

PERFORMANCE ANALYSIS OF DYNAMIC SCHEDULING IN COMMUNICATION NETWORKS

SMRUTI PADHY



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY DELHI
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PERFORMANCE ANALYSIS OF DYNAMIC SCHEDULING IN COMMUNICATION NETWORKS

by

SMRUTI PADHY

Department of Computer Science and Engineering

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Certificate

This is to certify that the thesis titled **Performance Analysis of Dynamic Scheduling in Communication Networks** being submitted by **Smruti Padhy** for the award of **Doctor of Philosophy in Computer Science & Engg.** is a record of bona fide work carried out by her under our guidance and supervision at the **Dept. of Computer Science & Engg., Indian Institute of Technology Delhi**. The work presented in this thesis has not been submitted elsewhere, either in part or full, for the award of any other degree or diploma.

Dr. Arzad Alam Kherani
Principal Design Engineer
Beceem Communications Inc
Bangalore
India

Prof. Huzur Saran
Dept. of Computer Science & Engg.
Indian Institute of Technology Delhi
New Delhi
India

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Abstract

Scheduling plays an important role in improving the system performance in resource constrained environment. Scheduling policies used in current communication networks are dynamic in nature. For example, scheduling policies such as Least-Attained Service (LAS) and Shortest Remaining Processing Time (SRPT), assign priorities to users based on their attained service and remaining service, respectively. In this thesis, we study the performance of dynamic scheduling policies in communication networks.

We first consider two important classes of policies, Age-based and Remaining Processing Time (RPT)-based scheduling, and obtain, useful parametrization for RPT based scheduling, tail equivalence property for both the classes and results on short term fairness for Age-based scheduling. Specifically, we propose a priority function for the class of RPT-based scheduling and parameterize the class using a single parameter. Using this parametrization and a similar one already existing in the literature for Age-based scheduling, we obtain conditions on the parameters for which tail-equivalence property holds: the tail of sojourn time distribution of a customer, starting a busy period, is as heavy as the tail of service requirement distribution (to be made precise later) under heavy-tailed service requirement distribution. Tail-equivalence property implies that the large sojourn time of a customer starting a busy period is due to its own large service requirement, and thus, not affected by the presence of other jobs in the system. We observe that tail equivalence for Age-based scheduling indicates the presence of long-term fairness under specified network consideration but short term fairness may not be guaranteed. To this end, we propose a continuous time and a discrete time model to study short-term fairness under Age-based scheduling. We validate our findings for continuous time model with NS2 simulations. The discrete time model enables us to show various asymptotic properties of Age-based scheduling and is consistent with observations in continuous time model.

We next study the performance of dynamic scheduling policies in vehicular ad-hoc networks. We propose fixed point approach to analyze performance of a new security

scheme, Multiple Digital Signature Scheme (MDSS), used at the security layer in a node in Vehicle-to-Vehicle (V2V) communications, under various scheduling policies such as First Come First Served (FCFS), SRPT and Weighted Fair Queuing (WFQ). The fixed point approach proposed requires the security and MAC layer to be stable. Thus, we also provide stability conditions for the system which are necessary for the fixed point approach to be valid. We validate our results with numerical computations and simulations.

Finally, we consider dynamic node activation policies in rechargeable sensor networks and show that the threshold based policies are optimal for a useful class of utility functions.

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