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NETWORK MANAGEMENT IN DISTRIBUTED SYSTEMS

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The emergence of Web as a ubiquitous platform for innovations has laid the foundation for the rapid growth of the Internet and emerging distributed computing platforms. Other than being a great source of fun and enjoyment, hundreds and thousands of people around the world rely on these systems for various tasks related to their livelihoods. The overwhelming growth of Internet and its users is a reality, which has put new thoughts among the research community to devise new ideas for giving coverage to a huge number of people around the globe. Side-by-side, the use of mobile and wireless devices such as PDA, laptop, and cell phones for accessing the distributed systems has paved the ways for related distributed computing technologies to flourish through recent developments. However, the increasing scale, complexity, heterogeneity, and dynamism of Internet and distributed computing systems with respect to communication networks, resources and applications have made such systems brittle, unmanageable and insecure. This scenario calls for innovative solutions to deal with the complexity, dynamism, heterogeneity, and uncertainty of distributed systems and provide a holistic approach for the development of systems that can meet the requirements of performance, fault tolerance, reliability, security, and Quality of Service (QoS). As of today, numerous applications depend on distributed computing and networking infrastructures to operate. The management of these functionally and geographically distributed infrastructures is crucial to ensure effective operation of applications. This special issue aims at compiling the recent advancements as well as some basic issues in the fields of network management in distributed computing and Internet-based systems.

In general terms, a distributed system is defined as a system that consists of several autonomous computers that communicate through a computer network. Usually there is a common goal that all these networked computers try to achieve. A computer program that runs in a distributed system is called a distributed program, and distributed programming is the process of writing such programs. The same definitions could be rewritten by considering different types of computing devices instead of only computers in traditional sense. With the advancements of micro-electronics, many low-resource computing devices have been devised that can form useful distributed systems. One of the most recent attractive technologies is wireless sensor networks. Sensors are small computing devices that form a distributed system or network over a target area to collect and process required data. The workloads and network traffic in such type of distributed system could be divided among the participants. Thus, sensor network becomes a major type of distributed system. Other commonly known distributed systems are various types of telecommunications networks like; telephone networks and cellular networks, computer networks such as the Internet, World Wide

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Web (WWW) and Peer-to-Peer (P2P) networks, multiplayer online games network and virtual reality network, distributed database network, distributed information processing network (e.g. airline ticket reservation system), aircraft control system, industrial control system, clustered and grid systems. As the topics of distributed systems are very diverse and vast, many types of network management issues fall under the intended talking point of this special issue.

As this special issue aimed at getting the latest advancements in the areas of network management in distributed systems, the papers have been submitted from the authors of diverse backgrounds working on various aspects of the issues related to the scope of the call. Among the submitted papers, after rigorous reviewing, some papers were suggested for some modifications. Accordingly authors have responded with the improved versions of the papers. The works from diverse fields related to the call for papers make this special issue a good common platform for getting the essence of a broad area of network management issues in distributed systems.

Out of the four accepted papers for this special issue, two are selected and extended versions of the papers presented at IDCS 2010, the 3rd International Workshop on Internet and Distributed Computing, held in conjunction with the 12th IEEE International Conference on High Performance Computing and Communications (HPCC 2010) at Melbourne, Australia in September 2010. Other two accepted papers are received via open call and have been selected through rigorous peer-review by renowned researchers in the area of distributed computing.

Network management as network layer resource signaling protocols provide a useful set of tools to dynamically install, maintain, and manipulate state in network nodes. To this end, Bless and Röhricht in their paper, “Implementation and Evaluation of a NAT-Gateway for the General Internet Signaling Transport Protocol”, present the design, implementation, and evaluation of an application level gateway for the General Internet Signalling Transport (GIST) protocol, which translates GIST messages in a way that allows to establish signaling sessions between any two GIST nodes across a Network Address Translation (NAT) gateway. In their work, the authors have presented evaluation results in a real testbed environment. Results show only a slight overhead for processing initial Query messages on a GIST-aware NAT gateway in the range of about 2.15ms on average. All subsequent GIST messages show almost no processing overhead and do not exceed 0.026ms on average. These findings are used to demonstrate how this work can be directly adopted in real-world implementations.

Wireless Mesh Networks (WMNs) is an emerging technology for next generation wireless broadband networks. Routing in WMN is one of the most challenging issues to support stringent QoS requirements of resource management applications. Sen in this paper, “A Throughput Optimizing Routing Protocol for Wireless Mesh Networks”, attempt to meet the user QoS requirements while addressing security and privacy concerns in WMN, by proposing an efficient and reliable routing protocol that provides user anonymity in WMNs. The protocol is based on an accurate estimation of the available bandwidth in the wireless links and a robust estimation of the end-to-end delay in a routing path, and minimization of control message overhead. The user anonymity, authentication and data privacy is achieved via a protocol that is based on Rivests ring signature scheme. Simulation results are presented to demonstrate that the proposed scheme is more efficient than some of the existing routing protocols. Specifically, it has been shown that the protocol has very low overhead and has high network throughput with a large number of source nodes in a WMN.
Recent years have witnessed the development of transport layer protocols to avoid congestions in Wireless Sensor Networks (WSN) and provide data or application level reliability support, thereby ensuring QoS requirements of heterogeneous WSN applications. In this context, Sharif et al. has proposed a light weight transport protocol in the paper, “ERCTP: End-to-End Reliable and Congestion Aware Transport Layer Protocol for Heterogeneous WSN”. The protocol achieves high data reliability using the distributed memory concept within network and results in minimum packet drop due to congestion by the effective implementation of congestion detection and rate adjustment scheme that uses stochastic control framework. Authors have evaluated the proposed scheme with existing transport protocols and demonstrated that it can control congestion and exhibits good throughput, limited end-to-end data packet latency, and high data packet reliability and low per packet communication cost.

Introduced in late 90’s, Grid computing provides a loosely coupled, heterogeneous and geographically dispersed distributed computing platform. With the increase of application complexities in Grid computing environments, the presence of security threats are becoming prevalent. As human administrations are unable to cope with the amount of work required to properly secure the computing infrastructure, there is the need to find innovative solutions to overpower the limitations of manual management of the system, i.e. slow speed, increasing chances of errors and unmanageability by human administrators. In this context, Chopra and Singh has presented an agent-enabled Self-Protection Model (SPM) in the paper “Implementing Self-Protection in Distributed Grid Environment”. This model adopts intelligent agents to dynamically organize system management with centralized control. At the system level, each element contributes its capabilities on the functions of system management and cooperate with each other to implement autonomic computing for grid systems. With this approach, the authors seek to achieve system robustness and scalability, that has been demonstrated in the results from the conducted simulation experiments.

With the above four selected papers, we have tried to make this issue as rich as possible within our capacity. We have directed the authors to provide high quality manuscripts with minimal errors within the texts. We would like to thank the contributing authors of the papers for their efforts to deliver all the required items within the specified timelines. Specially, we would like to express our appreciation to the Editor-in-Chiefs, Dr. Marcin Paprzycki and Dr. Dan Petcu, and the reviewers for their immense support and cooperation for preparing this special issue. We hope this special issue would be a good addition to the current practices and experiences in the fields of network management in distributed systems.

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