there is no many details nor much understanding about the client functional requirements. On the other hand, unstructured keyword based identification approaches are known of having low precision and recall. To overcome this problem, we argue that assets descriptions should have explicit information about the business activities realized by the assets. To be able to capture this information in a machine understandable format, this paper proposes a model for describing reusable assets functional scopes using Component Business Maps (CBMs), in which the asset scope is represented as a hierarchy of CBM elements. Adopting this scope model, the paper proposes a rapid identification approach for reusable assets that retrieves assets based on their CBM projections. We believe the proposed approach provides better precision and recall when compared to unstructured keyword-based approaches.

**Application and Industry Session 5 – Cloud Computing**

**Session Chair: Heiko Ludwig, IBM T.J. Watson Research Center, USA**

**CCOA: Cloud Computing Open Architecture**

*Liang-Jie Zhang, Qun Zhou*

(ICCWS2009-0076)

Cloud Computing is evolving as a key computing platform for sharing resources that include infrastructures, software, applications, and business processes. Virtualization is a core technology for enabling cloud resource sharing. However, most existing Cloud Computing platforms have not formally adopted the service-oriented architecture (SOA) that would make them more flexible, extensible, and reusable. By bridging the power of SOA and virtualization in the context of Cloud Computing ecosystem, this paper presents seven architectural principles and derives ten interconnected architectural modules to form a reusable and customizable Cloud Computing Open Architecture (CCOA). Two case studies on Infrastructure and Business Cloud are used to deliver business and practical value of infrastructure and business process provisioning services over the Internet. We also present some potential value-added services of the proposed CCOA to guide strategic planning and other consulting practices of Cloud Computing.

**Virtualizing Services and Resources with ProBus: The WS-Policy-Aware Service and Resource Bus**

*Ralph Mietzner, Tammo van Lessen, Alexander Wiese, Matthias Wieland, Dimka Karastoyanova, Frank Leymann*

(ICCWS2009-0077)

A fundamental principle of service oriented architectures is the decoupling of service requesters and service providers to enable late binding of services at deployment time or even dynamic binding of services at runtime. This is important in enterprise settings, where different services that implement business functions in critical business processes are dynamically chosen based on availability or price. The same problem also applies to dynamic Grid environments where resources need to be dynamically chosen based on availability and other non-functional properties. The WS-
Policy framework describes how policies for both providers and requesters are specified to allow the selection of services based on these policies. Existing approaches, using WS-Policy, have drawbacks by placing the burden of the service selection partially on the client. In this paper, we present an extended enterprise service bus that allows service clients to submit policies to which service providers need to comply with together in one message with the service invocation request. We show how these policies are evaluated in the bus and how policies are defined for not only stateless services, but also stateful resources.

**Vulnerable Cloud: SOAP Message Security Validation Revisited**

*Nils Gruschka, Luigi Lo Iacono*  
(ICWS2009-0078)

The service-oriented architecture paradigm is influencing modern software systems remarkably and Web Services are a common technology to implement such systems. However, the numerous Web Service standard specifications and especially their ambiguity result in a high complexity which opens the door for security-critical mistakes. This paper aims on raising awareness of this issue while discussing a vulnerability in Amazon’s Elastic Compute Cloud (EC2) services to XML wrapping attacks, which has since been resolved as a result of our findings and disclosure. More importantly, this paper discusses the verification steps required to effectively validate an incoming SOAP request. It reviews the available work in the light of the discovered Amazon EC2 vulnerability and provides a practical guideline for achieving a robust and effective SOAP message security validation mechanism.

**Application and Industry Session 6 – Services QoS**

Session Chair: Jeane Chen, Blackbaud, USA

**Scalable and Reliable Location Services through Decentralized Replication**

*Gong Zhang, Ling Liu, Sangeetha Seshadri, Bhuvan Bamba, Yuehua Wang*  
(ICWS2009-0079)

One of the critical challenges for service oriented computing systems is the capability to guarantee scalable and reliable service provision. This paper presents Reliable GeoGrid, a decentralized service computing architecture based on geographical location aware overlay network for supporting reliable and scalable mobile information delivery services. The reliable GeoGrid approach offers two distinct features. First, we develop a distributed replication scheme, aiming at providing scalable and reliable processing of location service requests in decentralized pervasive computing environments. Our replica management operates on a network of heterogeneous nodes and utilizes a shortcut-based optimization to increase the resilience of the system against node failures and network failures. Second, we devise a dynamic load balancing technique that exploits the service processing capabilities of replicas to scale the system in anticipation of unexpected workload changes and node failures by taking into account of node heterogeneity, network proximity, and changing workload at each node. Our experimental evaluation shows that the reliable GeoGrid architecture is highly scalable under changing service workloads with moving hotspots and highly reliable in the presence of both individual node failures and massive node failures.

**A Contract-based Accountability Service Model**

*Chen Wang, Shiping Chen, John Zic*  
(ICWS2009-0080)

As growing number of real-world activities are performed through Internet connected services, there are increasing needs to make the behaviors of both service consumer and provider accountable. Many efforts attempting to regulate services and to guarantee service qualities lack sufficient accountability support. This paper treats accountability as a service and proposes a novel contract-based accountability service model to tackle this problem. The model uses federated accountability services to audit interactions between service consumers and service providers so that misbehaviors can be detected with undeniable evidences. We show how Internet data management services can be made accountable using this service model. We implemented the data management service and characterized its performance.

**WS-Policy: On Conditional and Custom Assertions**

*Bernhard Hollander*  
(ICWS2009-0081)

Today, Web services play a dominant role in Enterprise Application Integration (EAI) and for realizing Service Oriented Architectures (SOA), which define the architectural foundation for various kinds of distributed applications. In many business domains, Web services must exhibit quality attributes such as robustness, security, and maintainability. As a consequence, there is a high demand to develop Web services with Quality of Service (QoS) properties. Several specifications of the WS-* family, e.g. WS-Security and WS-ReliableMessaging, aim at simplifying the development and deployment of QoS-aware Web services. Although these approaches cover some typical application scenarios, their expressivity and flexibility are limited by the underlying WS-Policy framework. This paper proposes the syntax and semantics of a new WS-Policy operator that enables the introduction of conditional assertions. Secondly, a framework for managing different types of custom assertions is presented. Finally, this paper describes a proof of concept implementation demonstrating the practical feasibility of both extensions.

**Application and Industry Session 7 – Services Composition**

Session Chair: Soo Dong Kim, Soongsil University, Korea

**A Dynamic Approach toward QoS-Aware Service Workflow Composition**

*David Chiu, Sagar Deshpande, Gagan Agrawal, Rongxing Li*  
(ICWS2009-0082)

Web service-based workflow management systems have garnered considerable attention for automating and scheduling dependent operations. Such systems often support user preferences, e.g., time of completion, but with the rebirth of distributed computing via the grid/cloud, new challenges are abound: multiple disparate data sources, networks, nodes, and the potential for moving very large datasets. In this paper, we present a framework for integrating QoS support in a service workflow composition system. The relationship between workflow execution time and accuracy is exploited through an automatic workflow composition scheme. The algorithm, equipped with a framework for defining cost models on service completion times and error propagation, composes service workflows which can adapt to user’s QoS preferences.
A MapReduce-Enabled Scientific Workflow Composition Framework
Xubo Fei, Shiyong Lu, Cui Lin
(ICWS2009-0083)

MapReduce has recently gained a lot of attention as a parallel programming model for scalable data-intensive business and scientific analysis. In order to benefit from this powerful programming model in a scientific workflow environment, we propose a MapReduce-enabled scientific workflow composition framework consisting of: i) a dataflow based scientific workflow model that separates the declaration of the workflow interface from the definition of its functional body; ii) a set of dataflow constructs, including Map, Reduce, Loop, and Conditional, and their composition semantics to enable MapReduce-style scientific workflows; iii) an XML-based scientific workflow specification language, called WSL, in which both Map and Reduce are fully composable with other dataflow constructs in both flat and hierarchical manners. Besides leveraging the power of MapReduce to the workflow level, our workflow composition framework is unique in that workflows are the only operands for composition; in this way, our approach elegantly solves the two-world problem of existing composition frameworks, in which composition needs to deal with both the world of tasks and the world of workflows. The proposed framework is implemented and a case study is conducted to validate our techniques.

An Abstraction Framework for Service Composition in Event-driven SOA systems
Sourish Dasgupta, Satish Bhat, Yuguung Lee
(ICWS2009-0084)

In this paper, we propose an Internet public Web service matching approach that paves the way for (semi-)automatic service mashup. We will first provide the overview of the solution, which requires a detailed review of two fundamental models – schema/graph matching and semantic space. Based on the conceptual model level, literature study, the complete service matching approach is then provided with four essential steps – semantic space, parameter tree, similarity measures, and WSDL operation matching. The system demonstration that proves the concept proposed in this approach is finally presented. The solution has the potential to facilitate the Internet services mashup.

Application and Industry Session 9 – Services Optimization
Session Chair: Saayan Mitra, Adobe Systems Inc., USA

A Conceptual Modeling Approach to Business Service Mashup Development
Alessandro Bozzone, Marco Brambilla, Federico Michele Facco, Giovanni Toffetti Carughi
(ICWS2009-0088)
Professional mashups that include complex choreographies, data mediation, and result publishing within Web pages are still affected by implementation and design practices that rely either on very simple models or on low-level scripting and programming skills of developers, thus hampering the use of mashups in business context as rapid solution to immediate problems. Indeed, industrialization of their development is still a hard objective to achieve. We propose a design methodology based on visual models to improve the quality and the productivity of service mashups and presentation of the results, thus increasing their acceptance as professional applications in the business scenario. Existing software engineering methods are combined together in an innovative mix, comprising standard business process modeling languages (namely, BPMN) to
describe a high-level view of the mashup orchestration and on WebML (Web Modeling Language) to specify the detailed Web application model, including Web service interactions, hypertext navigation, event management, and rich user interfaces.

A Novel Dynamic Priority Scheduling Algorithm of Process Engine in SOA
QiMing Tian, Li Li, Ling Jin, XinXin Bai
(ICWS2009-0089)

EAI and SOA are widely adopted in enterprise information systems with business processes being orchestrated by a process engine. An algorithm which schedules tasks of process instances to maximize overall customer satisfaction is proposed in this paper. This new algorithm maximizes the total value of all process instances by dynamically assigning different priority to each task based on the business value and time-left of the corresponding process instances. The value of each kind of process instance is modeled as a utility function of response time which reflects the inverse proportional relationship between the customer satisfaction and response time. Experiments show that the total value of utility function with the proposed algorithm is promoted a lot than traditional methods.

A Relational Approach for Efficient Service Selection
Qi Yu, Manjeet Rege
(ICWS2009-0090)

Web services are gaining momentum as a major vehicle to deliver business functionalities on the Web. More and more business organizations have begun to use Web service to facilitate user interactions and the collaboration among themselves. This essentially forms a large service space, which still keeps growing. Meanwhile, there may be functionality overlaps among different service providers. The concept of Quality of Web Service (QoWS) is emerging as a key feature in distinguishing between competing service providers. We present in this paper a systematic approach for efficiently service selection by using QoWS as the major criterion. In particular, we adopt a relational approach that enables to store QoWS information in a relational DBMS and leverage standard relational operators for efficient service selection. We perform a preliminary experiment to evaluate the proposed service selection algorithms.

Application and Industry Session 10 – Services Applications
Session Chair: Jun-Jung Jeng, IBM T.J. Watson Research Center, USA

Mobile In-Store Personalized Services
Jun Li, Ismail Ari, Jhilmil Jain, Alan H. Karp, Mohamed Dekhil
(ICWS2009-0091)

The Mobile Shopping Assistant (MSA) is a mobile application platform to deliver real-time, in-store, and personalized services, such as personalized product offerings and in-store customer advisory support, to improve the shopping experiences of in-store customers. The service delivery network that powers the MSA involves retail stores and their business partners such as manufacturers. This paper presents the core technologies that we developed in this crossorganizational service network to support the MSA and its personalized services, with focus on service delivery, customer behavior understanding and information sharing. Our eventbased techniques allow customers, stores and manufacturers to deliver and consume the services in a loosely coupled manner, thus solving a critical store-specific real-time engagement problem in a seamless way. Service response tracking enables the stores to construct a comprehensive view of a customer’s in-store shopping behavior. Finally, the cross-organizational authorization-based access control mechanism effectively enforces information sharing between the stores and their partners.

A Service-Oriented System for Optimizing Residential Energy Use
Chen Wang, Martin de Groot, Peter Marendy
(ICWS2009-0092)

Significant consumption and cost savings can be made by better managing energy usage within small commercial properties and individual dwellings. By combining Web services and off-the-shelf home automation equipment, it is now possible to build a cost-effective infrastructure to support the delivery of energy management services to small consumers. In this paper we treat residential energy management as a resource management problem in a distributed computing system. Energy consumers are able to delegate the energy management of smart-meter connected appliances to these energy service providers and specify their energy consumption preference through access policies. We give an optimal scenario in terms of energy cost and efficiency in this service model. We also design an algorithm that makes use of aggregated user information to achieve near optimal energy use among residential electricity users.

The Web Service Browser: Automatic Client Generation and Efficient Data Transfer for Web Services
Stefen Heinzl, Markus Mathes, Thilo Stadelmann, Dominik Seiler, Marcel Diegelmann, Helmut Dohmann, Bernd Freisleben
(ICWS2009-0093)

Web services are supported by almost all major software vendors, but nevertheless there is still a certain barrier that prevents a broader user community to actually use them. The barrier is the lack of appropriate clients offered in conjunction with the services. This paper presents a Web Service Browser that automatically generates a dynamic user interface when the user browses to the location of the service description and additionally handles the invocation of the service. To ease the use of the service, the browser takes care of data management by using an implementation of the Flex-SwA architecture. Results are presented to the user in a human-readable manner. When the result contains multimedia data, an audio or video player is used to present the result. Use cases demonstrate the benefits of the browser. With the Web Service Browser, web services simply become a usable component offered in the WWW.

Application and Industry Session 11 – Services Mashup
Session Chair: Meiko Jensen, Ruhr University Bochum, Germany

Infoset for Service Abstraction and Lightweight Message Processing
Li Li, Wu Chou
(ICWS2009-0094)
Web services technologies are undergoing some significant changes at several levels, ranging from architectural styles (REST vs. SOAP) to message formats. To cope with these changes, there is a need to design services in an abstract fashion that is less sensitive to these changes so that our technological and economic investments are protected. To address this issue, this paper proposes an abstract modeling framework, called Infoset, both as a design and analysis tool and a message processing architecture. The benefit of Infoset is demonstrated first on some dual web services that provide both REST and SOAP access. The Infoset analysis modeling reveals the commonality and differences between dual web services, making it feasible to design abstract web services. Infoset also leads to a rule-based message processing architecture that avoids the problems in current static Object/XML SOAP engines. By dynamically computing the context of Infoset rules in message workflows, dependences between integrated web services are reduced and the reusability of services logic is increased. A prototype of this architecture is implemented and the preliminary experimental results indicate that the performance is satisfactory.

Intelligent Matching for Public Internet Web Services –Towards Semi-Automatic Internet Services Mashup
Chen Wu, Tharam Dillon, Elizabeth Chang
(ICWS2009-0095)

In this paper, we propose an Internet public Web service matching approach that paves the way for (semi-)automatic service mashup. We will first provide the overview of the solution, which requires a detailed review of two fundamental models – schema/graph matching and semantic space. Based on the conceptual model and the literature study, the complete service matching approach is then provided with four essential steps – semantic space, parameter tree, similarity measures, and WSDL operation matching. The system demonstration that proves the concept proposed in this approach is finally presented. The solution has the potential to facilitate the Internet services mashup.

Service-Oriented Architecture for Privacy-Preserving Data Mashup
Thomas Trojer, Benjamin C. M. Faug, Patrick C.K. Hung
(ICWS2009-0096)

Mashup is a web technology that combines information from more than one source into a single web application. This technique provides a new platform for different data providers to flexibly integrate their expertise and deliver highly customizable services to their customers. Nonetheless, combining data from different sources could potentially reveal person-specific sensitive information. In this paper, we study and resolve a real-life privacy problem in a data mashup application for the financial industry in Sweden. Therefore, we propose a service-oriented architecture for privacy-preserving data mashup together with a multiparty protocol to securely integrate private data from different data providers, whereas the integrated data still retains the essential information for supporting general data exploration or a specific data mining task, such as classification analysis. Experiments on real-life data suggest that our proposed method is effective for simultaneously preserving both privacy and information usefulness.

Application and Industry Session 12 – Services Management
Session Chair: Ustun Yildiz, University of California, Davis, USA

Composing Services for Third-party Service Delivery
Ingo Weber, Alistair Barros, Norman May, Jörg Hoffmann, Tomasz Kaczmarek
(ICWS2009-0097)

This paper proposes a model-based technique for lowering the entrance barrier for service providers to registerservices with a marketplace broker, such that the service is rapidly configured to utilize the broker’s local service delivery management components. Specifically, it uses process modeling for supporting the execution steps of a service and shows how service delivery functions (e.g. payment points) “local” to a service broker can be correctly configured into the process model. By formalizing the different operations in a service delivery function (like payment or settlement) and their allowable execution sequences (full payments must follow partial payments), including crossfunction dependencies, it shows how through tool support, the non-technical user can quickly configure service delivery functions in a consistent and complete way.

Establishing and Monitoring SLAs in Complex Service Based Systems
Marco Comuzzi, Constantinos Kotsokalis, George Spanoudakis, Ramin Yahyapour
(ICWS2009-0098)

In modern service economies, service provisioning needs to be regulated by complex SLA hierarchies among providers of heterogeneous services, defined at the business, software, and infrastructure layers. Starting from the SLA Management framework defined in the SLA@SOI EU FP7 Integrated Project, we focus on the relationship between establishment and monitoring of such SLAs, showing how the two processes become tightly interleaved in order to provide meaningful mechanisms for SLA management. We first describe the process for SLA establishment adopted within the framework; then, we propose an architecture for monitoring SLAs, which satisfies the two main requirements introduced by SLA establishment: the availability of historical data for evaluating SLA offers and the assessment of the capability to monitor the terms in a SLA offer.

