Zoubir Mammeri
Pascal Lorenz (Eds.)

LNCS 3079

High Speed Networks and Multimedia Communications

7th IEEE International Conference, HSNMC 2004
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Library of Congress Control Number: 2004107864

CR Subject Classification (1998): C.2, H.5.1, H.3, K.4, K.6, D.2

ISSN 0302-9743
ISBN 3-540-22262-6 Springer-Verlag Berlin Heidelberg New York

Springer-Verlag is a part of Springer Science+Business Media

springeronline.com

Typesetting: Camera-ready by author, data conversion by Olgun Computergrafik
Printed on acid-free paper SPIN: 11013549 06/3142 5 4 3 2 1 0

Preface

Nowadays, networks and telecommunications are two of the most active fields. Research and development in these areas have been going on for some time, reaching the stage of products. The objectives of HSNMC 2004 (International Conference on High Speed Networks and Multimedia Communications) were to promote research and development activities and to encourage communication between academic researchers and engineers throughout the world in the areas related to high-speed networks and multimedia communications.

The seventh edition of HSNMC was held in Toulouse, France, on June 30–July 2, 2004. There were 266 submissions to HSNMC this year from 34 countries, which were evaluated by program committee members assisted by external reviewers. Each paper was reviewed by several reviewers. One hundred and one papers were selected to be included in these proceedings. The quality of submissions was high, and the committee had to decline some papers worthy for publication.

The papers selected in this book illustrate the state of the art, current discussions, and development trends in the areas of networks, telecommunication and multimedia applications. The contributions published in this book underline the international importance of the related field of research. They cover a variety of topics, such as QoS in DiffServ networks, QoS analysis and measurement, performance modelling, TCP modelling and analysis, MPLS for QoS provision, scheduling and resource allocation, routing, multicast, security and privacy issues, peer-to-peer applications, video applications, software and middleware for networks, mobile networks, mobility, satellite, mobile IP, wireless networks, WLAN, ad hoc networks, 3G/UMTS, IEEE 802.11, optical networks, opto-VLSI, hardware for communications/networks, and WDM.

We heartily thank the program committee, and the external reviewers, for their efforts and hard work. Without their support, the program organization of this conference would not have been possible. We would like to thank all the authors for their paper submission, as well as Springer-Verlag for the good cooperation during the preparation of the manuscript. We are also indebted to many individuals and organizations that made this conference possible: Paul Sabatier University, IEEE and IEE. Finally, many thanks to the local organizers, and all the other people who helped with the conference organization.

June 2004

Zoubir Mammeri
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Network Admission Control for Fault-Tolerant QoS Provisioning*

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Abstract. In a connection oriented network layer, admission control (AC) is easily combined with connection state management at each network node. However, after a link or node failure, existing connections are dropped or reservations must be restored on new paths, which requires high signalling effort. In contrast, a connectionless network layer like IP does not deal with connection or resource management at the network nodes. After a failure, connectivity is easily restored by rerouting, affecting higher layer connections only via some packet drops. Thus, a resource management scheme for IP should allow rerouting to cope with failures without affecting reservation states. A *network* admission control (NAC) handles reservations only at dedicated locations, e.g. the borders of a network, not burdening individual routers with admission decisions or reservation states. The NAC architecture enables *resilient* resource reservation, maintaining reservations even after failures and intra-domain rerouting. In this paper, we investigate the efficiency of three different distributed budget management schemes with single and multi-path routing. We show how the admission decision can be designed to be tolerable against failure scenarios by admitting only the amount of traffic that can still be carried after a failure and the corresponding rerouting.

1 Introduction

A next generation Internet is expected to fully integrate all kinds of data and media communications. In contrast to today's telephone network, applications have variable bitrate requirements and the management of the individual nodes should be simpler. And in contrast to today's Internet, broadband real-time applications require a minimum Quality of Service (QoS). This implies that in future networks the traffic load must be limited [1] to meet applications' bit rate and delay requirements. The corresponding function is called admission control (AC). High quality transmission is guaranteed at the expense of blocking reservation requests in overload situations.

Networks are dimensioned such that for a given traffic matrix the blocking probability is small enough not to upset customers while keeping link capacities and thus cost as

* This work was funded by the Bundesministerium für Bildung und Forschung of the Federal Republic of Germany (Förderkennzeichen 01AK045) and Siemens AG, Munich. The authors alone are responsible for the content of the paper.

Z. Mammeri and P. Lorenz (Eds.): HSNMC 2004, LNCS 3079, pp. 1–13, 2004.

low as possible. Introducing a QoS reservation architecture does not make much sense unless the QoS is also maintained throughout periods of failures of network elements like links, routers, or router interfaces. Whereas intra-domain routing protocols like OSPF [2] can quickly restore connectivity in an IP network, current resource reservation architectures do not ensure that after rerouting there is sufficient bandwidth available on the new paths for the existing reservations. Unlike with physical layer protection, the corresponding additional capacity can be used for best-effort traffic in normal operation, which makes resilience on the network layer cheaper than on the physical layer. A simple option to exploit this feature in a protection context would be to use MPLS fast rerouting [3], abandoning the flexibility and adaptivity of IP routing.

Network admission control (NAC) schemes allow keeping resource reservation states separate from the routers. In [4] we have identified several fundamentally distinct NAC categories which reveal different resource efficiency. Link-by-link NAC budgets similar to ATM or IntServ [5, 6] may be managed in a centralized database; ingress and/or egress rate budgets may be allocated to border routers like in the DiffServ context [7]; or the network resources may be managed as virtual tunnels [8, 9]. In this paper we show how these NAC schemes can be used to provide resilient resource reservation by preventively including failure scenarios in the budgets. We investigate the efficiency of three different NAC schemes and compare their efficiency under resilience requirements, using the single-path and Equal Cost Multi-Path (ECMP) variants of shortest path routing as in OSPF.

The paper is structured as follows. Section 2 gives an overview of three basic budget based NAC categories. Section 3 explains how suitable budget and link capacities can be dimensioned and how to include resilience requirements in NAC budgets. Section 4 compares the resource efficiency of NAC methods for networks with and without backup capacity as well as for single- and multi-path routing.

2 Methods for Network Admission Control (NAC)

In this section we distinguish between link and network admission control and explain three basically different NAC concepts.

2.1 Link and Network Admission Control

QoS criteria are usually formulated in a probabilistic way, i.e., the packet loss probability and the probability that the transport delay of a packet exceeds a given delay budget must both be lower than certain thresholds. Link admission control (LAC) takes the queuing characteristics of the traffic into account and determines the required bandwidth to carry flows over a single link without QoS violations.

Network admission control (NAC) needs to protect more than one link with one admission decision. This is a distributed problem with various solutions differing in their degree of storage and processing demands, locality and achievable multiplexing gain due to the partitioning of resources into budgets administered in different locations. Moreover, the solutions have different efficiency, i.e. they require different amounts of network capacity to meet the same border-to-border (b2b) flow blocking probability p_{b2b} which affects the network operator's costs.