

**10TH SYMPOSIUM ON
HIGH PERFORMANCE INTERCONNECTS**



[blank page]

PROCEEDINGS

10TH SYMPOSIUM ON HIGH PERFORMANCE INTERCONNECTS



INTERCONNECTS

<http://www.hoti.org/>

21-23 AUGUST 2002

STANFORD UNIVERSITY
STANFORD, CALIFORNIA, USA

SPONSORED BY

IEEE COMPUTER SOCIETY
TECHNICAL COMMITTEE ON MICROPROCESSORS AND MICROCOMPUTERS



<http://computer.org>

Los Alamitos, California

Washington Brussels Tokyo

Copyright © 2002 by The Institute of Electrical and Electronics Engineers, Inc.
All rights reserved

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries may photocopy beyond the limits of US copyright law, for private use of patrons, those articles in this volume that carry a code at the bottom of the first page, provided that the per-copy fee indicated in the code is paid through the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

Other copying, reprint, or republication requests should be addressed to: IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, P.O. Box 133, Piscataway, NJ 08855-1331.

The papers in this book comprise the proceedings of the meeting mentioned on the cover and title page. They reflect the authors' opinions and, in the interests of timely dissemination, are published as presented and without change. Their inclusion in this publication does not necessarily constitute endorsement by the editors, the IEEE Computer Society, or the Institute of Electrical and Electronics Engineers, Inc.

IEEE Computer Society Order Number PR01650
ISBN 0-7695-1650-5
ISBN 0-7695-1652-1 (microfiche)
Library of Congress Number 2002109374

Additional copies may be ordered from:

IEEE Computer Society
Customer Service Center
10662 Los Vaqueros Circle
P.O. Box 3014
Los Alamitos, CA 90720-1314
Tel: + 1 714 821 8380
Fax: + 1 714 821 4641
[http://computer.org/
csbooks@computer.org](http://computer.org/csbooks@computer.org)

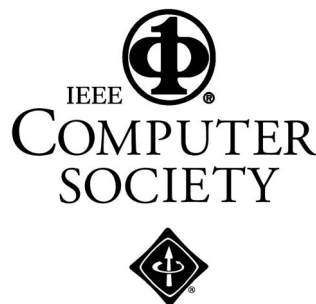
IEEE Service Center
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331
Tel: + 1 732 981 0060
Fax: + 1 732 981 9667
[http://shop.ieee.org/store/
customer-service@ieee.org](http://shop.ieee.org/store/customer-service@ieee.org)

IEEE Computer Society
Asia/Pacific Office
Watanabe Bldg., 1-4-2
Minami-Aoyama
Minato-ku, Tokyo 107-0062
JAPAN
Tel: + 81 3 3408 3118
Fax: + 81 3 3408 3553
tokyo.ofc@computer.org

Editorial production by Anne Jacobs

Cover art production by Joe Daigle/Studio Productions

Printed in the United States of America by The Printing House



HOT Interconnects 10

Table of Contents

Message from the General Co-Chairs.....	ix
Message from the Program Chair	x
Hot Interconnects 10 Committees	xi

Keynote

Delay Tolerant Networking	1
<i>Vincent Cerf</i>	

Session 1: Gigabit/sec and Terabit/sec Switching Technologies

A Four-Terabit Single-Stage Packet Switch with Large Round-Trip Time Support	5
<i>F. Abel, C. Minkenberg, R. P. Luijten, M. Gusat, and I. Iliadis</i>	
Feedback Output Queuing: A Novel Architecture for Efficient Switching Systems	15
<i>V. Firoiu, X. Zhang, and E. Gündüzhan</i>	
A Power Model for Routers: Modeling Alpha 21364 and InfiniBand Routers	21
<i>H.-S. Wang, L.-S. Peh, and S. Malik</i>	
Multicast Scheduling for Switches with Multiple Input-Queues	28
<i>S. Gupta and A. Aziz</i>	

Session 2: High Speed Packet Scheduling

A Flow Table-Based Design to Approximate Fairness.....	37
<i>R. Pan, L. Breslau, B. Prabhakar, and S. Shenker</i>	
Stable Round-Robin Scheduling Algorithms for High-Performance Input Queued Switches	43
<i>J. Liu, H. C. Kit, M. Hamdi, and C. Y. Tsui</i>	
Architecture and Hardware for Scheduling Gigabit Packet Streams.....	52
<i>R. Krishnamurthy, S. Yalamanchili, K. Schwan, and R. West</i>	

Session 3: Multiprocessors, Clusters, and Storage Area Networks

Scalability Port: A Coherent Interface for Shared Memory Multiprocessors.....	65
<i>M. Azimi, F. Briggs, M. Cekleov, M. Khare, A. Kumar, and L. P. Looi</i>	
Scalable Opto-Electrical Network (SOENet).....	71
<i>A. K. Gupta, W. J. Dally, A. Singh, and B. Towles</i>	
Distributed-and-Split Data-Control Extension to SCSI for Scalable Storage Area Networks.....	77
<i>Y. Birk and N. Bishara</i>	

Panel

Wireless Wars: Wi-Fi vs. GPRS vs. 3G.....	83
<i>D. Liddle</i>	

Keynote

Thinking across Layers: What Do We Want Out of a Network?.....	85
<i>Eric Brewer</i>	

Session 4: Gigabit/sec and Terabit/sec Routing Technologies

A Middle Ground between CAMs and DAGs for High-Speed Packet Classification.....	89
<i>A. Prakash and A. Aziz</i>	
Efficient Mapping of Range Classifier into Ternary-CAM.....	96
<i>H. Liu</i>	
Sorting and Searching using Ternary CAMs.....	102
<i>S. Sharma and R. Panigrahy</i>	
Reducing TCAM Power Consumption and Increasing Throughput.....	108
<i>R. Panigrahy and S. Sharma</i>	

Session 5: High Speed Packet Processing Engines

Stream Handlers: Application-Specific Message Services on Attached Network Processors.....	117
<i>A. Gavrilovska, K. Mackenzie, K. Schwan, and A. McDonald</i>	
DiffServ over Network Processors: Implementation and Evaluation.....	123
<i>Y.-D. Lin, Y.-N. Lin, S.-C. Yang, and Y.-S. Lin</i>	

TCP-Splitter: A TCP/IP Flow Monitor in Reconfigurable Hardware.....	129
<i>D. V. Schuehler and J. Lockwood</i>	

Session 6: Wireless, Broadband, and Optical Networks

Radioport: A Radio Network for Monitoring and Diagnosing Computer Systems	137
<i>H. Eberle</i>	
Optimized Upstream Scheduling in Broadband Cable Networks	142
<i>Y. Dong, Z.-L. Zhang, and D. H.-C. Du</i>	
WDM Optical Interconnect Architectures under Two Connection Models	148
<i>Y. Yang and J. Wang</i>	

Tutorials

Tutorial 1: Optical Networking: Recent Developments, Issues, and Trends	157
<i>R. Jain</i>	
Tutorial 2: InfiniBand Architecture and Where It Is Headed	159
<i>D. K. Panda</i>	
Tutorial 3: High-Speed Networking: A Systematic Approach to High-Bandwidth Low-Latency Communication	161
<i>J. Sterbenz</i>	
Tutorial 4: Mobile Ad Hoc Networking: Medium Access Control and Routing Protocols.....	163
<i>N. Vaidya</i>	
Author Index	165