Inferring Behavioural Models from Traces of Business Applications
Arnaud Dury, Hesham H. Hallal, Alexandre Petrenko
(ICWS2009-0099)

We present an approach to the inference of automata models of web-based business applications using only execution traces recording the externally observable behaviour of such applications. The proposed approach yields behavioural models representing both the control flow of an application and the data variations corresponding to different types of users. We also describe how the obtained models allow the use of verification techniques like model checking in the validation phase using a case study featuring a travel reservation agency.

Application and Industry Session 13 – Services Assessment
Session Chair: Marco Comuzzi, Technical University of Eindhoven, the Netherlands

A Performance Evaluation Study for Web Services Attachments
Julio Cezar Estrella, André Takeshi Endo, Rubens Kenji T. Toyohara, Regina H. C. Santana, Marcos J. Santana, Sarita Mazzini Bruschi
(ICWS2009-0100)

Web Services are a technology based on the Service Oriented Architecture that enables communication between applications through the Internet.
Using Web Services, it is possible to send any type of information in any form of encryption. In this context, different techniques have been used to attach binary files in SOAP messages. However, there is no consensus on which technique has the best performance. This paper presents a performance evaluation study with three techniques for Web Service attachments: Pure Binary, MTOM and SwA. A testing environment was configured to verify the influence of the network and the size of files. Also, we present a tool called WSATPerf that supports the execution of the performance evaluation.

Analytic Architecture Assessment in SOA Solution Design and Its Engineering Application
Nianjun Zhou, Liang-Jie Zhang
(ICWS2009-0101)

In this paper, we present an architecture-centric assessment approach for model evaluation over reference architecture to quantitatively estimate architecture maturity and architecture quality. Such assessment is essential to support design-level refinement for an enterprise solution. To achieve this analytic goal, we select a nine-layer SOA solution stack (S3) as reference architecture, and introduce the necessary mathematical definitions and formulation. The baseline for such assessment is a model template composed by S3 solution patterns. A template is the starting point of creating a design model. The selection of such template will largely determine the architecture properties of final SOA solution. The maturity analysis is carried out at different granularity levels (architecture building block, architecture layer, and architecture model) to justify the ‘completeness’ of a design. The quality assessment is accomplished through a set of quality-indicators to justify the ‘goodness’ of an architecture based on the relationships of architecture building block instances. Finally, using UML 2.0 to capture the model of S3, we provide a real assessment prototype developed over IBM RSA platform.

SOA Middleware Support for Service Process Reconfiguration with End-to-End QoS Constraints
Yanlong Zhai, Jing Zhang, Kwei-Jay Lin
(ICWS2009-0102)

In SOA, services may become volatile and fail to deliver the quality of service as requested by users. In this paper, we present an approach for repairing failed services by replacing them with new services and ensuring the new service process still meets the user specified end-to-end QoS constraints. An iterative structural inspection algorithm is designed to produce reconfiguration regions that include one or more failed service. By reconfiguring only services in the selected regions, the business process will not be affected significantly. The algorithm may also utilize those available QoS constraints to relax the original constraints of a reconfiguration region and to provide more effective reconfiguration solutions. We also present the middleware components to support the service reconfiguration in the LLAMA framework.

Application and Industry Session 14 – Services Delivery and Orchestration
Session Chair: Li Li, Avaya Labs Research, USA

Reiki: Serviceability Architecture and Approach for Reduction and Management of Product Service Incidents
Chris Connelly, Brian Cox, Tim Forel, Rui Liu, Dejan Milojicic, Alan Nemeth, Peter Piet, Suhais Shivanna, Wei-Nian Zhou, Liang-Jie Zhang
(ICWS2009-0103)

Hong Wang There is a significant number of IT failures per year because parts fail, products are used in ways they were not designed for, and humans make errors in using products. These failures result in incidents that product vendors service as a part of the warranty or contracts. Incidents incur significant costs for servicing them, including call centers, parts, and field engineers. Some of the major problems include lack of coherent incident information, leading to inaccurate service diagnosis and inability to forecast failures. At the same time, technology has evolved. Hardware is generally more reliable, failures are moving from hardware to firmware, software, and applications. The scale effect limits human operator engagement, prevents centralized approaches, and expands automation. Traditional ways of handling incidents are not appropriate any more. In this paper we present a set of tools and approaches that enable unified serviceability with self-healing, automated learning, and an analysis engine. Unified serviceability with self-healing results in clean incident data and it reduces criticality of incidents into deferred maintenance. Automated learning produces empirically proven actionable knowledge enabling cost reduction of automated incident resolution. Using clean data and actionable knowledge, the analysis engine helps predict failures and determine trends, resulting in preventive maintenance. Collectively, preventive and deferred maintenance and automated incident service significantly reduce the costs. This way we have aligned incidents cost with the technology trends.

An Extensible Abstract Service Orchestration Framework
Stéphanie Chollet, Philippe Lalanda
(ICWS2009-0104)

Service composition is complex. It has to reach a set of pre-defined non-functional qualities, like security for instance, which requires the production of complicated code. This code, often distributed between client and server sides, is highly error-prone and difficult to maintain. In this paper, we present a generative environment for the orchestration of abstract services and the separate specification of non-functional properties. This environment has been built within the European SODA project and validated on several industrial use cases. In this paper, we focus on an alarm management scenario with stringent security requirements.

Pat: A P2P based Publish/Subscribe System for QoS Information Dissemination of Web Services
Xiao Zheng, Junchao Luo, Jiuxin Cao
(ICWS2009-0105)

A fundamental problem that confronts QoS-aware service selection and composition is the efficient and timely QoS information obtainment. Current research on this problem usually involves query-based or monitoring-based methods. However, in a dynamic and volatile service oriented computing (SOC) environment, these solutions suffer some or all of the limitations, such as cost, timeliness guarantee and salability. This paper presents Pat, a P2P based publish/subscribe system to disseminate new revised QoS information. Pat aims at reliable and efficient QoS information dissemination in large-scale SOC environments. It exploits specialized rendezvous points (RP) and a replicas mechanism to reduce the risk of subscriptions loss and consequently improve reliability. A reverse RP ring is designed to quicken subscription delivery and QoS information publication. In addition, an optimization mechanism for composite services is built into Pat, which helps to reduce notification traffic. Simulation results show that Pat is reliable, efficient and scalable.
Application and Industry Session 15 – Process Management  
Session Chair: Wu Chou, Avaya Labs Research, USA

A Flexible Approach for Automatic Process Decentralization using Dependency Tables
Walid Fdhila, Ustun Yildiz, Claude Godart
(ICWS2009-0106)

Web service paradigm and related technologies have provided favorable means for the realization of collaborative business processes. From both conceptual and implementation points of view, the business processes are based on a centralized management approach. Nevertheless, it is very well known that the enterprise-wide process management where processes may span multiple organizational units requires particular considerations on scalability, heterogeneity, availability and privacy issues, that in turn, require particular consideration on decentralization. In this paper, our aim is to reconcile the decentralization of processes as a step towards the enterprise-wide solutions. We propose a methodology for transforming a centralized process specification into a form that is amenable to a distributed execution and to incorporate the necessary synchronization between different processing entities. The proposed technique has the advantage of being flexible that it computes the abstract constructs and provides a generalized approach to the decentralization of processes.

A Tool for Choreography Analysis Using Collaboration Diagrams
Tevfik Bultan, Chris Ferguson, Xiang Fu
(ICWS2009-0107)

Analyzing interactions among peers that interact via messages is a crucial problem due to increasingly distributed nature of current software systems, especially the ones built using the service oriented computing paradigm. In service oriented computing, interactions among peers participating to a composite service involve message exchanges across organizational boundaries in a distributed computing environment. In order to build such systems in a reliable manner, it is necessary to develop techniques for analysis and verification of interactions among services. Collaboration diagrams provide a convenient visual model for modeling service interactions. In this paper, we present a tool that 1) checks the realizability of interactions specified by the given collaboration diagram, 2) verifies the LTL properties of the interactions specified by the given collaboration diagram by automatically converting it to a state machine model, and 3) synthesizes peer state machines that realize the set of interactions specified by the given collaboration diagram.

An Approach to Composing Web Services with Context Heterogeneity
Xitong Li, Stuart Madnick, Hongwei Zhu, Yushun Fan
(ICWS2009-0108)

The potential benefits of Web services composition heavily rely on semantic interoperability, i.e., the ability to exchange data meaningfully amongst Web services. Context heterogeneity, which refers to different implicit assumptions about interpreting the exchanged data, hampers the automatic composition of Web services. However, existing initiatives of Semantic Web Services (SWSs) often ignore context heterogeneity. In this paper, we introduce an approach to address this issue. The contexts of the involved Web services are defined in a lightweight ontology and their WSDL descriptions are annotated by an extension of a W3C standard, i.e., Semantic Annotation for WSDL and XML Schema (SAWSDL). The composition of Web services is described using BPEL specification. Given a BPEL file that ignores context heterogeneity, the approach automatically detects all context differences among the involved services, and reconciles them by producing a mediated BPEL file that incorporates necessary conversions using XPath functions and/or Web services.

Application and Industry Session 16 – Services Assurance
Session Chair: Susan Urban, Texas Tech University, USA

User-Perceived Service Availability: A Metric and an Estimation Approach
Lingshuang Shao, Junfeng Zhao, Tao Xie, Lu Zhang, Bing Xie, Hong Mei
(ICWS2009-0109)

Web-service-related techniques have become popular to improve system integration and interaction. In distributed and dynamic environment, web services’ availability has been regarded as one of the key properties for (critical) service-oriented applications. Quality of Service (QoS), including availability, has been regarded by IEEE as a user perceived property. However, based on our investigation of monitoring invocation records of real web services, existing availability metrics, which were proposed in traditional domains, have not addressed the “user-perceived” characteristics. Based on analyzing the limitations of the existing availability metrics, we propose a status-based userperceived service availability metric and a corresponding estimation approach. Experiments on monitoring and analyzing the invocation records of real services demonstrate that the new metric and the corresponding estimation approach could lead to a feasible estimation on web services’ availability from the user side.

A Unified Test Framework for Continuous Integration Testing of SOA solutions
Hehui Liu, Zhongjie Li, Jun Zhu, Huafang Tan, Heyuan Huang
(ICWS2009-0110)

The quality of Service Oriented Architecture (SOA) solutions is becoming more and more important along with the increasing adoption of SOA. Continuous Integration Testing (CIT) is an effective technology to discover bugs as early as possible. However, the diversity of programming models used in an SOA solution and the distribution nature of an SOA solution pose new challenges for CIT. Existing testing frameworks more focus on the integration testing of applications developed by a single programming model. In this paper, a unified test framework is proposed to overcome these limitations and enable the CIT of SOA solutions across the whole development lifecycle. This framework is designed following the Model Driven Architecture (MDA). The information of an executable test case is separated into two layers: the behavior layer and the configuration layer. The behavior layer represents the test logic of a test case and is platform independent. The configuration layer contains the platform specific information and is configurable for different programming models. An extensible and pluggable test execution engine is specially designed to execute the integration test cases. A global test case identifier instrumentation approach is used to merge the distributed test case execution traces captured by ITCAM – an IBM integrated management tool. A verification approach supporting Boolean expression and back-end service interaction verification is proposed to verify the test execution result. Initial experiments have shown the effectiveness of this unified test framework.
Service Composition as Generative Constraint Satisfaction
Wolfgang Mayer, Rajesh Thirugnaraj, Markus Stumptner
(ICWS2009-0111)

The ability to build new (complex) services by composing existing services is one of the key benefits of the Service Oriented Architecture paradigm. Existing approaches to automate composition requires pre-planning or prediction of the number of required services, making them unsuitable in dynamic composition scenarios. To address this gap, we present a consistency-based service composition approach, where composition problems are modeled in a generative constraint-based formalism. We illustrate how the configuration of service processes differs from established constraint-based configuration techniques and develop an algorithm to synthesis valid service process compositions. We also show that our technique scales well to non-trivial problems.

SOA-based Integration of the Internet of Things in Enterprise Services
Patrick Spiess, Stamatis Karnouskos, Dominique Guinard, Dominic Savio, Oliver Baeker, Luciana Moreira Sá de Souza, Vlad Trifá
(ICWS2009-0112)

Advances in the areas of embedded systems, computing, and networking are leading to an infrastructure composed of millions of heterogeneous devices. These devices will not simply convey information but process it in transit, connect peer to peer, and form advanced collaborations. This “Internet of Things” infrastructure will be strongly integrated with the environment, and its integration with the enterprise systems will not only further blur the line between business IT systems and the real world, but will change the way we design, deploy, and use services. New opportunities can emerge for businesses, which can now closely collaborate with the real world. The work presented here proposes an architecture for an effective integration of the Internet of Things in enterprise services.

Application and Industry Session 17 – Data Management
Session Chair: Pearl Brazier, University of Texas-Pan American, USA

Collaborative Web Data Record Extraction
Gengxin Miao, Fiyat Kart, I.E. Moser, P. M. Melliar-Smith
(ICWS2009-0113)

This paper describes a Web Service that automatically parses and extracts data records from Web pages containing structured data. The Web Service allows multiple users to share and manage a Web data record extraction task to increase its utility. A recommendation system, based on the Probabilistic Latency Semantic Indexing algorithm, enables a user to find potentially interesting content or other users who share the same interests with the user. A distributed computing platform improves the scalability of the Web Service in supporting multiple users by employing multiple server computers. A Web Service interface allows users to access the Web Service, and allows programmers to develop their own applications and, thus, extend the functionality of the Web Service. Index Terms—collaborative information extraction, data mining, Web Service.

Adaptive Prefetching Scheme Using Web Log Mining in Cluster-based Web Systems
Heung Ki Lee, Baik Song An, Eun Jung Kim
(ICWS2009-0114)

The main memory management has been a critical issue to provide high performance in web cluster systems. To overcome the speed gap between processors and disks, many prefetch schemes have been proposed as memory management in web cluster systems. However, inefficient prefetch schemes can degrade the performance of the web cluster system. Dynamic access patterns due to the web cache mechanism in proxy servers increase mispredictions to waste the I/O bandwidth and available memory. Too aggressive prefetch schemes incur the shortage of available memory and performance degradation. Furthermore, modern web frameworks including persistent HTTP make the problem more challenging by reducing the available memory space with multiple connections from a client and web processes management in a prefork mode. Therefore, we attempt to design an adaptive web prefetch scheme by predicting memory status more accurately and dynamically. First, we design Double Prediction-by-Partial-Match Scheme (DP5) that can be adapted to the modern web framework. Second, we propose Adaptive Rate Controller (ARC) to determine the prefetch rate depending on the memory status dynamically. Finally, we suggest Memory Aware Request Distribution (MARD) that distributes requests based on the available web processes and memory. For evaluating the prefetch gain in a server node, we implement an Apache module in Linux. In addition, we build a simulator for verifying our scheme with cluster environments. Simulation results show 10% performance improvement on average in various workloads.

RDF Data-Centric Storage
Justin J. Levandoski, Mohamed F. Mokbel
(ICWS2009-0115)

The vision of the Semantic Web has brought about new challenges at the intersection of web research and data management. One fundamental research issue at this intersection is the storage of the Resource Description Framework (RDF) data: the model at the core of the Semantic Web. We present a data-centric approach for storage of RDF in relational databases. The intuition behind our approach is that each RDF dataset requires a tailored table schema that achieves efficient query processing by (1) reducing the need for joins in the query plan and (2) keeping null storage below a given threshold. Using a basic structure derived from the RDF data, we propose a two-phase algorithm involving clustering and partitioning. The clustering phase aims to reduce the need for joins in a query. The partitioning phase aims to optimize storage of extra (i.e., null) data in the underlying relational database. Our approach does not assume a particular query workload, relevant for RDF knowledge bases with a large number of ad-hoc queries. Extensive experimental evidence using three publicly available real-world RDF data sets (i.e., DBLP, DBPedia, and Uniprot) shows that our schema creation technique provides superior query processing performance compared to state-of-the-art storage approaches. Further, our approach is easily implemented, and complements existing RDF-specific databases.

Application and Industry Session 18 – Services Management
Session Chair: Onyeka Ezenwonye, South Dakota State University, USA

Static vs. Dynamic Validation of BSP Conformance
Stefan Prennisch’utz-Sch’utzenau, Nirmal K. Mukhi, Satoshi Hada, Naoto Sato, Fumiko Satoh, Naohiko Uramoto
(ICWS2009-0116)
many matches and they return a set of matched advertisements without rank ordering them. We believe it’s important to rank the returned set of ontology. Many semantic matchmakers exist today and they focus on matching the IOPE form of the advertisement to the query. This may result in the services relative to the query. Our algorithm can complement other approaches that use the history of issued queries and data mining. We have evaluated the effectiveness of the ranking algorithm against a benchmark ranking that is done manually and shown that our ranking scheme is close to the best ranking scheme possible.

A Process Modeling-based Approach for Web Service Management
Yan Liu

The promise of dynamic binding and the ability to dynamically and seamlessly move between service providers can only be realized through the path of semantic expressibility. Once we describe the semantics of a service in it’s advertisement, a semantic matchmaker can match a query with the set of advertisements that satisfy the query conditions. The state of the art today uses the IOPE (Inputs Outputs Preconditions and Effects) form of advertisements with languages such as OWL-S being used to represent the semantics. Inputs and outputs usually refer to concepts in an ontology. Many semantic matchmakers exist today and hey focus on matching the IOPE form of the advertisement to the query. This may result in many matches and they return a set of matched advertisements without rank ordering them. We believe it’s important to rank the returned set of services in order to choose the best service. In this paper we present such a ranking algorithm that uses the IOPE information present in the each of the services relative to the query. Our algorithm can complement other approaches that use the history of issued queries and data mining. We have evaluated the effectiveness of the ranking algorithm against a benchmark ranking that is done manually and shown that our ranking scheme is close to the best ranking scheme possible.

