

A Tutorial Proposal on

QoS Support in Internet and Web Servers

For ISIMP – 2001

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SYNOPSIS:

The increasing volume and evolving types of Internet applications have been demanding enhanced services, both in terms of performance and quality of service (QoS), from the Internet infrastructure. The current best-effort service model of the Internet and the web servers are not suitable for fast growing applications such as, continuous media, e-commerce, and several other business services. To provide better services to these important and expanding classes of applications, it is necessary for the Internet infrastructure to provide service differentiation. The Internet infrastructure includes not only the network components but also the web servers (includes proxy servers, application servers, etc.). This tutorial targets QoS issues at both the network level as well as server level.

The differentiated service (DiffServ) model proposed by the Internet Engineering Task Force (IETF) has received wider acceptance in the research community and is being actively considered for possible implementation in the next generation Internet. Unlike integrated services, DiffServ does not require end-to-end resource reservation or any state maintenance at the core routers of the Internet domains. Rather than the per-flow basis model, DiffServ routes packets based on the concept of per-hop behavior (PHB) model, in which packets are marked at the edge routers and are routed by the core routers based on the markings. The markings relate to the QoS requirements. Both the markings and the PHB are handled on an aggregated basis. In addition to providing service differentiation in the Internet, DiffServ architecture is a scalable, feasible, and economical. We will do a detailed study of the various issues involved in DiffServ, its basic support requirements, characteristics, and several other research and implementation aspects. Two different approaches for DiffServ – expedited forwarding and assured forwarding – will be analyzed. We will also discuss other approaches for providing DiffServ, such as relative differentiation and QoS-guaranteed DiffServ. In addition, we will discuss the role of TCP in supporting differentiated services.

The goals of DiffServ architecture may not be met if it is implemented only at the network level. To provide end-to-end QoS, Internet server must also be capable of providing differentiated services. Unfortunately, the research on the server-level service differentiation has not kept on par with the network-level service differentiation. The current generation Internet servers provide service on a first-come-first serve basis, which is inadequate for QoS-aware applications. We will propose and discuss in detail about service differentiating Internet servers (SDIS). Resource management is the key issue in providing efficient service differentiation at the server level. Thus, we will analyze scheduling, admission control, and other implementation details of SDIS.

The capacity planning of Internet servers are based on the average workload characteristics. However, Internet workload is very indeterministic; the maximum bandwidth or computation requirements may exceed the corresponding average value by several orders of magnitude. Thus overload control is a critical issues in managing the server loads. We will explore the issues involved in the implementation of efficient overload control techniques.

In this tutorial we will present the state of the art issues on the proposed topic as well as introduce new and novel avenues for research and development. Future work on important issues like multicasting and security will also be discussed.

OUTLINE OF THE TUTORIAL:

1. Introduction

- The current state of the art of the Internet.
- The current state of the art of the web services
- What is the need for service differentiation in the Internet?
- What is the need for differentiated web services?

2. Preliminaries

- TCP/IP Protocol and its relation to differentiated services
- Internet traffic management issues – congestion control, queuing services

3. Internet QoS – An Overview

- Integrated services
- MPLS
- Constraint based routing

4. Differentiated Services in the Internet

- Basic aspects and characteristics
- DiffServ architecture
- Expedited Forwarding
- Assured Forwarding
- Relative service differentiation
- QoS –guarantee with DiffServ
- DiffServ-friendly TCP

5. Support for Service Differentiation in the Web Servers

- Framework of SDIS
- Performance evaluation of a SDIS
- Resource Management in SDIS – scheduling and admission control
- Overload Control

6. Ongoing and Future Research

- Multicasting in DiffServ domain
- Security issues

7. Concluding Remarks

AUDIENCE:

This tutorial is aimed both at researchers and practitioners. It will also immensely help students pursuing research in Internet and other networking issues. The discussions can be useful for both beginners and intermediate level audiences. The prior knowledge required for this tutorial is a basic understanding of computers networks.

BIOGRAPHY:

Prasant Mohapatra received his Ph.D. in computer engineering from the Pennsylvania State University in 1993. He was an assistant professor and then an associate professor in the Department of Electrical and Computer Engineering at Iowa State University from 1993 to 1999. Since then he has been an associate professor in the Department of Computer Science and Engineering at Michigan State University. During the summers of 1998 and 1999, he worked in the Panasonic Information Networking and Technologies Laboratory (PINTL) and at the Server Architecture Laboratory of Intel Corporation, respectively.

Dr. Mohapatra has published extensively in various international journals and conferences, and has two patents pending in the internetworking area. He has been an invited speaker at several universities and other organizations. He has taught several advanced courses in computer networks, architecture, performance evaluation, and multimedia systems. Dr. Mohapatra has graduated three Ph.D. students and about fifteen Masters students, and is current guiding about five Ph.D. and four Masters students. His research work has been funded and collaborated by National Science Foundation, EMC Corporation, Panasonic Technologies, Rockwell International, and Intel Corporation.

Dr. Mohapatra is a senior member of the IEEE and a member of the ACM. He is currently on the editorial board of the IEEE Transactions on Computers. He has been on the program committees of several international conferences. He was the Program Chair of the workshop on Performance and Architecture of Web Servers (PAWS) held in conjunction with the SIGMETRICS-2000, and is the Vice-Chair for ICPP-2001.