

Recent Advances in Distributed Systems Operations and Management: Report on DSOM '98

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1 Introduction

DSOM '98 was the Ninth Annual IFIP/IEEE International Workshop on Distributed Systems: Operations & Management held at the University of Delaware in Newark, Delaware, USA on October 26-28, 1998. This series of annual workshops is sponsored by the IFIP Working Group 6.6 on Network Management for Communication Networks with technical co-sponsorship by the IEEE Communications Society Technical Committee on Network Operations and Management (CNOM).

The general scope of the DSOM workshop series is the operations and management of application software or services within a distributed system and the impact of advanced computing and networking technologies on management. In addition, the theme topic of DSOM '98 was **Management of Mobility**. The workshop attracted over 75 participants from the USA, Canada, Germany, U.K., France, Italy, Switzerland, Sweden, the Netherlands, Portugal, Spain, Japan, Korea, Australia, India, and Brazil. The 24 technical paper presentations were divided into 8 sessions with three sessions focusing on the theme topic of managing mobility. In addition, a concluding Panel Session explored emerging issues and problems in the theme area.

2 New Directions in Distributed Systems Management

As middleware technologies mature, *Distributed Management over Middleware* takes on increasing importance. A session with this title examined the management of services and applications using Java, the World Wide Web, and CORBA. An important issue here is the scalability of management capability and how these middleware technologies can help in that direction. Can management of delegation be of use or are there other paradigms to

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be explored? In a middleware architecture for coordinating distributed applications, many issues of synchronization arise including allowing flexibility to applications in choosing the type and level of coordination and synchronization, and the scalability of the synchronization mechanism itself. While a Quality-of-Service (QoS) framework based on CORBA can be designed for distributed services and applications, more work is needed in studying QoS of “bundled” products and in issues of integrated QoS.

A session on *Fault and Event Management* explored the problems of integrated event management, the use of intelligent assistants in fault localization, and the automation of end-to-end system diagnosis. In spite of the considerable progress made in these fields in recent years, we still do not understand how to do event correlation in a perfect manner. A variety of techniques, such as decision trees, dependency graphs, case-based reasoning, and model-based reasoning have been applied to this problem, but how similar or different are they? Is there a method that can find a fault in a system irrespective of the kind of system it is? This capability is crucial to allowing users to directly manage the process of fault localization. Again, there are issues of scalability here; should a hierarchy of tools and systems be considered?

Data Management and Information Models continue to be at the heart of effective distributed systems management. This session presented directory based management as a way to integrate MIB information into directory services, an information model to allow the generation of computed views of management information, and an access control algorithm for OSI MIBs. An interesting issue here is the use of directories to enhance or even substitute SNMP and the progress made by WBEM and JMAPi in this direction. Is SNMP dead? In the long run, protocols do not really matter, as they keep changing and evolving. Functionality is more important, and we must standardize functionality, in addition to protocols and MIB information, to support interoperability.

Distributed Service Management is an evolving area of great importance; this session examined how services and their management can provide a greater degree of transparency to users, the support that can be provided for distributed application development, and how a universal service management architecture can be designed. If service management can be made transparent, what control will customers have over their services, and how can they verify that they are indeed getting the requested quality of service? Converting between low-level network QoS and high-level application and service QoS continues to be a difficult issue. A unified language that facilitates interaction between applications and services can help, but does the need justify a new language?

An evolution of management architectures towards *Distributed Management Frameworks* was discussed in the session with this title. One path in this direction is the integration of scripting frameworks with management frameworks, while another is the examination of process-centered environments which have become feasible with the evolution of distributed object architectures such as DCOM, CORBA, and Java. A third is to provide integrability and programmability to TMN, again with the use of object technologies. Interesting

issues here are the debugging of distributed management applications, concurrency and coherency in a distributed system, fault tolerance and recovery mechanisms, and problems of interoperability.

3 Theme Topic: Management of Mobility

The theme topic of the workshop was addressed over the course of three technical sessions and one panel session. The first session on *Management of Services to Support Mobility* examined services for physically locating assets in a mobile system, a security service to recognize a cloned mobile phone as an impostor, and adaptive management of network resources in defense networks. The problem of cloned phones is an important one, but it is not clear whether the solution can be general or only specific to a certain region; the distinction between a genuine and a fraudulent call can be made by classification systems using neural networks or by other AI techniques. In adaptive resource management systems, there are interesting issues of persistence of information, scalability, degree of adaptiveness, and heterogeneity.

The rapid growth in the mobility of users has given rise to many interesting problems in the *Management of Nomadic Computing*. Nomadic computing infrastructures require automated dynamic management of service location and configuration; designing flexible policies for effective policy-based management of these systems is a challenging task. Another challenge is replication of data objects and their management for optimizing performance. The problems here include synchronization, consistency, fault tolerance, and scalability. A third issue is the manner in which mobile applications get access to network services in a heterogeneous environment; this can be done in a seamless transparent manner with glue components using constraint meta-objects.

Mobile/Intelligent Agents has been a hot topic of late and this was reflected in the very interesting discussion during this session. The use of intermediary agents can supply mobile agents with the capability of accessing new services; mobile agents can be used to efficiently manage data warehouses; and intelligent agent technology can be applied to provide an integrated approach to the management of data and events occurring on different time scales. As in many of the other emerging technologies, mobile and intelligent agents are also faced with issues of scalability and performance. In addition, caching and gathering of information means choices must be made. What are the tradeoffs between memory, computational power, and bandwidth, and how can these be exploited in the most effective way by this technology? Finally, even after a flurry of activity in this area, no “killer” application appears to be in sight that can justify a mobile agent moving with its complete context.

The workshop closed with a Panel session on *Management of Mobility, Mobility of Management: Issues and Problems*. The discussion ranged across a variety of topics including mobile agents, active networks, mobile IP and the general issue of managing mobile agents,

mobility management in wireless networks, and security issues in the presence of mobility. Many interesting issues surfaced during this discussion, a number of them touching on security, perhaps because this topic was not covered by any of the regular technical sessions, and perhaps because this is perceived by many as an unsolved but significant issue that the management community must tackle. There are many ways in which mobile agents can be misused, and current security techniques are simply not adequate for distributed systems. The viewpoint was expressed that management and control techniques must be combined with security techniques and designed into applications and distributed systems from the very start. However, experience shows that it is hard enough to design manageability into network elements; how can security too be incorporated in addition to manageability? There are also difficult issues of performance and scalability to be considered.

In conclusion, DSOM '98 was a very productive and fruitful forum for the discussion of management issues in distributed systems with a special focus on mobility. Over and over again, it became apparent that some of the most important challenges facing our community are integration in the face of constantly emerging and evolving technologies, scalability as our tasks and systems grow in size, the ever-present performance problems that are exacerbated by mobility, and the always neglected but nevertheless significant issues of security in managing distributed systems with mobility.

DSOM '99 will be held in New York City, USA; for more information, please contact Rolf Stadler (email stadler@ctr.columbia.edu).

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