Web Service Ranking Using Semantic Profile Information
Umesh Bellur, Harin Vadodaria

The promise of dynamic binding and the ability to dynamically and seamlessly move between service providers can only be realized through the path of semantic expressibility. Once we describe the semantics of a service in it’s advertisement, a semantic matchmaker can match a query with the set of advertisements that satisfy the query conditions. The state of the art today uses the IOPE (Inputs Outputs Preconditions and Effects) form of advertisements with languages such as OWL-S being used to represent the semantics. Inputs and outputs usually refer to concepts in an ontology. Many semantic matchmakers exist today and hey focus on matching the IOPE form of the advertisement to the query. This may result in many matches and they return a set of matched advertisements without rank ordering them. We believe it’s important to rank the returned set of services in order to choose the best service. In this paper we present such a ranking algorithm that uses the IOPE information present in the each of the services relative to the query. Our algorithm can complement other approaches that use the history of issued queries and data mining. We have evaluated the effectiveness of the ranking algorithm against a benchmark ranking that is done manually and shown that our ranking scheme is close to the best ranking scheme possible.

Design Quality Analytics of Traceability Enablement in Service-Oriented Solution Design Environment
Liang-Jie Zhang, Zhi-Hong Mao, Nianjun Zhou

This paper provides an artifact-pattern-matching framework and mathematical model to analyze the dynamic behaviors of the SOA solution design in modeldriven fashion and provide recommendations for optimal solution pattern enablement for solution artifacts. The artifact-pattern-matching system can be dynamically tuned based on the practitioners’ final selections of the recommendations. Specifically, we propose a set of Solution patterns to guide SOA solution architects through the process of consuming and configuring SOA artifacts for composing SOA solutions. The resulting multi-dimensional cascading flagging method is also presented in this paper. As an example, impact analysis patterns are used as solution patterns to support traceability enablement. We present some future directions of leveraging reinforcement learning algorithms to enrich the design quality analytics of SOA solution.

A Petri Net Siphon Based Solution to Protocol-level Service Composition Mismatches
Pengcheng Xiong, Mengchu Zhou, Calton Pu

Protocol-level mismatch is one of the most important problems in service composition. The commonly used reachability exploration method focuses on verifying deadlock-freeness. When this property is violated, the states and traces in the reachability graph only give clues to re-design the composition. The process must then repeat itself until no deadlock is found. In this paper, multiple web service interaction is modeled with a Petri net called Composition net (C-net). The protocol-level mismatch problem is transformed into the deadlock structure problem of a C-net. If mismatches are found, a solution based on Petri siphons is proposed. The proposed method is shown to achieve higher efficiency for resolving protocol-level mismatching issues than traditional ones do.

Dynamic Collaborative Business Process Formulation via Ontologised Hierarchical Task Network (HTN) Planning

Increased trade and globalisation has created an increasing need for the dynamic formulation and integration of cross-enterprise collaborative business processes (cBP’s). However, current systems and methodologies, being static in nature, are unable to dynamically formulate cBP’s based on business goals and selection criteria. Much of this stems from the current inability to bridge high level strategic business goals to low-level operational tasks, and the inability to dynamically decompose compound business process tasks into primitive operational tasks for direct Web service execution. In this paper, we demonstrate how the concepts from hierarchical task network (HTN) planning are feasible for dynamically creating cBP task sequences ideal for direct Web service execution. We also establish the rationale behind modelling business-to-business (B2B) collaboration tasks as hierarchical Web ontologies. To demonstrate the achievability of dynamic cBP formulation, we developed the Genesis methodology, which consists of (1) Business-OWL (BOWL) - a B2B hierarchical task Web ontology, and (2) the Genesis algorithm – an extension of the hierarchical task network (HTN) planning algorithm to handle business criteria and control flows commonly found in business.
The huge demand for situational and ad-hoc applications desired by the mass of business end users cannot be fully implemented by IT departments. New approaches that allow for End User Development (EUD) are needed to overcome this “long-tail” dilemma. More specifically, most existing approaches insufficiently support EUD for infrequent, situational, and ad-hoc B2B Collaborations. Enterprise Mashup- and Lightweight Composition approaches and tools are promising solutions to unleash the huge potential of integrating the mass of users into development. Within the current research project FAST, a Web based Mashup/ Gadget development tool is in development that allows for different options to realize B2B collaborations via Mashups. In this work, five patterns for the development of Enterprise Mashups are identified, characterized, and evaluated with focus on their adequacy for B2B collaborations.

**BlueInfo: Open Architecture for Deploying Web Services in WPAN Hotspots**

Hanna Kukka, Fabio Kruger, Timo Ojala

We introduce BlueInfo, an open architecture for deploying web services in WPAN hotspots for cost-free context-aware mobile access over Bluetooth. A BlueInfo hotspot either pushes subscribed services at desired intervals to registered devices (BlueInfo Push) or alternatively the user invokes a particular service by sending a simple keyword query to the hotspot (BlueInfo Pull). The BlueInfo hotspot requests the service from the origin server in the Internet and relays the response to the mobile device, possibly after adaptation for mobile viewing. The usability of BlueInfo Pull in comparison to a mobile phone browser is demonstrated with an empirical user evaluation conducted in a laboratory setting.

**XDM-Compatible Service Repository for User-Centric Service Creation and Discovery**

Jian Yu, Paolo Falcarin, Sancho Rego, Isabel Ordas, Eduardo Martins, Quan Sun, Ruben Trapero, Quan Z. Sheng

The key objective of OPUCE system is to enable the participation of end-users in the management of their own services, by providing them with innovative tools which allow an easy creation and delivery of personalized communication and information services. This paper describes the OPUCE service and component repository, which extends the OMA OSPE service model storage approach XDM. By integrating an ebXML Registry using the native notification mechanisms of XDM, the search capability of the repository is dramatically improved. Moreover, this repository also exploits semantic Web technology to provide an intuitive visualized browser for convenient service exploring.

**Risk Management Framework for Service-Oriented Architecture**

R. William Maule, William C. Lewis

A current focus of military research and development is Service-Oriented Architecture (SOA) and processes to transition legacy systems into SOA. While there have been many excellent examples of cutting-edge SOA and web services implementations there remains a need for models, methodologies and specifications to help programmers integrate their work into selected SOA and to more easily access web services. Research proposed herein will aid both programmer and management understanding of selected SOA through an application that provides baselines, reference specifications, and integration methodology to assist developers seeking to utilize SOA components or interface with SOA services. There is an additional need in the Department of Navy to consider issues in a distributed SOA where either the SOA, and/or a component of the SOA, and/or dependent web services, must be re-synchronized after significant communication outages. Research herein will establish baselines, models and a prototype application to help define, categorize, normalize, and weight risks in the development of distributed SOA including methodology to manage risk.

**An Approach to Non-functional Property Evaluation of Web Services**

Pei Li, Marco Comerio, Andrea Maurino, Flavio De Paoli

Web service evaluation is a phase of the Web service selection in which discovered Web services are evaluated with respect to user request, which means that the non functional properties (NFPs) offered by Web services are compared with the non functional properties requested by users. The fact that users and providers can express their NFPs in very flexible ways makes the management of NFPs a very complex task. In this paper we propose a computing-oriented description of NFPs and a novel approach to NFP-based service evaluation based on Hierarchical Constraint Logic Programming. This proposal extends our previous work on Policy Centered Meta-model (PCM) [2].

**Mutation Test Based on OWL-S Requirement Model**

Xiaojuan Wang, Ning Huang, Rui Wang

Web service evaluation is a phase of the Web service selection in which discovered Web services are evaluated with respect to user request, which means that the non functional properties (NFPs) offered by Web services are compared with the non functional properties requested by users. The fact that users and providers can express their NFPs in very flexible ways makes the management of NFPs a very complex task. In this paper we propose a computing-oriented description of NFPs and a novel approach to NFP-based service evaluation based on Hierarchical Constraint Logic Programming. This proposal extends our previous work on Policy Centered Meta-model (PCM) [2].
When web services play more important roles in software development, the corresponding software dedicated for web services testing has attracted more attention. This paper proposes a new mutation testing method based on the requirement model presented by OWL-S, which not only improves the test efficiency, but also makes the test work undergoing automatically. How to define the mutant operators, generate mutants and test cases automatically according to the requirement model are discussed in detail by the author.

**Modeling and Analysis of Flexible Transaction for Web Services**  
Min Yuan, Zhiqiu Huang, Fangxiong Xiao  
(ICWS2009-0128)

A variety of extended transaction models have been proposed in distributed database community, and the development of such models has drawn more attentions since they are not adequate for long-running Web services. From a formal method perspective, a Flexible transaction model for Web services based on MPI-calculus is proposed in this work. MPI-calculus, without introducing any new operators, creates the dynamic association between the changes of transaction scope and their interactive actions in the original Pi-calculus. According to the flexible transaction dependency, a new weak transactional open bisimulation relationship is presented to characterize the transactional equivalence. All of the results can serve as the theoretical foundation to model flexible and powerful mechanisms for implementing long-running transactions.

**Formal Analysis for Multimedia Conferencing Communication Services Orchestration**  
Bo Cheng, Xiangtuo Lin, Xiaoxiao Hu, Junliang Chen  
(ICWS2009-0129)

Service-oriented communication (SOC) is a new trend in the industry to enable communication through a service-oriented architecture (SOA) and thereby encapsulate communication capabilities as services. In this paper, we design the session initiation protocol (SIP) based multimedia conferencing communication services model, and mainly focus on formal analysis for BPEL based multimedia conferencing communication services orchestration and to guarantee the process correctness for such applications, and also providing an automated support for the formal analysis model of their behavior. Finally, we give the conclusions.

**Change Detection and Correction Facilitation for Web Applications and Services**  
Alfredo Alba, Varun Bhagwan, Tyrone Grandison, Daniel Gruhl, Jan Pieper  
(ICWS2009-0130)

There are a large number of websites serving valuable content that can be used by higher-level applications, Web Services, Mashups, etc. Yet, due to various reasons (lack of computing resources, financial constraints etc.) they are unable to provide Web Service APIs to access their data. In their desire to incorporate the latest and greatest technologies, as well as to adapt layouts that are more preferred by users, websites undergo changes over time. These changes can range from minor, e.g. function name changes, to major, e.g., shifting the web platform to AJAX technologies. This paper addresses the problem of detecting layout changes for websites which are unable to provide any Web Service to access their content, yet do not mind others harvesting said content.

**Deactivation of Unwelcomed Deep Web Extraction Services through Random Injection**  
Varun Bhagwan, Tyrone Grandison  
(ICWS2009-0131)

Websites serve content both through Web Services as well as through user-viewable webpages. While the consumers of web-services are typically ‘machines’, webpages are meant for human users. It is highly desirable (for reasons of security, revenue, ownership, availability etc.) for service providers that content that will undergo further processing be fetched in a prescribed fashion, preferably through a supplied Web Services. In fact, monetization of partnerships within a services ecosystem normally means that website data translate into valuable revenue. Unfortunately, it is quite commonplace for arbitrary developers to extract or leverage information from websites without asking for permission and or negotiating a revenue sharing agreement. This may translate to significant lost income for content providers. Even in cases where website owners are happy to share the data, they may want users to adopt dedicated Web Service APIs (and associated API-servers) rather than putting a load on their revenue-generating websites. In this paper, we introduce a mechanism that disables automated web scraping agents, thus forcing clients to conform to the provided Web Services.

**Poster Session 2 – Services Applications**  
Session Chair: Masoom Alam, SERG Pakistan

**Web Services SIP based Open Multimedia Conferencing on Internet**  
Bo Cheng, Xiaoxiao Hu, Xiangtuo Lin, Yang Zhang, Junliang Chen  
(ICWS2009-0132)

In this paper, we introduce the session initiation protocol (SIP) based multimedia conferencing on Internet, and mainly focus on the design and implementation for conferencing communication services model, such as SIP connection, session management, media control conferencing management, also we provide a prototype. Finally, we give the conclusions.

**A Framework for Building Reliable Distributed Bioinformatics Service Repositories**  
Francois Moreeens  
(ICWS2009-0133)

The reliability is a major factor that limits the success of promising service oriented architecture in bioinformatics. To evaluate services reliability and availability and create indicators of quality of service, we have defined an XML format designed to exchange service status reports. We demonstrate the interest of sharing status reports between service consumers and producers by providing two example applications, a workflow management system plugin and a web report generator. Furthermore, we describe the framework that we use to distribute quality of service management features, QBIOS. QBIOS enables service test case creation, scheduled execution and monitoring. We illustrate the use of our open test strategy at the level of a group of scientific partners sharing bioinformatics services.

**A Governance Model for SOA**  
Pierre de Leusse, Theo Dimitrakos, David Brossard  
(ICWS2009-0134)

Currently, business requirements for rapid operational efficiency, customer responsiveness as well as rapid adaptability are driving the need for
ever increasing communication and integration capabilities of the software assets. Service Oriented Architecture (SOA) is generally acknowledged as being a potential solution to expose finely grained pieces of software components on a network that are reusable and composable. Provisioning of business services for different business purposes may require the rapid assembly of their core functionality with different infrastructure capabilities and policies in different contexts. In this paper, the authors propose a SOA based governance model that permits to handle non-functional requirements in a dynamic way.

**Out of the Confusion of Tongues: A Unified Database Programming Paradigm**

*Rui Liu, Weihong Wang*  
(ICWS2009-0135)

Data-intensive applications are calling for (1) significant performance improvement in data processing, and (2) lowered entries for domain expertise to create higher value. Pursuing a database approach to the challenges, the paper presents an automated database extension mechanism, which allows one to seamlessly program application level workflows, and computations to be pushed down to (heterogeneous) database systems, in one programming language. We thus greatly ease the job of implementing scalable data intensive computations, with multiple databases as the computation platform.

**A Semantic Repository for Geological Modeling Workflows**

*Nabil Belaid, Yamine Ait-Ameur, Jean-Franc¸ois Rainaud*  
(ICWS2009-0136)

Nowadays, many engineering studies are conducted to securely exploit depleted Oil Fields for CO2 Storage. These studies follow complex workflows of data processing services described by geologists. If no explicit semantics is applied to describe these workflows, it is not possible to share them between geologists by reusing existing ones or for composing new ones. The focus of our work is to make the semantics explicit in order to facilitate the geologists daily work. In this article, we first explain how geologists operate today. Then, we enrich such workflows with semantic indexes through ontology based characterizations.

**Poster Session 3 – SOA Techniques**

**Session Chair: Incheon Paik, University of Aizu, Japan**

**Generic Web Services - Extensible Functionality with Stable Interface**

*Vadym Borovskiy, Sebastian Enderlein, and Alexander Zeier*  
(ICWS2009-0137)

Extending the functionality of Web services without invalidating the code of existing clients has been a challenging task. This paper proposes a new interface design technique called “Generic Web Services” that preserves a service’s backwards compatibility while enriching its functionality. This is accomplished by applying interface relaxation technique - shifting the semantics of a service’s API from design time to runtime by using identity parameters. The paper gives an example illustrating the idea on a Web service from SAP Enterprise Services Workplace.

**GroupSpeak: High-level Language Extension for Workflow Capability**

*Moshe Gutman, Sridhar Radhakrishnan, Changwook Kim, Chandra N. Sekharan, Konstantin Läufer*  
(ICWS2009-0138)

Currently, workflow systems are either XML based or component based. Both paradigms have usability deficiencies. XML is not designed for procedural programming. Legacy code is difficult to adapt to component based systems. We propose a new paradigm by adding workflow keywords to an existing high-level language. This approach, called GroupSpeak, uses a procedural style of programming and allows for easy introduction of workflow patterns to legacy code. The programmer can leverage their existing knowledge of the high-level language to easily add workflow capabilities to their applications.

**Enabling Scaleable, Efficient, Non-Visual Web Browsing Services**

*Ashish Verma, Tyrone Grandison, Himanshu Chauhan*  
(ICWS2009-0139)

Over the last few decades, the discipline of Web Accessibility has been focused on building more efficient and more effective speech generators for Web Browsers. The visual browser interface is central to the current paradigm. However, in many cases, visual interaction is not required or desired, e.g. it is not relevant for blind people. More generally, when the input and output points are WAV files, SMS messages or natural queries, it becomes very clear that going through the visual user interface is overkill. In this paper we introduce a solution to this problem - a scalable, efficient, non-visual web browser that works with a Web whose central assumption is that visual interaction is an integral part of the user experience.

**The Fourth Party Service Platform and Service Charging**

*Xuhui He, Xiaolin Zheng, Deren Chen, Jianyue Wang*  
(ICWS2009-0140)

To solve the difficulties of the service operators on how to manage services and achieve a continuable operation goal, we propose and develop the 4th party service platform. We also develop a rule-based customizable charge service management component for the platform. The website www.food.cn is the demonstration. The charging service is used to charge for the 3rd services such as search services, electronic authentication services, online communication services, online payment services and so on. The results show that the 4th party service platform can greatly shorten the construction time of a business application, reduce construction and operating costs, and enable service providers to share in the financial rewards properly.

**MWS-MCS: A Novel Multi-agent-assisted and WS-Management-based Composite Service Management Scheme**

*ZhiHui Lu, JiaJun Wang, Yu Wu, Jie Wu, YiPing Zhong*  
(ICWS2009-0141)

From the analysis of some hard drawbacks faced with system service and composite service management today, a novel Multi-agent-assisted and WS-Management-based Composite Service Management Scheme: MWS-MCS is introduced in this paper. Firstly we propose model architecture of this scheme. The prototype system had proved the feasibility of this design scheme. At last, we conclude this paper and analyze the prospective research challenges.
Shinichi Nose, Mituaki Shimono, Michiko Nishiyama, Tetuya Kon, Kazuhiro Watanabe, Kazumasa Takami

When creating a personal web service, the personal identification method used in the service should not give users a feeling of being managed or supervised. We have proposed a personal identification method based on information about the “sole” of the foot, which has not yet been applied in the biometrics field, and evaluated the algorithm used in this method. This paper describes on the implementation of the filtering, packetizing and matching functions needed in a realtime identification system, and on the evaluation of the method using a prototype. Also, we propose a personal web service that uses this personal identification method. We built the integrated system in order to evaluate the algorithm for the personal web service, in which TV programs are selected based on a user’s preferences.

