Journal of Computer and System Sciences 77 (2011) 835–836

Contents lists available at ScienceDirect

Journal of Computer and System Sciences

www.elsevier.com/locate/jcss

Foreword

Performance modeling and evaluation of heterogeneous computer networks

There is tremendous research interest recently in the convergence of wired networks wireless, and wireless sensor access networks and systems. Especially, recent development in wireless communication technologies and mobile networks has posed various challenges to the researchers in the field of performance modeling. These challenges require effective performance evaluation tools, techniques and methodologies to design new protocols and robust solutions before a global and wide-scale integrated broadband infrastructure of convergent multi-service networks can be established towards the next generation of network with efficient support of multimedia applications. As a result, performance modeling and evaluation has gained increasing importance.

This special issue solicits papers on advances in the analytical and simulation based modelling and evaluation of new challenges in heterogeneous computer networks and systems. Papers in this special issue were selected from the IEEE International Workshop on Performance Modelling and Evaluation in Computer and Telecommunication Networks (PMECT2009) held in San Francisco, CA, USA, August 3–6, 2009. These papers were selected by the scientific program committee and extended and revised before undergoing a rigorous period of peer-review. Contributions of these papers are summarized as follows.

Gate-limited service is a type of service discipline found in queuing theory and can be used to describe a number of operational environments, for example, large transport systems. Recently, there has been the observation that such systems can also be used to describe interactive Internet Services which use a Client/Server interaction. Mapp et al. has proposed an analytical model for gate-limited service and applied to a high-performance server doing prefetching using clustering techniques. The model shows a high level of accuracy for simple gatelimited service at operational loads. Using the concept of optimal operational points, an algorithm was developed and tested on a real system using an Experimental File System (EFS).

The use of wireless devices and networks is becoming a large-scale universal communication phenomenon. Dargie et al. investigate the extent of performance fluctuations in randomly deployed networks and investigate the contribution of various adaptation strategies at different abstraction layers to deal with these fluctuations. They present the outcome of an exhaustive simulation for different applications, including VoIP, HTTP, and FTP. They demonstrate that collision due to hidden-terminals is a minor influence on the performance and stability of these networks, whereas dynamic channel allocation greatly affects them.

In the third paper, Clegg et al. criticize the notion that long-range dependence is an important contributor to the queuing behavior of real Internet traffic. The idea is questioned in two different ways. Firstly, a class of models used to simulate Internet traffic is shown to have important theoretical flaws. It is shown that this behavior is inconsistent with the behavior of real traffic traces. Secondly, the notion that long-range correlations significantly affects the queuing performance of traffic is investigated by destroying those correlations in real traffic traces (by reordering). It is shown that the longer ranges of correlations are not important except in one case with an extremely high load.

Hong et al. examine user registration patterns in empirical WLAN traces, identify elusive patterns that are abused as user movements in constructing empirical mobility models, and analyze them to build up a realistic user mobility model. The examination shows that about 38−90% of transitions are irrelevant to actual user movements. In order to refine the elusive movements, they investigate the geographical relationships among APs and propose a filtering framework for removing them from the trace data. They then analyze the impact of the false-positive movements on an empirical mobility model. The numerical results indicate that the proposed framework improves the fidelity of the empirical mobility model. Finally, we devise an analytical model for characterizing realistic user movements, based on the analysis on the elusive user registration patterns, which emulates elusive user registration patterns and generates true user mobile patterns.

In recent years, the Session Initiation Protocol (SIP), an Internet Engineering Task Force (IETF) standard has been considered as a promising signalling protocol for the current and future IP telephony services because of its simplicity, flexibility, and built in security features. In the fifth paper, Subramanian et al. established that the efficient design and implementation of the SIP proxy server architecture can enhance the performance characteristics of a SIP proxy server significantly. They

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doi:10.1016/j.jcss.2010.08.009

emulated the M/M/1 performance model of the SIP proxy server and studied some of the key performance benchmarks such as average response time to process the SIP calls, and mean number of SIP calls in the system. They showed its limitations, and then studied an alternative M/M/c based SIP proxy server performance model with enhanced performance model and studied additional key performance characteristics such as server utilization, queue size and memory utilization. Provided the comparative results between the predicted results with the experimental results conducted in a lab environment.

In the sixth paper, Lim et al. present an adaptive queue management scheme to maintain queuing delay in a router at a required level based on a comprehensive analytical model under aggregated Internet traffic flows from various traffic classes. The proposed scheme uses a closed-loop feedback control mechanism to constrain the average queuing delay by regulating traffic arrival rate implicitly through a movable queuing threshold. A discrete-time queuing model is developed based on superposition of N MMBP-2 arrival processes. Packets are dropped dynamically with respect to the changes of queuing threshold and the packet loss events serve as implicit congestion indicators. Matlab is used to perform queuing analysis and simulation. Statistical evaluation is performed to show the efficiency and accuracy of the analytical and simulation results.

And Last but not least, Noh et al. have proposed a model of energy harvesting in solar-powered sensor networks, and presented both basic and advanced expectation models. They also developed two practical algorithms to allocate the harvested energy to each time-slot. The simple SSEA scheme uses a basic expectation model, which is designed for a resource-constrained node, and the cost of the resource allocation process is very low. The more advanced ASEA scheme is based on a advanced expectation model, and is suitable for a node which needs a more precise energy allocation and has adequate resources to support additional computation. Both algorithms minimize variability in the allocation of energy over time, leading to a more stable application performance, while at the same time maximizing utilization of the energy harvest. Most of all, the main advantage of these new algorithms is that they can contribute to enhance the network-wide performance.

Finally we would like to take this opportunity to thank the Editor-in-Chief Professor Edward K. Blum for his guidance and support. We would also like to express our deepest gratitude to the PMECT2009 programme committee members and the invited reviewers for their valuable and timely comments.

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14 July 2010
Available online 17 August 2010

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