The Development of Human-System Interactivity Metrics for Ubiquitous Service Applying User-Centered Design Methodology
Joobong Song, Yun Ryang Park, Sanghyun Kwon, Ji Hwan Lee, Myung Hwan Yun, Joohwan Lee

As the ubiquitous era took off, the interactions between ubiquitous services and users have come to take an important position. So it is necessary to develop new evaluation method that evaluates interactivity with a user-centered perspective. The main objective of this study is the development of user-centered interactivity evaluation metrics of ubiquitous service attributes. Detailed goals of this study are as follows. First, existing ubiquitous service evaluation methodologies are reviewed to define the evaluation attributes for ubiquitous service evaluation. Second, user oriented interactive metrics that can overcome the limitations of those service evaluation methodologies, such as personal service evaluation techniques, usability evaluation techniques and psychometrics based evaluation techniques, are developed. As a validation study, suggested evaluation metrics is utilized to evaluate the u-home service, and priority of each metrics is derived. The suggested evaluation metrics can be used to evaluate the interactivity level of ubiquitous service and identify the potential users and their requirements at the stage of service development.

Constraint-Based Authorization Management for Mobile Collaboration Services
Yuqing Sun, Matthias Farwick, Dickson K.W. Chiu

With the fast development of high speed wireless technologies and the growing population of mobile portable devices, location information is potentially available for access control systems. Such applications are especially meaningful in emergency situations, where quick responses are urgently required for persons to be physically present in a certain place to perform sensitive tasks without conflicting with security policies. In this paper, we investigate this challenging problem and propose a novel Constraint-based Authorization Management Model, which takes the mobile execution of tasks with handheld devices into account. The authorizations are activated by means of Location Based Execution Binding to handle uncertain conditions such as flexible business processes and emergency situations, considering both the user’s location and attributes. With the introduced algorithms the model is capable of execution planning to detect and avoid inconsistencies in the security constraints of activities at design and runtime. Finally we propose a system architecture based on Web service technologies and a XACML based syntax for defining the
we present a case study of applying SOAR to show how it is applied in practice and how the diagnosis can be conducted in autonomous way. In addition, we extend the basic MBR to diagnose faults in various SOA components. SOAR provides an enhanced inference capability with state-based and QoS-based reasoning in addition to the basic setting/observation-based reasoning. We propose concrete schemes to formally represent system heterogeneity, grid-like distribution, evolvability, and limited visibility. Hence, services management presents non-conventional challenges. Through this approach we can automatically model the request of services discovery and recommend the most suitable composite services to developers in the light of their behavioral similarity. Finally, we illustrate the effectiveness of BestRec with a case study and expe-rimental evaluation in the area of Web services testing applications.

SOAR: An Extended Model-Based Reasoning for Diagnosing Faults in Service-Oriented Architecture
Soo Dong Kim, Soo Ho Chang
(SERVICES2009-0007)

Service-Oriented Architecture (SOA) is a cost effective approach to building enterprise applications. SOA reveals non-conventional characteristics of heterogeneity, grid-like distribution, evolvability, and limited visibility. Hence, services management presents non-conventional challenges. Especially, fault diagnosis at runtime is challenging due to the SOA features. Model-Based Reasoning (MBR) is a formal approach to diagnosing faults, which is based on predicate calculus and term resolution. In this paper, we present SOAR (Service-Oriented Abductive Reasoning) which extends the basic MBR to diagnose faults in various SOA components. SOAR provides an enhanced inference capability with state-based and QoS-based reasoning in addition to the basic setting/observation-based reasoning. We propose concrete schemes to formally represent system description, normal behavior, fault model and observations, and reasoning methods to diagnose faults and to determine their causes. In addition, we present a case study of applying SOAR to show how it is applied in practice and how the diagnosis can be conducted in autonomous way.

A Distributed Agent Coalition Algorithm for Web Service Composition
Hongxia Tong, Jian Cao, Shensheng Zhang, Minglu Li
(SERVICES2009-0008)
The topic of agent-based service composition has been experiencing much attention. In this paper, a service agent model is proposed, which integrates the Web service and software agent technologies into a cohesive entity. Based on the service agent model, a distributed agent coalition algorithm for autonomic Web service composition named as DACA is proposed. DACA is fully distributed, which is based on the distributed decision making of the autonomous service agents and addresses the distributed nature of Web service composition. The simulation experimental results demonstrate that the proposed DACA is effective for its ability to produce high quality solution at a low cost of communications.

Building Interoperable 3D Virtual World Platforms with RESTful Web Services
Zhi-Cong Fang, Hong Cai
(SERVICES2009-0009)
The topic of agent-based service composition has been experiencing much attention. In this paper, a service agent model is proposed, which integrates the Web service and software agent technologies into a cohesive entity. Based on the service agent model, a distributed agent coalition algorithm for autonomic Web service composition named as DACA is proposed. DACA is fully distributed, which is based on the distributed decision making of the autonomous service agents and addresses the distributed nature of Web service composition. The simulation experimental results demonstrate that the proposed DACA is effective for its ability to produce high quality solution at a low cost of communications.
Web-FIM: Automated Framework for the Inference of Business Software Models
Hesham H. Hallal, Arnaud Dury, Alexandre Petrenko
(SERVICES2009-0014)
We present an automated framework for the inference of behavioral models from the execution traces of a web-based business application (WBA). The model inference framework consists of a formal approach to infer automata models from traces of WBA’s and an advanced prototype tool set implemented around the data mining engine Weka, the model checker SPIN, the formal language manipulation framework ANTLR and the graph visualization software GraphViz. The traces of a WBA are collected by monitoring the communications in client-server architectures, where a client can be an Internet browser or a service accessing the server side of the application. The inferred models depict both the control and data flow (showing data variations) of the WBA and can be used for its visualization and verification. Finally, we discuss Web-FIM an online deployment of the model inference framework and illustrate the use of the tools with an example.

Standing Processes in Service-Oriented Environments
Steffen Preissler, Dirk Habich, Wolfgang Lehner
(SERVICES2009-0012)
Current realization techniques for service-oriented architectures (SOA) and business process management (BPM) cannot be efficiently applied to any kind of application scenario. For example, an important requirement in the finance sector is the continuous evaluation of stock prices to automatically trigger business processes—e.g., the buying or selling of stocks—with regard to several strategies. In this paper, we address the continuous evaluation of message streams within BPM to establish a common environment for stream-based message processing and traditional business processes. In detail, we propose the notion of standing processes 1 as (i) a process-centric concept for the interpretation of message streams, and (ii) a trigger element for subsequent business processes. The demonstration system focuses on the execution of standing processes and the smooth interaction with the traditional business process environment.

Services Cup Session 2
Session Chair: Sujoy Basu, HP Labs - Palo Alto, USA
Genesis - Dynamic Collaborative Business Process Formulation based on Business Goals and Criteria
Ryan K. L. Ko, Andre Jusuf, S.G. Lee
(SERVICES2009-0013)
This technical paper discusses the architectural design and implementation details of Genesis – a novel Web application which formulates business process definitions dynamically, given a user business goal and underlying business criteria (e.g. total order cost, type of sourcing methods, etc.). Guided by an algorithm that references a hierarchical ontology file containing business process task decomposition, Genesis traverses through the ontology and dynamically produces two types of output: (1) a graphical breakdown of task sequences and decompositions required to fulfill the user’s business goals, and (2) an abstract BPEL file containing the control flow structures, and web service invocation points needed to execute the collaborative business processes in a service-oriented environment. The outputs demonstrate the potential of Genesis as a standalone module which can provide dynamic capabilities, thereby complementing current service-oriented architecture (SOA) business-to-business (B2B) information systems which require hardcoded, inflexible business process definitions. An online demonstration of Genesis is available at http://imss.simtech.a-star.edu.sg/Genesis/.

SAP Research Roof Top Marketplace: Putting a Face on Service-Oriented Architectures
Volker Hoyer, Florian Gilles, Till Janner, Katrinara Stanojevska-Slabeva
(SERVICES2009-0011)
The huge demand for situational and ad-hoc applications desired by the mass of business end users cannot be fully covered by traditional Service-Oriented Architectures (SOAs). By putting a face on SOA, Enterprise Mashups empower these end users to combine and reuse Web-based resources within minutes to create value added applications. In this paper, we present the SAP Research RoofTop Marketplace prototype that transfers established marketplace concepts to the Enterprise Mashup paradigm in order to leverage the power of peer production. The underlying concepts and the resulting architecture of the platform are presented. By means of a business scenario, the features of the grassroot Enterprise Mashup platform are demonstrated.

Posr: A Comprehensive System for Aggregating and Using Web Services
Mohammer Abujarour, Mircea Craciuleac, Falko Menge, Tobias Vogel, Jan-Felix Schwarz
(SERVICES2009-0015)
Recently, the number of public Web Services has been constantly increasing. Nevertheless, consuming Web Services as an end-user is not straightforward, because creating a suitable user interface for consuming a Web Service requires much effort. In this work, we introduce a novel approach where user interface fragments for consuming Web Services are generated automatically, and aggregated and customized by end-users to match their preferences. Users can collaboratively improve the auto-generated user interfaces and share them among each other. Our three main sources of Web Services are explicit registration, automatic identification and collecting over the Web, as well as extraction and generation from existing web applications. We validated our approach by implementing it as a comprehensive system coined “Posr”.

Ph.D. Symposium
Session Chair: Rama Akkiraju, IBM T.J. Watson Research Center, USA
A Service-Oriented Grid Environment with On-Demand QoS Support
Gerhard Engelbrecht, Siegfried Benkner
(SERVICES2009-0016)
The evolution of Grid computing technologies over recent years has been dominated by the adoption of a service-oriented paradigm and an increasing use of commercial Web services technologies. Closely linked to this transition are QoS mechanisms such as service level agreements.
The work presented in this paper contributes to this evolution by proposing a service-oriented Grid infrastructure with on-demand Quality of Service support. The presented infrastructure is based on standard Web services technologies and enables the provision of compute intensive HPC applications as services in an automated way. The system employs a business-oriented model for Grid computing incorporating dynamic negotiation of service level agreements. The underlying QoS support relies on advance resource-reservation, application-specific resource requirement estimation and according dynamic resource pricing.

**SOA and Web Services for Leveraging Inter-Organizational Integration in Travel and Tourism Industry**

**Anas Najdawi**

This paper will present a general description of an on going PhD research that belongs to the eTourism research field. Mainly, this research is concerned with leveraging interorganizational integration for destination management organizations in the travel and tourism industry by using Service Oriented Architecture (SOA) and web services. Also, this study aims to find to which limit SOA can be applied in a static or dynamic business federation scenarios, and to which extent it will improve business collaboration and integration between different stakeholders in order to increase competitiveness and so the economic receipts in tourism destinations.


**WS-Testing 2009 Workshop Session 1**

**Session Chair:** Srijam Krishnan, San Diego Supercomputer Center, USA

**A Model of Message-Based Debugging Facilities for Web or Grid Services**

**Qiang Yue, Xiaoyi Lu, Zhiguang Shan, Zhifei Xu, Haiyan Yu, Li Zha**

Message-based debugging facilities for Web or Grid Services are separated from an infrastructure of source level debugging and can work in a self-identifying and coexisting mode within a normal services container. In this paper, we discuss problems for services debugging and approaches we take. We present the operational model and context inspection of message-based debugging facilities. The facilities are able to trace service behaviors, dump debugging information, and manage states and behavioral breakpoints of debugged services. This model supports a mechanism of multi-user and multi-site service debugging without requiring programmers or developers to one by one duplicate full scenarios in multiple servers.

**SOArMetrics: A Toolkit for Testing and Evaluating SOA Middleware**

**Xiang Li, Junpeng Hua, Xuadong Liu, Jin Zeng, Zicheng Huang**

SOA has emerged as a new methodology for software development and system integration through composing existing web services. The basic idea of SOA bootstrap testing is to test and evaluate SOA middleware and applications by using existing SOA infrastructures. In this paper, we present a toolkit, named SOArMetrics, is proposed to enable the SOA bootstrap testing based on our existing SOA middleware, SOArWare. We describe the design requirements and implementation details of SOArMetrics, which abundantly reuse the existing modules in SOArware and hence prominently decrease its development work. We also present three case studies and our experimental experience, which shows that SOArMetrics provides a manageable, flexible and reliable testing and evaluating framework for service oriented applications.

**FLTL-MC: Online High Level Program Analysis for Web Services**

**Zhengwei Qi, Liang Liu, Fuyuan Zhang, Haibing Guan, Hao Wang, Ying Chen**

Although Java- or .NET-centric technologies are the most commonly used in Web services, they are by no means the only ones in practice. This paper proposes an online finite model checking tool FLTL-MC to check the high level safety and liveness properties in complex distributed web service systems, which can offer both a richer and more natural way to search errors. Liveness properties can specify desirable system behaviors which must be satisfied eventually but are not always satisfied. Existing software model checkers cannot verify liveness in real code because doing so requires finding an infinite execution that does not satisfy a liveness property. In our proposed model, we adopt the finite linear temporal logic to specify the semantics of the online model checking, use binary instrumentation to obtain the distribute states and apply the FLTL-MC engine to dynamically verify the finite linear temporal logic properties in Web service systems. At last, we investigate the well-known distributed protocol WS-ReliableMessaging to demonstrate its applications and detect some hidden bugs with our prototype system.

**WS-Testing 2009 Workshop Session 2**

**Session Chair:** Junfeng Zhao, Peking University, China

**A Combinatorial Approach to Multi-Session Testing of Stateful Web Services**

**Li Li, Wu Chou**

Most researches on web service testing have been focused on single session test where all messages are correlated. However, web services should support multisession interactions as part of the functional requirements. Concurrent multi-session testing is useful but non-deterministic. This paper proposes a combinatorial approach for multi-session test sequence generation by multiplexing single session test sequences. The paper shows that directly multiplexing operation sequences is impractical, and it introduces inverse operation sequence and condition combinations to reduce the search space. However, finding optimal operation sequences to completely cover the condition combinations turns out to be NP hard as it is equivalent to the classic set covering and Hamiltonian cycle problems. To address this issue, we introduce the concept of pivotal condition and devised a counting scheme to generate complete condition transition graphs for pivotal conditions. An efficient random walk algorithm is proposed to minimize condition transition graphs with guaranteed coverage of pivotal conditions. The proposed algorithms have been implemented and their performances are reported in the experimental results.

**Testing Web Services Composition Using the TGSE Tool**

**Tien-Dung Cao, Patrick F’elix, Richard Castanet, Ismail Berrada**

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This paper proposes an approach to test (actively and passively) Web services composition described in BPEL using TGSE (Test Generation, Simulation and Emulation), that is a tool for generating test cases for Communicating Systems (CS). TGSE implements a generic generation algorithm allowing either test cases derivation or traces checking. It supports the description of one or several components with data and temporal constraints. First, in order to model the BPEL behaviors, the timing constraints, and data variables, the BPEL specification is transformed into the Timed Extended Finite State Machines (TEFSM) model. As our framework can handle both active and passive testing, on the one hand test cases are obtained by stimulating the CS. In this case, the exploration is guided by the use of test purposes modeled by TEFSM (a test purpose is considered as a part of the CS). On the other hand, TGSE can check whether a trace is valid according the specification or not. Finally, the Loan Web Service is used as a case study.

Better Compliance Management Using Service Oriented Approach for Non-profit Organizations
Zhixiong Chen, Ivan Arellan

In this article, we present our experience on exploiting service oriented approach and methodology to deliver better IT support system so that the goal of IT development is in line with the strategy goal and objectives of the organization. The non-profit organization in our discussion provides various services to disabilities. The funding of the organization is given mostly by the government such as Medicaid. Complying with government laws and regulations when providing quality services and when reimbursing cost is crucial to the survival and success of the organization. Our project is to have an IT support system that embeds various requirements into business processes so that compliance management is dealt with in a systematic way rather than by manual process. We believe our unique experience could be valuable by many similar organizations around the nation. The service oriented approach guides us from a unique service angle to visualize and analyze main business processes of the organization. We are able to identify compliance requirements and risks and vulnerabilities that affect the bottom-line of the organization. By adopting Services Oriented Architecture (SOA) methodologies in the IT support system, we not only loosen the tightly coupled the existing business applications for better management and for services reuse in any new business processes, but also shift government laws and regulations into the IT system for systematic compliance management.

International Workshop on Self Healing Web Services (SHWS 2009)

SHSW 2009 Workshop Session 1
Session Chair: Khalil Drira, CNRS-LAAS, Universite de Toulouse, France

Periodic Checkpointing for Strong Mobility of Orchestrated Web Services
Soumaya Marzouk, Aref Jmal Maalej, Ismael Bouassida Rodriguez, Mohamed Jmaiel

Web service composition allows a fast and modular creation of applications by orchestrating several Web services. Such applications are frequently faced to performance and availability problems which may affect the partner Web services or the orchestration process itself. This requires mechanisms for adapting the architecture and the behaviour to this variable context. In this paper, we deal with strong mobility of orchestration processes as a mechanism for adaptation. We provide a solution that relies on checkpoint/rollback mechanisms. It is also based on source code transformation of the orchestration process. We apply our approach on WS-BPEL based orchestration processes. Hence, we establish a set of rules which transform WS-BPEL processes to equivalent mobile ones. When an adaptation is to be performed, the execution of some or all instances of a mobile process will be interrupted, and then they will be migrated to another node. After migration, the interrupted instances will resume starting from the last checkpoint. Experimentation results show the efficiency of our approach and the low overhead it introduces.

A Semantic Repository for Adaptive Services
Yamine Ait-Ameur

The semantic characteristics related to the web services definition are weakly addressed in the original definition of the stack of web services. Web services languages like WSDL or composition languages like BPEL still have syntactic oriented definitions. Several research activities tend to use semantic based descriptions in order to describe approaches for automatically discovering services and for defining adaptive services. Our claim is that it is needed to proceed as for static data by providing on the one hand another level of abstraction that hides the WSDL descriptions of services and on the other hand a subsumption relationship capable to define a substitutability relationship between semantic web services. This paper proposes to use a semantic registry, to store semantic web services (SWS), equipped with an exploitation language that supports semantic based process discovery. Semantic web services are being described in an ontology of services, with a subsumption relationship. Their input and output parameters refer to concepts of a domain ontology.

Using Stateful Activities to Facilitate Monitoring and Repair in Workflow Choreographies
J. Eder, J. Mangler, E. Mussi, B. Pernici

The repair of faulty processes (workflows, webservice compositions) needs information about the state of the involved webservice. We introduce an architecture where (webservice based) activities and their instances are treated as manageable resources. Based on the WAMO Model our activities provide detailed information about the state they currently hold, possible states they can reach, as well as operations to affect the current state. The strength of this approach is that we can introduce independent repair and monitoring facilities, that utilize a generic way to access information about running activities.

SHSW 2009 Workshop Session 2
Session Chair: Khalil Drira, CNRS-LAAS, Universite de Toulouse, France

A Practical Framework of Realizing Actuators for Autonomous Fault Management in SOA
Hyun Jung Lee, Soo Dong Kim

Due to the key features of Service-oriented architecture (SOA); blackbox-nature of services, heterogeneity, service dynamism, and service
evolvability, fault management in SOA is known to be more challenging than conventional system management. An efficient way of managing faults in SOA is to apply principles of autonomic computing (AC), of which process is specified in MAPE. The first two phases of MAPE are to monitor target systems and diagnose faults to determine underlying cause. The other two phases are to plan healing/actuation methods and to execute them. Devising methods to remedy service faults which can run in autonomous manner is a hard problem, mainly due to the remoteness and the limited visibility and controllability. In this paper, we present a practical framework to design actuators which can be invoked autonomously. By considering the relationships among fault, cause, and actuator, we derive the abstract and concrete actuators. For some essential concrete actuators, we present their algorithms which can be implemented in practice. We believe our proposed service actuation framework makes the realization of autonomous service management more feasible.

Self-Diagnosis and Self-Regulation through Performance Monitoring and Tuning
A. Noori-Mehudi
(SERVICES2009-0028)
Although often relegated behind other more critical qualities of service, performance has a number of characteristics that make it an ideal target for monitoring and assurance. First, there are a number of metrics easily accessible that are indicators of a decrease in performance. Second, a lack of availability is often preceded by a decrease in performance. Finally, many functional problems emerge only when resources are stressed and performance is low. These characteristics are the motivation we use to develop an approach by which web-service systems are able to detect problems before they occur, and take appropriate corrective actions without human intervention, or trigger alarm and notification processes to request human intervention.

Enforcing User-Defined Management Logic in Large Scale Systems
Srinath Perera, Dennis Gannon
(SERVICES2009-0029)
The ubiquity of information technology, technological advances, and utility computing trends have motivated largescale systems, but managing and sustaining these systems is far from trivial. Automatic or semi-automatic monitoring and control are a potential solution to this problem. However, since management scenarios differ from system to system, a generic management framework that can manage a wide variety of systems should support user-defined management logic. This paper proposes a novel architecture that can manage large-scale systems according to userspecified management logic that depends on both global and local assertions of the managed system. Furthermore, the paper demonstrates that despite having a global view of the managed system, a management framework can scale to manage most real world usecases.

IEEE 2009 Third International Workshop on Scientific Workflows (SWF 2009)
SWF 2009 Workshop Session 1
Session Chair: Ian Gorton, Pacific Northwest National Laboratory
Towards a Taxonomy of Provenance in Scientific Workflow Management Systems
Sérgio Manuel Serra da Cruz, Maria Luiza M. Campos, Marta Mattoso
(SERVICES2009-0030)
Scientific Workflow Management Systems (SWfMS) have been helping scientists to prototype and execute in silico experiments. They can systematically collect provenance information for the derived data products to be later queried. Despite the efforts on building a standard Open Provenance Model (OPM), provenance is tightly coupled to SWfMS. Thus scientific workflow provenance concepts, representation and mechanisms are very heterogeneous, difficult to integrate and dependent on the SWfMS. To help comparing, integrating and analyzing scientific workflow provenance, this paper presents a taxonomy about provenance characteristics. Its classification enables computer scientists to distinguish between different perspectives of provenance and guide to a better understanding of provenance data in general. The analysis of existing approaches will assist us in managing provenance data from distributed heterogeneous workflow executions.

Using Mediation to Achieve Provenance Interoperability
Tommy Ellkvist, David Koop, Juliana Freire, Claudio T. Silva, and Lena Stromback
(SERVICES2009-0031)
Provenance is essential in scientific experiments. It contains information that is key to preserving the data, to determining their quality and authorship, and to reproduce as well as validate the results. In complex experiments and analyses, where multiple tools are used to derive data products, provenance captured by these tools must be combined in order to determine the complete lineage of the derived products. In this paper we describe a mediator-based architecture for integrating provenance information from multiple sources. This architecture contains two key components: a global mediated schema that is general and capable of representing provenance information represented in different model; and describe a a new system-independent query API that is general and able to express complex queries over provenance information from different sources. We also present a case study where we show how this model was applied to integrate provenance from three provenance-enabled systems and discuss the issues involved in this integration process.

Provenance Information Model of Karma Version 3
Bin Cao, Beth Plale, Girish Subramaniam, Ed Robertson, Yogesh Simmhan
(SERVICES2009-0032)
Provenance that captures e-Science activity has long term value only if the right amount and kind of information is collected. In this paper, we propose a two-layer model for representing provenance information capable of representing both execution information and higher level process details. The information model forms the basis for efficient relational database storage and query, and sets the stage for investigation of the necessary and sufficient information for long-term preservation.

A Strategy for Provenance Gathering in Distributed Scientific Workflows
Anderson Marinho, Leonardo Murta, Cláudia Werner, Vanessa Braganholo, Sérgio Manuel Serra da Cruz, Marta Mattoso
(SERVICES2009-0033)
Running scientific workflows in distributed environments is motivating the definition of provenance approaches that are loosely coupled to the workflow system. This kind of approach is interesting because it allows both storage and access to provenance data in an integrated way, even in
an environment where different workflow management systems work together. In order to provide provenance functionalities, the existing approaches overload scientists with many manually computing tasks, such as script adaptations and implementations of extra functionalities. However, when we are dealing with users who do not have such expertise (the majority of scientists do not have it), this is not a good solution. Hence, the objective of this paper is to define a provenance strategy that facilitates the gathering of provenance information in a distributed environment scenario.

Hasan Jamil, Aminul Islam
(SERVICES2009-0034)

Scientific workflow design is usually complex and demands integration of numerous resources. Geographical distribution and semantic heterogeneity of resources add to this complexity. The cost effectiveness of such workflow design thus depends upon the lifespan of the application and its anticipated use. Shorter application lifespan usually entails prohibitive development costs. In this paper, we present an alternative platform for declarative workflow design using BioFlow in such environments. We argue that a declarative workflow design using BioFlow is more efficient and cost effective compared to traditional approaches using systems such as Taverna. To demonstrate the advantages of BioFlow, we compare a canonical micro array data analysis workflow application design approach using both Taverna and BioFlow. We show that BioFlow supports ad hoc and modular application design at a throw away cost, and produces a superior maintainable application that can adapt to changes in the source without significant effort. Finally, we discuss a visual application builder, called VizBuilder, with which end users are able to design workflows without any knowledge of BioFlow.

Reasoning on Scientific Workflows
Z. Lacroix, C. R. L. Legendre, S. Tacmen
(SERVICES2009-0035)

Scientific workflows describe the scientific process from experimental design, data capture, integration, processing, and analysis that leads to scientific discovery. Laboratory Information Management Systems (LIMS) coordinate the management of wet lab tasks, samples, and instruments and allow reasoning on business-like parameters such as ordering (e.g., invoicing) and organization (automation and optimization) whereas workflow systems support the design of workflows insilico for their execution. We present an approach that supports reasoning on scientific workflows that mix wet and digital tasks. Indeed, experiments are often first designed and simulated with digital resources in order to predict the quality of the result or to identify the parameters suitable for the expected outcome. ProtocolDB allows the design of scientific workflows that may combine wet and digital tasks and provides the framework for prediction and reasoning on performance, quality, and cost.

SWF 2009 Workshop Session 2
Session Chair: Artem Chebotko, University of Texas at Pan American

Accelerating Parameter Sweep Workflows by Utilizing Ad-hoc Network Computing Resources: An Ecological Example
Jianwu Wang, Ilkay Altintas, Parvıez R. Hosseini, Derik Barseghian, Daniel Crawl, Chad Berkley, Matthew R. Jones
(SERVICES2009-0036)

Making use of distributed execution within scientific workflows is a growing and promising methodology to achieve better execution performance. We have implemented a distributed execution framework in the Kepler scientific workflow environment, called Master-Slave Distribution, to distribute sub-workflows to a common distributed environment, namely ad-hoc network computing resources. For a typical parameter sweep workflow, this architecture can realize concurrent independent sub-workflow executions with minimal user configuration, allowing large gains in productivity with little of the typical overhead associated with learning distributed computing systems. We explain details of the Master-Slave architecture and demonstrate its usability and time efficiency by a use case in the theoretical ecology domain. We also discuss the capabilities of this architecture under different computational domains in Kepler.

New Execution Paradigm for Data-Intensive Scientific Workflows
Mahmoud El-Gayyar, Yan Leng, Serge Shumilo, Armin Cremers
(SERVICES2009-0037)

With the advent of Grid and service-oriented technologies, scientific workflows have been introduced in response to the increasing demand of researchers for assembling diverse, highly-specialized applications, allowing them to exchange large heterogeneous datasets in order to accomplish a complex scientific task. Much research has already been done to provide efficient scientific workflow management systems (WfMS). However, most of such WfMS are coordinating and executing workflows in a centralized fashion. This creates a single point of failure, forms a scalability bottleneck, and often leads to excessive traffic routed back to the coordinator. Additionally, none of the available WfMS provides means for dynamic data transformation between services in order to overcome the data heterogeneity problem. This work presents a new approach for scientific workflow management targeted to provide ways for an efficient distributed execution of data-intensive workflows. The proposed approach reduces the communication traffic between services and overcomes the data heterogeneity problem. Moreover, it allows full control over long-running applications as well as provides support for smart re-run, distributed fault handling and distributed load balancing.

Kepler + MeDICi –Service-Oriented Scientific Workflow Applications
Jared Chase, Ian Gorton, Chandrika Sivarakumthphan, Justin Almquist, Adam Wynne, George Chin, Terence Critchlow
(SERVICES2009-0038)

Scientific applications are often structured as workflows that execute a series of interdependent, distributed software modules to analyze large data sets. The order of execution of the tasks in a workflow is commonly controlled by complex scripts, which over time become difficult to maintain and evolve. In this paper, we describe how we have integrated the Kepler scientific workflow platform with the MeDICi Integration Framework, which has been specifically designed to provide a standards-based, lightweight and flexible integration platform. The MeDICi technology provides a scalable, component-based architecture that efficiently handles integration with heterogeneous, distributed software systems. This paper describes the MeDICi Integration Framework and the mechanisms we used to integrate MeDICi components with Kepler workflow actors. We illustrate this solution with a workflow application for an atmospheric science application. The resulting solution promotes a strong separation of concerns, simplifying the Kepler workflow description and promoting the creation of a reusable collection of components available for other workflow applications in this domain.
Towards Quality of Service in Scientific Workflows by Using Advance Resource Reservations

Christoph Langguth, Paula Ranaldi, Heiko Schuld

(SERVICES2009-0039)
The increasing interest in web services has led to a recent proliferation of service-oriented platforms for supporting scientific workflows in a variety of e-Science domains. These platforms mainly address the application-specific composition and enactment of workflows. However, since scientific workflows are characterized by complex computations and large volumes of data, non-functional criteria like Quality of Service (QoS) guarantees can significantly raise the predictability of the computations, and thus constitute an important benefit to users. This paper introduces the DARWFS vision of a distributed execution engine for scientific workflows which features support for QoS guarantees by making use of Advance Resource Reservations. In particular, we present the DARWFS methodology to enact workflows under QoS constraints and report on the ongoing implementation activities.

Using Ontologies to Support Deep Water Oil Exploration Scientific Workflows

Daniel de Oliveira, Luis Cunha, Luiz Tomaz, Vinicius Pereira, Marta Mattoso

(SERVICES2009-0040)
Scientific experiments generate a large amount of data to be processed and analyzed. As the amount of data increases, the way engineers define their own experiments, analyze the output and share them is becoming complex to manage. Scientific Workflow Management Systems (WfMS) are being used to orchestrate a sequence of programs, services and resources, defined by scientific workflows. However, current WfMS are focused on the workflow execution and present limitations on the semantic support to design the experiment. These tools lack on semantic descriptions of available resources to design scientific workflows. This paper presents an ontology for deep water oil exploration workflows. This ontology has been used to present some semantic concepts to help defining a workflow to be further executed by a WfMS. We evaluate this semantic support on a real workflow that calculates fatigue on risers in deep water oil platforms. The results reinforce the benefits of semantic support over program chaining in manual workflow design.

Analyzing the Gap between Workflows and Their Natural Language Descriptions

Paul Groth, Yolanda Gil

(SERVICES2009-0041)
Scientists increasingly use workflows to represent and share their computational experiments. Because of their declarative nature, focus on pre-existing component composition and the availability of visual editors, workflows provide a valuable start for creating user-friendly environments for end user scientists. However, there is still work to be done to create even more user-friendly environments. In this paper, we aim to identify key constructs that intelligent workflow systems could support to allow for more natural workflow representations. These constructs are identified through a comparison of bioinformatics workflows and their associated natural language descriptions obtained from the virtual research environment myExperiment.

SWF 2009 Workshop Session 3

Session Chair: Shiyong Lu, Wayne State University, USA

Adapting the Galaxy Bioinformatics Tool to Support Semantic Web Service Composition

Rui Wang, Douglas Brewer, Shefali Shastri, Srikanth Swayampakula, John A. Miller, Eileen T. Kraemer, Jessie C. Kissinger

(SERVICES2009-0042)
As the availability of Web services for the biological domain increases, the need emerges for a Web service composition designer that is easy for biologists to use. Our work focuses on providing biologists and bioinformaticians with an online, semantic Web service composition tool. We adapt a bioinformatics tool called Galaxy, to support semantic Web service composition. A semi-automatic approach for semantic Web service composition is utilized. An easy to use online interface is provided.

GEO-SEED: A Metadata Repository for Geosciences Web Service Discovery

Pearl Brazier, Artem Chebotko, Ann Q. Gates, Leonardo Salayandia

(SERVICES2009-0043)
We propose a framework, which blends Web 2.0 and SemanticWeb technologies, to collect semantic descriptions of Web services and other software that enables their automatic discovery, invocation, composition, and interoperaction. The pilot project, called GEO-SEED, aims to support Web services annotation and discovery for the geosciences. GEO-SEED provides both human and machine friendly interfaces represented by a structured wiki and a knowledge management system, respectively. While the former serves as the collaborative services annotation environment for geoscientists, the latter delivers acquired knowledge via RDF, OWL, OWL-S, SPARQL, and geosciences-based ontologies to powerful automated agents, such as scientific workflow management systems.

Analysing Scientific Workflows: Why Workflows Not Only Connect Web Services

Ingo Wassink, Paul E. van der Vet, Katja Wolstencroft, Pieter B.T. Neerincx, Marco Roos, Han Rauwerda, Timo M. Breit

(SERVICES2009-0044)
Life science workflow systems are developed to help life scientists to conveniently connect various programs and web services. In practice however, much time is spent on data conversion, because web services provided by different organisations use different data formats. We have analysed all the Taverna workflows available at the myExperiment web site on December 11, 2008. Our analysis of the tasks in these workflows shows several noticeable aspects: their number ranges from 1 to 70 tasks per workflow; 18% of the workflows consist of a single task; Of the tasks used are 22% web services; local services, i.e. tasks executed by the workflow system itself, are very popular and cover 57% of tasks; tasks implemented by the workflow designer, scripting tasks, are also used often (14%). Our analysis shows that over 30% of tasks are related to data conversion.

Business versus Scientific Workflows: A Comparative Study

Usen Yildiz, Adhene Guadini, Anne H.H. Ngue

(SERVICES2009-0045)
The need for design primitives for scientific workflows has steadily increased over the years and, actually, has become more pronounced in recent
years, with the employment of user-friendly scientific workflow management systems. In this paper, we conduct a comparative study between business and scientific workflows initiatives based on common workflow patterns found in business workflow. This study demonstrates some precise differences and identifies some key scientific workflow patterns that can be used in dataflow oriented scientific workflow systems without compromising the data-oriented modeling in scientific workflow.

Ahlem Ben Younes, Leila Jemni Ben Ayed
(SERVICES2009-0046)
In this paper, we present a new approach to generating Event B specification from UML Activity Diagrams (AD). The goal of this work is to define a formal semantics of activity diagrams that is suitable for workflow modelling. The semantics should allow verification of functional requirements using the B powerful support tools like B4free. In important characteristic of workflows is that the workflow systems are reactive systems. In this paper, we present a formal syntax and semantic for UML AD endowed with interactive aspects (send/receive event concepts), and we illustrate the proposed technique by an example of workflow application.

CBR Based Workflow Composition Assistant
Eran Chinthaka, Jaliya Ekanayake, David Leake, Beth Plale
(SERVICES2009-0047)
Composing a scientific workflow from scratch may be time-consuming, even if the scientist is fully aware of the semantics, the inputs, and the outputs of the expected workflow. Reusing existing services and parts from already composed workflows can aid in reducing the total workflow composition time. However, matching the semantics and the inputs and outputs of these reusable components manually is not an easy task, especially when there are hundreds of such components available. Even components are annotated with information on the semantics of their inputs and outputs, the complex nature of the semantic languages may make manual component selection even harder. In this paper, we propose a Case-Based Reasoning (CBR) approach to assist composition of workflows based on the characteristics of the inputs and the outputs of the reusable workflow components, facilitating user exploitation of existing services and workflows during workflow composition. The architecture can also be extended to utilize the semantics of the various components improving the precision of the identified reusable components.

Scientific Workflows for the Enterprise
Alonzo Jarman
(SERVICES2009-0048)
Organizations that depend on complex calculations for their day-to-day business such as science and engineering firms need enterprise-level management systems for their calculations. These systems ideally allow subject-matter experts to automate calculations and disseminate them to other users in a controlled way that encourages standard practice and tracks results. Scientific workflow ideas have a large part to play, graphical workflow composition and provenance metadata are examples that directly apply. Scientific workflow systems can provide the leverage to promote business-critical calculations to first-class enterprise-level content. As techniques continue to mature and standards emerge, scientific workflows will inevitably become a standard business tool for organizations that rely on complex calculations for their everyday work.

International Workshop on Web Services Performance (WSP 2009)

WSP 2009 Workshop
Session Chair: Ernesto Damiani, University of Milan, Italy

Data Loading & Caching Strategies in Service-Oriented Enterprise Applications
Matthieu-P. Schapranow, Jens Krueger, Vadym Borovskiy, Alexander Zeier, Hasso Plattneri
(SERVICES2009-0049)
The use of distributed functionality through service interfaces provides enhanced application functionality. In contrast to traditional desktop applications, enterprise applications have to consider performance aspects as a result of the distributed application setup. Cost models identified data transmissions as cost-drivers in service-oriented applications because of their substantial size. An object cache helps to avoid redundant service calls and it improves perceived application performance. We present implementation details about our abstract application layer for consumption of enterprise services providing dynamic load and transparent caching methods. Dynamic loading of business object data facilitates comfortable use of enterprise services by clients without expertise on service implementations. We examine various server- and client-side caching strategies and implemented a performance testbed. Our performance results are discussed and solutions for enterprise architectures are drawn.

Ensuring time in Service Composition
E. del Val, M. Navarro, V. Julian, M. Rebollo
(SERVICES2009-0050)
Time is an important non-functional parameter to consider in service compositions, especially in environments where a service must be provided before a deadline. This paper presents a framework that deals with service compositions taking into account the service execution time. To enhance this composition it is important to provide service execution times with reliability, bearing in mind the workload and availability of the service.

A Model for Web Services Data in Support of Web Service Composition and Optimization
Chien-Hsiang Lee, San-Yih Hwa
(SERVICES2009-0051)
Automatic Web services composition has attracted much attention in recent years with the focus on control flow specification. Data mismatch between WSs is often considered as an orthogonal problem that can be solved using XML data model and query languages, e.g., XQuery. We argue that Web services composition and data manipulation should be considered holistically such that further optimization on Web service composition becomes possible. In this work, we define a model, called WS-data model, for composing WSs with focus on their data exchanges. We propose several operators that can be used to compose WSs and manipulate the generated data. Properties of these operators are discussed and
an example is given to show how these properties can be utilized to identify a more efficient way for realizing a complex task expressed using a WS-data expression.

3rd International Workshop on Web Service Composition and Adaptation (WSCA-2009)

WSCA 2009 Workshop Session 1
Session Chair: Samik Basu, Iowa State University, USA

A Constraint-Based Approach for Developing Consistent Contracts in Composite Services
Basem Saleiman, Fuyuki Ishikawa
(SERVICES2009-0052)
A key problem that challenges the designers of service-oriented systems is ensuring the consistency of composite Web service contracts based on their parameters. This paper utilizes constraint satisfaction approach to examine the problem at design time and by focusing on quality of service (QoS) contract parameters. It proposes a generic framework to formalize service contract composition as a constraint satisfaction problem (CSP). It also introduces an initial tool design for automating composite contract consistency checking and adaptation based on QoS parameters. The tool aims at supporting Web service orchestrators to specify appropriate contract parameter values and adapt them so that consistency of composite contracts is increased to some extent. Further, it enables them to analyze and reason about violation percentages during contract negotiation phase. The benefits of the proposed CSP framework and the tool design have been illustrated through a Stock Manager Web service composition scenario.

Dynamically Changing Workflows of Web Services
M. Hegner, R. Baird, R. Gamble
(SERVICES2009-0053)
Workflow reconfiguration traditionally modifies only workflow definitions. Incorporating dynamism in web service workflows should also adapt instance execution as services change availability. Commercial workflow engines lack mechanisms to adapt instances except where instances deploy with all possible workflow paths, to achieve pseudodynamism. This error prone method has the potential for unsound specifications and still does not allow runtime modifications. We perform workflow reconfiguration through an inspection-feedback loop that decouples services specifications and priorities that can change BPEL workflows from their actual execution. When a change occurs, such as service unavailability, immediate adaptation of the workflow instance takes place. To guarantee proper reconfiguration, we formally specify the architecture, interactions, and change directives, according to a natural separation of reconfiguration concerns. We prove the workflow instance will correctly adapt to an alternative service when certain conditions are met.

Fast and Scalable Semantic Web Service Composition Approach Considering Complex Pre/Postconditions
Peter Bartalos, Mária Bieliková
(SERVICES2009-0054)
The process of semantic web service composition arranges several web services into one composite service to realize complex workflows with an exploitation of semantics. This paper proposes an approach to automatic semantic web service composition. Its advantage is good scalability regarding the complexity of user constraints and pre/postconditions. Based on these conditions it propagates the value restrictions constraint from the user goal through the overall composite service. The resulting plan depicts all the possible branches of the workflow leading to a goal. This includes the automatic generation of the conditions deciding which branch will be chosen during the execution. Finally, our approach exploits available data which can be used as input parameters for web services. If these are not offered, it searches for a web service producing them.

Automated Web Service Composition: A Decentralised Multi-Agent Planning Architecture
Mohamad El Falou, Maroua Bouzid, Abdel-Illah Mouaddib, Thierry Vidal
(SERVICES2009-0055)
Automated composition of Web services has received much interest in the last decade, as it supports B2B applications. It aims at selecting and inter-connecting services provided by different partners in response to client requests. Planning techniques are used widely in the literature to describe Web services composition problem. However, since Web services proliferate day after day, classical planners are no longer well suited to compose Web services in a reasonable time. This weakness is due to the explosion of the search space caused by the large number of services and the broad range of data exchanged among services. In this paper, we propose a decentralised multi-agent approach to solve the Web services composition problem at runtime. Our model consists of a set of Web service agents where each agent has a set of services organised in a graph. Responding to a request, agents propose partial plans which are partial paths in the graph, then they coordinate their partial plans to provide the best global plan for the submitted request. The analysis of the complexity and results of the implementation show the ability of our approach to scale up when compared to the of state-of-the-art techniques for automated web service composition.

WSCA 2009 Workshop Session 2
Session Chair: Prashant Doshi, University of Georgia, USA

JaxSON: A Semantic P2P Overlay Network for Web Service Discovery
Mario Bisignano, Giuseppe Di Modica, Orazio Tomarchio
(SERVICES2009-0056)
The increasing number of Web Services provided by several service providers demands for effective, scalable and accurate mechanisms to search and select the most appropriate service, fulfilling some user requirements. Distributed, semantics-enabled infrastructures for service discovery could satisfy these requirements, even if the promise of dynamic selection and automated integration of web services is far from being kept. In this paper we present a P2P overlay infrastructure, aiming to better support a scalable service discovery process. Overlay groups are formed by clustering together peers offering services which are semantically related: a search request for a service (query) will be handled by the group where it has the highest chance to be satisfied. The main focus of the paper is on the groups creation and maintenance strategy, and on the query routing mechanism. A system prototype has been implemented and validated through a case study.
Modeling Service Composition and Exploring Its Characteristics  
Jiehan Zhou, Jukka Riekki, Mika Ylianttila  
(SERVICES2009-0057)

Service composition combines two or more services from one or multiple parties over heterogeneous networks to achieve complex computational goals taking account of user requirements of reliability, adaptability, etc. Service composition provides a powerful approach of managing complex service activities in conventional B2B, C2C, and B2C application developments. This paper reexamines and formalizes service composition with categories of service collaboration and coordination. It describes characteristics of service composition and presents the state of the art of service composition.

Solution Reuse for Service Composition and Integration  
Hamid R. Motahari-Nezhad, Jun Li, Bryan Stephenson, Sven Graupner, Sharad Singhal  
(SERVICES2009-0058)

Service composition and integration are well investigated problems in SOA. However, they still remain among the hard SOA challenges for which automated approaches have yet to be developed. These issues are hindering the agile and cost-effective development of service-based business solutions, and the need for addressing them becomes more pressing with the increase in the number of online (cloud) services. We refer to a composition of services that solves a business problem as a (composition) solution. In this position paper, we argue that solution reuse at a large scale can be exploited to address challenges of service composition and integration by harnessing the collective intelligence and labor of various businesses and people present on the Internet. We propose a reference architecture and technical design of a platform for representation, sharing, and search of solutions and also a marketplace which fosters the reuse of service composition and integration solutions.

Building an On-Line Geospatial Analysis System with Ajax and Web Services  
Weiguo Han, Liping Di, Peisheng Zhao, Xiaoyan Li  
(SERVICES2009-0059)

Service Oriented Architecture (SOA), Web Services, Asynchronous JavaScript and XML (AJAX), and other new Web technologies have revolutionized the use of geospatial Web applications. The GeoBrain project has built a powerful online extensible and scalable geospatial analysis system based on SOA. This system utilizes Web Services and AJAX to increase the interactive capabilities of user interfaces and improve the user experience. It provides Geosciences community a highly interoperable way of accessing Open Geospatial Consortium (OGC) Web services for geospatial data discovery, retrieval, visualization and analysis. It also leverages Web service standards to enable geospatial services discovery, selection, negotiation and invocation to be used in making more informed decisions.

Section II. 2009 International Conference on Cloud Computing  
(CLOUD-I 2009)

SOA Industry Summit

SOA Industry Summit Session 1  
Session Chair: Tony Shan, CTS Inc., USA

Service-Enabling Enterprise Legacy Applications with Assurance  
Shrikant Mulik, Kavindra Sharma, Manish Godse  
(CLOUD2009-0001)

In spite of favorable technical feasibility and cost-benefit analysis, there is a need of assured system stability for service-enabling enterprise legacy applications. We have proposed a three-phase methodology that addresses this key concern of IT management. The paper also provides the on-field experience of using this methodology and the lessons learned. The use of this methodology can help enterprises undertake SOA adoption journey with relatively more ease.

Proprietary Data Transformation and Modeling in a Web Service-Based Integration Environment  
Shawn X.K. Hu, Tony C. Shan  
(CLOUD2009-0002)

Proprietary data transformation is a common task in a Web service-based integration environment. Decision on where and when a piece of proprietary data is transformed, however, can have a tremendous impact on the overall integration solution. Several scenarios are presented in this article with pros and cons articulated to demonstrate how to leverage SOA principles while meeting business requirements to better achieve enterprise integration goals in terms of effective data transformation. Data modeling strategies are also provided for different situations at the enterprise level.

Unraveling the Reality of SOA in Integration Environments  
Gandhi Sivakumar, Faried Abrahams, Kerard Hogg  
(CLOUD2009-0003)

The rudimentary principle of SOA (Service oriented architecture) is “reuse”. In hub and spoke integration projects leveraging SOA, creating service components with high reuse becomes a huge challenge and results in the problem of either the service component just enabling integration which in turn has very poor reuse when new consumers are introduced or mere reuse theoretically but not enabling integration. This is because the Integration paradigm is focused on one extreme (integrating applications) whilst the SOA paradigm believes in the other extreme (reuse of components). In this paper, we discuss the core dimensions of problems faced in a real world integration environment when combining SOA and integration solutions and propose trade off mechanisms.

From Portfolio Management to Portfolio Optimization – Application Portfolio Management in the SOA Era  
Jacek P. Maryan  
(CLOUD2009-0004)
Application Portfolio Management (APM) in today’s Service Oriented Architecture (SOA) enabled world is becoming increasingly difficult. A traditional APM approach does not address the need to manage not only the business applications but all the SOA related assets (i.e., services, components, applications and underlying infrastructure). Improper portfolio management during and after SOA implementation could undermine business benefits and hinder institutionalization. The Service And Value Excellence Application Portfolio Management (SAVE APM) approach addresses all these deficiencies. Similar in nature to a traditional APM, it applies a patented, leading edge Application Balanced Scorecard Optimizer (ABSCO) “fuzzy logic” algorithm together with “Monte Carlo” simulation to actively manage and optimize the portfolio of all the SOA related assets. This approach is also highly applicable to traditional, non-SOA environments and portfolios, including IT Portfolio Management.

**ProtocolDB:** A Semantic Workflow Solution for Innovative Translational Research  
Zoe Lacroix, Spyro Mousses  
(CLOUD2009-0005)

The use of workflow models to integrate intelligently complex experimental and analytical processes is becoming more and more critical to support scientific discovery. At the Translational Genomics Research TGen) we are working on the development of an architecture that supports workflow design, recording, planning, and optimization. We report on the evaluation of ProtocolDB.

**SIMPLE: Template Based Service Integration**  
Jim Laredo, Jeeha Yang, Jun-Jang Jeng, Gabriela Pérez  
(CLOUD2009-0006)

These days, in rapid changing environments, when building an integration solution, reusable assets are brought into the design and composition to accelerate the time to market and more importantly time to value. Assets need to offer a standard interface and be easily configured to minimize the adaptation time to address the use case in question. We proposed and developed a new approach to address the above issues, coined as SIMPLE. The center of SIMPLE is the concept solution template. Customizable points are defined in a solution template and leveraged to adapt to changes. Solution template acts as the unifying artifact throughout the lifecycle of a solution (from engagement to deployment). In the development phase, solution templates are instantiated to generate concrete solutions for specific platform. We present the model and methodology rendered for solution template-based development of SOA solutions. We developed the Solution Template Tool to simplify the lifecycle of an integration of services, through flexible design and customization of Solution Template and an interactive environment driven by Wizards.

**SOA Industry Summit Session 2**  
Session Chair: Jim A. Laredo, IBM T.J. Watson Research Center, USA

**Cogito: An Adaptive Business Process Framework**  
Jun-Jang Jeng, Henry Chang  
(CLOUD2009-0007)

Business process management (BPM) has been an active research area for more than a decade and increasingly becoming more popular in the corporate world as an important vehicle to performance improvement. The major activities of BPM include formally describing business processes, enhancing their responsiveness, efficiency and effectiveness - such as modeling, design, deployment, instrumentation, execution and analysis. There is great advancement in this area, for example, many notations have been created for describing business processes with various purposes such as BPMN, BPEL, and ARIS. In industry, BPM technologies are exploited to align business processes with customer needs, and furthermore, to enable process automation and monitoring via information systems. Lately, with the advancement of SOA, services are exploited to implement process tasks and can be composed to form a complete process systematically. Some process analysis and improvement methodologies have been introduced such as Six Sigma, Lean and so on. Prior efforts in BPM are fertile but there are still many problems ahead. For example, most methodologies are meant to optimize business processes statically instead of dynamically. As such, current BPM approaches empower the process modeling by formalism, shorten the transactional latency by automation, and increase business insights by process improvement methodology. Few of them intend to address the issues of dynamic process optimization in terms of real time in-process decision support and dynamic process re-configuration. The goal of this research is to explore and build the foundation of dynamic business process optimization with the ultimate goal of developing an intelligent system that constantly manages and supervises each process instance (in a controlled way), for example, by having influence in routing and task assignment decisions in order to maximize certain business objectives. There are three main areas in our framework coined as Cogito: process representation, process analysis and process optimization.

**Service Evolution Lifecycle for Service Oriented Architecture**  
R. William Maule, William C. Lewis  
(CLOUD2009-0008)

This paper presents some lessons learned from complex field experimentation with SOA initiatives over the past 5 years. These were large-scale experiments with nodes in several countries and 100s of participants. Tested scenarios included support for coalition and civilian agencies for disaster relief in international emergencies. SOA technologies were tested as communications and information resources for both human usability and service interoperability.

**Web Service Validation Enabling Test-Driven Development of Service-Oriented Applications**  
Paul Hamill, David Alexander, Svetlana Shasharina  
(CLOUD2009-0009)

Test-Driven Development (TDD) is an important software development practice that enables rapid iterations, refactoring, and improved quality. Supporting TDD can be difficult when building Service-Oriented Architecture (SOA) applications, since standard test frameworks often do not have capabilities for performing and validating Web service (WS) calls; invoking Web services depends on running and connecting to a service container; and services and clients often have entirely separate implementations. In this paper we present case studies of two SOA applications we developed, GRIDL[1] and TxFlow. These are distributed, multi-language applications using Web services as the interface between service and client components. They implement Web service and client tests both for verification and validation of the application components and to facilitate the TDD process. Our approach to Web service testing to support TDD is easily reproducible in any SOA application without requiring significant development effort or changes to the software design.

**Towards a Model-Driven Approach for Planning a Standard-Based Migration of Enterprise Applications to SOA**
Mohammed Aboutaam
(CLOUD2009-0010)
As SOA adoption trend accelerates within industry, enterprises, especially those with large application portfolio, need to carefully plan for their SOA migration. We propose an abstract, model-driven and vendor-independent SOA migration planning approach. Represented as a sequence of model transformation steps, our approach seeks to transform existing use cases into standard-based SOA service model and map this to a legacy model to generate a migration path model which can be used to identify alternative migration options an enterprise could consider. This approach can help enterprise application management team plan for an effective SOA migration effort and maximize SOA adoption benefits.

Service-Oriented Architecture Roadmapping
Tony Shan, Winnie W Hua
(CLOUD2009-0011)
This paper presents an overarching metamodel for service-oriented architecture roadmapping (SOAR). An SOA roadmap is of paramount importance to strategize and operationalize an effective SOA program in a heterogeneous enterprise computing environment. There are 20 steps defined in the framework, broken down into 4 streams: Planning and Analysis, Design and Construction, Deployment and Operations, and Management and Governance. The key inputs and prerequisites are specified for each step in the major streams. The detailed artifacts in each step are articulated in the context. This roadmap can serve as a holistic blueprint to adopt and implement SOA in a large organization.

Implementing Context Aware Services in a Telecom SOA Infrastructure
Abhijit Sar, Ali Arsanjani, Sri Ramamohan
(CLOUD2009-0012)
As telecom carriers migrate their networks to a common IP Multimedia Subsystem (IMS) based infrastructure, they face a challenge of providing services to their customers based on the current need or situation of the customer. We have seen how Web 2.0 allows a user to build situational applications or mashups. We have used the concept of Context to provide a framework to service providers for providing such services. Context can be defined with attributes such as presence and location. A SOA based services infrastructure would help Telecom service providers to use context in providing composite services to their customers. This paper focuses on how to use context in defining call flows within a Telecom services infrastructure. We assume a Next Generation Network (NGN) infrastructure for the Telecom Services Provider, which would ensure a common IP backbone for all services. Based on our industry implementations, we will describe a generic call flow for one of the context attributes.

IEEE 2009 Third International Workshop on Web X.0 (WebX 2009)
WebX 2009 Workshop
Session Chair: Ali Noui-Mehidi, General Motors Corporation, USA

Building a User Friendly Service Dashboard: Automatic and Non-Intrusive Chaining Between Widgets
Nassim Laga, Emmanuel Bertin, Noel Cresp
(CLOUD2009-0013)
End-users self service and end-users as co-developers are two main characteristics of web 2.0 paradigm. They will harness the great potential of the Internet of services. However, today's service exposure tools and service composition tools are too complex to be used by ordinary end-users. They are based on technologies such as REST, WSDL, and SOAP which are hardly understandable by the end-user. In this paper, we propose a widget based service exposure and service creation tool. Our framework creates links between loaded widgets automatically; additional functionalities are thus added automatically to existing widgets as long as the end-user loads other widgets to his personal environment; in the same way as he launches an application on his Windows environment. This mechanism is definitely more intuitive than SOA technologies as it is based on the user interface.

Ontology-Based Semantic Blog Model for Recommending Blog Resource to Interest Communities
Kyung-Ah Yang, Ronghua Xu, Jae-Dong Yang, Wan Choi
(CLOUD2009-0014)
This paper suggests an intelligent semantic blog model to systematically analyze and manage blogosphere with ontology. In the proposed model, system managers enable bloggers to easily find appropriate blog resources such as posts or other related bloggers. The resources are found by tracking and analyzing various relationships specified in the ontology. Relevant sets of bloggers usually termd interest communities may be recommended to each other, since the ontology is capable of interrelating them by dynamically monitoring interaction activities in the blogosphere. To develop our model, we first express the conceptual structure of the resources based on the ontology and then design a set of operators to interrelate them. System queries formulated by system managers are implemented by the combination of the operators. Finally, we introduce a rule embedding the system queries, which is dedicated to recommending appropriate blog resources to interest communities.

Towards Lightweight Application Integration Based on Mashup
Wei Ye, Wenhui Hu, Wen Zhao, Xin Gao, Shikun Zhang, Lifu Wang
(CLOUD2009-0015)
Traditional application integration technologies are performed in a rigid and slow process that usually takes a long time to build and deploy, requiring professional developers and domain experts. Moreover, they are server-centric and do not fully utilize the computing power and storage capability of client. As an emerging technology, mashup helps move Web 2.0 into the enterprise and can reduce application integration costs and leverage SOA investments. In the paper, we employ a software architecture view for application integration based on mashup. We propose a component model to encapsulate integrated objects as well as a connector model to specify communication style and communication content between integrated objects. Implementation details of abstract models and a case study are also presented. Our approach allows end user to integrate enterprise applications and services in a more lightweight manner.
Automating Workflows with Service Oriented Media Applications
D. Van der Weken, S. Van Assche, D. Clabaut, S. Desmet, B. Volckaert
(CLOUD2009-0016)
This paper describes the infrastructure we have built for the automation of several typical workflows in a professional media production environment. We fully adopted the Service Oriented Architecture and Business Process Management vision in which stand-alone services provide modular functionality, service invocations are being orchestrated by a process engine and human interaction is possible in the business process through human tasks. The architecture was designed, the infrastructure was built, services were implemented, and several workflows were automated.

Existence Dependency-Based Domain Modeling for Improving Stateless Process enactment
Raf Haesen, Monique Snoeck, Wilfried Lemahieu, Stephan Poelmans
(CLOUD2009-0017)
In a process-enabled service oriented architecture, a process engine typically stores the state of the process instances during enactment. As an alternative, stateless process enactment entails that process state is derived from the state of business objects, which are organized in a domain model. The business objects are referred to in pre- and postconditions of activities, which determine when the activity is enabled and completed, respectively. Despite the fact that the latter approach has multiple benefits compared with the former, the repeated state (re)calculations deteriorate performance and the formulation of clear conditions is not self-evident if typical domain modeling techniques (e.g. UML or ER) are adopted. In this paper we show that by adopting a specific domain modeling technique, which is based on the notion of existence dependency between the business objects, the performance and comprehensibility issues can proficiently be dealt with. We illustrate the technique using a real-world case from the insurance domain and analyze the emerging duality between process modeling and domain modeling.

Modeling Delegation in Requirements-Driven Trust Framework
Wattana Viriyasitavat
(CLOUD2009-0018)
Exponentially growing of global dynamic interoperat ion in service workflow requires promising mechanisms and processes to establish trust relationship among entities involved. The information and service sharing on each domain has different set of policies and requirements. In order to provide in place mechanisms to allow previously unknown entities to cooperate or participate in a workflow, the holistic Requirement-Based Trust Framework that facilitates interacting domains through access control policy mapping between interoperating domains has been proposed in [1,2,4]. However, trust negotiation and establishment processes including policies and roles integration are very costly and sophisticated, especially when more than two domains are involved in the interoperation. In this paper, we propose the model to depict the trust propagation for service distribution and service delegation based on Hierarchical Elementary Net System (HENS) [3] called HENS+ applied to the Requirements-Driven Trust Framework [2] in which the cost incurred during interoperation in many cases is reduced compared to the original framework.

A Distributed Problem Solving Approach for Service-Oriented Computing Systems
Agnes F. N. Lamala, Jose Ghislain Quenum
(CLOUD2009-0019)
Dynamic service selection has been considered the biggest challenge in service-oriented computing systems (SOC). Some of the existing solutions to request execution in SOC give a higher priority to service selection than their composition. While this is appropriate to some application domains, it biases request fulfillment in some others as it limits the composition possibilities by the selected components. In this research we introduce a different approach to composition, in which we consider composition purely from a problem solving perspective and place service selection within the composition process.

From Organizational Requirements to Service Choreography
Ayman Mahfouz, Leonor Barroca, Robin Laney, Bashar Nuseibeh
(CLOUD2009-0020)
Choreography is emerging as a standard for specifying multi-participant interactions. However, conventional choreography descriptions provide only a partial view of the interaction. They do not capture critical business-domain knowledge including: goals motivating participants to interact, organizational dependencies that enable the interaction, and physical activities that are part of the interaction contract. In the absence of this knowledge, it is hard to argue if a choreography description satisfies the business goals of participants. This deficiency is critical when the need
arises to adapt the choreography to changes in business requirements. In this paper, we argue for representing choreography at the level of requirements motivating the interaction. To bridge the two worlds of choreographed messaging and requirements, we propose an automated technique for deriving choreography descriptions. Utilizing the precise semantics offered by requirements models we infer constraints on the choreographed messaging, from which we generate a choreography description that satisfies the requirements.

Flexible Service Selection Optimization Using Meta-Metrics
Roland Ukor, Andy Carpenter
(CLOUD2009-0021)

The web services paradigm enables an organization to implement business processes by orchestrating existing services, some of which may be provided by external organisations. Service selection optimization is the application of techniques to optimize the selection of services for business processes. These processes are often modelled to accommodate anticipated variations in control-flow during execution using choice control-flow patterns. This enables a single business process model to represent multiple execution paths, a phenomenon known as modelled flexibility. In certain scenarios, modelled flexibility can cause conflicts in service selection optimization, making it impossible to simultaneously optimize all execution paths. This paper presents an approach to service selection that addresses this type of conflicts by enabling the user to bias service selection based on an arbitrary set of metametrics.

SEASS 2009 Workshop Session 3
Session Chair: Martin Eggenberger, Quanis Inc., USA

Verifying WS-CDL-Based Web Services Collaboration by Model Checking
Zuling Kang, Hongbing Wang
(CLOUD2009-0022)

WS-CDL is a W3C-proposed formal language for Web service collaboration, featuring the peer description of composite Web services amongst multiple participants. After describing the Web Service Collaboration in WS-CDL, it is important to ensure its satisfaction of certain attributes by formal verification. This paper proposes a new language, namely TLA4CDL to express the temporal and action attributes in WS-CDL, which is actually based on the idea of the temporal logic of actions, and an algorithm to model check the WS-CDL choreography in TLA4CDL. We will first extend WS-CDL with the new language, TLA4CDL for expressing the temporal and action attributes, and analyzing its technology benefits as well as its expressiveness. Then, an algorithm to model check WS-CDL in TLA4CDL will be introduced, the optimizing method called partial order reduction will be presented, and the complexity of this algorithm will be discussed, all of which lead the way to the implementation of a WS-CDL model checker. At last, experiment cases are designed to show the validation of the WS-CDL model checker on TLA4CDL.

Model-Driven Engineering of Service Orchestrations
Marco Brambilla, Matteo Dossi, Piero Fraternali
(CLOUD2009-0023)

This paper presents a methodology for the Model Driven Engineering of complex, multi-actor business processes, mixing tasks executed by humans and by machines. The idea is to enrich business description languages with a few extra details on task assignment, semantics, and typed dataflows, so as to enable a two-step generative approach: first the Process Model is automatically transformed into an Application Model, which seamlessly express both human and machine-executable tasks; secondly, the Application Model is fed to a state-of-the-practice Web/Web Service development tool capable of producing the code. The resulting method and generative framework unify Web Service orchestration and Web User Interface design into a coherent Model-Driven Engineering process.

AOP-Based Monitoring Instrumentation of JBI-Compliant ESB
Marek Pisku
(CLOUD2009-0024)

The popularity of the Enterprise Service Bus (ESB) pattern as a foundation of Service Oriented Architectures (SOA) for enterprise environments is increasing. Java Business Integration (JSR-208) is an attempt at Java-centric standardization of the ESB pattern. JSR-208 lacks a complete monitoring facility, which nowadays is crucial for management of complex environments and for establishing Quality of Service (QoS) and Service Level Agreements (SLA). The aim of this paper is to propose JBI-compliant monitoring enrichment without container source modification, which is realized by means of Aspect Oriented Programming (AOP). The instrumentation design is based on analysis of interfaces specified in JBI and is further verified on the ServiceMix and OpenESB open source JBI containers. The result is a monitoring mechanism compatible with any JBI container and compliant with all stated requirements.

Ensuring Correctness of Dynamic Reconfiguration in SOA Based Software
YuYu Yin, Ying Li, JianWei Yin, ShuiGuang Deng, Wei Shi
(CLOUD2009-0025)

SOA based software is typically based on dynamic reconfiguration, since it is the composition of services. Then ensuring the correctness of dynamic reconfiguration is an important challenge. But few work focuses on it, this paper gives a better answer to solve the problem. It uses services-behavioral type discipline extended the Martin-Löf’s Type Theory (for short, MLTT) which supports a type-theoretic formulation of services behavior structured patterns, so that services can be formally constructed by type services-behavioral type. Then, the type rules for subtype, duality, and correctness of dynamic reconfiguration are discussed. In our case study, the deductions are gave to show that how to verify the correctness of the dynamic reconfiguration. Finally, the implement of our approach is discussed.

SEASS 2009 Workshop Session 4
Session Chair: Ian Gorton, Pacific Northwest National Laboratory

N-to-1 SOAP Requests Bundling for Efficient Software Service Delivery
Feng-Lin Li, Cheng Qian, Wei Yi Liu, Chi-Hung Chi
(CLOUD2009-0026)

One key factor towards the success of software and service is the standardization of service protocols/languages and the interoperability among
them. While SOAP (Simple Object Access Protocol) is one such protocol for service message, its heavy performance overhead is often a big concern, as compared to the light-weighted REST (Representational State Transfer) and HTTP protocols. In this paper, we propose an innovative SOAP requests bundling mechanism to amortize service innovation overhead. This is done by performing serialization and de-serialization on one SOAP message for multiple requests. Details of this bundling mechanism, together with its supporting architecture are given. Our experimental results on TPC-W show that the system throughput can be improved significantly, in the order of about 50% to about a few hundred percents.

Policy Controlled Message Transformations

Martin Eggengerber, Darrell Tharmond, Nupur Prakash
(CLOUD2009-0027)

When implementing a heterogeneous service infrastructure several criteria must be met to exchange information between a service provider and a service consumer. Most often a homogenous messages model is recommended to describe messages within such an ecosystem. Most organizations architectures’ though have evolved without such meta-model; and therefore, a message transformation model is necessary to convert from one service representation to the other. In this paper we propose and validate a meta - processing model that allows a service to transform a message before the main processing starts in the service using a policy language. These message transformations are based on dynamic policies that control and govern the individual message properties. From a processing perspective we are using an interceptor pattern on the service node itself and apply our policy term rewriting rules to the message. This approach not only provides the mathematical foundation for message transformations using policies (rewrite rules) but also allows us to extend the model for other policy related control problems.

Toward the Development of Cross-Platform Business Applications via Model-Driven Transformations

Rama Akkiraju, Tulak Mitra, Nilay Ghosh, Dipankar Saha, Usha Thulasiram, Soham Chakraborty
(CLOUD2009-0028)

In this paper, we present an enhanced model-driven development technique for porting business software applications across multiple software middle-ware platforms (such as IBM WebSphere platform, SAPNetWeaver platform, Oracle/BEA platform, etc). Our approach enhances both forward and reverse engineering of models. First, we present a service oriented approach to reverse engineer platform independent models from platform specific implementations. We demonstrate that by focusing on service level components of software design one can simplify the model extraction problem significantly while still achieving up to 40%-50% of model reusability. Second, we present a semantic Web service matching based technique for automatic binding of generated artifacts with available client assets in forward engineering. By generating implementation artifacts that are bound where appropriate with clients’ existing functionality, our approach helps cut down the development time during project implementations and thereby resulting in reduced project durations and costs. Combining these two enhancements to the traditional model-driven development approach, we demonstrate the feasibility of porting of business applications between two platforms: IBM WebSphere and SAP NetWeaver. Experimental results show that 40%-50% of development efforts can be reduced using our model driven transformation technique in a 4-6 month development effort.

IEEE 2009 International Workshop on Web Services Security Management (WSSM 2009)

Opening (CLOUD2009-0100)
Chair: Stephen Yau, Arizona State University, USA

WSSM 2009 Workshop Session 1
Session Chair: Ernesto Damiani, University of Milan, Italy

Types for Workflow Access Control in Web Service Context

Yuhui Lu, Li Zhang
(CLOUD2009-0029)

Workflow provides a promising solution for organizations to achieve their business goals by interactions and collaborations between Web services. Access control is an important security mechanism to protect the resources to be only accessed by authorized users in such collaborative environments. In this paper, we aim at developing a method for formalizing and analyzing workflow access control in Web service context. To achieve this goal, we first present WSPI, Web Service _ calculus, to formalize Web services and workflow processes. Based on WSPI, a type system is proposed to ensure that the specified TBA C policy is respected during system reductions. By subject reduction, the well-typed system can guarantee the system security and avoid access violations in run time.

A Model to Verify Quality of Protection Policies in Composite Web Services

Davi Böger, Joni Fraga, Paulo Mafra, Michelle Wangham
(CLOUD2009-0030)

Description languages for Web service composition deal specifically with the definition of the business process logic, and do not provide support for the specification of security aspects related to the Web services involved. This paper uses the WS-Policy standard, and the WS-BPEL and WS-CDL languages to propose a model for verifying the compatibility of Quality of Protection Policies of the business process participants, avoiding many conflicts between policies incompatibilities during execution time. The model emphasizes a general policy for the composite process.

Adaptive Rule Loading and Session Control for Securing Web-Delivered Services

Yu Zhang, Vugranam Sreedhar, Lin Luo, Shun Xiang Yang
(CLOUD2009-0031)

In this paper, we present Arctic, an adaptive reinforcement learning control technique for web intrusion check. A rule-based model is designed to describe the requirement of vulnerability detection. The whole validation rule set is divided into multiple sections, and each can be enabled in either in-line control mode or off-line monitoring mode based on the observation and analysis of user behaviors, balancing security and system cost. For the different sizes of in-line validation rules, we use the reinforcement learning technique to adjust the session admission control, maintaining the response time in an acceptable level as well as maximizing the utilization of system resources. We design a runtime protection mechanism using a HTTP session listener and servlet filters in the J2EE container to intercept HTTP requests and responses. Preliminary results of
our implementation are presented in this paper.

**WS-Certificate**

_Ernesto Damiani, Nabil El Ioini, Alberto Sillitti, Giancarlo Succi_

(CLOUD2009-0032)

Assessing the correct operation of individual web services or of entire business processes hosted on a Service Oriented Architecture (SOA) is one of the major challenges of SOA research. The unique features of WS/SOA require new quality assessment approaches, including novel testing and monitoring techniques. In this paper, we present a framework for assessing the correct functioning of WS/SOA systems by introducing a third party certifier as a trusted authority that checks and certifies WS/SOA systems. Our certifications are based on signed test cases and their respective results and operate at different level of granularity, providing a sound basis for run-time service selection and process orchestration decisions.

**Quality of Security Service for Web Services within SOA**

_Hany F. El Yamany, Miriam A. M. Capretz, David S. Allison_

(CLOUD2009-0033)

Service-Oriented Architecture (SOA) is a paradigm for creating and encapsulating business processes in the form of loose-coupling, autonomous and abstracted services. Managing the non-functional requirements of SOA such as security, is an overarching problem due to the wide variety of ways the service consumer can access the services offered by the service provider and the equally varied restrictions the service provider can set for gaining access by the service consumer. In this work, we propose a metadata for quality of security service for SOA. The proposed metadata provides different levels to describe the available variations of the Authentication, Authorization and Privacy features that are related to SOA security. A Web Service for Quality of Security Service (QoSS) is then constructed to encapsulate the suggested metadata in order to assist the service consumer and provider to achieve a QoSS agreement meeting both of their requirements. The QoSS agreement will perform as an enforced policy for managing the interactions between the service provider and consumer. The service of QoSS is located inside a complete framework for securing SOA.

**Discussions**

Chair: Stephen Yau, Arizona State University, USA

(CLOUD2009-0034)

**International Workshop on Cloud Services (IWCS 2009)**

IWCS 2009 Workshop Session 1

Opening Keynote and Panel

Workshop Opening: welcome and introduce agenda & guests (workshop chairs) (CLOUD2009-0035)

Keynote 1: Insights from enterprise cloud service practice - raise challenges to the research community (CLOUD2009-0036)

Jinzy Zhu (IBM Cloud Computing Practice Executive, Asia Pacific)

Keynote 2: Insights from public cloud service operations - raise challenges to the research community (CLOUD2009-0037)

Panel discussions: What are the major open research topics in cloud service area?

IWCS 2009 Workshop Session 2: Cloud Services

Session Chair: Wei Sun, IBM China Research Lab

**Design and Evaluation of Opal2: A Toolkit for Scientific Software as a Service**

_Sriram Krishnan, Luca Clementi, Jingyuan Ren, Philip Papadopoulos, Wilfred Li_

(CLOUD2009-0038)

Grid computing provides mechanisms for making large-scale computing environments available to the masses. In recent times, with the advent of Cloud computing, the concepts of Software as a Service (SaaS), where vendors provide key software products as services over the internet that can be accessed by users to perform complex tasks, and Service as Software (SaS), where customizable and repeatable services are packaged as software products that dynamically meet the demands of individual users, have become increasingly popular. Both SaaS and SaS models are highly applicable to scientific software and users alike. Opal2 is a toolkit for wrapping scientific applications as Web services on Grid and cloud computing resources. It provides a mechanism for scientific application developers to expose the functionality of their codes via simple Web service APLs, abstracting out the details of the back-end infrastructure. Services may be combined via customized workflows for specific research areas and distributed as virtual machine images. In this paper, we describe the overall philosophy and architecture of the Opal2 framework, including its new plug-in architecture and data handling capabilities. We analyze its performance in typical cluster and Grid settings, and in a cloud computing environment within virtual machines, using Amazon’s Elastic Computing Cloud (EC2).

**Towards BPEL in the Cloud: Exploiting Different Delivery Models for the Execution of Business Processes**

_Tobias Anstett, Frank Leymann, Ralph Mietzner, Steve Strauch_

(CLOUD2009-0039)

More and more companies are outsourcing parts of their business processes to third party providers to exploit the expertise and economies of scale of these third party providers. In the IT field, emerging delivery models for software such as Software as a Service and cloud computing offer the possibility to outsource applications and computing infrastructure and thus enable enterprises to focus on their core competences. In this paper we investigate how the new delivery models affect the outsourcing of business processes modeled in WS-BPEL. WS-BPEL is the standard to model and execute business processes in Web service-based IT landscapes. We describe how security and trust issues affect the execution of BPEL processes in the cloud and show the requirements on the middleware supporting the execution of BPEL processes.
Crowdsourcing for Enterprises

Maja Vuković

(CLOUD2009-0040)

Crowdsourcing is emerging as the new on-line distributed problem solving and production model in which networked people collaborate to complete a task. Enterprises are increasingly employing crowdsourcing to access scalable workforce on-line. In parallel, cloud computing has emerged as a new paradigm for delivering computational services, which seamlessly interweave physical and digital worlds through a common infrastructure. This paper presents a sample crowdsourcing scenario in software development domain to derive the requirements for delivering a general-purpose crowdsourcing service in the Cloud. It proposes taxonomy for categorization of crowdsourcing platforms, and evaluates a number of existing systems against the set of identified features. Finally, the paper outlines a research agenda for enhancing crowdsourcing capabilities, with focus on virtual team building and task-based service provisioning, whose lack has been a barrier to the realization of a peer-production model that engages providers from around the world.

A Pattern-Based Design Approach for Subscription Management of Software as a Service

Zhongbo Jiang, Wei Sun, Kai Tang, Jane L. Snowdon, Xin Zhang

(CLOUD2009-0041)

Software as a Service (SaaS) is essentially about delivering a software application as a service over the Web with a usage-based charging plan. Existing Web service subscription models do not consider the complexity of the application and the business environment; for example, multiple service elements with mutual dependencies derived from one application, or various business partnership models for reselling and cross-selling services. Therefore the design of subscription management is critical for a SaaS provider to appropriately decompose its application into service elements (SLAs) as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLAs as end-to-end QoS requirements of an application, the SLA

Session Chair: Kumar Bhaskaran, Emerging Service Systems, IBM Research, USA

Queuing Theoretic and Evolutionary Deployment Optimization with Probabilistic SLAs for Service Oriented Clouds

Hiroshi Wada, Junichi Suzuki, Katsuya Oha

(CLOUD2009-0042)

This paper focuses on service deployment optimization in cloud computing environments. In a cloud, each service in an application is deployed as one or more service instances. Different service instances operate at different quality of service (QoS) levels. In order to satisfy given service level agreements (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an application, the (SLAs) as end-to-end QoS requirements of an applica

Session 3: Cloud Infrastructure

Session Chair: Dickson K. W. Chiu, Dickson Computer Systems, Hong Kong

Service Performance and Analysis in Cloud Computing

Kaiqi Xiong, Harry Perros

(CLOUD2009-0043)

Cloud computing is a new computing paradigm in which information and computer power can be accessed from a Web browser by customers. Understanding the characteristics of computer service performance has become critical for service applications in cloud computing. For the commercial success of this new computing paradigm, the ability to deliver Quality of Services (QoS) guaranteed services is crucial. In this paper, we present an approach for studying computer service performance in cloud computing. Specifically, in an effort to deliver QoS guaranteed services in such a computing environment, we find the relationship among the maximal number of customers, the minimal service resources and the highest level of services. The obtained results provide the guidelines of computer service performance in cloud computing that would be greatly useful in the design of this new computing paradigm.

Intelligent Workload Factoring for a Hybrid Cloud Computing Model

Hui Zhang, Guofei Jiang, Kenji Yoshihira, Haifeng Chen, Akhilesh Saxena

(CLOUD2009-0044)

We present an intelligent workload factoring service for enterprise customers to make the best use of public cloud services along with their privately-owned (legacy) data centers. It enables federation between on- and off-premise infrastructures for hosting Internet-based applications, and the intelligence lies in the explicit segregation of base workload and trespassing workload, the two naturally different components composing the application workload. The core technology of the intelligent workload factoring service is a fast frequent data item detection algorithm, which enables factoring incoming requests not only on volume but also on data content, upon changing application data popularity.

IEEE 3rd International Workshop on Service Intelligence and Computing (SIC 2009)

SIC 2009 Workshop Session 1

Session Chair: Dickson K. W. Chiu, Dickson Computer Systems, Hong Kong

Supporting Bioinformatic Experiments with a Service Query Engine

Xuan Zhou, Shiping Chen, Ashman Bouguettaya, Kai Xu

(CLOUD2009-0045)

We describe a service-oriented approach to model, design, and implement biological processes and data. In particular, we summarize a novel service query framework to query bioinformatic services. Our approach treats biological data and computational tools as Web services. The query framework is part of an all-encompassing system that manages the end-to-end life-cycle of services, called Web Service Management System. The
proposed service query framework allows users to efficiently conduct bioinformatic experiments through service queries. We describe a real life implementation of the proposed framework and our experience in its deployment.

**A Hybrid Web Service Selection Approach Based on Singular Vector Decomposition**

Shan-Liang Fan, Qin-Jiao Mao, Ying-Xin Zhang

(CLOUD2009-0046)

With the number of registered web services growing, identifying desired Web service is crucial for Web users. Current keyword based service search are inefficient in two main aspects: poor scalability and lack of semantics. Firstly, the users are overwhelmed by the huge number of irrelevant services returned. Secondly, the intentions of users and the semantics in Web services are ignored. We propose a hybrid approach of Web service selection that complements logic based reasoning with approximate matching. In particular, the large set of available web services is first clustered into a set of smaller groups. Then a logic based reasoning with approximate matching based on Ontology is applied, which is followed by a syntactic matching method based on Singular Value Decomposition (SVD). Therefore, service matching is conducted within both syntactic-level and semantic-level. A set experimental results demonstrate that the proposed method outperforms several other alternative methods.

**Attributed Publication and Selection for Web Service-Based Distributed Systems**

Michael Brock, Andrzej Goscinski

(CLOUD2009-0047)

With the emergence of cloud computing, the need for flexible and detailed publication and selection of services that expose cloud resources is greatly stressed. While dynamic attributes have improved the publication and selection of resources in distributed systems, the use of dynamic attributes is yet to be tried in Web services: a key element that makes cloud computing possible. We propose a new approach to Web service publication and selection using dynamic attributes shown in Web service WSDL documents, the most commonly accessed and used element of Web services.

**SIC 2009 Workshop Session 2**

Session Chair: Patrick C. K. Hung, The University of Ontario Institute of Technology (UOIT), Canada

**Composite Service Selection Based on Dot Pattern Mining**

Mingwei Zhang, Bin Zhang, Jun Na, Xizhe Zhang, Zhiliang Zhu

(CLOUD2009-0048)

There are complicated correlations among atomic Web services in a composite service. Considering the influence of such correlations on the quality of composite service is important to do service selection. Now, existing selection approaches don't consider this issue. Using the idea of division, a dot pattern based composite service selection approach is presented in this paper. The main idea of this approach is that according to the correlation degree of atomic services, dividing the composite service into a series of composite service dots; then regarding the dot as selecting unit to do service selection based on the quality of corresponding dot patterns. Experimental results show that our selection approach can improve the quality of the selected composite service.

**User Experiences on a Community-Based Music Voting Service**

Timo Koskela, Janne Jalkunanen, Ville Keränen, Nonna Kostamo, Mika Vlianttila

(CLOUD2009-0049)

In this paper, we introduce and evaluate a community-based music voting service that relies on a DHT-based peer-to-peer network. Each community is created as a separate DHT overlay that is connected to a specific entertainment premise such as a cafeteria. A small-scale user testing was conducted in a laboratory environment to examine the attitudinal, social and perceived behavioral control factors associated with the community-based music voting service. Data was collected using questionnaires and short group interviews. The results indicate that the community-based services are seen attractive, and the service as such a very interesting and applicable idea, but the functionality would need to be enhanced.

**SIC 2009 Workshop Session 3**

Session Chair: Ho-fung Leung, The Chinese University of Hong Kong, China

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

Guadalupe Ortiz, Alfonso García de Prado

(CLOUD2009-0050)

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.

**Replication Decision Mechanism for Service-Oriented Multi-Agent System**

Dong Yeol Lee, Seung Yeop Shin, Hee Yong Yoon

(CLOUD2009-0051)

In order to reliably support various services using multi-agent system, the faults in the system need to be tolerated. While various schemes have been proposed for fault tolerant MAS, the replication approach provides the basis of short recovery latency, less intrusive with respect to the execution time, and high scalability. In this paper we propose a new replication scheme making a decision on either replicating data or replacing the failed agent according to the current status of the agents. It thus greatly reduces the overhead of the fault tolerance mechanism by minimizing the amount of replication of the agents. The effectiveness of the proposed approach is verified using the agent-based hospital information provisioning system implemented on the agent platform developed by the authors. The experiment displays that the proposed approach significantly outperforms the existing approach in terms of recovery latency.
Concurrency Control for Transactional Composite Services

A composite service can be built from Web Services, and its workflow can be specified using BPEL4WS. Many composite services are long-running transactional processes. This paper proposes a concurrency control scheme for executing transactional composite services. The scheme uses the information gathered from the workflow specifications of the composite services to guarantee the correctness of the execution of the composite services. Empirical studies were carried out to compare the performance of the proposed scheme with the strict two-phase locking scheme.

Model-Based Monitoring and Policy Enforcement of Services

Runtime monitoring is necessary for continuous quality assurance of Web services. In a monitoring system, sensors with policies are widely used to collect runtime execution data, detect behavior anomalies and generate alerts. Hard-coded sensors and policies are expensive to develop and maintain. They are hard to accommodate the flexible changes of the service-based system to be monitored. The paper proposes a model-driven approach to facilitate automatic sensor generation and policy enforcement. The sensors and policies are decoupled from the software and are defined at the abstraction model level, including structure and behavior models. WSDL and OWL-S are used for modeling the service-base software, and automatic generating sensors based on dependency and coverage strategies. The policy model is constructed following the WS-Policy framework with a 3-tuple policy definition and a correlation matrix identifying the associations between policies and sensors. Policies are enforced by the policy engine that interoperates with service execution engine to communicate runtime behavior information and verification results. These features have been implemented and experimented with data.

Using Proportional-Integral-Derivative Control in Self-Healing Adaptive Content Systems

Database-driven web applications have become the norm, especially in service-oriented applications. As network bandwidth has increased the bottleneck in web application survivability has moved to the server and application level. With social bookmarking sites increasing in popularity, flash crowds are becoming more prevalent leading to higher than expected request loads. In this paper we describe the self-healing adaptive content (SHAC) system used to prevent server overload at the application level. We respond to requests with multiple resolutions of the textual content, using lower resolution requests to reduce the service demand on server hardware. We present a novel proportional-integral-derivative (PID) controller-based autonomic manager that is seeded from a queueing network (QN) model in order to best manage response times. In this paper we describe the methodology used to implement the SHAC system and evaluate the impact of the system on a popular open source blog server.

IEEE International Workshop on Software and Services Maintenance and Management (SSMM 2009)

**SSMM 2009 Workshop Session 1**
Session Chair: Zhixiong Chen, Mercy College, USA

**WS-CHMA: A Composite-Pattern Based Hierarchical WS-Management Architecture**
Xiao Chuan, Lv ZhiHui, Zhang ShiYong

The success of all kinds of commercial applications or scientific computing running on heterogeneous computing environments is absolutely dependent on the availability and reliability of resources composing the environment. In order to support the major Monitor/Analyze/Plan/Execute management activities for resources, Web service based WS-Management rather than SNMP is drawing more and more attention. This paper proposes WS-CHMA, a hierarchical WSMangement architecture adopting the composite pattern design. Its benefit lies in that it can easily support the dynamic grouping management of resources to eliminate the bottleneck of the management software. At last we define three typical operations provided by group resource, whose implementation in detail is also described. Key words: resource management, WSMangement, composite pattern, M/A/P/E, architecture.

**Concurency Control for Transactional Composite Services**
Xinfeng Ye, Yi Chen

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**Model-Based Monitoring and Policy Enforcement of Services**
Xiaoying Bai, Yongli Liu, Lijun Wang, Wei-Tek Tsai, Peide Zhong

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Henri Naccache, Gerald C. Gannod

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**Rule-based Semi Automatic Web Services Composition**
Ehtesham Zahoor, Olivier Perrin, Claude Godart

In this paper we propose a rule-based approach for the semi-automatic Web services composition problem, giving end-user the control to guide the overall composition process. The end-user builds the composition flow by selecting known Web service instances or constrained Web service types, called nodes, and by connecting them using a set of control/data flow connectors. The specified nodes will then be bound to concrete Web service instances using a set of rule-based queries satisfying the associated constraints. When compared to the traditional approaches, our model is
declarative, allows for specifying both the functional and non-functional requirements, provides connectors that include both the data and control flow aspects and aims to choose the one best matched Web service for a node instantiation.

**Scalable Self-Governance Using Service Communities as Ambients**  
Martin Randles, A. Taleb-Bendiab, David Lamb  
(CLOUD2009-0058)

The Internet of Services, as a global Service Oriented Architecture, is a complex large scale system that presents many problems in the design and implementation of systems to autonomously manage, protect and tune it. Whilst the emerging data centres or service ‘Cloud’ represent a move towards centralization, computing power is becoming disembodied and is consumed where and when it is needed in a decentralized manner. Thus this paper investigates the use of ambient type entities, to identify and optimize core structures as bounded service ambients, to address the gap between desired global outcome and service actions. The approach is assessed against an implemented decentralized approach to load balancing at a server farm.

**Compatibility Checking of Heterogeneous Web Service Policies Using VDM++**  
Quan Z. Sheng, Jian Yu, Zakaria Maamar, Wei Jiang, Xitong Li  
(CLOUD2009-0059)

Web service policies capture the capabilities and requirements of Web services from both functional and nonfunctional perspectives. Policies of a Web service govern and ensure the runtime consistency of the service, i.e., people or services interacting with this service are only allowed to perform legitimate actions. When composing Web services, policies of the participated Web services have to be compatible in order to make sensible compositions. Unfortunately, due to heterogeneity of policy specification languages, it is difficult to compare policies of different Web services directly. In this paper, we propose an approach for compatibility checking of Web service policies specified in difference languages. In particular, our approach applies the model-oriented specification from the Vienna Development Method (VDM++). An executable formal model of policy languages is represented in VDM++ and different policies are then translated to this VDM++ model for compatibility checking. Our approach has been validated by a prototype with different Web service policy languages such as WSPL and WS-Policy.
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